

MANONMANIAM SUNDARANAR UNIVERSITY
ABISHEKAPATTI, TIRUNELVELI-627012, TAMILNADU, INDIA

Master of Science – Environment Science
(with effect from the academic year 2020-2021)

Sem.	Sub. No.	Subject Status	Subject Title	Contact Hrs./ Week	Credits
(1)	(2)	(3)	(4)	(5)	(6)
III	14	Core - 14	Pollution: Assessment, Instrumentation and Control Technologies	6	4
	15	Core - 15	Environmental Biotechnology	6	4
	16	Core - 16	Environmental management and impact assessment	5	4
	17	Core - 17	Research Methodology	5	4
	18	Core - 18 Practical - 5	Practical- Pollution: assessment, instrumentation and control technologies	4	2
	19	Core - 19 Practical - 6	Practical- Environmental Biotechnology	4	2
	Subtotal				30
IV	20	Core - 20	Natural disaster management	4	4
	21	Core - 21	Forest and Wildlife Ecology	4	4
	22	Core - 22	Remote sensing and Geographical Information	4	4
	23	Core - 23 Practical - 7	Practical- Natural disaster management and Forest and Wildlife Ecology	4	2
	24	Core - 24 Practical - 8	Practical- Remote sensing and Geographical Information	4	2
	25	Elective - 1	Field Work / Study Tour	3+	3
	26	Core - 25	Project	7+	8
	Subtotal				30
Total				120	90

+ Extra hours for the Project

For the Project, flexible credits are b/w 5 – 8 & Hours per week are b/w 10 - 16.

Total number of credits \geq 90	:	90
Total number of Core Courses	:	25 (15 T + 8 P + 1 Prj. + 1 FW.)
Total number of Elective Courses / F.W. / S.T.	:	1
Total hours	:	120

Pollution: Assessment, Instrumentation and Control Technologies

Unit I: Introduction to Pollution Concept of pollution, causes of environmental pollution, Environmental problems due to pollution, Major conflicts of Development and Environment, Mining and Environment.

Unit II: Regulatory Aspects and legislation Industrial Emissions Liquids and gasses; pollution caused by various chemical industries and its overall effect on quality of human life and the environment, water quality management in India. MINAS for sugar industries, distilleries, pesticides industry and mercury from caustic soda industry, Good analytical practices for proper assessment of pollutants, Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, National and International conventions and agreements on environment.

Unit III: Pollution and its Measurement Nature of industrial effluents, gaseous effluents, methods of gas analysis, analysis of natural water, analysis of waste water for BOD, free acids and basic; dissolved organic and inorganic compounds like alkali and alkaline salt, SO_4^{2-} , PO_4^{3-} , NO_2^- - determinations. Industrial effluent treatment recovery and recycle techniques.

Unit IV: Removal of pollutants Methods for removal of pollutants from gaseous effluents; particulate matter, waste water treatment Activated sludge process. Removal of Nitrogenous pollution, Removal of nitrogen; physico-chemical processes; biological method of pollution control. Analytical methods of small amount of the metal pollutants; removal and recovery techniques of heavy metals.

Unit V: Hazardous waste and Biomedical waste management Hazardous waste, characterization and site assessment waste minimization and resource recovery, chemical physical and biological, treatment; hazards of improper treatment and disposal method; accidental exposure of dangerous waste and emergency measures. Biomedical waste classification and its management methods

References:

1. Waste water engineering, Met Calf and Eddy, INC, Tata Mc Graw Hill.
2. Fundamentals of Environmental Pollution, Krishnan Khannan, S. Chand and Company Ltd.,1994.
3. Environmental Pollution Control, C.S. Rao, Wiley Eastern Ltd.,1993.
4. Air Pollution Control and Engineering, De Nevers, Mc Graw Hills, 1993.

Environmental Biotechnology

Unit I: Concept of Environmental Biotechnology: Definition – concept and scope – Application of biotechnology – Role of microbial systems – Principles – Characteristics - Genetically engineered organisms – Merits and demerits – Bio tools for environmental monitoring – Role of biotechnology in environmental protection.

