COURSE OF STUDY

Doctor of Philosophy
in
Environmental Science

(Effective from Academic Year 2023-2024)

Department of Environmental Studies

BERHAMPUR UNIVERSITY

COURSE OUTLINE

Paper code	Title of the Paper	Credits	Marks
ENVS P-101	Research Methodology (Quantitative Analysis and Computer Application)	04	100
ENVS P-102	Nature and Society	04	100
ENVS P-103 (Any One)	Subject Specialization (Any One Course to be opted)		
	(A) Environmental Monitoring and Ecotoxicology	04	100
	(B) Environmental Geochemistry and Isotopes		
	(C) Natural Re source Governance: Issues and Perspectives		
ENVS P-104	Research and Publication Ethics (RPE)	02	50
ENVS P-105	Review of Research papers published in referred Journal on the topic assigned and seminar	02	50
Total Credits = 14			**400**

1. ENVS P-101: RESEARCH METHODOLOGY (Quantitative Analysis and Computer Application) (Core Course, 04 Credits)

Unit-I (10 Lectures)
Application of statistical concepts/procedures. Data, diagrammatic representation of data, Probability, Measure of Central tendency, Measure of dispersion, Skewness and Kurtosis; Normal distribution: Simple correlation, regression analysis; Sampling: Simple random sampling, Stratified random sampling, Systematic sampling.

Unit- II (16 Lectures)
Testing of Hypothesis tests, X (Chi-square), F and T-tests: Analysis of variance, covariance, Principal component analysis; Experimental design: completely randomized block design, randomized block design, Latin square design. One-way analysis of variance, Two-way analysis of variance, follow up tests; Non-parametric procedures; Probability Distribution (Normal, Binomial and Poison)

Unit- III (06 Lectures)
The standards of a scientific paper, scientific words, paragraph, writing scientific text, presenting numerical data, constructing scientific figures, sections of research paper, choosing a journal, preparing and submitting a manuscript, responding to editors and Referees.

Unit-IV (08 Lecture)
Windows operating system; Learning software packages: Microsoft-Excel, Megastat, SPSS, R, Endnote.

Suggested Readings:

1. Fundamentals of Biostatistics; Eighth Edition; 2016 by Bernard Rosner.
2. Research Methodology: Methods and Techniques, C. R. Kothari.
3. From Research to Manuscripts: A Guide to scientific writing, Katz & M. Jay

2. ENVS P-102: Nature and Society (Core Corse: 04 Credits)

Unit1: Role of Human in Transforming Earth and its Resources
Concepts and definitions of natural resources, scarcity and sustainability
Human dimension of Environmental changes: environmental degradation; ecological crisis, global warming and climate change; deforestation, soil erosion; environmental hazards and disaster.

Unit 2: Valuing Natural Resource
Economic Valuation of Natural Resources: Natural capital and ecosystem services
Resource Scarcity: Classical and Neo-classical approaches.

Unit 3: Approaches to understand human-nature relations
Political ecology: Role of social Structure in Nature-society relation
Ecofeminism: Revisiting role of women in the discourse of human-nature relations

Cultural-ecology: Role of culture, identity, and language, in shaping natural resource use and conservation; Post-modernist and Post-humanist and human-nature relations.

Unit 4: Knowledge systems and research needs for sustainability
Environmental Ethics; Sociology of Knowledge employed in Natural Resource Management: Traditional and Scientific; Choosing among strategies for development.

Suggested Readings:

1. Pretty, J. et al (edt.). The Sage Handbook of Environment and Society. Los Angeles. Sage Publication
2. White, L. 1967. The Historical Root of Ecological Crises. *Science. 153(3767): 1203-1207.*
3. Hajer, M.A. 1995. The Politics of Environmental Discourse: Ecological Modernisation and the Policy Process. Clarendon: Oxford
4. Dryzek, J. 1997. The Politics of the Earth. Oxford: Oxford University Press
5. Costanza, R. (ed.) 1991. Ecological Economics, New York: Columbia University Press.
6. Berkes, F. 1999. Sacred Ecology: Traditional Ecological Knowledge and Resource Management. Philadelphia: Taylor and Francis.
7. Turner, B. L. 1993. The Earth as Transformed by Human Action: Global and Regional Changes in the Biosphere over the past 300 years. Cambridge University Press.

