Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar

(Autonomous)

(Affiliated to Savitribai Phule Pune University, Pune)

Choice Based Credit System (CBCS)

Details of Syllabus

Masters of Science (M.Sc.)

Implemented from

Academic year 2021 -22

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar

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Board of studies in Environmental Science

Sr. No.	Name	Designation
1.	Dr. Satish D.Kulkarni	Chairman
2.	Prof.Dr. N.R.Bandella	Academic Council Nominee
3.	Dr. Nilesh Wagh	Academic Council Nominee
4.	Dr, Deepali Nimbalkar	Vice-Chancellor Nominee
5.	Dr. D. D.Ahire	Member
6.	Dr. A.P.Pandit	Member
7.	Prof.Dr. D.C. Meshram	Member (co-opt)
8.	Dr. Ashish V.Mane	Member (co-opt)
9.	Mr. Kaliprasad Ningurkar	Alumni
10.	Dr. Prakash Mundhe	Industry Expert

Prologue/ Introduction of the programme:

M.Sc. in Environmental Science happens to be a 4-semester course spread across 2 years and is mostly full time. Candidates enrolled in the course have the option of specializing in many different areas such as Ecology, Engineering, Chemistry and, Biology Conservation. After completing this course, the postgraduates usually engage in research with respect to the protection of natural resources and the discovery of new resources, management and control of waste (domestic and industrial) and even opt for environmental conservationist or engineer, etc.

This a newly emerging domain in the science field especially in the wake of greater awareness about environmental issues in today's technologically driven world. To understand the unique adjustments and modifications in the environment and its effect on organism's especially agricultural species, this dimension of scientific study has gained momentum of late. This field has become a prominent part of biology and biomedical research.

The course plans to address the developing requirement for skilled experts in the public eye for applying best administration rehearses attracted from different orders to make inventive answers for a maintainable future. M.Sc. Environmental Science program plans to create prepared experts who are furnished to manage the logical, lawful, financial, mechanical, and approach-based concerns identified with the condition and asset the board. M.Sc. Environmental Science program additionally expects to build up an all-encompassing way to deal with natural and asset-based issues in understudies from various scholarly, social, and expert foundations. The educational program has been structured basically on the idea of reasonable improvement in a between disciplinary system, with an accentuation on research and application.

Programme outcomes (Pos) (M.Sc. Environmental Science):

PO.1. Ability of Problem Analysis: Student will be able to analyse the problems of physical as well as cultural environments of both rural and urban areas. Moreover, they will try to find out the possible measures to solve those problems.

PO.2. Conduct Social Survey Project: They will be eligible for conducting social survey project, which is necessity for the assessment of development status of a particular group or section of the society.

PO.3. Individual and teamwork: Works effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.

PO.4. Application of modern instruments: Students will be able to apply various modern instruments for data collection and field survey.

PO.5. Application of GIS and modern Geographical Map Making Techniques: Students will learn how to prepare map based on GIS by using the modern geographical map-making techniques.

PO.6. Critical Thinking: Students will able to understand and solve the critical problems of physical and cultural environment.

PO.7. Development of Observation Power: As a student of Geography, they will be capable to develop their observation power through field experience and in future, they will be able to identify the socio-environmental problems of a locality.

PO.8. Development of Communication Skill and Interaction Power: After the completion of the course, they will be efficient in their communication skill as well as power of social interaction.

PO.9. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO.10. Enhancement of the ability of Management: Demonstrate knowledge and understanding of the management principles and apply these to their own work, as a member and leader in a team, to manage projects. They will perform effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO.11. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions and accept responsibility for them.

PO.12. Understand Environmental Ethics and Sustainability: Understand the impact of the acquired knowledge in societal and environmental contexts and demonstrate the knowledge of need for sustainable development.

PO.13. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context social, environmental and technological changes.

PO.14. Presentation Skill: Students are being able to understand and write effective reports and design credentials, make effective demonstrations, give and receive clear instructions.

M Sc. Part I Environmental Science

Semester-I

Course Type	Course Code	Course Title	Credits
DSCC-01 (04)	MSC-EN111T	Environmental Biology & Biodiversity	04
DSCC-02 (04)	MSC-EN112T	Environmental Physics & Chemistry	04
DSCC-03 (04)	MSC-EN113T	Environmental Geosciences	02
DSCC-04 P	MSC-EN114 P	Practical based on EN-111	02
DSCC-05 P	MSC-EN115 P	Practical based on EN-112	02
DSCC-06 P	MSC-EN116P	Practical based on EN-113	02
DECC-01 T	MSC-EN117 T(A)	Atmospheric Science	02
DECC-01 T	MSC-EN117 T(B)	Environmental Statistics-I	02
DECC-02 P	MSC-EN118 P(A)	Practical based on EN-117 (A)	02
DECC-02 P	MSC-EN118 P(B)	Practical based on EN-117 (B)	02
GE-01	MSC-EN119T	Environmental Instrumentation	02
TOTAL			**22**

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Syllabus of M.Sc. Environmental Science

(Under Faculty of Science)

Semester -I	**Paper -I**
Course Code: MSC-EN111T	**Title of the Course:** Environmental Biology & Biodiversity
Credits: 04	**Teaching Hours: 60**

Course outcomes (Cos):

- To understand the basics of biological environment
- To understand various Ecological concept like energy fixation and transportation
- Plant and animal behavior in ecosystem
- To understand the population and community dynamics in ecosystem
- To aquire the knowledge related with carrying capacity of ecosystem
- To know the functioning of microbial ecosystem

Unit. No.	Name of the Unit	Course contents	Number of lectures
1	Environmental Biology: Concepts and Scope:	• Concept of Ecosystem; • Biosphere as an ecosystem; • ecological processes and life support systems.	2
2	Fundamental Concepts of Ecology.	Ecology: Definition, development and scope. • Ecology as an experimental science Ecosystems: concept, components and functioning. • Energy Fixation (photosynthesis and chemosynthesis) and energy flow through food chains (grazing and detrital) and webs (include Y shaped energy flow model). • Ecological efficiencies and pyramids. Trophic levels • Influence of environmental factors (including temperature, light, moisture, soil, nutrients) on organisms and their adaptations in response to them	6
3	Ecology of Populations And Communities	**Population Ecology:** • Abundance and distribution of a species • Commonness, rarity and vulnerability of extinction of a species. • Population Dynamics: Patterns of survival, age distribution, dispersal andrates of change. Attributes of K- selected and r-selected species, Population Growth **Community Ecology:** • Competition, Exploitation (including herbivore, predation, parasitism), • Mutualism (including commensalism, cooperation,	14