Unit II: Biotechnology and pollution abatement : Biotechnology of wastewater treatment - Bioreactors - Microbial system in waste water stabilization – Biofilms - immobilization technology in waste water treatment – Microbial metabolism and growth kinetics – oil degradation – biodecolourization – Reed bed technology – Rhizosphere engineering - Biofiltration and Bioindicators.

Unit III: Role of Biotechnology in Bioremediation: Soil pollution - Bioremediation – Principles - Biodegradation of agro chemicals and other organic compounds – Biotransformation of xenobiotic compound - Role of GEMS in degradation of xenobiotics; Bioscrubbers – Biomining of metals - Biopulping.

Unit IV: Biotechnology and value addition: Bio processes in waste treatment - Production of value added products from waste – single Cell Protein (SCP), ethanol, methane and hydrogen, amino acids, vitamins -Enzyme production from wastes – Biodegradable plastics - Environmental implications -.Biotechnology of Microbial composting - Biofertilizers- Biopesticides

Unit V: Environmental Monitoring: Bioindicators –Biomarkers –Biosensors –Biomonitoring – Polluted environment – Short- and long-term monitoring of remediated sites

References:

1. Chatterji. A.K., 2003. Introduction to Environmental Biotechnology. Prentice Hall of India Pvt. Ltd., New Delhi.
2. Miller Jr. G. T., 2004. Environmental Science. Tenth Edition. Thompson Brooks/Cole. United States.
3. Kumar H.D, 1998. A text book on biotechnology. II Edition, Affiliated east west press Pvt. Ltd., New Delhi.

Environmental Management and impact assessment

Unit I : Principles of Environmental Management, Ecosystem Concepts, Environmental Concerns in India, Policy and Legal Aspects of Environmental Management, Introduction to Environmental Policies, Environmental Laws and Legislations, Environmental Legislations in India.

Unit II: Environmental Impact Assessment (EIA), Impact Prediction, Evaluation and Mitigation, Forecasting Environmental Changes, Strategic Environmental Assessment (SEA), Environmental Clearance Procedure in India, EIA Documentation and Processes, EIA Monitoring and Auditing.

Unit III: Environmental Auditing, Elements of Audit Process, Waste Audits and Pollution Prevention Assessments, EA in Industrial Projects. Life Cycle Assessment (LCA), Stages in LCA of a Product, Procedures for LCA, Different Applications of LCA. Sustainable approach towards Environment Management, Environmental Protocols.

Unit IV: Environmental Management System Standards, Implementation of EMS Conforming to ISO 14001. Environmental Economics: Introduction, economic tools for evaluation, Green GDP, Cleaner development mechanisms and their applications.

Unit V: Prediction and assessment of impacts on the noise environment: Basic Information on Noise, Key federal Legislation and Guidelines, Conceptual Approach for Addressing Noise-Environment Impacts. Prediction and assessment of impacts on the biological Environment: Basic Information on Biological Systems, Key Federal Legislation, Conceptual Approach for Addressing Biological Impacts. Environmental laws and policies – Environmental laws for managing Air, water, land, wastewater, solid waste, hazardous waste, natural resources

References:

1. Lohani B.N (1984)., “Environmental Quality Management”, South Asian Publishers, New Delhi
2. Chanlett, (1973)“Environmental Protection”, McGraw Hill Publication, New York.
3. Canter L., (1995), “Environmental Impact Assessment”, McGraw Hill.
4. Jain R.K., Urban L.V., Stacey G.S., (1977), “Environmental Impact Analysis – A New Dimension in Decision Making”, Van Nostrand Reinhold Co.
5. Rau and Wooten, (1981), “Environmental Impact Assessment Handbook”. McGraw Hill.
6. Dharmendra S. Sengar (2007). Environment Law. PHI [prentice Hall of India]

Research Methodology

Unit I: Introduction: Sampling, data collection and recording. Central tendency – concept, arithmetic mean, mode, median for ungrouped and grouped data. Measures of dispersion - absolute and relative measures, range, standard deviation (grouped and ungrouped data), variance, quartile deviation, coefficient of variability. Probability - normal and binomial

Unit II: Statistical Methods: Hypothesis testing, significance and correlation. Correlation - linear models and regressions. Pearson and other correlation coefficients. Multiple regressions, Distribution- Normal, t and chi square test Difference among means: F-test: 1 way ANOVA, F-test: 2 ways ANOVA.