3. ENVS P-103: Subject Specializations (Elective Course - Any One: 04 Credits)

A. ENVS P-103 (A): Environmental Monitoring, Ecotoxicology and Risk Assessment (Elective Course, 04 Credits)

Unit-I (10 lectures): Introduction and Scope of Toxicology
History - Disciplines of toxicology, Importance and significance.
General classification of environmental contaminants - air, water and soil. Common Terminologies; Contaminant, Pollutant, Risk, Cumulative & Additive toxicity, Syngerism, Antagonism, Fate, Half-life, Depuration, Metabolites, Threshold concentration, Dose, Response, Acute, Chronic, Lethal Dose and Lethal Concentration.

Unit-II (10 lectures): Factors Affecting Toxicity of Environmental Contaminants: Dose-response relationship, curves, routes of exposure - physical and chemical factors. Study of Specific Environmental Contaminants: Heavy metals, Pesticides – Organochlorine, Organophosphate and Carbamates, PAH , PCBs, PBDEs, PBDFs, Dioxins and Furans. Classification, source, routes of exposure, effects and fate with special reference to fish and birds

Unit-III (10 lectures): Toxicity Mechanism and Detoxification: Biotransformation of contaminants – conjugation and hydrolysis, transformation reactions. Translocation of contaminants - absorption, distribution and excretion. Detoxification mechanisms-Metallothionein, Glutathione, MFO. Bioconcentration, Bioaccumulation and Biomagnification of Toxicants. Biomarkers and Bioindicators – Terminology, Criteria and Processes.

Unit-IV (10 lectures): Hazard and Safety Evaluation: Usage pattern, Environmental and health effects, Decision making, Monitoring, Surveillance and follow-up. Restrictions on use. Teratogenicity, Carcinogenicity, Genotoxicity and Mutagenicity. Environmental guidelines – FAO/WHO, ISI for aquatic wildlife toxicology, Codex Alimentaris

Suggested Readings:

1. Fundamentals of Aquatic Toxicology. Edited by Rand G M Taylor and Francis, London.
2. Ecotoxicology – Ecological fundamentals, Chemical exposure and Biological effects. Edited by Gerrit Schuurmann and Bernd Markert – Wiley, New York.
3. Behavioural Ecotoxicology – Edited by Giacomo Dell'Omo. – John Wiley and Sons Ltd, UK.
4. Handbook of Ecotoxicology – Edited by Peter Calow. – Blackwell Scientific Publications, London
5. Experimental Toxicology The Basic Principles – Edited by Diana Anderson and DM Conning. – The Royal Society of Chemistry, Cambridge
6. Biomarkers for Agrochemicals and Toxic Substances. Applications and Risk Assessment. – Jerry N Blancato, Robert N Brown, Curtis C Dary and Mahmoud Abbas Saleh. – American Chemical Society, Washington.
7. Wildlife Toxicology Tony J Peterle. Van Nostrand Reinhold, New York.
8. Handbook of Toxicology – Edited by David J Hoffman, Barnett A Rattner, G Allen Burton Jr, and John Cairns Jr. – Lewis Publishers , Boca Raton.

B. ENVS P-103 (B): Environmental Geochemistry and Isotopes Study

Unit-I (10 lectures): Introduction to Geochemistry: Origin of the solar system and distribution of elements with respect to distance from the Sun. Abundances of elements, Oddo-Harkin Law. Meteorites, Geochemical and Cosmochemical classification of elements and their basis. Chemical weathering, soil formation, geochemistry of clays.

Unit-II (10 lectures): Radiogenic Isotopes: Stability of nuclides. Radioactive decay schemes. Decay constant, half-life, parent-daughter relations. U-Pb, Rb-Sr, Sm-Nd and radiocarbon dating and their use in geochemistry.

Unit-III (10 lectures): Stable Isotopes: Stable isotopes: processes of isotope fractionation, δ-notation for H, C and O isotopes. Principles of stable isotope mass spectrometry and various standards used in the mass spectrometric measurements. O isotopes: fractionation in the hydrologic cycle.

Unit-IV (10 lectures): Application of Isotopes in Different Proxies: Applications of stable isotopes in climate, hydrologic/hydrogeologic and biogeochemical studies. Paleo climatic/Paleoceanographic reconstruction from clay, diatom, radiolarian, foraminifera, Mangroves, corals, speleothems, lake sediments.

