

Savitribai Phule Pune University

(Formerly University of Pune)

Syllabus for M.Phil./Ph.D. (PET) Entrance Exam: Environmental Science

Research Methodology

- 1) Foundation of Research:** Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method - understanding the language of research - Concept, Construct, definition, Variable. Research Process
- 2) Problem Identification & Formulation:** definition and formulating the research problem, Necessity of defining the problem, Importance of literature review in defining a problem, Research Question - Investigation Question - Measurement Issues - Hypothesis - Qualities of a good hypothesis - Null hypothesis & Alternative Hypothesis. Hypothesis Testing - Logic & importance
- 3) Research Design:** Concept and Importance in Research - Features of a good research design - Exploratory Research Design - Concept, Types and uses, Descriptive Research Design - concept, types and uses. Experimental Design - Concept of Independent & Dependent variables.
- 4) Qualitative and Quantitative Research:** Qualitative - Quantitative Research - Concept of measurement, causality, generalization, replication. Merging the two approaches.
- 5) Data Collection and analysis:** Execution of the research - Observation and Collection of data - Methods of data collection, hypothesis-testing - Generalization and Interpretation.
- 6) Measurement:** Concept of measurement - what is measured? Problem in measurement in research - Validity and Reliability. Levels of measurement - Nominal, Ordinal, Interval, Ratio.
- 7) Sampling:** Concept of Statistical population, Sample, Sampling Frame, Sampling Error, Sample size, Non Response. Characteristics of a good sample. Probability Sample - Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample - Practical considerations in sampling and sample size.
- 8) Data Analysis:** data Preparation - Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis - Cross tabulations and Chi-square test including testing hypothesis of association.
- 9) interpretation of Data and Paper Writing:** Layout of a Research Paper, Journals in Physics, Impact factor of journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.
- 10) Use of Encyclopedias, Research Guides, Handbook etc., Academic databases for Physics Discipline.**
- 11) Use of tools / techniques for Research:** methods to search required information effectively, Reference Management Software like Zotero/mendeley, Software for paper formating like LaTeX/MsOffice, software for detection of Plagiarism.
- 12) Reporting and Thesis writing:** Structure and components of scientific reports - Types of report - Technical reports and thesis - Significance - Different steps in the preparation - Layout, Structure and Language of typical reports - Illustrations and tables - Bibliography, referencing and footnotes - Oral presentation - Planning - Preparation - Practice - Making presentation - Use of visual aids - Importance of effective communication

12) Application of results and ethics: Environmental impacts - Ethical issues - ethical committees - Commercialization - Copy right - royalty - Intellectual property rights and patent law - Trade related aspects of intellectual property Rights - Reproduction of published material - Plagiarism - citation and acknowledgement - citation and acknowledgement - Reproducibility and accountability.

13) Reasoning and Mentalability: Analogy, Classification, Series, Coding-Decoding, Direction Sense, Representation Through Venn Diagrams, Mathematical Operations, Arithmetical Reasoning, Inserting the Missing Character, Number, Ranking and Time Sequence Test, Eligibility Test, Representation through Venn-diagrams, Number & symbols ordering, Comprehension questions, Statement & assumptions, Statement & conclusions, Statement & actions

Books Recommended

- 1) Research Methodology - C. R. Kothari
- 2) Research Methodology : An Introduction - Stuart Melville and Wayne
- 3) Practical Research Methods - Catherine Dawson
- 4) Select references from the Internet

REFERENCES

- 1) Garg, B. L., Karadia, R., Agarwal, F. and Agarwal, U. K., 2002. An introduction to Research Methodology, RBSA Publishers.
- 2) Kothati , C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
- 3) Sinha, S. C. and Dhiman, A. K., 2002. Research Methodology, Ess Ess Publications. 2 columes.
- 4) Trochim, W. M. K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p
- 5) Wadehra, B. L. 2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.

Additional reading

- 1) Anthony, M., Graziano, A. M. and Raulin, M. L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
- 2) Carlos, C. M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
- 3) Coley, S. M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
- 4) Day, R. A., 1992. How to Write and Publish a Scientific Paper, Cambridge University Press.
- 5) Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
- 6) Leedy, P. D. and Ormrod, J. E., 2004 Practical Research: Planning and Design, Prentice Hall.
- 7) Satarkar, S. V., 2000. Intellectual property rights and Copy right. Ess Ess Publications.