Unit III: Research Writing: Overall outline and structure of the article/manuscript. Description, value, and development of points/outlines before writing. Screening of Material for inclusion within the structure of the manuscript. Importance of authors & their sequence, importance of clear title, abstract and summary. Introduction, methods, results and discussion.

Unit IV: Writing Style - Active or passive, Punctuation, use of commas, apostrophe, semicolon and colon. Avoiding duplication and repetition. Importance of revisions and references. Plagiarism - paraphrasing and copy write violation. Consequences of plagiarism. Why not to fudge, tinker, fabricate or falsify data.

Unit V: Computer applications in environmental modeling: Computer-based modeling: Linear, regression, validation and forecasting. Computer-based modeling for population and population studies.

References:

1. Biostatistics: A Guide to Design, Analysis and Discovery, 2nd Edition
2. Environmental Statistics (Handbook of Statistics) - Ganapati P. Patil and C. Radhakrishna Rao
3. Environmental Statistics - Books LLC
4. Scientific Writing: A Reader and Writer's Guide - Lebrun, Jean-Luc
5. Scientific Writing - Hall Marian Rose
6. From Research to Manuscript: A Guide to Scientific Writing- Michael J. Katz
7. Computing Research for Sustainability - Committee on Computing Research for Environmental and Societal Sustainability, Computer Science and Telecommunications Board, Division on Engineering and Physical Sciences and National Research Council
8. Statistics for Environmental Science and Management-Manjunatha

Pollution: Assessment, Instrumentation and Control Technologies

1. Determination of Sulphur dioxide by Colorimetric method.
2. Dust retaining capacity of plants.
3. Measurement of noise.
4. Estimation of BOD.
5. Estimation of COD.
6. Estimation of Chlorophyll.
7. Estimation of Total, organic and inorganic carbon.
8. Designing of waste water treatment plant.

Environmental Biotechnology

1. Isolation and characterization of microbes from polluted aerobic habitats.
2. Isolation and characterization of microbes from anaerobic habitats.
3. Assessment of total coliforms from water systems.
4. To study blue green algae by gram staining.
5. Screening of cellulose producing micro-organisms from wood degrading soil.
6. Waste water treatment-Bacterial and algal system.
7. Microbial degradation of organochlorine and organophosphorus compounds.
8. Extraction of enzymes from waste using microbial cultures.
9. Visit to industrial wastewater treatment plants (Activated sludge, UASB reactors) or Spirulina / Mushroom production units.

Natural disaster management

Unit I: Definition and types of disaster: Hazards and Disasters, Risk and Vulnerability in Disasters, Natural and Man-made disasters, earthquakes, floods drought, landside, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes. Man-made disasters: Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.

Unit II: Study of Important disasters: Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, landside and its managements case studies of disasters in Sikkim (e.g) Earthquakes, Landside). Social Economics and Environmental impact of disasters.

Unit III: Mitigation and Management techniques of Disaster: Basic principles of disasters management, Disaster Management cycle, Disaster management policy, National and State Bodies for Disaster Management, Early Warning Systems, Building design and construction in highly seismic zones, retrofitting of buildings.

Unit IV: Disaster Risk Management (DRM) plan – Preparing Hazard-Vulnerability profile; Stakeholder analysis; Disaster risk assessment; Incorporation of Preparedness, Mitigation and Prevention plans

Unit V: Training, awareness program and project on disaster management. Training and drills for disaster preparedness, Awareness generation program, Usages of GIS and Remote sensing techniques in disaster management, Mini project on disaster risk assessment and preparedness for disasters with reference to disasters in Sikkim and its surrounding areas.