Suggested Readings:

1. K. B. Krauskopf (1979). Introduction to Geochemistry. McGraw Hill.
2. Hoefs, J. (1997). Stable Isotope Geochemistry, 4th edition, Springer-Verlag, Berlin.
3. Faure G., (1986). Principles of Isotope Geology, 2nd edition, J. Wiley & Sons.
4. Hoefs, J. (1997). Stable Isotope Geochemistry, 4th edition, Springer-Verlag, Berlin.
5. Brian Mason (1982). Principles of Geochemistry. J. Wiley & Sons.
6. Allegre (2008), Isotope Geology

C. ENVS P-103 (C): Natural Resource Governance: Issues and Perspectives

Unit-I (10 Lectures): Governing Natural Resources: Theoretical approaches to governance of Natural Resources: Rational Choice and New Institutional Economics. Establishing the rationale for NRM: carrying capacity, ecological foot-print, resilience, sustainability, property rights, externalities

Unit-II (10 Lectures): State and Natural Resources: The relevance and appropriateness of the bureaucratic set-up for NRM (Weberian concepts). Understanding accountability and transparency; rent-seeking perspectives. The "participation" paradigm: emergence, experiences and challenges, resource user organizations.

Unit-III (10 Lectures): Gender and Natural Resources: Key issues and concepts about the gender and environment relationship, feminist political ecology, role of gender in shaping control and access to Natural Resources, Gender and Experiences of the impacts of environmental and climate change; Gender inequality in political decisions over natural resources and case studies of gender-transformative approaches in resource governance

Unit-IV (10 Lectures): Case Studies of current issues in Natural Resource Governance and Policy Interventions.

References:

1. Ascher W (1999). Why Governments Waste Natural Resources: Policy Failures in Developing Countries. Baltimore: The John Hopkins Univ. Press.
2. Auty RM (2001). Resource Abundance and Economic Development. Oxford: Oxford University Press.
3. Bryant, R. & Bailey, S. (1997). Third world political ecology. London: Routledge.
4. Johnston, R. J. (1996). Nature, State, and Economy: A political economy of the environment. Chichester: John Wiley.
5. Pretty, J; Ball, A. S. (2007). The Sage handbook of environment and society. Sage Publication: NewDelhi
6. Robbins, Paul; Hintz, John and Sarah A. Moore (2014) Environment and Society: A Critical Introduction, Wiley-Blackwell

4. ENVS P-104: RESEARCH AND PUBLICATION ETHICS (Core Course, 02 Credits)

THEORY

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 honest and research integrity
3. Scientific misconducts: falsification, fabrication, and plagiarism.
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-verse, types
5. Violation of publication ethics, authorship and contributor ship
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 resourse to check publisher copyright and self-archiving policies.
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder/ journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

RPE 05: PUBLICATION MISCONDUCT (4 hrs)

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 (2 hrs.)

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

RPE 06: DATABASES AND RESEARCH METRICS (7 hrs)

A. Databases (4 hrs.)

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

B. Research Metrics (3 hrs.)

1. Impact Factor of journal as per journal citation report, SNIP, SJR, IPP, Cite Score.
2. Metrics: h-index, g index, i10 index, altmetrics

Suggested Readings:

1. Bird, A. (2006). *Philosophy of Science.* Routledge.
2. MacIntyre, Alasdair (1967). *A Short History of Ethics.* London.
3. Chaddah, P. (2018). *Ethics in Competitive Research: Do not get Scooped; do not get Plagiarized.* ISBN: 978-938748086
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 Academies 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), 179-179. https://doi.org/10.1038/489179a
7. INSA (2019). *Ethics in Science Education, Research and Governance*. Indian National Science Academy, New Delhi. ISBN: 978-81-939482-1-7. http://www.insaindia.res.in/pdf/Ethics_Book.pdf

5. ENVS P-105: Review of Research papers published in referred Journal on the topic assigned and seminar (Practical /Tutorials /Assignments /Seminar, 02 Credits)

In this course, students shall have to make a Systematic Literature Rivew (SLR) on their preferred topics of research and submit the review report for evaluation. Further, they shall also have to deliver seminar presentations on assigned topics of research and case studies.