Subject Concerned Syllabus Environmental Science

Environmental Biology:

Definition principles and scope of Environmental Science. Earth Man and Environment, Ecosystems, Pathways in Ecosystems. Physico-chemical and Biological factors in the Environment. Geographical classification and zones. Natural resources, conservation and sustainable development. Definition Principles and scope of ecology. Human ecology and Human settlement Evolution Origin of life and speciation. Ecosystems : Structure and functions Abiotic and Biotic components energy flows Food chains, Food web Ecological pyramids types and diversity. Ecological Succession Population Community ecology and Parasitism Prey predator relationships.

Common flora and fauna in India,

Aquatic : Phytoplankton zooplankton and Macrophytes

Terrestrial : Forests

Endangered and Threatened Species

Biodiversity and its conservation : Definition 'Hotspots' of Biodiversity Strategies for Biodiversity conservation National Parks and Sanctuaries Gene pool. Microflora of Atmosphere: Air Sampling techniques Identification of aeroallergens Air-borne diseases and allergies. Environmental Biotechnology : Fermentation Technology Vermiculture technology Biofertilizer technology.

Environmental Chemistry:

Fundamentals of Environmental Chemistry : Stoichiometry, Gibbs' energy, Chemical potential, chemical equilibria, acid base reactions. solubility product. solubility of gases in water, the carbonate system, unsaturated and saturated hydrocarbons radionuclides.

Chemical composition of Air : Classification of elements chemical speciation Particles ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Thermochemical and photochemical reactions in the atmosphere. Oxygen and ozone chemistry. Chemistry of air pollutants. Photochemical smog.

Water Chemistry : Chemistry of water concept of DO BOD COD. sedimentation coagulation filtration Redox potential.

Soil Chemistry : Inorganic and organic components of soil Nitrogen pathways and NPK in soils. Toxic Chemicals in the environment-Air, Water : Pesticides in water Biochemical aspects of Arsenic Cadmium Lead Mercury Carbon Monoxide O₃ and PAN Pesticides Insecticides MIC carcinogens in the air.

Principles of Analytical Methods : Titrimetry Gravimetry Colourimetry Spectrophotometry Chromatography Gas Chromatography Atomic Absorption Spectrophotometry. GLC HPLC Electrophoresis. X-ray fluorescence X-ray diffraction Flame photometry.

Environmental Geosciences:

The earth systems and Biosphere : Conservation of matter in various geospheres-lithosphere hydrosphere atmosphere and biosphere Energy budget of the earth. Earth's thermal environment and seasons. Ecosystems flow of energy and matter. Coexistence in communities-food webs.. Earth's major ecosystems-terrestrial and aquatic. General relationship between landscape biomes and climate. Climates of India. Indian Monsoon El Nino Droughts Tropical cyclones and Western Disturbances.

Earth's Processes and Geological Hazards : Earth's processes; concept to residence time and rates of natural cycles. Catastrophic geological hazards Study of floods landslides earthquakes volcanism and avalanche. Prediction and perception of the hazards and adjustments to hazardous activities.

Mineral Resources and Environment : Resources and Reserves Minerals and Population. Oceans as new areas for exploration of mineral resources. Ocean ore and recycling of resources. Environmental impact of exploitation processing and smelting of minerals.

Water Resources and Environment : Global Water Balance Ice sheets and fluctuations of sea levels. Origin and composition of seawater. Hydrological cycle Factors influencing the surface water. Types of water Resources of oceans Ocean pollution by toxic wastes. Human use of surface and groundwater. Groundwater pollution.

Landuse Planning : The landuse plan Soil surveys in relation to landuse planning Methods of site selection and evaluation.

Environmental Geochemistry : Concept of major trace and REE Classification of trace elements. Mobility of trace elements. Geochemical cycles Biogeochemical factors in environmental health. Human use trace elements and health. possible effects of imbalance of some trace elements. Diseases induced by human use of land.

Remote sensing and GIS

Principles of Remote sensing and its application of Environmental Sciences Application of GIS in Environmental Management.

Energy & Environment

Sun as source of energy : solar radiation and its spectral characteristics : Fossil fuels-classification. composition physico-chemical characteristics and energy content of coal petroleum and natural gas. Principles of generation of hydroelectric power, tidal, Ocean Thermal Energy Conversion wind geothermal energy solar collectors photovoltaics solar ponds: nuclear energy-fission and fusion: magnetohydrodynamic power bio-energy-energy from biomass and biogas, anaerobic digestion: energy use pattern in different parts of the world.

Environmental implication of energy use : CO₂ emissions global warming: air and thermal pollution: radioactive waste and radioactivity from nuclear reactors impacts of large-scale exploitation of Solar wind Hydro and Ocean energy.

