Ph.D. Entrance Test Syllabus for Ph.D. in Environmental Science

The PET (Ph.D. Entrance test) for **Ph.D. in Environmental Science** consists of **two parts:**
• **Part I:** Research Methodology (50 marks) and
• **Part II:** Subject Specific (Related to the branch for 50 marks)

Total Marks for PhD Entrance Test: 100 Marks

The Syllabus for Research Methodology is common to all branches of Science

SYLLABUS
Part I: Research Methodology (50 Marks)

- **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.
- **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.
- **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.
- **Qualitative and Quantitative Research:** Qualitative - Quantitative Research - Concept of Measurement, causality, generalization, replication. Merging the two approaches.
- **Data Collection and analysis:** Execution of the research - Observation and Collection of Data Methods of data collection, hypothesis-testing - Generalization and Interpretation.
- **Measurement:** Concept of measurement - what is measured? Problem in measurement In research - Validity and Reliability. Levels of measurement - Nominal, Ordinal, Interval, Ratio.
- **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.
- **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.
- **Interpretation of Data and Paper Writing:** Layout of a Research Paper, Journals in Computer Science, Impact factor of journals, When and where to publish? Ethical issues Related to publishing, Plagiarism and Self-Plagiarism. Use of Encyclopedias, Research Guides, Handbook etc., Academic databases for concerned discipline.

- **Use of tools / techniques for Research:** methods to search required information Effectively, Reference Management Software like Zotero/Mendeley, Software for paper Formatting like Latex/MSOffice, Software for detection of plagiarism.
- **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.
- **Application of results and ethics:** Environmental impacts - Ethical issues – Ethical committees - Commercialization - Copyright - 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.
- **Reasoning and Mental ability**: 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

Reference Books:

1. Garg, B. L., Karadia, R., Agarwal, F. and Agarwal, U. K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Sinha, S. C. and Dhiman, A. K., 2002. Research Methodology, EssEss Publications. 2Columns.
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, trademarks, copyright designs and Geographical indications. Universal Law Publishing.

For Additional Reading:

1) Anthony, M., Graziano, A. M. and Raulin, M. L., 2009. Research Methods: A Process ofInquiry, Allyn and Bacon.
2) Carlos, C. M., 2000. Intellectual property rights, the WTO and developing countries: theTRIPS 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 Copyright. EssEss Publications

Ph.D. in Environmental Science
Part II: Subject Specific Syllabus (50 Marks)

1. Environmental Chemistry
- Chemical composition of the atmosphere
- Water quality parameters and analysis techniques
- Soil chemistry and nutrient cycling
- Organic pollutants and their degradation pathways
- Industrial pollutants and remediation techniques
- Fate and transport of contaminants

2. Ecology and Ecosystem Dynamics
- Population dynamics and ecological modeling
- Biodiversity assessment and conservation strategies
- Ecological succession and community ecology
- Biogeochemical cycles and ecosystem functioning
- Ecosystem resilience and adaptation to climate change
- Ecological interactions and trophic dynamics

3. Climate Change and Mitigation
- Greenhouse gas emissions and their sources
- Climate modeling and prediction techniques
- Impacts of climate change on ecosystems and human society
- Mitigation strategies and policies
- Renewable energy technologies and their environmental implications
- Climate adaptation and resilience measures

4. Environmental Policy and Governance
- International environmental treaties and agreements
- Environmental laws and regulations
- Stakeholder engagement and participatory decision-making processes
- Environmental impact assessment and risk management
- Environmental justice and equity considerations
- Policy implementation and enforcement mechanisms

5. Pollution Control and Remediation
- Air pollution control technologies
- Water and wastewater treatment processes
- Soil remediation techniques
- Bio-remediation and phytoremediation methods
- Emerging contaminants and treatment strategies
- Pollution monitoring and environmental health assessment

6. Sustainable Development
- Principles of sustainability and sustainable development goals (SDGs)
- Sustainable resource management practices
- Life cycle assessment and eco-design principles
- Sustainable agriculture and food systems

- Urban sustainability and smart city initiatives
- Indigenous knowledge and traditional ecological practices

7. Environmental Risk Assessment
- Hazard identification and exposure assessment
- Toxicological risk assessment methodologies
- Ecological risk assessment frameworks
- Risk communication and management strategies
- Uncertainty and variability in risk assessment
- Multi-criteria decision analysis in environmental risk assessment

8. Environmental Monitoring and Data Analysis
- Sampling techniques for environmental monitoring
- Analytical methods for environmental data analysis
- Geographic Information Systems (GIS) applications
- Remote sensing technologies for environmental monitoring
- Data interpretation and statistical analysis
- Big data analytics and machine learning in environmental monitoring

9. Environmental Ethics and Philosophy
- Ethical theories and their application to environmental issues
- Anthropocentrism vs. biocentrism vs. ecocentrism
- Environmental justice and environmental racism
- Rights of nature and legal personhood for ecosystems
- Environmental stewardship and intergenerational equity
- Ethical considerations in scientific research and policy-making

10. Environmental Education and Communication
- Effective communication strategies for environmental issues
- Environmental education curriculum development
- Public engagement and citizen science initiatives
- Media framing and environmental discourse analysis
- Role of social media in environmental communication
- Environmental literacy and public awareness campaigns

Reference Books:

- Environmental Chemistry by Stanley E. Manahan. 2022. 389 pp. Routledge.
- Ecology: Concepts and Applications by Anna Sher & Manuel C. Molles Jr. 2014. McGraw Hill.
- Climate Change Biology by Jonathan A. Newman and Madhur Anand. 2011. Wallingford, UK.
- Environmental Policy: New Directions for the Twenty-First Century by Norman J. Vig and Michael E. Kraft
- Principles of Environmental Engineering and Science by Mackenzie Davis and Susan Masten
- Environmental Risk Assessment: A Toxicological Approach by Ted Simon
- Environmental Monitoring Handbook by Frank R. Spellman
- Environmental Ethics: An Introduction by Joseph R. DesJardins

Websites:

- United Nations Environment Programme (UNEP) website
- Intergovernmental Panel on Climate Change (IPCC) website
- US Environmental Protection Agency (EPA) website
- Environmental Protection Agency (EPA) website
- Environmental Science & Technology Journal website
- Ecological Society of America (ESA) website