		symbiosis), Food webs and concepts of niche and keystone species. • Nutrient cycling, Biogeochemical cycles (Carbon, Nitrogen, Phosphorus), • Limiting factors and their tolerance Succession, development, • Climax and stability of ecosystems • Cake and other ecological models, model of successions	
4.	Introduction To Plant And Animal Behavior	Ethology and socio-biology: General definition and concept Types of behavior • Feeding Behavior: Herbivores, Carnivores, Parasites, Saprophytes, • Response of prey / plants (deterrence, defence, reward). Animal Architecture and use of tools • Circadian and other rhythms. • Migration, orientation, navigation, and homing • Communication (including visual, olfactory, tactile, auditory, chemical) • Aggression, Territoriality, Altruism. Reproductive Behaviour: Courtship, Mating, Parental care, breeding systems. Instinct and Learning: Genotype and phenotype behavior.	8
5.	Terrestrial and aquatic Biomes	• Climatic and edaphic factors of terrestrial biomes. Heinrich Walter's Biome Climate Diagrams Classification of land biomes – • soil, climate and vegetation characteristics. • Natural history, wildlife, geography and human influences. • Mountain Biome: Replication of latitudinal changes in the altitudes of high mountains. • Terrestrial biomes, ecosystem diversity, • forest and vegetation types in India. • Freshwater Biomes (Rivers, streams, lakes, ponds) • Marine Biomes (including mangroves, coral islands, kelp forests,saltwater marshes, seashores, estuaries) and their natural history • Wetlands – definitions, types, ecological functions and resources	8
6.	Concept of Carrying Capacity	Biotic and abiotic components of environment, concept of sustainability and carrying capacity,tragedy of commons, human population and food, water and energy security.	6
7.	Environmental	Classification of microbes and their metabolism and ecology	16

	Microbial ecology	• Micro-organisms and their association with man, animals and plants. • Role of microbes in bio-remedial processes, ecological restoration and other environmental applications Environmental factors affecting microbes, their cultivation and growth. • Concept of bioindicators, bioindicators as plants, animals, bioindicators in manmade environment, role of bioindicator in pollution control. • Fundamentals of microbial nitrogen fixation and other pathways in terms of enzymology	

Reference Books:

1. Environmental Science - Arms Karen

2. Principles of Environmental Science-Watt, K. E. F. (1973) McGraw-Hill Book Company.

3. Environmental Science –Noble, B .J. Kormandy, E.J. (1981). The way world works, Prentice-Hall Inc., N .J.

4. Environmental Science-Turk A. , Turk J. Wittes J.T. and Wittes, R.E.

5. Environmental Issues: Measuring, Analyzing, Evaluating, Abel, Daniel C. McConnell, Robert L. Abel, Daniel C. Edi. 2 Prentice Hall Publication

6. Chaudhuri AB and Sarkar DD (2003) Megadiversity Conservation, Flora, Fauna and Medicinal Plants of India's Hotspots. Daya Publishing House, New Delhi.

7. Gary K Meffe and Ronald Carroll C (1994) Principles of Conservation Biology. Sinauer Associates Inc., Massachusetts.

8. Groombridge B (Ed.) (1992) Global Biodiversity Status of the Earths Living Resources. Chapman & Hall, London.

9. IUCN (1992) Global Biodiversity and Strategy.

10. Sharma PD (2000) Ecology and Environment. Rastogi Publications, Meerut, India.

11. Singh MP, Singh BS and Soma S. Dey (2004) Conservation of Biodiversity andNatural Resources. Daya Publishing House, New Delhi.

12. Virchow D (1998) Conservation and Genetic Resources, Springer-Verlag, Berlin.

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Semester -I	**Paper -II**
Course Code: MSC-EN112T	**Title of the Course:** Environmental Physics & Chemistry
Credits: 04	**Teaching Hours: 60**

Course outcomes (Cos):

- To understand the basics of stoichiometry
- To understand the fluid properties
- Acquire the factors influencing waves and oscillation
- Application of optics in spectrophotometry crystallography
- To understand the application to atomic physics, lasers, and spectroscopy
- To understand the application to nuclear physics, and thermodynamics

Unit. No.	Name of the Unit	Course contents	Number of lectures
1.	Stoichiometry	• Gibb's energy, • Chemical Potential, • Chemical equilibria, • acid base reactions, solubility product, • solubility of gases in water, • the carbonate system, • unsaturated and saturated hydrocarbon, • radionuclides, • Chemical bonding, • chemical reactions and equations, • Organic functional groups, • classes of organic compounds. • Free radical reactions, catalytic processes. • Elemental cycles (C, H, N, S, O, P) and their environmental significance. • Reversible and irreversible reactions of water, • Cations and anions in water and their sources, • Mass Balancing,	14

2.	Fluids	• Pressure, • buoyancy, • fluid flow, • viscosity, • surface tension. • Applications to hydraulics, • biophysics, • atmospheric physics, • aerodynamics	6
3.	Waves and oscillations	• Reflection, • refraction, • superposition, • resonance, • energy transport, • absorption, • Doppler effect. • Applications to water waves, • acoustics	6
4.	Optics	• Geometrical optics including dispersion, lenses, mirrors, interference, diffraction, polarisation. • Applications to microscopy, imaging, vision, crystallography	6
5.	Quantum physics	• Interaction of light with matter, x- rays. • Application to atomic physics, lasers, and spectroscopy	6
6.	Nuclear physics	• Atomic nucleus, • radioactive decay, • half-life, • ionising radiation, • nuclear fission and fusion. • Application to nuclear energy, radiation safety, nucleo-genesis, carbon dating. • Effects of radiation on living tissue, background radiation, radon; units for radiation exposure; • applications of nuclear technology, nuclear medicine, contaminant tracing, ion beam analysis	12
7.	Thermo dynamics	• Carnot cycle, • refrigerators, • heat engines, • throttling process; • Helmholtz and Gibbs Free energies, and phase transformations. • Heat Energy And Kinetic Theory Heat and Temperature. Internal Energy, Specific Heat. • Ideal gas Equation. Kinetic theory interpretation of pressure and temperature.	10

		• Work, heat, and laws of thermodynamics. • Adiabatic lapse rate. • Radiant energy. Optics: Fourier optics, Fourier transforms in 1 and 2D, Dirac delta function and comb, discrete Fourier transforms and the sampling theorem, convolution, cross and autocorrelation. • Fresnel and Fraunhofer diffraction, • Polarized light including production and control of polarization.	

