INDIRA GANDHI NATIONAL TRIBAL UNIVERSITY, AMARKANTAK (M.P.)

SYLLABUS

Department of Environmental Science
Faculty of Science

RECOMMENDED COURSE
FOR
DOCTOR OF PHILOSOPHY (Ph.D.) IN ENVIRONMENTAL SCIENCE

(Effective from Session 2024-2025)

Ph.D. Course Work

Department of Environmental Science, Faculty of Science

Indira Gandhi National Tribal University, Amarkantak (MP)

Course code	Paper name	Credits
Common course (University/faculty level)		
PZCC-101	Research methodology	4
RCS-103	Computer application and data analysis	4
PZCC-102	Research and publication ethics	2
Discipline elective paper/Research Theme-Specific Courses (Department level)		
DSET104	Tools and Techniques in Environmental Science	4
Any one of the following (Elective Theory)		2
DSET105	Environmental Issues and Sustainable Development	
DSET105	Water Quality Assessment, wastewater treatment methodologies	
DSET105	Biodiversity and its Conservation	
Total credit		**16**

Code DSET 104: Tools and Techniques in Environmental Science

Credit: 4

Unit 1: Environmental monitoring and sample analysis

Environmental sampling: Air, Water, Soil-collection, preservation, storage and analysis of samples. Methods for analysis of Environmental Samples. automation in environmental monitoring and remote sensing tools for large-scale environmental sampling.Basic Terminology: Equivalent weight of acids and bases, Normality, Molarity, Molality, Specific weight, Buffer solution. Precision and accuracy.

Unit 2: Instrumentation and analysis

Fundamentals of basic instruments: Theory, Principles, Working operation and application of Colourimetry, Flame photometry, Polarimetry, Spectrophotometry: AAS, Chromatographic techniques,HPLC, LC-MS, GC-MS.

Unit3: Advanced techniques for sample analysis

Microscopy- Different types of Microscopes light, fluorescence, phase contrast microscopes, Electron Microscopy: Scanning and Transmission electron microscopes, Electrophoresis, auto radiography, Ultracentrifugation, next-generation sequencing techniques, real-time data analytics, and advanced spectrometry tools, FTIR, ICP-MS.

Unit 4: Environmental impact assessment

Concept of screening and scooping, baseline information and predictions (land, water & atmosphere), EIA guidelines 1994, notification of government of India, impact assessment methodologies and analysis, Environmental risk assessment and mitigation measures; restoration and rehabilitation technologies, Eco-labeling /Eco-markscheme.

Suggested Reading

1. Skoog, D.A., Holler, F., Crouch, S.R., Instrumental Analysis, Cenage Learning IndiaPvt. Ltd, New Delhi,2007
2. Settle, F. Instrumental Techniques for Analytical Chemistry, Prentice-Hall, Inc.,Englewood Cliffs, NJ, (1997).
3. Popek, E. P. Sampling and analysis of environmental pollutants: a complete guide,USA: Academic (2003).
4. Lillesand, T., Kiefer, R. W., & Chipman, J. Remote sensing and image interpretation.John Wiley & Sons, (2014)
5. Handbook of Thin-Layer Chromatography, 2003. 3rd Edition; Edited By Joseph Sherma,Bernard Fried. CRC Press

Code DSET105: Environmental Issues and Sustainable Development

Credits: 2

Unit I: Environmental Issues and Challenges

Local, Regional and GlobalEnvironmental issues and scales: Concepts of micro-, meso-, synoptic and planetary scales; Temporal and spatial extents of local, regional, and global phenomena. Air, water, and soil pollution and emerging contaminants, radioactive radiation; municipal solid waste, hazardous waste; solid waste management, acid rain, smog. Ambient air quality and its effects on humans, Land use and Land cover change: land degradation, deforestation, desertification, urbanization. Global change: Ozone layer depletion; Climate change, Natural calamities and disasters management.

Unit 2: Resources exploitation and environmental impact

Environmental impact of over-exploitation of natural resources, issues and challenges; Water scarcity issues, emerging water contaminants-challengesand their mitigation measures;Drinking water quality and standards; adverse impacts of emerging water contaminants on human health, Acute and chronic effects, carcinogens, recalcitrant contaminants and their harmful effect, Principles and mechanisms of toxicity, bioaccumulation and biomagnifications. Land degradation, deforestation and their conservation approaches; Energy demand, implications, challenges and conservation approaches.

