



DEPARTMENT OF ENVIRONMENTAL SCIENCE

NAGALAND UNIVERSITY

Lumami 798627

Revised Ph.D. Syllabus 2024

COURSE STRUCTURE FOR Ph.D. PROGRAMME

TOTAL CREDIT: 16, TOTAL MARKS: 400

	Course No.	Course Title	Credit	Marks
Semester I	ESP101	Research Methodology	4	100
	ESP102	Research and Publication Ethics	4	100
	ESP103	Literature Review, Report Writing and Seminar	4	100
	ESP104	Elective Papers	4	100
		E1: Environmental Monitoring		
		E2: Environmental Biology		
		E3: Environmental Geoinformatics		
		E4: Solid Waste management		
		Total	16	400

ESP101: Research Methodology

Unit-I: Introduction to research:

Meaning of research, objectives of research, motivation of research; Classification of research; Critical appraisal of research studies; Planning research projects, advance planning and its value; Research Design, meaning and need of research design, features of a good design, different research designs.

Unit-II: Data & data collection:

Data and data types, methods of data collection and analysis, interpretation and presentation; Collection of primary data, observation method, interview method; Collections of data through questionnaires; Collection of data through schedules; Difference between questionnaire and schedule; Selection of appropriate method for data collection.

Unit-II: Sampling techniques:

Population and sample; Advantages of sampling over complete census and its limitations; Different techniques of sampling – simple random sampling, stratified random sampling, systematic sampling; Relative advantages and disadvantages of different techniques.

Unit-IV: Scientific Communications:

Types of scientific communications-research paper, review article, letter, short communication, poster etc; Citations and reference style, management; How to search for literature, literature review, indexing databases; looking for a suitable journal, journal impact factor, citation index, H index, five year impact factor, citation immediacy etc; How to prepare a presentation and how to present, Research ethics and publication ethics.

Suggested Readings

1. Agricultural Statistics in India: Chadda, A. (1989); Suman Book House, New Delhi.
2. An Introduction to database system: Date, C. J. (1986); Addison Wesley, U.K.
3. Research Methodology for Biological Sciences: Gurumani, N. (2006); MJP Publishers, Chennai.
4. Environmental Statistics: Methods and Applications: Barnett, Vic (2006); John Wiley and Sons, New Delhi.
5. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor; S. Chand & Co.
6. Statistical Methods: An Introductory Text : J. Medhi; New Age International Ltd. Publishers.

ESP 102: Research and Publication Ethics

Unit-I: Introduction to philosophy:

Definition, nature and scope, concept, branches; Ethics: definition, moral philosophy, nature of moral judgments and reactions; Ethics in science and research; Intellectual honesty and research integrity.

Unit-II: Scientific misconducts:

Falsification, fabrication and plagiarism (FFP); Redundant publications: duplication and overlapping publications; Selective reporting and misrepresentation of data; Use of

plagiarism software like Urkund, iThenticate, Plagiarism Checker X and other subscription based and open source software tools.

Unit-III: Publication ethics:

Definition, introduction and importance; Best practices; Conflicts of interest; Publication misconduct: definition, concept, problems that lead to unethical behaviour, violation of publication ethics, authorship and contributorship; Identification of publication misconduct, complaints and appeals; Predatory publishers and journals.

Unit-IV: Indexing databases, citation databases:

Web of Science, Scopus, etc.; Impact factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score; Metrics: h-index, g index, i10 index etc.

Suggested Readings

1. Bird, A. 2006. Philosophy of Science. Routledge.
2. Mac Intyre, Alasdair 1967. A Short History of Ethics. London.
3. Chaddah, P. 2018. Ethics in Competitive Research: Do Not get scooped, do not get plagiarized.
4. National Academy of Sciences, National Academy of Engineering and Institute of Medicine. 2009. On Being a Scientist: A Guide to Responsible Conduct in Research: 3rd edn. National Academies Press.
5. Beall, J. 2012. Predatory publishers are corrupting open access. Nature, 489(7415), 179- 179. Doi: 10.1038/489179a
6. Indian National Science Academy (INSA). 2019. Ethics in Science Education, Research and Governance. www.insaindia.res.in/pdf/Ethics_Book.pdf

ESP 103: Literature Review, Report Writing and Seminar

The Ph.D. Scholar will carry out a critical appraisal of the relevant literature and will submit the report to the supervisor. The Scholar will also need to present the report as a PowerPoint Presentation following an examination of the relevant literature.