References:

1.Destruction of hazardous chemicals- G.Lunn, E.B.Sandome

2.. Hazardous substances in chemical lab-G.D.MuMivir

3. Essentials of Nuclear Chemistry, H. J Arnikar, Wiley Eastern Limited, 4 th Edition.(1995)

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Semester -I	**Paper -III**
Course Code: MSC-EN113T	**Title of the Course: Environmental Geosciences**
Credits: 02	**Teaching Hours: 30**

Course outcomes (Cos):

- To understand the basics of earth origin and related theories
- Information related with surface process es and landforms
- Genesis, physical ,chemical and biological changes in soil wrt environmental parameters

Unit. No.	Name of the Unit	Course contents	Number of lectures
1	Earth: Origin, Structure, Dynamics & Composition	• Origin: Origin of Earth & its spheres (Lithosphere, Biosphere, Hydrosphere, Atmosphere) • Structure: Internal Structure of Earth - Core, Mantle and Crust; • Thermal, Magnetic & Gravitation Fields of the Earth • Dynamics: Concepts of Plate Tectonics & Sea Floor Spreading, Mountain building (folding and faulting), Earthquakes, Volcanism • Composition: Igneous, Sedimentary & Metamorphic Rocks; Processes and formation; Characteristics of major Rocks and Minerals.	08
2	Surface processes & landforms	• Processes and agents of weathering, erosion, transportation and deposition; Cycles of erosion- Davis and Penck Models • Mass-wasting; • Erosional and depositional landforms: Glacial, Aeolian, Fluvial, Coastal, shallow marine and deep marine. • Concept of Engineering & Urban Geology	8
3	Soil	• Genesis of Soil; Soil Profile; Soil texture, structure; Bio-, Physico-, Chemical properties of soil; Soil Classification; Soil types w.r.t. genesis;	8

		• Fertility; Lateritization; Land use and Land capability classification; • Water-logging, salinization, desertification and degradation of soil.	
4	Earth Resources:	• Occurrence, exploitation and environmental impacts Coal, Hydrocarbons and mineral resources.	6

Reference Books

1. The Earth System (3rd Edition) 3rd Edition- Lee R. Kump, James F. Kasting, Robert G. Crane

2. Holmes' Principles of Physical Geology 4th ed. 1993 EditionArthur Holmes (Ed) P. Mc L. D. Duff

3. Introduction to Physical Geology 1998. G.R. Thompson, & J. Turk

4. Planet Earth: Cosmology, Geology, and the Evolution of Life and Environment- Cesare Emiliani

5. Environmental Geology – K.S. Valdiya

6. Plate Tectonics & Crustal Evolution- Kent. C. Condie, 1997

7. Tectonic Geomorphology – D. Burrbank & R. S. Anderson, 2012

8. Mineralogy: Berry Mason, Dietrich

9. Rock Forming Minerals: Deer, Howie, Zussman

10. A.D. Howward and I Remson : Geology in Environmental Planning

11. Soroie: Geology for Engineers.

12. Rise and Wateson: Elements of Engineering Geology.

13. Todd, D.K.: Groundwater Hydrology.

14. Davis S.N. and Dewiest R.J.M.: Hydrogeology.

15. Economic Geology: Economic Mineral Deposits 2nd ed.

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Semester -I	**Paper -VI**
Course Code: MSC-EN114P	**Title of the Course:** Practical in EN-111 Environmental Biology & Biodiversity
Credits: 02	**Total hours -60** **Total Practicals:. (12x 4= 48 Hours)** **Internal and External evaluation =12 hours**

Course outcomes (Cos):

- To understand the importance of quadrate methods in field ecology studies
- To know the accumulation of biomass and photosynthesis relation
- To analysis the biomass and productivity of freshwater lake pond and river
- Student will well acquainted with basic microbial techniques
- Student will learn sample processing and analysis on various instruments

Unit	**Title**	**No. of practical**
1.Environmental Biology & Biodiversity	Vegetation studies by line and belt and quadrates methods	**2**
	To study wetland floral and faunal diversity	**2**
	Determine the carbon sequestration of indigenous plant in college campus	**1**
	Estimate the organic carbon of soil	**1**
	Determination of CO_2 and water transparency by Sacchi disc	**1**
	Determining the rate of photosynthesis and chlorophyll content in an aquatic plant	**1**
	Estimation of Phytoplankton ,zooplankton and Productivity of lake	**1**
	a)Preparation of media for microbial culture, b) Gram Staining. c) Isolation and culturing of microbes from soil / water samples	**4**
	Bacterial growth curve enzyme analysis from soil samples	**2**

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Semester -I	**Paper -VI**
Course Code: MSC-EN115P	**Title of the Course:** Practical in EN-112 Environmental Physics & Chemistry
Credits: 02	**Total hours -60** **Total Practicals:. (12x 4= 48 Hours)** **Internal and External evaluation =12 hours**

Course outcomes (Cos):

- To understand the principle and theory of conductivity meter
- To understand the principle and theory of potentiometer meter
- To understand the principle and theory of colorimeter meter
- To understand the principle and theory of spectrophotometer
- To understand the principle and theory of Paper Chromatography
- To understand the principle and theory of thin layer Chromatography

Unit	**Title**	**No. of practical**
2.Environmental Physics and chemistry	Determine of cell constant of the conductivity cell	**1**
	Determination of solubility and solubility product of the given sparingly soluble salt by conductivity meter	**1**
	Estimation of halides in water samples by Potentiometer	**1**
	Potentiometric titration of strong/weak and against weak/strong base	**1**
	Preparation of water samples and analysis of Sodium (Na) using Flame photometer	**1**
	Preparation of water samples and analysis of Potassium (K)using Flame photometer	**1**
	Verification of beer's law using CuSo4 solution	**1**
	Determinethe concentration of given KMnO4 solution by verifying the Beer's law using colorimeter.	**1**
	Spectrophotometric determination of Nitrogen,	**1**
	Spectrophotometric determination of Phosphorus	**1**

	Spectrophotometric determination of Sulphate	**1**
	Preparation of samples and analysis using Paper Chromatography	**1**
	Preparation of samples and analysis using Thin layer Chromatography	**1**

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Semester -I	**Paper -VI**
Course Code: MSC-EN116P	**Title of the Course:** Practicals in EN-113
Credits: 02	**Total hours -60** **Total Practicals:. (12x 4= 48 Hours)** **Internal and External evaluation =12 hours**

Course outcomes (Cos):

- Physically examine and identification of rocks and mineral samples
- To know the soil Textural analysis technique .
- To develop the skill of climatic maps and diagram from provided data
- Study of textural soil analysis
- To understand and draw the climatic maps

Unit	**Title**	**No. of practical**
Environmental Geosciences	**Minerals** Quartz, Calcite, Aragonite, Orthoclase, Mica, Haematite, Kyanite, Hornblende, Chlorite, Baryte, Halite, Gypsum, Galena, Pyrite, Anhydrite, Apatite, Fluorite, Asbestos	**3**
	Rocks Igneous: Granite, Rhyolite, Basalt, Gabbro, Diorite, Dunite, Sedimentary: Conglomerate, Sandstone, Limestone, Shale, Laterite Metamorphic: Marble, Slate, Schist, Gneiss	**2**
	Textural analysis of soil & Ternary Plots	**2**
	Slope analysisa ,aspect maps and Drainage analysis	**3**
	Exercises based on adiabatic lapse rates	**2**
	Climatic maps and diagrams – circular, graph, wind roses	**3**