Unit 3: Sustainability and Sustainable Development

Introduction to sustainable development, strategies of sustainable development, Sustainable Development Goals (SDGs)- targets and indicators, challenges and strategies for SDGs. Sustainable agriculture practices, concept of vulnerability and its assessment; Adaptation vs. resilience; Climate-resilient development. Concept of carbon intensity, energy intensity and carbon neutrality; National and international policy instruments for mitigation, decarbonizing pathways and net zero targets for the future.

Suggested Reading

1. E., Bharucha, *Text book of Environmental Studies for undergraduate courses,* Universities Press, Hyderabad, 2nd Edition, 2013.
2. R. Rajagopalan, Environmental Studies: From Crisis to Cure, Oxford University Press, 2016.
3. R. DanielHeadrick, Humans versus Nature- A Global Environmental History, Oxford University Press, 2020.
4. P.Cunningham Williamand A.Mary, Cunningham Environmental Science: A Global Concern, Publisher (Mc-Graw Hill, USA), 2015.

5. S.E.Manahan, Environmental Chemistry (11th ed.). CRC Press. https://doi. org/10.1201/9781003096238, 2022.

Code DSET105: Water quality assessment, and wastewater treatment methodologies 2 Credits

Unit I: Water resources

Water resources: Global distribution of water on earth, Surface water and groundwater resources, shrinking water resources, water crisis, and other major issues related to water demand

Unit II: Water Quality Assessment & Water Pollution

Water Quality: Definitions, Characteristics, Water quality parameters (Physical, Chemical, biological), water quality standards,
Water pollution: Sources of water pollutants, effects of water pollutants on plants, animals and human health, Water quality monitoring status of water pollution in different water bodies with reference to the Indian context, eutrophication, effect of water pollutants on plants, animals and human health

Unit III: Wastewater treatment methodologies

Water purification in natural systems, engineered systems for water treatment, water treatment process (aeration, solids separation, settling operation, Coagulation, softening, filtration, disinfection, wastewater treatment (primary treatment, secondary treatment, sludge treatment), Tertiary treatment

Suggested Reading

1. Environmental Chemistry by Stanely Manhan
2. Environmental Engineering by Peavy. McGraw Hill Book Co., New Delhi
3. Environmental Chemistry by A. K. De
4. Environmental Science – Enger, Smith and Smith W.M.C. Brown company Publication
5. Environmental Science - Taylar and Miller
6. Environmental Science – Botkin and Kelter, John Wiley and Sons, New York.

Code DSET105: Biodiversity and its Conservation

Credits: 02

Unit I: Biodiversity: concept and biodiversitymonitoring

Introduction to biodiversity; Levels of biodiversity: Genetic, species, community and ecosystem. Magnitude and distribution: Diversity gradients and related hypotheses, methods for biodiversity monitoring, megadiversity zones and hot spots, Biodiversity and ecosystem functions: Concepts and models.Biodiversity and ecosystem services: Provisioning, regulating, supporting andcultural

Unit II: Threats to biodiversity:

Threats to biodiversity: Causes of biodiversity loss, species extinction, vulnerability of species to extinction, IUCN threat categories, Red Data Book

Unit III:Biodiversity conservation

Strategies for biodiversity conservation: Principles of biodiversity conservation, in-situ and ex-situconservation strategies; Biodiversity Act of India, International Convention on Biological Diversity

Suggested Readings:

1. Gaston, K J. & Spicer, J.I. 1998. *Biodiversity: An Introduction.* Blackwell Science, London, UK.
2. Krishnamurthy, K.V. 2004. *An Advanced Text Book of Biodiversity - Principles and Practices*. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
3. Pandit, M.K. & Grumbine R.E. 2012. Ongoing and proposed hydropower development in the Himalaya and its impact on terrestrial biodiversity. *Conservation Biology* **26**:1061-1071.
4. Primack, R.B. 2002. *Essentials of Conservation Biology* (3rd edition). Sinauer Associates, Sunderland, USA.
5. Singh, J. S. & Singh, S. P. 1987. Forest vegetation of the Himalaya. *The Botanical Review* **53**: 80-192.
6. Singh, J. S., Singh, S.P. & Gupta, S. 2006. *Ecology, Environment and Resource Conservation.* Anamaya Publications, New Delhi.
7. Sodhi, N.S. & Ehrlich, P.R. (Eds). 2010. *Conservation Biology for All*. Oxford University Press.
8. Sodhi, N.S., Gibson, L. & Raven, P.H. 2013. *Conservation Biology: Voices from the Tropics.* Wiley-Blackwell, Oxford, UK.