References:

1. Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012)
2. Damon, P. Copola, (2006) Introduction to International Disaster Management, Butterworth
3. Heineman.
4. Gupta A.K., Niar S.S and Chatterjee S. (2013) Disaster management and Risk Reduction, Role of
5. Environmental Knowledge, Narosa Publishing House, Delhi.
6. Murthy D.B.N. (2012) Disaster Management, Deep and Deep Publication PVT. Ltd. New Delhi.
7. Modh S. (2010) Managing Natural Disasters, Mac Millan publishers India LTD.
8. Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012).
9. Damon, P. Copola, (2006) Introduction to International Disaster Management, Butterworth Heineman.
10. Gupta A.K., Niar S.S and Chatterjee S. (2013) Disaster management and Risk Reduction, Role of Environmental Knowledge, Narosa Publishing House, Delhi.
11. Murthy D.B.N. (2012) Disaster Management, Deep and Deep Publication PVT. Ltd. New Delhi.
12. Modh S. (2010) Managing Natural Disasters, Mac Millan publishers India LTD.

Forest and Wildlife Ecology

Unit I: Forestry- Introduction to forestry, Production forestry- Actual production, uses of wood, potential productivity, planning, increased production, Wood technology- anatomical, physical and mechanical properties, pulp, paper and rayon, saw milling and preservation, Defects in Wood, Forest Utilization– definition and scope, gums, resins, oleoresins, fibers, oil seeds, nuts, rubber, canes, bamboo, medicinal plants, charcoal, honey, lac and tassar silk, beedi leaves, collection, processing and disposal of non-wood forest produces.

Unit II: Forest mensuration- Methods of measuring diameter, girth, height and volume of trees, form factor, volume estimation of stand, sampling methods, yield calculation, current annual increment, mean annual increment, sample plots, yield and stand tables, scope and objectives of forestry inventory.

Unit III: Forest Management: Objectives and principles, techniques, sustained yield rotation, yield regulation, working plan preparation, General forest protection against fire, pests and 4 diseases, Biological and chemical control. Forest soils and their conservation, Forest soils classification, factors affecting soil formation, physical and chemical properties, causes of erosion, soil conservation, waste lands, waste land development, watershed management.

Unit IV: Basics of wild life ecology - Basic concepts of ecology, structure of ecosystems- Abiotic and biotic components, climatic and edaphic regimes, nutrients and mineral, producers, consumers and decomposers, Communities, populations, groups and individuals, Functions of ecosystem: energy flow, food chain, food web and bio-geo-chemical cycles, Concepts of productivity, types of productivity, GPP, NPP, Secondary productivity, community productivity. Ecological efficiencies, producer and consumer level efficiencies, Ecological niche, succession, Eutrophication, Biological magnification.

Unit V: Behavioral Ecology- Concepts of behavioral ecology, instinctive behavior, fixed action pattern, learning, habituation, imprinting, memory, infanticide, reflex and complex behavior, sign stimuli, group living, altruism, leks, reception and its types, kin selection, Polygamy, monogamy, Ethograms, Social interaction, matrices and their analysis, pheromones. Social Organization in primates, Territoriality, Dominance, Courtship, Animal migration, Communication and its types, Plant – animal interactions, Shelter and Nesting by animals,

Reference:

1. Antony Joseph Raj and S. B. Lal., 2013. Forestry Principles and Applications. Scientific Publishers (India), New Delhi.
2. Chandra P. Singh. 2015. Forestry and Agro-forestry. Agrotech Press, Jaipur.
3. Dennis W. Woodland., 2000. Contemporary Plant Systematics. Andrews University Press, US.
4. Fatik Baran Mandal. 2013. Vertebrate Zoology. Oxford and IBH Publishing Corporation, New Delhi.
5. Manikandan, K and S. Prabhu. 2018. Indian Forestry: A Breakthrough Approach to Forest Service. Jain Brothers Publishers.