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emester -I	**Paper -III**
Course Code: MSC-EN117T (A)	**Title of the Course: EN-118 Environmental Statistics**
Credits: 02	**Teaching Hours: 30**

Course outcomes (Cos):

- To understand the basics of Statistical methods
- Application of various methods of data analysis in environmental sampling
- To understand the population and catch model
- To understand the application of Excel programming in data analysis

Unit. No.	Name of the Unit	Course contents	Number of lectures
1	Foundation of environmental statistics	Nature of environmental data: Survey based (empirical) and experimental data. Concepts of population and sample – Random variable and parameters of interest. Concepts of statistical inference, Simple random sampling for selection of sampling units for making observations.	8
2	Univariate data –	Frequency distribution and their properties (including Skewness and Kurtosis), Histogram, Frequency Curve and Ogaive Curves. Measure of central tendancy: Mean, Median and Mode. Measure of Dispersion: Range, Variance, standard deviation and co-efficient of variation. Presentation of data: Summery statistics and graphical methods	8
3	Bi-variate data	Obtaining bivariate data by measuring two variables on a single sampling unit. Summary statistics for bivariate data: Mean,mode standard deviation and covariance, correlation coefficient. Scatter plot and its interpretation. Prediction models: linear and non- linear regression models, fitting a regression line and parabolic curve, estimating	6

		regression coefficients. Calculation of fitted values and residuals	
4	Tests of Significance-	Chi- squared test: goodness of fit. Independence of attributes, T and F tests for significance	2
5	Statistical method Using Excel	Presentation of data: Summery statistics and graphical methods Measures of central tendency, dispersion using (Univariate data &Bivariate data) Scatter plot ,correlation coefficient, linear regression Analysis	6

Reference books

1. Barnett Vic (2004) Environmental Statistics: methods and applications.

2. Ott, Wayne R. (1995) Environmental Statistics and data analysis.

3. Zar, Jerrold H. (1997) Biostatistical Analysis. Prentice Hall (India)

4. Nychka, Douglas and Piegorsch Walter W (1998) Case studies in environmental Statistics.

5. Manly Bryan F.J. (2001) Statistics for Environmental Science and Management.

6. Walpole R. and Myem R. (1993) Statistics for engineers and scientists

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Semester -I	**Paper -III**
Course Code: MSC-EN117T(B)	**Title of the Course:** Atmospheric Science
Credits: 02	**Teaching Hours: 30**

Course outcomes (Cos):

- To understand the basics composition and related theories
- Information related with surface process climate change
- Genesis, physical and chemical l changes in atmoshphere wrt environmental parameters
- To understand the climatology and weather parameter, energy budget and atmospheric stability phenomenon
- Understand the monsoon behavior

Unit. No.	Name of the Unit	Course contents	Number of lectures
1	Atmosphere	• Evolution, Composition and Structure; Elements of weather and climate; Weather Parameters (temperature, wind pressure, relative humidity, rainfall); • Climatology of weather parameters; Long and Short term climatic effects Insolation; The energy system and its balance; Flux of solar systemin the biosphere; • Earth's radiation budget; Net radiation and latitudinal heat balance; Green House Effect and Human influence on radiation balance. Atmospheric pressure, measurements& Distribution;	10
2		• Pressure & Wind Belts; local winds; Geostrophic & gradient winds; Air masses, Classification and modifications of air masses. Fronts, Classification of fronts. • Atmospheric moisture- Condensation; Forms of precipitation; CloudClassification; • Indian Monsoon; Inter-tropical Convergence Zone (ITCZ); Walker Circulation: El Nino- La Nina	10

3		• Atmospheric Stability & Instability; Dry and moist adiabatic lapse rate; Environmental lapse rate, plume behaviour • Environmental Meteorology - Atmospheric chemical transport models; emission inventory- aerosol and gas pollutants; • National Air Quality Standards and Indices; Dry and wet deposition fluxes of gas and aerosol pollutants; • Intercontinental and hemispheric transport of air pollutants	10

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emester -I	**Paper -VI**
Course Code: MSC-EN118P	**Title of the Course:** Practicals in EN-118 **Environmental Statistics** (A)
Credits: 02	**Total hours -60** **Total Practicals:. (12x 4= 48 Hours)** **Internal and External evaluation =12 hours**

Course outcomes (Cos):

- To understand the basics of Statistical methods
- Application of various methods of data analysis in environmental sampling
- To understand the population and catch model
- To understand the application of Excel programming in data analysis

Unit	**Title**	**No. of practical**
Environmental Statistics Practical	Grouping of data and preparation of frequency distribution. Histogram and frequency polygon	**2**
	Calculating mean, median and mode for grouped and ungrouped data	**1**
	Calculating variance, standard deviation and coefficient of variation for grouped and ungrouped data	**2**
	Fitting simple linear regression. Plotting scatter diagram and regression line	**2**
	Computing correlation coefficient and testing its significance for ungrouped data	**2**

	Comparison between means of two independent samples.	**1**
	Paired t-test	**1**
	Analysis of variance: one way and two- way classification	**1**
	Multivariate Analysis : STATISTICA/ANOVA/SPSS	**2**
	Fitting statistical model of air pollution to data	**2**

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Semester -I	**Paper -VI**
Course Code: MSC-EN118P	**Title of the Course:** Practicals in EN-118 (B)
Credits: 02	**Total hours -60** **Total Practicals:. (12x 4= 48 Hours)** **Internal and External evaluation =12 hours**

Course outcomes (Cos):

- Information related with surface process climate change
- Genesis, physical and chemical l changes in atmoshphere wrt environmental parameters
- To understand the climatology and weather parameter, energy budget and atmospheric stability phenomenon
- Understand the monsoon behavior

Unit	**Title**	**No. of practical**
Environmental Atmospheric Science Practical	Wind Rose Diagram	**1**
	Climographs	**1**
	Circular Graphs: Climatograph	**1**
	Water Budget Diagram	**1**
	Modified Köppen - Geiger Climatic Classification	**1**
	Estimation of distribution of solar radiation/ insolation over Earth's surface	**1**
	• Exercises based on incoming and outgoing solar radiations • Estimations of dry and wet deposition fluxes of gases and aerosol	**1**

	pollutants	
	• Global average temperature estimations with & without Greenhouse effect	**1**
	• Plume dispersion model (case studies) (optional)	**1**
	• Exercises based on adiabatic lapse rates • Climatic maps and diagrams – circular, graph, wind roses	**1**
	• Air-m• Calculation of ventilation coefficients for the fate of air pollutants (optional).ass back trajectory analysis (optional)	**1**

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Semester -I	**Paper -I**
Course Code: MSC-EN119T	**Title of the Course:** Environmental Instrumentation
Credits: 02	**Teaching Hours: 30**

Course outcomes (Cos):

- To understand the basics Basics principles of analytical instruments
- To understand Spectroscopy principle, structure and function
- To aquire the knowledge related chromatography
- To know the techniques of sample collection of air, water and soil .