ESP104 (E1): Environmental Monitoring

Unit-I: Sampling and Sample preparation:

Sampling of Air, Water and Soil; Sampling equipments; Preparation of sample for trace metal analysis in water air and soil: Dissolution techniques and microwave digestion.

Unit-II: Analysis of water, soil and metal ions:

Physiochemical parameters– Definition and determination of Conductivity, pH, DO, BOD, COD, Instruments for nephelometry and turbidimetry and their applications.

Unit-III: Separation Techniques:

Principle and process of solvent extraction, Chromatography – principle and application of thin layer and ion exchange chromatography; Gel permutated liquid chromatography

(GPLC); Gas chromatography and Mass spectroscopy (GC-MS); High performance liquid chromatography (HPLC); Electrophoresis.

Unit-IV: Instrumental techniques for environmental monitoring:

Measuring instruments; Colorimetry and Spectrophotometry – theory and instrumentation; Theory, instrumentation and application of Atomic Absorption Spectrometry, Flame Emission, XRD, XRF; Spectrometry and Inductively Coupled Plasma Mass Emission Spectrometry;

Suggested readings

1. Standard Methods for examination of water and waste water: A. E. Greenberg, A. D. Eaton; APHA, AWWA, WEF.
2. Chemistry for Environmental Engineering and Science: C. N. Sawyer, P. L. McCarty and G. F. Parkin.
3. Laboratory Manual for the examination of water, waste water and soil: H. H. Rupa and H. Krist; VCH Publication.

ESP104 (E2): Environmental Biology

Unit-I: Fundamentals in Ecology

Basic concepts and structure of ecosystems; Concept of community ecology; Energy fixation and energy; Ecological efficiencies; Nutrient cycling and retention; Functioning of ecosystem; Anthropogenic impact on the biosphere and its life support systems; Influence of environmental factors on organisms and their adaptations.

Unit-II: Introduction to Plant Systematics and Vegetation Science

Morphology and Taxonomy of major groups; Plant identification and use of Taxonomic literature; Principles of plant nomenclature; Plant conservation issues and strategies; Major vegetation types of India; Structural and functional attributes of vegetation; Plant succession; Techniques of vegetation surveys and quantification; India's biogeographic classification and Protected Area network.

Unit-III: Environmental Microbiology

Microbiology of air, water and soil; Microbial properties; Basic microbial culture techniques; Food Microbiology; Microbes of different environment; Microbial transformations of pesticides: Microbial transformations of heavy metals; Microbes in relation to environment remediation technology.

Unit-IV: Conservation Biology

Introduction to conservation biology, values of biodiversity and conservation ethics, Patterns and process of biodiversity, losses and threats to biodiversity; Conservation strategies; Control of invasive species; Significance of ecological restoration in conservation.

Suggested Readings

1. Environmental Science - The natural environment and human impact (1998): A. R. W. Jackson and J. M. Jackson, Longman.

2. Introduction to Environmental Science and Engineering (2nd Ed.) (2004): G. M. Masters, Pearson Education Pvt. Ltd.
3. Fundamentals of Ecology: E. P. Odum.
4. Botany: A. C. Dutta; Oxford University Press, Calcutta.
5. Microbiology: A Laboratory Manual by James G. Cappuccino, Natalie Sherman, 10th Ed. (2013), Pearson.
6. Prescott's Microbiology by Joanne Willey, Linda Sherwood, Chris Woolverton; 8th Ed. (2011), McGraw Hill Education.
7. Ecology and Environment by P.D. Sharma; Rastogi Publications
8. Tropical Plant Families: An Identification Handbook by Timothy Utteridge, Gemma Bramley; Publisher: Royal Botanic Gardens (31 March 2014)

ESP104 (E3): Environmental Geoinformatics

Unit-I: Principles of Remote Sensing:

Concepts of Remote Sensing; Effects of atmosphere; Concepts of resolutions; Satellite types; Satellites and their sensors; Data products; Applications of remote sensing in environmental monitoring and management.