PZCC-101 RESEARCH METHODOLOGY

(Credits- 04; Contact hour- 60h; maximum marks – 100)

Unit-I An overview of research methodology
Research concept, steps involved, identification, selection and formulation of research problem, justification, hypothesis; literature collection- textual and digital resources (internet)

Unit-II Research design, data collection and interpretation
Research design; sampling techniques, collection and documentation, presentation, analysis and interpretation of data

Unit-IIIScientific writing:
Forms of scientific writing- Article, notes, reports, review article, monographs, dissertations, popular science articles, bibliographies,

Unit-IVFormulation of scientific communication
Outline preparation, drafting title, sub titles, tables, illustrations; Formatting tables- title, body footnotes; figures & graphs- structure, title and legends, Impact factor, citation indices, plagiarism

Unit-V Elementary Biostatistics:
Standard deviation/error; Correlationcoefficient, types of correlation, regression equation, biological significance of correlation and regression; Test of significance, chi-square test, analysis of variance.

SUGGESTED READINGS

- Research Methodology - Methods & Techniques, CR Kothri CR (1990), Vishva Prakashan, New Delhi.
- Research Methodology & Statistical Techniques, S Gupta (1999) Deep & Deep Publications, New Delhi.
- Research Methodology for Biological Sciences, N Gurumani (2007), MJP Publishers, Chennai.
- Introduction to Biostatistics, L Forthofer (1995), Academic Press, New York.
- Biostatistical Analysis, JH Zar (2006), Prentice-Hall.
- Research Design: Qualitative, Quantitative & Mixed Method Approaches, John W. Creswell (2009), Sage Publication, USA.
- Experimental Design & Data Analysis for Biologists. PQ Gerry & JK Michael (2002), Cambridge University Press.

- Choosing & Using Statistics: A Biologists Guide, D Calvin (2003), Blackwell Publisher.

PZCC-102 RESEARCH & PUBLICATION ETHICS

(Credits- 02; contact hours - 30h; maximum marks - 50)

Unit I: Philosophy & Ethics (3h)

Introduction to philosophy: definition, nature and scope, concept, branches.

Ethics: definition, moral philosophy, nature of moral judgements and reactions.

Unit II: Scientific Conduct (5h)

Ethics with respect to science and research; intellectual honesty and research integrity; scientific misconducts – falsification, fabrication and plagiarism (FFP); redundant publications – duplicate and overlapping publications, salami slicing; selective reporting and misrepresentation of data.

Unit III: Publication Ethics (7h)

Publication ethics – definition, introduction and importance, best practices/standard setting initiatives and guidelines – COPE, WAME; conflicts of interest; publication misconduct – definition, concept, problems that led to unethical behaviour vice-versa, types; violation of publication ethics -, authorship and contributionship; Identification of publication misconducts, complaints and appeals; predatory publishers and journals.

Practices – Open Access Publishing (4h)

Open access publications and initiatives; SHERPARoMEO online resource to check publishers copyright & self-archiving policies; software tool to identify predatory publications developed by SPPU; journal finder/journal suggestion tools viz., JANE; Elsevier Journal Finder; Springer Journal Suggester etc.

Publication Misconduct (4h)

Group discussions – subject specific ethical issues, FFp, authorship; conflicts of interest; complaints and appeals - examples from India and abroad (**2h**).

Software tools – use of plagiarism tools like Turnitin, Urkund and other open-source software tools (**2h**).