Unit. No.	Name of the Unit	Course contents	Number of lectures
1	Basics principles of analytical instruments -	spectroscope, diffraction, chromatography, electronic transition, fundamentals of optics and photometry, principles of microscopy	2
2	Spectroscopy	Introduction, basic principles, Electromagnetic radiations and interactions with matters: Define Spectroscopy, Types of spectroscopy, Absorption spectrum, Emission spectra, Wave length and Wave number, Electromagnetic radiation, Quantisation of energy, Electronic, vibrational and rotational spectroscopy. fluorescence and phosphorescence. Absorption of radiation, Beer-Lambert's law, deviation of Beer-Lambert's equation and its limitations. UV-Visible spectroscopy, Fluorescence spectroscopy, IR/Raman spectroscopy, Flame Photometry, Atomic Absorption Spectroscopy,	8

		NMR Spectroscopy and Mass spectroscopy	
3	Principle of X-ray diffraction:	X- ray spectra, Bragg's law and intensity of X- rays, Mosley's law, XRD techniques	4
4.	Introduction to Chromatography	Classification – Theory – distribution coefficient, rate of travel, retention time, retention volume, adjusted retention volume, specific retention volume, column capacity, separation number, peak capacity, shapes of chromatic peak, column efficiency, resolution	6
5.	Gas Chromatography	Principle, carrier gas, stationery phase, instrumentation, sample injection, column detectors (TCD, FID, ECD), effect of temperature on retention, qualitative and quantitative analysis High Performance Liquid Chromatography: Principle, instrumentation, column, sample¬ injection, detectors (absorbance, refractive index, electrochemical), mobile phase selection, ion pair chromatography.	6
6.	Environmental sampling	Introduction to sampling techniques and analytical methods to measure environmental contamination in air, water, soils, and food. Safe Laboratory Practices, Quality assurance and Quality control	4
			30

References:

1.Skoog D. A. and Crouch S. R., Principles of Instrumental Analysis (7th Edition)

2.Ewing G. R., Instrumental Methods of Chemical Analysis (5th Ed.), McGraw Hill.

3. Rouessac F. , Rouessac A., Chemical Analysis: Modern Instrumentation Methods and Techniques,

4.Wiley Kemp W., Organic Spectroscopy, Palgrave Macmillan, 1991

M Sc. Part I Environmental Science

Semester-II

Course Type	Course Code	Course Title	Credits
DSCC-07 (04)	MSC-EN211T	Water & Soil Pollution: Management & Mitigation	04
DSCC-08 (04)	MSC-EN212T	Air, Noise & Radiation Pollution: Management & Mitigation	04
DSCC-9(04)	MSC-EN213T	Environmental Law, Ethics & Policy	**02**
DSCC-10 P	MSC-EN214 P	Environmental Sciences Practical based on EN- 211	02
DSCC-11 P	MSC-EN215 P	Environmental Sciences Practical based on EN-212	02
DSCC-12 P	MSC-EN216P	Environmental Sciences Practical based on EN-213	02
DECC-03 T	MSC-EN217 T(A)	Wildlife conservation and Management	02
DECC-03 T	MSC-EN217 T(B)	Water & Wastewater Technology	02
DECC-04 P	MSC-EN218 P(A)	Practical based on EN-217 (A)	02
DECC-04 P	MSC-EN 218 P(B)	Practical based on EN-217 (B)	02
GE-02	MSC-EN219T	Research Methodology	02
TOTAL			**22**

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Semester -II	**Paper -I**
Course Code: MSC-EN211T	**Title of the Course:** Water & Soil Pollution: Management & Mitigation
Credits: 04	**Teaching Hours: 60**

Course outcomes (Cos):

- **To understand the basics of freshwater, marine water, groundwater and soil pollution**
- **Student will know about the sources and effects of water and soil pollution**
- **Understanding the control measures and techniques to mitigate the pollution**
- **Additional awareness creating by explain the case studies**

Unit. No.	Name of the Unit	Course contents	Number of lectures
1	Freshwater Pollution	• Types and sources, Inorganic and organic pollutants responsible for water pollution: • Biological pollutants; Pesticides; Radioactive pollutants, etc. • Effluent standards, Drinking water standards, Characteristics of Domestic waste, Characteristics of Agricultural waste. • Consequences of water pollution: Effects on health, on biosphere and on economy. • Remedial measures of Freshwater pollution. • Case studies based on freshwater remediation using traditional and modern technology	15
2	Marine Water Pollution:	• Sources, types;	15

		• Ballast water pollution pollution due to off shore drilling, deep mining and oil extraction and other sources; • Prevention methods, control measures using bioremediation (bio-surfactants, microcosms), physical (booms, skimmers, absorbents etc) and chemical methods (dispersants, detergents etc). • Case studies based analysis of marine water pollution and prevention• strategies.	
3	Ground water Pollution	• Sources, groundwater contamination zones, • groundwater remediation- in situ and ex situ techniques; • bioremediation strategies -bio-venting, biosparging, bio-slurpping, permeable reactive barriers; • groundwater monitoring using Piezometer, slug and pumping tests; • Darcy's Law for estimation of hydraulic parameters, • Simulation for aquifer yield prediction, Artificial recharge and induced infiltration, Land subsidence; Coastal aquifers & Sea water intrusion Environmental regulatory bodies preventing groundwater pollution; • Case studies based insight in to groundwater remediation techniques	15
4.	Soil Pollution and Control	• Types, Effects and sources and consequences. • Mechanism of interaction of waste with soil. • Transport processes — biological process-microbial transformation of heavy metals. • Specifications for disposal of sewage and effluent on land for irrigation and ground water recharge. • Methodology of wastewater disposal on land. • Impacts on land of solid waste disposal MSW and industrial solid • wastes (fly ash from thermal power station, lime sludge from • pulp and paper mills). • Disposal of hazardous solid waste (heavy metals, toxic organic compounds) on land its impact. • Deterioration of soil due to mining activities • Case study of restoration of land due to a disposal of fly ash	15

		and iron ore extraction	

Reference Books:

1 Groundwater In the Environment: An Introduction, Paul L Younger 2014, ISBN: 978-265-4636-7

2. Groundwater Hydrology, Bhagu R Chahar, McGraw Hill Education

3. Environmental Chemistry, B. K. Sharma

4. Environmental Chemistry and Pollution Control, S. S. Dara

5. Environmental Pollution, N. Manivasakam 6. Environmental Chemistry, Samir K. Banerjee

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Semester -I	**Paper -II**
Course Code: MSC-EN212T	**Title of the Course:** Air, Noise & Radiation Pollution: Management & Mitigation
Credits: 04	**Teaching Hours: 60**

Course outcomes (Cos):

