

**Pre-Ph. D Syllabus
For
Environmental Sciences**

**I K Gujral Punjab Technical University
Kapurthala**

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Pre Ph.D course work will be of 17 credits and shall be offered on regular basis at IKGPTU campus. The structure of the course work is as under

Sr. No.	Nature of course	Name of course	Credits	Remarks
1.	Core	1. Research Methodology	4	The syllabus of RM should be formulated faculty wise such as Engineering, Science, Management/ Humanities and Life sciences
		2. Subject related theory paper Recent Advances in Environmental Science	4	Discipline specific related to advancements in theoretical methods for research
		3. Presentation / <i>Seminar</i>	3	Discipline specific
2.	Interdisciplinary	4. Elective Soil And the Environment	4	From list of subjects from allied fields
3.	Research and Publication Ethics (RPE)	5. Research and Publication Ethics (RPE)	2	As per UGC
Total Minimum credits			15	

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RESEARCH METHODOLOGY

Course code PHAS - 901

1. Introduction to Research:-

Objectives of reSearch, motivation in research, types of research, significance of research, research methods vs methodology, research process in flow chart, criteria of good resorch, problems encountered by researchers in India.

2. Thinking Processes:

Role of thinking in research, levels and styles of thinking; common-sense and . scientific thinking; examples.

3. Problem solving:

Problem solving strategies — reformulation or rephrasing, techniques of representation, logical thinking, division into sub- problems, verbalization, awareness of scale; importance of graphical representation; examples

4. Experimental and modeling skills:

Census and sample survey, sampling procedure, important scaling techniques, methods of data collection, estimation and reduction of random errors; detection and elimination of systematic errors; guidelines for constructing questionnaire, Scientific method: role of hypothesis in experiment; hypothesis testing; F test, t test, Chi Square test, use of ANOVA; Types of models; the art of making approximations; problem representation; logical reasoning; mathematical skills; techniques of numerical simulation.

5. Problem finding and literature survey:

Information gathering — reading, searching and documentation; types, attributes and sources of research problems; problem formulation, relative importance of various forms of publications; choice of journal and reviewing process; Difference between publishing and patenting;

6. Chemdraw and documentation

Difference between TEX and LATEX, basics of using latex, latex input files, input file structures, layout of the document, titles, chapter and sections, cross references, foot note, environments, typesetting, building blocks of a mathematical formula, matrices, tables, including encapsulated postscript graphics, bibliography, downloading and working of CHEMDRAW software

7. Data And its Presentation

Introduction to origin, basics of importing and exporting data, working with Microsoft excel, graphing, statistics it; origin, hypothesis testing, power and sample size, basic linear regression and curve fitting.

8. Statistical Analysis of Data

Error Analysis and Basic Statistics Measuring errors, uncertainties, parent and sample distributions, mean and standard deviation of distribution, types of probability distribution, instrumental and statistical uncertainties, propagation of errors, specific error formulas, method of least square fitting.

9. Multivariate analysis:

Multiple regression, multiple discriminant analysis, multiple analysis of variance, canonical correlation analysis, Factor analysis cluster analysis, path analysis. Computational techniques.

10. Stress management, Time management, Interpersonal skills, professional ethics:

Psychological phases of a PhD process; stress points; Managing self; teamwork; sense of humor; Plagiarism and research ethics

REFERENCES:

1. Research methodology: (<http://www.newagepublishers.com/samplechapter 1000896.pdf>)
2. The not so short introduction to LATEX by Tobias Oetiker, Hubert Partl, Hrene Hyna and Elisabeth Schlegl, Version 4.16, May 08, 2005. (<http://tobi.oetiker.ch/lshort/lshort.pdf>)
3. T. Veerarajan and T. Ramachandran "Numerical methods" Tata McGraw Hill, New Delhi, 2008
4. Data reduction and error analysis for physical sciences by Philip R. Bevington and D. Keith Robinson. (<http://www.physast.uga.edu/files/phys3330 fertic/Basic ErrorAnalysis.pdf>)
5. E.M. Phillips and D S Pugh, "How to get a PhD — a handbook for PhD students and their supervisors", Viva books Pvt. Ltd for all scholars irrespective of the disciplines.
6. Handbook of Science Communication, compiled by Antony Wilson, Jane Gregory, Steve Weller, Shirley Earl, Overseas Press Indian Pvt. Ltd, New Delhi, first edition 2005.
- TG L Squires, "Practical physics", Cambridge University Press for all scholars except those from Humanities and Management sciences.
8. Peter B Medeq, "Advice to a Young Scientist", Pan Books, London 1979.
9. Kothari C R, "Research Methodology — Methods and Techniques", Wishwa Prakashan, New Delhi, Third Edition 2008.