Unit-II: Digital Image Processing & Image interpretation:

Principles, image rectification, image enhancement and mosaicking; Image classification- Supervised, Unsupervised, Ground truth data and training set manipulation; Classification accuracy assessment. Elements of image interpretation, interpretation keys; Interpretation of photographs and images for environmental analysis.

Unit-III: Geographical Information System (GIS) & Global Positioning System (GPS):

Basic principles, Components of GIS, Hardware and software, Raster and vector data, Map projection, Topology creation, Overlay analysis, Data structure and Digital cartography; Basic principles of GPS; Applications to environmental studies.

Suggested Readings

1. Remote Sensing of the Environment – An earth resource perspective: J. R. Jensen; Pearson Education.
2. Remote sensing and Image interpretation: JW Chipman, Ralph W Kiefer and Thomas M Lillesand.
3. Geographic Information Systems: Martin, Routledge.
4. An Introduction to GIS: Heywood, Pearson.
5. Remote sensing in Land Evaluation: Yadav; Rajesh Pub.
6. Essentials of GPS (2004): N. K. Agarwal; Spatial Networks Pvt. Ltd., Hyderabad.

ESP 104 (E4): Solid Waste Management

UNIT I: Introduction to Solid Waste and Regulatory Framework:

Solid waste and Hazardous Waste- Definition, types, sources, characteristics, and impact on environmental health; Need for solid

and hazardous waste management, Elements of integrated waste management and roles of stakeholders, Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, lead acid batteries, electronic wastes, plastics and fly ash.

Module II: Municipal Solid waste:

Physical and Chemical composition of municipal solid waste, Factors affecting Waste generation rates, Concepts of waste reduction, recycling and reuse. Waste Management Hierarchy, MSW management- Collection, Storage, Transportation and Disposal systems.

UNIT III: Storage, Collection and Transport of Wastes:

Handling and segregation of wastes at source, storage and collection of municipal solid wastes, Analysis of Collection systems; Need for transfer and transport , Transfer stations , Optimizing waste allocation– compatibility, storage, labelling and handling of hazardous wastes –hazardous waste manifests and transport.

UNIT IV: Waste Processing Technologies and Their Disposal:

Solid waste processing technologies: Mechanical and thermal volume reduction, Biological and chemical techniques for energy and other resource recovery, Composting, Vermicomposting , energy recovery – incineration, solidification & stabilization of hazardous wastes, treatment of biomedical wastes, Waste disposal options, Disposal in landfills: site selection, design, and operation of sanitary landfills, leachate and landfill gas management; landfill closure and postclosure environmental monitoring; landfill remediation.

Suggested readings:

1. LaGrega. 2004. Hazardous Waste Management. McGraw Hills
2. Mahajan 1985. Pollution control in process industries. Tata McGraw Hill
3. Waste Management Practices: Municipal, Hazardous and Industrial, John Pichtel (2014)., 2nd Ed., CRC Press, USA.
4. Integrated Solid Waste Management, Engineering Principles and Management Issues, Tchobanoglous G, Theisen H and Vigil SA, McGraw Hill Education, 2014, Indian Edition
5. Handbook of Solid Waste Management, Tchobanoglous G and Kreith F, McGraw-Hill Education, 2002, 2nd Edition
6. Plastic Waste Management, 2024; Kalim Deshmukh, Jyotish kumar Parameswaranpillai, John Wiley & Sons
7. Handbook of electronic waste management: international best practices and case studies. Prasad, M. N. V., Vithanage, M., & Borthakur, A. (Eds.). (2019). Butterworth-Heinemann.
8. E-Waste Management: Challenges and Opportunities in India. Bhagat-Ganguly, V. (2021). Routledge India.
9. Biomedical waste management in hospitals. Latha, G., & Rajasekhar, M. (2021). Lulu Publication.