- To know the sources and effects of air pollution
- Impact of metrological parameters on dispersion of pollutants in atmosphere
- Chemical alteration in pollutant in various zones of atmosphere
- To study the various control measurement techniques available in atmosphere
- How to frame the EMP for air pollution monitoring and control
- Information about Noise Management & Mitigation

Unit. No.	Name of the Unit	Course contents	Number of lectures
1	Air Pollution: Causes and Effects	• Definition, Composition of air, Classification, Sources, • Effect of gaseous and particulate pollutants on animals, plant and human health, • Economic effects of air pollutants, Vehicular Pollution , Industrial Pollution	06
2	Air Pollution Meteorology& Chemistry	• Wind, • Temperature, • Atmospheric stability, • Dispersion • Chemical Properties in Troposphere • Stratospheric Ozone Chemistry: Ozone formation & destruction, Polar Stratospheric Clouds (PSPs).	08

3	Air Quality Analysis	**Air monitoring instruments and techniques: sampling ,storage and shipment of-** • SOX, NOX, O3, C6H6, • Pb, CO, • Particulate Matters samples	06
4	Air Pollution Control Technology :	**Basic Operating Principle, working and application of –** • Cyclones, • Scrubbers • (Wet and Dry) • Settling chambers • Electrostatic precipitators. • Fabric filters • Control of gaseous pollutants – • Absorption, adsorption, condensation, • Vapor incineration. .	08
5	Air Quality Management : Policy and Institutional Framework	• Ambient Air Protection Policy, • Air Quality Norms, Regulation of Emissions from Stationary & Non-Stationary Sources. • Public Informing and Participation in Decision Making Process, Planning and Implementation of Ambient Air Protection Measures. **Strategies for Air Pollution Control** – • Control of air pollution by fuel selection and utilization, • by process modification or equipment, • by site selection and zoning.	08
6	Noise Pollution & Control	Introduction to noise and vibrations, physics of sound and hearing, Noise Pollution- Sources and effects. **Noise control at source:** • Source path receiver concept, • control by design, • control by redress **Noise control in the transmission path**: Acoustical separation, physical barriers, Isolators and Silencers Protecting the receiver: personal protection device	06
7	Noise Monitoring and Impact Criteria	• Noise measuring techniques, • national standard for noise, noise monitoring methods, • A-weighted Sound Level: The Basic Noise Unit; Maximum Sound Level (Lmax) During a Single Noise Event; • Sound Exposure Level (SEL):Exposure from a Single Noise Event Hourly Equivalent Sound Level(Leq (h)); • Day-Night Sound Level (Ldn): 24- Hour Exposure from All Events; • A Noise-Exposure Analogy for Leq and Ldn	08

		Investigation and assessment of impact of noise, • Considerations in Applying the Noise Impact Criteria; Mitigation Policy Consideration; • Determining the Need for Noise Mitigation.	
8	Radiation Pollution	**Radioactivity – T**ypes and measurement**.** **Classification of radio-active wastes –** gas, solid, liquid**.** **Detection of nuclear radiations –** • G. M. counter, • scintillation counter, • semi-conductor detector. **Radiation hazards and safety** – natural and manmade. **Types of radiations-** Internal and external radiation hazards, safe handling methods, personal dosimeter, reactor safety. **Units of measurement**- • half-life period, • radiation dose measurement. **Biological effects and health hazards:**. Interaction of radiations with biological cells, somatic and genetic effects. **Control measures** – treatment and disposal of radio-active waste, generation of waste from various sources. ICRP recommendations. AERB classification, maximum permissible dose.	10

References:

Reference Books 1. Fundamentals of Air Pollution – Daniel A. Vallero

2. Air Pollution: Health and Environmental Impacts – L.T Molina & B.R Gurjar

3. Advanced Air and Noise pollution Control – L.K Wang & N.C Pereira

4. Textbook of Noise Pollution & Its Control – S.C. Bhatia

5. Environmental Chemistry - A.K. De 6. Environmental Chemistry – B.K. Sharma

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Semester -II	**Paper -III**
Course Code: MSC-EN213T (A)	**Title of the Course:** Environmental Law, Ethics & Policy
Credits: 02	**Teaching Hours: 30**

Course outcomes (Cos):

- Candidates should be able to demonstrate knowledge and understanding of the issue
- Constitutional and secular approaches conservation approach
- Importance of legal aspect in air water soil and forest conservation and protection programme
- To understand Various amendments and its importance in present scenario Candidates should be able to discuss these areas critically.
- Various environmental agreements ,convention and its implementation programme at national and international level

Unit. No.	Name of the Unit	Course contents	Number of lectures
1	Fundamental Rights and ethics	• Environmental Policies in the Indian Constitution • Role of constitution in environment protection, • Fundamental rights and duties, Article 48A, 51A (g)and 58A. • National Environmental Policy, Ethical dilemma, Issues of Sustainable Developmen	8
2	Environmental Laws in India	• Water Act, 1974 • Air Act, 1981 • Indian Forest Act, 1927/1982 • EPA, 1986 • The Wildlife Act, 1972 • The Biological Diversity Act, 2002	8

		• National Forest Policy, 1988	
3	Rules and Regulations (As amended)	• Hazardous Waste Rules, • Solid Waste Management Rule • Biomedical Waste Rules • E- waste rules Construction and Demolition waste Rules • Concept of Eco sensitive zones, Coastal Regulation Zone	6
4	Convention ,agreements and policies	• International Environmental Laws and Policies • UNFCCC, • Paris climate accord or Paris climate agreement 2015 • Kyoto Protocol • Convention on Biodiversity • International Solar Alliance • CITES Ramsar Convention • Basel Convention • MARPOL • Cartagena Protocol on Bio-safety • Agenda 21	08

Reference Books

1.T. S. Doabia. 2017. Environmental and Pollution Laws In India. 3rd Edition. Publisher: Lexis Nexis

2. P. Leelakrishnan. 2016. Environmental Law in India. 4th edition. Publisher: Lexis Nexis.

3. S. K. Mohanty. 2009. Environment and Pollution Laws. Publisher: Universal.

4. P. Leelakrishnan. 2006. Environmental Law Case Book. 2nd edition. Publisher: Lexis Nexis.

5. Divan Shyam and Rosencrantz Armin. 2002. Environmental Law and Policy in India: Cases, Material & Statutes. Publisher: Oxford.