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Course Code:

RPE 01: Philosophy and Ethics (3 hrs)

1. Introduction to Philosophy: definition, nature and scope, concept, branches
2. Ethics: Definition, moral philosophy, nature of moral judgments and reactions.

RPE 02: Scientific Conduct (5 hrs)

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

RPE 03: Publication Ethics (7 hrs)

1. Publication ethics: definition, introduction and importance
2. Best practices/standards setting initiatives and guidelines: COPE, WAME etc.
3. Conflicts of interest
4. Publication misconduct: Definition, concept, problems that lead to unethical behavior and vice versa, types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

Practice

RPE 04: Open Access Publishing (4 hrs)

1. Open access publications and initiatives
2. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
3. Software tool to identify predatory publications developed by SPPU: UGC-CARE list of journals
4. Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

RPE05: Publication Misconduct (4 hr)

A. Group discussions (2 hrs)

1. Subject specific ethical issues, FFP, authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad

B. Software tools (2hrs)

Use of plagiarism software like Turnitin, Urkund and any other open-source software tools.

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RPE 06: Databases and research metrics Databases (7hrs)

A. Databases (4 hrs)

1. Indexing databases
2. Citation databases: Web of Science, Scopus etc.

B. Research Metrics (3 hrs)

5. Impact factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
6. Metrics: h-index, g-index, i-10 index, altmetrics

Unit I Environmental Pollution

Electrosmog (5G revolution)-environment and health hazards; Invasion of microplastics and consequences thereof, 1.3. Emerging environmental contaminants(Pharmaceuticals/POPs) 1.4. Environmental footprints of digital world

1.5, Biological warfare agents-threat to humanity

Unit II Environmental Management

2.1. Economic evaluation of ecosystem services- a way towards sustainability 2.2. Artificial intelligence as a tool for management of pollution

2.3. Application of UAV (Unmanned Aerial Vehicle) in pollution monitoring and management

2.1. Sustainable waste treatment and management

2.5. Advances in ecological restoration- rising to the challenges of coming decades

Unit III Environmental Technologies

3.1 Bioremediation technologies - latest trends

3.2 Application of membrane technology in pollution control

3.3 Best available technology (BAT) for management of persistent organic pollutants 3.4 Sustainable green technologies (Green cities and Carbon sequestration)

3.5 Advanced application of remote sensing and GIS

3.6 Nanotechnology in pollution control

Unit IV Environmental Initiatives

4.1. National action plan on climate change, Paris agreement(IPCC Reports) 4.2. Sustainable development goals (SDG's)

4.3. Latest EIA notifications

4.4. Comprehensive environmental pollution index (CEPI)

4.5. UNEP's report-global environment outlook

Soil and Environment

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1. **Soil and its components:**

Soil as component of ecosystems, Soil and man, soil pollution.: Texture and structure, bulk density, pore space, soil water, soil air, mineral, organic and chemical components of soil, Interactions between soil components.

2. **Soil Development:**

Rock and their weathering, addition and decomposition of organic matter, processes of soil formation, soil horizons, soil classification and characteristics.

3. **Soil properties and Processes:**

Electrically charged surfaces, Exchangeable cations and cation exchange capacity, Diffuse layer, Selectivity of cation adsorption, Anion retention, sorption of gases, Organic materials sources and decomposition, Soil fauna, soil microorganisms, biological nitrogen fixation, Ammonification, nitrification, denitrification, Oxidation and reduction

4. **Soil as a medium for plant growth:**

Plant development and growth, Restrictions to root growth, Requirements of water and nutrients, rhizosphere and mycorrhizas, cultivations, fertilizers, organic manures. Soil acidification: pH and buffering, Percentage base saturation, Processes of soil acidification, Effects of acidity on plants, Acid rain, Acidification of ecosystems

5. **Heavy metals and radionuclides in soil:**

Hazardous elements in soil, Accumulation in soil, Treatment of contaminated land, Radionuclides in soils and their effects on growth of plants

6. **Soil erosion and conservation:**

Natural erosion, Anthropogenic factors responsible for soil erosion, soil conservation methods. Nitrates, Eutrophication, pesticides, degradation of soils, drought, organic farming and sustaining soil fertility.