Environmental Pollution

Air : Natural and anthropogenic sources of pollution. primary and Secondary pollutants. Transport and diffusion of pollutants. Gas laws governing the behavior of pollutants in the atmosphere Methods of monitoring and control of air pollution SO₂, NO_x, CO, SPM Effects of pollutants on human beings, plants, animals, materials and on climate. Acid Rain Air Quality Standards.

Water : Types, sources and consequences of water pollution. Physico-chemical and Bacteriological sampling and analysis of water quality. Standards, sewage and waste water treatment and recycling. Water quality standard.

Soil : Physico-chemical as bacteriological sampling as analysis of soil quality soil Pollution Control. Industrial waste effluents and heavy metals their interactions with soil components. Soil micro- organisms and their functions degradation of different insecticides fungicides and weedicides in soil Different kinds of synthetic fertilizers (NP & K) and their interactions with different components of soil.

Solid Waste: Sources and generation of solid wastes, their characterization, chemical composition and classification. Different methods of disposal and management of solid wastes (Hospital Wastes and Hazardous Wastes) Recycling of waste material. Waste minimization technologies.

Noise: Sources of noise pollution measurement of noise and Indices effect of meteorological parameters on noise propagation. Noise exposure levels and standards. Noise control and abatement measures. Impact of noise on human health.

Marine : Sources of marine pollution and control Criteria employed for disposal of pollutants in marine system-coastal management.

Radioactive and Thermal Pollution.

Environmental Management:

Introduction to environmental impact analysis.

Environmental impact Statement and Environmental Management Plan. EIA guidelines 1994, Notification of Government of India. Impact Assessment Methodologies.

Generalized approach to impact analysis.

Procedure for reviewing Environmental impact analysis and statement. Guidelines for Environmental audit.

Introduction to Environmental planning.

Base line information and predictions (land, water, atmosphere, energy, etc.) Restoration and rehabilitation technologies.

Landuse policy for India. Urban planning for India.

Rural planning and landuse pattern.

Concept and strategies of sustainable development. Cost- Benefit analysis.

Environmental priorities in India and sustainable development.

Environmental Legislations:

Hazardous Wastes Management and Handling Rules, 1989. Resource Management. Disaster Management and Risk analysis.

Environment protection-issues and problems. International and National efforts for Environment

Protection. Provision of Constitution of India regarding Environment (Article 48A and 58A).

Environmental Policy Resolution. Legislation, public Policy Strategies in Pollution Control. Wildlife

Protection Act, 1972 amended 1991. Forest Conservation Act, 1980. Indian Forests Act (Revised)

1982. Air (Prevention and Control of Pollution) Act, 1981 as amended by Amendment Act, 1987 and Rule 1982. Motor Vehicle Act, 1988. The Water (Prevention and Control of Pollution) Act,

1974 as amended up to 1988 and Rules 1975. The Environment (Protection) Act, 1986 and Rules 1986.

Scheme of labelling of environmentally friendly products (Ecomark), Public Liability Insurance Act, 1991 and Rules 1991.

Environmental Statistics:

Basic elements and tools of statistical analysis; Probability, sampling measurement and distribution of attributes; Distribution-Normal. t and c^2 . Poisson and Binomial; Arithmetic. Geometric and Harmonic means; moments; matrices, simultaneous linear equations; tests of hypothesis and significance.

Environmental Modeling:

Introduction to environmental system analysis; Approaches to development of models; linear simple and multiple regression models, validation and forecasting, Models of population growth and interactions-Lotka-Volterra model. Leslie's matrix model, point source stream pollution model, box model, Gaussian plume model.

Environmental Education, awareness, current issues and case studies:

Environmental Education and Awareness. Environmental Ethics and Global imperatives.

Global Environmental problems-ozone depletion, global warming and climatic change. Current Environmental issue in India.

Context : Narmada Dam. Tehri Dam, Almetti Dam, Soil Erosion, Formation and reclamation of Usar, Alkaline and Saline Soil.

Waste lands and their reclamation. Desertification and its control.

Vehicular pollution and urban air quality. Depletion of Nature resources. Biodiversity conservation and Agenda-21.

Waste disposal, recycling and power generation. Fly ash utilization. Water Crises-Conservation of water. Environmental Hazards.

Eutrophication and restoration of Indian lakes. Rain water harvesting. Wet lands conservation.

Epidemiological issues (e.g. Goitre, Fluorosis, Arsenic).