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Semester -II	**Paper -VI**
Course Code: MSC-EN214P	**Title of the Course: Practical in EN-211** Water & Soil Pollution: Management & Mitigation
Credits: 02	**Total hours =60Hr** • **Total Practicals: 12 (12x4= 48 Hours)** • **Internal and external evaluation: 12 hours**

Course outcomes (Cos):

To understand Collection and physical analysis of water parameters

- Learn the techniques of calibration of water analysis instruments .
- Analysis of dissolved solids and its interpretation
- To understand the DO,BOD and COD importance in water and waste water analysis
- To understand sulphate and nitrate importance in water and waste water analysis

Unit	**Title**	**No. of practical**
1.	Determination of pH & Electrical Conductivity water , industrial effluent and Soil	**1**
2.	Determination of Solids (TS, TDS,TSS).	**1**
3.	Determination of Turbidity Nephlometer	**1**
4.	Determination of Total Alkalinity and Total Hardness of water sample.	**2**
5.	Determination of Chlorides and Residual Chlorine of water sample	**1**
6.	Determination of DO and BOD of given water sample.	**2**
7.	Determination of COD in given water sample.	**1**
8.	Determination of Sulfates of given water sample.	**2**
9.	Determination of nitrate of given water sample.	

10.	Determination of Nitrate and nitrites of a water sample	**1**
11.	Texture Analysis of given soil sample	**1**
12.	Determination of Bulk density and water holding capacity of soil.	**1**
13.	To estimate organic carbon of soil sample	**1**
14.	To estimate cation exchange capacity of soil. 6. To determine sodium adsorption ratio of soil.	**1**

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Semester -I	Paper -II
Course Code: MSC-EN215P	**Title of the Course:** Air, Noise & Radiation Pollution: Management & Mitigation
Credits: 04	**Teaching Hours: 60**

Course outcomes (Cos):

- Candidates should be able to demonstrate knowledge and understanding of the issue
- The students will understand the air sample collection ,preservation and transportation techniques
- Candidates will aware the air pollution index of the area
- Collection of data of noise from various sites
- Demonstration of instruments and visits to industrial sector and laboratory will enrich the student with knowldge

Unit	Title	No. of practical
1.	Determination SOX concentration in air.	**1**
2.	Determination NOX concentration in air	**1**
3.	Determination PM 2.5 and PM10 Concentration in air.	**1**
4.	Determination of heavy metals in collected air samples	**2**
5.	Estimation of Carbon dioxide from air sample.	**1**
6.	Measurement of sounds by DB meter / SLM in silent, industrial, residential and commercial zones.	**2**
7.	Determination of SPL, Lmax, TWA, Leq, Ldn, L10, L50, L90.	**2**
8.	Determination of Noise dose.	**1**
9.	Industrial visit for Stack monitoring and sampling of air .	**1**
10.	Visit to state/central / NABL approved laboratory	**1**
11.	Demonstration of Giger /Scintillation Counter	**1**

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Semester -II	**Paper -VI**
Course Code: MSC-EN216 P	**Title of the Course: Practical in EN-213** Environmental Law, Ethics & Policy
Credits: 02	**Total hours =60Hr** • **Total Practicals: 12 (12x4= 48 Hours)** • **Internal and external evaluation: 12 hours**

Course outcomes (Cos):

- Legal report preparation of case studies
- Field studies encourages the awareness among students
- Functioning of NGT and its importance

Unit	**Title**	**No. of practical**
1.	Prepare the case study of pulp and paper mill under water act ,1974	**1**
2.	**Write legal report of hazard waste disposal site**	**1**
3.	Prepare the case study sugar under water act ,1974	**1**
4.	**Short Report on amendments made in Indian forest act ,1982**	**1**
5.	Explain the the legal penalties impose on violation of bidversity act 2002	**1**
6.	Study a social and health issues near landfill site and prepare report	**1**
7.	Problems and legal norms for construction and demolition rules	**1**
8.	Write a short report on structure, function and importance of National Green Tribunal (NGT)	**1**
9.	Prepare report on ship wrecking yard – Case study Alang , Gujrat or any other	**2**
10.	Report on legal norms ,standards and penalties for tannery waste	**1**

	disposal	
11.	Visit to MSW and BMW site	**2**
12.	Visit to Hazardous waste disposal site / industry	**1**

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Semester -II	**Paper -VI**
Course Code: MSC-EN217 (A)	**Title of the Course: EN-217** Forestry and Habitat Management
Credits: 04	**Total Hours :60**

Course outcomes (Cos):

- To know the importance of forest
- Acquire the knowledge of biotic and aboitic components
- Understanding the silviculture practices with traditional and advance practices
- Understanding the stages of tribal economy, education, cultural tradition, customs, ethos and participation in forestry programmes.
- To know the importance of forest Management Systems and Forest Protection

Unit. No.	Name of the Unit	Course contents	Number of lectures
1.	Introduction	Definition of forestry and habitat management, Concepts, terms and terminologies, need, scope of the subject	2
2.	Forest Ecology and Ethnobotany	Forest as a ecosystem, Biotic and abiotic components, productivity, nutrient cycling, stresses, Forest types in India and conservation initiatives. Role of Ethnobotany	4
3.	Silviculture	Principles, ecological and physiological factors influencing vegetation, nursery system, Silvicultural systems – wood selection, felling, establishment and and management of standards, technical methods and constraints, Silviculture practices in specialized ecosystems like Mangroves and Cold desert: Silviculture of trees -Traditional and advance methods, Silviculture of	6

		some of the economically important species in India	
4.	Agroforestry, Social Forestry, Joint Forest Management and Forest dwellers and their socio-economics.	Scope and necessity; objectives, techniques, participatory approach, Research and Extension needs, stages of tribal economy, education, cultural tradition, customs, ethos and participation in forestry programmes.	4
5.	Forestry and Environmental Conservation	Soil and water Conservation through Forestry, Environment; components and principles of conservation, impact of deforestation; forest fires and various human activities like mining, construction and developmental projects, population growth on environment, pollution.	4
6.	Forest Management Systems	Objective and principles; techniques; stand structure and dynamics, sustained yield relation; rotation of growing stock through management, Forest Working Plan, integrated approach, Forest Mensuration - Methods of measuring - diameter, girth, height and volume of trees; form-factor; volume estimation of stand, annual increment. Sampling methods and sample plots. Yield calculation; yield and stand tables. Forest cover monitoring through remote sensing, Geographic Information Systems, management and modelling. Surveying and Forest Engineering General principles, objects, types, methods	6
7.	Forest Protection	Injuries to forest, Susceptibility of forests to damage, chemical and biological control, protection against fire and other natural disasters. Role of afforestation and forest regeneration, shifting cultivation and control.	2

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Semester -II	**Paper -VI**
Course Code: MSC-EN217 (B)	**Title of the Course:** Water & Wastewater Technology
Credits: 02	**Total Hours :30**

Course outcomes (Cos):

- To know the requirement of water and its distribution on the basis of population forecasting methods
- National and international standards of water
- To know the basic and advance water treatment used in water treatment plant
- Waste water characteristics and Specifications of treated wastewater for disposal
- Principle and designing aspect of various units of waste water treatment plant
- Understanding with case studies of specific industries