7. **Soil analysis:**

Analysis of particle size, water holding capacity, temperature, pH, conductivity, exchangeable calcium and magnesium, sodium, potassium, Available phosphates, nitrogen, alkalinity, chlorides, sulphates, organic matter, calcium carbonate, boron, standard plate count, microbial activity, heavy metals, pesticides.

References

1. Bohn, H.L., McNeal, B.L. and O'Connor, G.A. (1979). Soil Chemistry. Wiley Interscience, New York.
2. Trivedy R.K. and Goul, P.K. (1987). Practical methods in ecology and Environmental Sciences. Enviro Media Publications, India.
3. White, R.E. (1987). Introduction to principles and practice of soil science, 2nd edition. Blackwell Scientific Publications, Oxford.
4. Wild, A. (1993). Soil and Environment: An introduction. Cambridge University Press. Cambridge.

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Disaster Management

Credits 4-0-0

1. Introduction to disasters
2. Earthquakes
Damage Prevention and Rehabilitation by Retrofitting Dos and Don'ts While Constructing Buildings
3. Floods
Standard Operating Procedure for Administration
Standard Operating Procedure for Individuals
4. Cyclones
5. Droughts
6. Landslides
7. Forest Fires
8. Avalanches
9. Nuclear Disasters
Dos and Don'ts While Commercial Nuclear Disaster
10. Chemical and industrial Disasters
Chemical and Industrial Disaster Mitigation
11. Tsunami

Case Studies

Bhopal Gas Tragedy 1984
 Orissa Super Cyclone 1999
 Bhuj Earthquake 2001
 Assam Floods 2004
 Peerchu Lake - A Disaster in Being Kumbakonam School Fire Tragedy
 Tsunami 2004

Reference:

Khanna B K (2005). All you wanted to know about Disasters. New India Publishing Agency, New Delhi. Pp.1-219.

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LABORATORY PRACTICES AND SEAFY

ESL964

Credits 4-0-0

1. Introduction to chemical analysis:

Nature of analytical chemistry, General directions of chemical analysis: Cleanliness in the laboratory, Recording and planning data. Data quality: Bias, Precision, Uncertainty, Method detection limit, Checking correctness of analysis, Expression of results, Significant figures, Collection and preservation of sample.

2. Data Analysis:

Uncertainties, Errors, calibrations, Mean, Standard Deviation, Least square fit.

3. Laboratory apparatus and glassware:

Lab wares, soft Vs heat resistant glasswares, lab ware's of plastic, porcelain, platinum and nickel. Volumetric flasks, Pipette, burette, Cleaning of volumetric glassware. Calibrations of Glass wares, Types of balances: Analytical balances, Desiccators.

4. Chemical reagents and standards:

Grade and purity of chemicals, Proper storage of chemicals and standards, Laboratory pure water, Preparation of reagent grade water, Reagent water quality.

Quality assurance of chemical measurements: Quality assurance, quality control, Quality assessment, Sampling, Sampling custody, Sample preparation, Analytical methodology with case studies, Calibrations, Detection limits, Statistics in chemical analysis, Quality control charts.

5. Reagents and solutions:

Stock standardization solutions. Preparation and standardization of common standard solutions.

6. Common Laboratory techniques:

Gravity, Vacuum, Centrifugation, Distillation: Simple, Fractional, Vacuum, Refluxing, Ion exchange, Drying and washing sample, Liquid-liquid extraction by separating funnel, Soxhlet extraction and filtration.

7. Inventory Management:

Software's for stock room management, Role of computers in Laboratory occupational health and safety, Waste minimization and disposal.

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8. Laboratory hazards and safety:

Lab design, Fume hoods, Chemical safety aspects, Fire, Careless habits, Safe Storage, Handling of Chemicals, Handling of compressed gases, Stockroom safety rules, and Laboratory safety rules, Protection of Environment, Disposal of Chemicals, Bio safety, chemical and electrical safety, Fire safety, Radiation safety, Eyewash and safety shows, Routine mock drills for lab safety.

References:

1. Csuros M, Environmental Sampling and Analysis, Lewis Publications (2002).
2. Eugene W Rice (Editor), Rodger B Baird (Editor), Andrew D Eaton (Editor), Lenore S. Clesceri, Standard Methods for Examination of Water and Wastewater (Standard Methods for the Examination of Water and Wastewater) Amer Public Health Assn (2012).
3. Robert II, Hill Jr, David C Finster, Laboratory Safety for Chemistry Students, , Wiley(second Edition)(2016).
4. Sandy Weinberg, Good Laboratory Practice Regulations, Fourth Edition, CRC press(2007)

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