6. Mark, V. Lomolino, Brett, R. Riddle and Robert, J Whittakar. 2017. Biogeography. Sinauer Associates, Sunderland USA.
7. Nandita Singh. 2018. Biogeography and Biodiversity. Random Publications, New Delhi.
8. Praveen Taank. 2010. Forest Product and their utilization. Cyber Tech Publications, New Delhi.
9. Anthony R.E. Sinclair, John M. Fryxell and Graeme Caughly, 2006. Wildlife Ecology, Conservation and Management. Blackwell Publishing, U.S.A. 2. Edward, J. Cormondy. 2017.
10. Concepts of Ecology. 4th Edition. Pearson Education. India. 3. Harsh Vardhan Bhaskar. 2009.
11. Animal Ecology. Campus Books International, New Delhi. 4
12. John Alock. 2018. Animal behavior. Oxford university Press, Sinauer Associates Press, USA.

Remote sensing and Geographical Information

Unit I: Remote Sensing- Introduction, Principles, Basic concepts, Electromagnetic spectrum, energy sources and radiation principles, Energy interaction with air, water, soil, rock and vegetation, Remote sensing data acquisition systems, Concept of spectral and spatial resolution in remote sensing. Micro wave remote sensing.

Unit II: Aerial Remote Sensing: Introduction to basics, Aerial photography, Geometric characteristics of aerial photographs, Film and filter combination techniques of photography, Instrumentation in aerial photography, vertical exaggeration and radial triangulation, Principle keys to interpretation of aerial photographs.

Unit III: Satellite Remote sensing: Indian remote sensing missions, Satellite data products, Hard copy and soft copy data and their uses, Interpretation of satellite data, Visual and Digital data, Visual interpretation keys. Digital image processing, Analysis of remote sensing data.

Unit IV: Geographic Information System (GIS): Introduction, fundamentals and functions of GIS, Components of GIS. Data models (Raster and Vector models), Resolution, orientation, Zones, Over-laying techniques, GIS analysis. Inputs – outputs, Meta data and conceptual design, GIS system integration and application development.

Unit V: Advanced Techniques: Molecular Techniques- Applications of Genomics and Proteomics in wildlife studies, Genetic diversity in wildlife - molecular markers – mtDNA, ribosomal DNA, Nuclear DNA markers.

Reference

1. Chang – Kang, Tsung, 2002. Introduction to Geographic Information Systems, Tata McGraw -Hill Publishing Company Limited, New Delhi.
2. Ganesh Prasad. 2019. Statistics, An Introduction Using R. Oxford Book Company, New Delhi.
3. John C Antenucci, Geographical Information System : A Guide to Technology — Van Norstrand Reinhold Publications
4. Shiv N.Pandey, Photogeology and Image Interpretation –, Wiley Eastern, New Delhi.
5. Chang – Kang, Tsung, Introduction to Geographic Information Systems, Tata McGraw -Hill Publishing Company Limited, New Delhi, 2002.
6. John C Antenucci, Geographical Information System : A Guide to Technology — Van Norstrand Reinhold Publications .
7. Chouhan T.S and K.N.Joshi, Applied Remote Sensing and Photo Interpretation — Vignan Prakasan, Jaipur.

Natural disaster management and Forest and Wildlife Ecology

1. GIS applications earthquake studies
2. GIS applications in flood hazard.
3. GIS applications in forest fire.
4. Systematic study of common plants, Field and Herbarium techniques.
5. Study of campus flora, Status of litter layer in various forest types.
6. Study the various types of Fruits, Inflorescence, Stem modifications, root modifications, inflorescence and leaf types.
7. Taxonomic study of different plant species.
8. Techniques of vegetation surveys and quantification
9. Adaptations in animals: use pictures or photographs with suitable labels.
10. Adaptations in plants: use pictures or photographs with suitable labels.

Remote sensing and Geographical Information

1. Study Arc-catalogue and Arc-map.
2. By using Satellite imageries map the important protected areas, vegetation type, soil type, wetlands etc.,
3. Use of GPS
4. Running of GIS software(QGIS and Google earth)
5. Mapping of roads, cities, waterholes.
6. Geo-referencing of Topo sheets by using GIS software.
7. Hands on participatory tools and techniques for social survey.

Field work

MSU/ 2020- 21/ PG -Colleges / M.Sc. Environmental Science / Semester IV / Ppr.No.25 (b)

Study Tour

Project