Unit. No.	Name of the Unit	Course contents	Number of lectures
1	Quantity of water	• Water Requirements for domestic consumption. Population forecasting method: Demographic Arithmetical progression, Geometrical progression, Logistic, Graphical projection and Final prediction. • Factors affecting rate of demand. • Specifications for drinking water (physical, chemical & bacteriological) by Bureau of Indian Standards & World Health Organization • Quality of water required for – Domestic, Institutional (Schools, Hostels, Hospitals), Fire fighting, Commercial (Shopping complex, Hotels, Restaurant), Industrial (Dairy,	6

		Sugar, Pulp and Paper, etc.). Specific requirement at pilgrimage place and recreation activities. • Quality parameters for water analysis, methods for analysis. Packaged drinking water	
2	Water Treatment	Principle, Application & Designing of- a. Collection & pumping; b. Aeration; c. Flocculation; d. Sedimentation; e. Filtration; f. Disinfection ; g. water softening	6
3	Advanced treatment methods	a. Demineralization; b. Ultra filtration; c. Reverse osmosis; d. Color & odor removal by activated carbon; e. Iron removal; f. Nitrification and denitrification	6
4	Wastewater disposal	Specifications of treated wastewater for disposal into surface water, on land & in marine waters after treatment. Self-purification of water bodie	4
5	Wastewater technology	• Different models of Physical, Chemical and Biological Treatment • Aerobic and anaerobic digestion by combination of attached & suspended growth	2
6	Wastewater engineering	Collection system - Methods of collection, conservancy systems, collection system, water carriage system, sewerage system. **Principle and designing of-** • Screen chamber, • Grit chamber, • Oil & grease removal, • Aeration and sedimentation, • Stabilization pond, Aerated lagoon, • Activated sludge process, • Trickling filter, • Rotating biological contactors • fluidized bed reactor, • UASB • Treatment and Disposal of sludge	6

Reference:

1.Waste water engineering – Metcalf & Eddy

2. Elements of Environmental Engineering –K.N. Duggal

3. Water Supply and Sanitary Engineering –G.S.Birdie and J.S.Birdie

4. Water Supply Engineering –Dr. P.N.Modi

5. Water Supply and Wastewater Engineering –Dr. B.S.N.Raju

6. Water Supply Engineering –B.C. Punmia

7. Water Supply Engineering –Hussain

8. Water Supply Engineering –Chatterjee

9. Environmental Biotechnology-T Srinivas (New Age Publications) 1

10. Environmental Engineering - Peavy, Rowe, Tchenobolus 11. Water supply and sanitary engineering - Rangwala

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Semester -II	**Paper -VI**
Course Code: MSC-EN218 (A)P	**Title of the Course: Practical in EN-217 (A)** Forestry and habitat management
Credits: 02	**Total hours =60Hr** • **Total Practical: 12 (12x4= 48 Hours)** • **Internal and external evaluation: 12 hours**

Course outcomes (Cos):

- Enable students undertake practical work and apply appropriate Taxonomic and inventory skills
- Collect, analyze and present data on functions and relationships existing between organisms..
- To develop students' field work analysis and reporting skills.

Unit	**Title**	**No. of practical**
1	Identification of seeds and seedlings of multipurpose tree species	**1**
2	Estimation of organic matter in mono and poly culture vegetation area	**1**
3	Estimation of carbon sequestration of selected plants in forest	**1**
4	Identification and preparation of herbarium of medicinal plant	**1**
5	Identification and preparation of herbarium of indigenous and exotic plants	**1**
6	Estimate the forest land cover in provided satellite image with the help of stereoscope	**1**
7	Estimate the forest land cover in provided map by grid method	**1**
8	Visit and Prepare the migratory bird register of the wetland	**1**
10	Visit to agro-forestry fields to study the compatibility of mpts (multipurpose trees and shrubs)with agriculture crops	**1**
11	Visit to alley cropping agro-forestry model	**1**
12	Visit to agro-silvopastoral agroforestry model	**1**
13	Energy plantation, characteristics of tree spp. & advantages of energy plantation	**1**

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Semester -II	**Paper -VI**
Course Code: MSC-EN218(B) P	**Title of the Course: Practical in EN-217 (B)** Water and waste water Technology
Credits: 02	**Total hours =60Hr** • **Total Practical: 12 (12x4= 48 Hours)** • **Internal and external evaluation: 12 hours**

Course outcomes (Cos):

- Enable to collect, label and shipment of sample
- Understand the DO,BOD and COD relationship in biological treatment
- Sludge indices give knowledge of loading of waste water in treatment
- Designing of the treatment unit by provided data

Unit	**Title**	**No. of practical**
1	Collection , labeling , sorage and shipment of water and waste water sample	
2	Determination of Chlorides and Residual Chlorine of water sample	**1**
3	Determination of DO and BOD of given water sample.	**1**
4	Determination of COD in given water sample.	**1**
5	Determination of Sulfates and nitrate of given water sample.	**1**
6	Determination of Nitrate and nitrites of a water sample	**1**
7	Determination of MLSS, MLVSS and SVI of waste water	**1**
8	Determination of organic loading in biological treatment	**1**
9	Design the grit chamber and sedimentation from the provided data	**1**
10	Design the trickling filter from the provided data	**1**
11	Design the oxidation pond from the provided data	**1**
12	Jar test for coagulation determination	**1**

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Semester -II	**Paper -IV**
Course Code: MSC-EN219T	**Title of the Course** : Research Methodology
Credits: 02	**Teaching Hours: 30**

Course Outcome :

- Create the scientific research awareness among the student
- To know the Ethical aspect of scientific research
- How to understand the Characteristics of a Problem Formulating and Hypothesis
- To acquire the techniques of data and sampling
- statistical approach in interpretation of data
- Develop scientific writing skill among students

Unit. No.	Name of the Unit	Course contents	Number of lectures
	Introduction to Research Methodology & Data Collection	• Importance of Research, • Meaning and Characteristics of Scientific Research, • Types of Research Steps in Research, • Ethical Problems in Research, • Selecting a Problem and Formulating Hypotheses, • Meaning and Characteristics of a Problem Formulating and Hypothesis	6
	Measurement of scale & Data collection	• Types of data, • Introduction to Measurement General Problems of Measurement Questionnaire design • Variables • Data coding • Data organization • Meaning and Types of Item and construct	8

		• Validity, Types of Validity • Reliability • Relation between Validity and Reliability • Primary and secondary data collection • Content analysis	
	Sampling Techniques	• Types of Sampling Requisites of Good Sampling Method • Errors in sampling • Simple and stratified sampling • Systematic sampling (concepts) • Sampling size calculation	6
	Data Analysis and report writing	• Descriptive statistics – Mean, Median, Mode • Standard deviation (concepts) Normal Curve • Testing of hypothesis - Null and Alternative hypothesis • Type I & Type-II errors • Level of significance • Concepts of Parametric and Non-Parametric Statistical Tests • Testing significance of single mean and difference between means (up to two samples) concepts only • Project report writing: General Purpose of Writing a Research Report	08