Databases and Research Matrices (7h)

Databases – Indexing databases; citation databases – Web of Science, SCOPUS etc**(4h).**

Research matrices – Impact factors of journals as per Journal Citation Reports, SNIP, SJR, IPP, cite score; Matrices – h-index, g-index, i10 index, altmetrics**(3h).**

Suggested Readings:

1. Bird, A. (2006). Philosophy of Science. Routledge.
2. MacIntyre, Alasdair (1967) A Short History of Ethics. London.
3. P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978- 9387480865
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: Third Edition. National Academics Press.
5. Resnik, D. B. (2011). What is ethics in research & why is it important. National Institute of Environmental Health Sciences, 1-10. Retrieved from https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm
6. Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489(7415), 179-17. https://doi.org/10.1038/489179a
7. Indian National Science Academy (INSA), Ethics in Science Education, Research and Govermance(2019), ISBN:978-81-939482-1-7.http://www.insaindia.res.in/pdf/EthicsBook.pdf

Ph.D Programme
(Core Course shall be taught at university level for Ph.D Course work)
Duration: One Semester

RCS-103: COMPUTER APPLICATIONS

Subject Code	Subject Name	Number of Credits	Maximum Marks
RCS-103	Computer Applications	4	100

(60:40:: End Sem Exam: Internal Exam)

Syllabus

Unit IFundamental of Computer:

Characteristics of Computers, Evolution of computers, computer generations, Basic computer organization; System software, Application software, Application packages, I/O devices, computer memory, introduction of operating system and characteristics, Windows, Mac etc.

Unit IIComputer Hardware basics and Software Installation:

PC Boot Process and BIOS, Description of Different parts of a computer, personal computer configuration, performing installation of operation system and other application, Usage of relevant tools and recovery using various tools/ software, perform cabling, connecting, and configuring of a peer-to-peer network (WiFI/ Broadband), Use of identifying different Desktop Icons. My Computer, My Documents, Changing Desktop Backgrounds, Mouse Pointer, Screen Saver and Notepad, WordPad, MS Paint, Operating System Installations and Procedures/ Booting Procedures, Windows Configurations & Adding Device Drivers.

Unit IIIIntroduction to Internet, WWW and Web Browsers:

Basic of Computer networks; LAN, WAN; Concept of Internet; Applications of Internet; connecting to internet; What is ISP; Knowing the Internet; Basics of internet connectivity related troubleshooting, World Wide Web; Web Browsing software (s), Search Engines; Understanding URL; Domain name; IP Address; Basics of Electronic mail; Getting an email account; Sending and receiving emails; Accessing sent emails; Using Emails; Document collaboration; Instant Messaging; Netiquettes. Using e-governance website, website for journal access, website for research applications: Shodhganga, ShodhGangotri, Research Gate,
SWAYAM, NPTEL, UGC-CARE etc.

Unit IVICT Tools for Documentation of Research Work:

Various format of e-research paper, e-book and e-document: .cbr, .cbz, .cb7, .cbt, .cba, .djvu, .doc, .docx,
.epub, .fb2, .html, .ibook, .cdr, .inf, .azw, .lit, .prc, .mobi, .exe, .pkg, .pdb, .txt, .pdb, .pdf, .ps, .tr2, .tr3, .oxps, .xps; Various useful Software for image to text, .pdf to .doc/docx, Voice to text/docx, text to image, , .pdf to jpeg/png, .doc/.docx to image and other type of conversation; E-document Conversation Tools Compatible with Multiple Formats, Plagiarism Checker software and its utilization.

Unit VResearch Writing Tools and Software:

General Purpose Software Package: REF-N-WRITE, Microsoft office: Word, Power Point, Excel; Software for Writing Your Dissertation: LaTeX, LyX, Scrivener; Referencing Tools and Reference Management Software: Zotero, Mendeley, Docear etc; Grammar Checkers and Sentence Correction Tools: MS Word Spelling & Grammar checker S/W: Grammarly Desktop Apps and Online Grammar checking sites; Image and Video editing software.

Text Books

1. Grotenhuis, Manfred te, and Matthisjissen, Anneke. Basics SPSS Tutorial. United States, SAGEPublications, 2015.
2. Raubenheimer, Jacques. Mendeley: Crowd-sourced Reference and Citation Management in the Information Era. United Kingdom, True Insight Publishing, 2014.
3. Goel, Anita. Computer Fundamentals. India, Pearson Education, 2010.
4. Maidasani, Dinesh. Learning Computer Fundamentals, MS Office and Internet & Web Tech. India, Laxmi Publications, 2005.

Reference Books

1. Wishnietsky, Dan H. Internet Basics: An Educator's Guide to Travelling the Information Highway. United States, Phi Delta Kappa Educational Foundation, 1997.
2. McCormick, Keith, and Salcedo, Jesus. SPSS Statistics for Data Analysis and Visualization. Germany,Wiley, 2017.