

# **M. Phil. ENVIRONMENTAL SCIENCE**

## **SYLLABUS**

**(2021-2022 ONWARDS)**



**P. G. DEPARTMENT OF ENVIRONMENTAL SCIENCE,  
FAKIR MOHAN UNIVERSITY, VYASA VIHAR  
BALASORE-756089  
ODISHA**

**Dept. of Environmental Science**  
**M.Phil. Environmental Science**

COURSE STRUCTURE

<b>Paper Code</b>	<b>Paper Name</b>	<b>Marks</b> <i><u>Internal +</u></i> <i><u>End term</u></i>	<b>Credit</b>
<b>Semester I</b>			
ENS-611	Research Methodology and Publication Ethics	40+60	8
ENS-612	Resent Advances Environmental Science Research	40+60	8
ENS-613	Research and Publication Ethics (RPE)	20 +30	2
ENS-614	Laboratory and Field Techniques/Practical; and Computer Application	100	6
<b>Semester II</b>			
ENS-621	Review work and Proposal Presentation	50	4
ENS-622	Presentation of Finding	50	4
ENS-623	Dissertation Submission, Presentation and Viva-voce	200	16
<b>Total Marks</b>		<b>600</b>	<b>48</b>

### MARKING/ EVALUATION PATTERN

From 2021-22 admission session, M.Phil. degrees offered by the University will follow a continuous evaluation system as per the marks distribution mentioned below.

	<b>Theory papers</b> (1st Sem Paper I and II)	<b>RPE</b> (1st Sem Paper III)	<b>Practical Paper</b> (1st Sem Paper IV)	<b>Review work and Proposal Presentation</b> (2nd Sem Paper I)	<b>Presentation of Finding</b> (2nd Sem Paper II)	<b>Dissertation Work</b> (2nd Sem Paper III)
<b>Total marks per paper</b>	<b>100</b>	<b>50</b>	<b>50</b>	<b>50</b>	<b>50</b>	<b>200</b>
<b>Credit per paper</b>	<b>8</b>	<b>2</b>	<b>6</b>	<b>4</b>	<b>4</b>	<b>16</b>
Internal Exam	<b>10 Marks</b> Best of the two quizzes	<b>5 Marks</b> Best of the two quizzes	----	----	---	----
	<b>20 Marks</b> Written (Mid Sem)	<b>5 Marks</b> Group Discussion				
	<b>10 Marks</b> Presentation and Home Assignment	<b>10 Marks</b> Presentation and Home Assignment				
End Term Exam	60 Marks	25 Marks	<b>25 Marks</b> Experiment	<b>10 Marks</b> (Presentation)	<b>10 Marks</b> (Presentation)	<b>40 Marks</b> (Presentation)
			<b>15 Marks</b> Computer Application	<b>30 marks</b> (Report)	<b>30 marks</b> (Report)	<b>120 marks</b> (Report)
			<b>5 Marks</b> Practical Record	<b>10 Marks</b> (Viva-voce)	<b>10 Marks</b> (Viva-voce)	<b>40 Marks</b> (Viva-voce)
			<b>5 Marks</b> Viva-Voce			
<b>Total no of papers in all semesters</b>	2	1	1	1	1	1
<b>Total marks</b>	200 Marks	50 Marks	50 Marks	50 Marks	50 Marks	200 Marks
<b>Grand Total of Marks</b>	<b>600 Marks</b>					
<b>Total Credit</b>	<b>48</b>					

**Scheme of Internal Evaluation (Theory):**

Each theory paper consists of five units and irrespective of the credit hours assigned, will be of 100 marks, out of which, 40 will be internal marks (continuous evaluation) and 60 will be end term examination marks. There will be three components of internal evaluation – Quiz, Mid Term Written Test and Presentation & Home Assignment as per the details below.

Component	Unit(s)	Marks	Remarks
Quiz – I	I	10	Best of the two quizzes of 10 marks each will be considered
Quiz – II	III		
Mid Term (Written)	I & II	20	Students are required to make presentations and home assignments on selected topics from the <b>self-study</b> section
Presentation & Home Assignment	All	10	
<b>Total</b>	<b>I – V</b>	<b>40</b>	

**SELF SYUDY**

25% of each unit of a theory paper is earmarked for self-study by students as per UGC directives. For completion of the portion in a particular semester, the course teacher is required to take one/ two introductory classes in the beginning, one/ two summarizing classes at the end and few doubt clearing classes in between, if required. Students are required to make presentation on selected topics from the self-study section during the class in order to assess their understanding of the subject and take remedial measures, if needed. The portion earmarked for self-study has been underlined in the syllabus.

**BOARD OF EXAMINERS**

Sl. No.	Section	Examiner(s)
01	Quiz	Internal Course Teacher/ Instructor from the University P. G. Department
02	Presentation and Home Assignment	A board of examiners consisting of faculty members of the Department.
03	Written (Mid Term)	Internal Course Teacher/ Instructor from the University P. G. Department
04	Written (End Term)	Examiner as appointed by the Board of Studies
05	Practical Paper	Internal and External Examiners as appointed by the Board of Studies
06	Review work and Proposal Presentation	A board of examiners consisting of faculty members of the Department.
07	Presentation of Finding	A board of examiners consisting of faculty members of the Department.
08	Dissertation Work	Concerned Supervisor as internal and External Examiner as appointed by the Board of Studies

## **Semester I**

### **ENS-611 RESEARCH METHODOLOGY AND COMPUTER APPLICATION**

Total Marks = 100 (Internal-40 + End Term-60)

Credit Hour =8

#### **UNIT-I: Research Methodology**

- Introduction to Philosophy: definition, nature and scope, concept, branches,
- Research as a creative and strategic thinking process, developing research aptitude,
- Literature survey, Preparing the Research Proposals, Skills and Tips for successful projects,
- Writing for Journals and Edited Books, Presenting papers at Conferences, Thesis writing,
- IPR, Patenting

#### **UNIT-II: Research Databases and Research Metrics**

- Concept of Plagiarism and its types,
- Importance of Bibliography, Referencing
- Use of scientific search engines and Databases: Publication databases, Molecular biology databases, Indexing databases, Citation databases.
- Impact factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
- Research Metrics: h-index, i-10 index, altmetrics etc.

#### **UNIT-III: Computer Application in Research**

- Components of personal Computer - Input-Output Devices, CPU and other Hardware components; Software (Operating system software, application software);
- Use of Computational tools and Statistical software like MS Excel and Sigma-plot
- Basic idea on use of anti-plagiarism software
- Basic idea on use of reference management software
- Basic idea on Environmental Science databases like USEPA, Bhuvan – NRSC etc.

#### **UNIT-IV: Data interpretation and Statistical analysis**

- Methodology design,
- Data collection/generation, Primary and secondary data, methods of collecting primary and secondary data,
- Sampling and Sampling Designs,
- Test of Significance for large and small samples (t-Test,  $\chi^2$  –test, F-test),
- Non parametric methods,
- Simple and multiple correlation & Regression Analysis,
- ANOVA and Multivariate Analysis,
- Concept of Modelling and Modelling Techniques.

#### **UNIT-V: Instrumental techniques for Environmental Sample Analysis**

- Principles and Applications of Spectrophotometer;
- Principles and Applications of Atomic Absorption Spectrophotometer,
- Electrophoresis Techniques (Types and application);
- Chromatographic techniques (Types and application);
- Basic concepts and applications of NMR, FTIR, XRD, XRF, TGA, DTA, SEM, TEM, ICPMS, Bomb Calorimeter;
- Remote Sensing & GIS Techniques- Its application in Environmental Monitoring

**BOOKS RECOMMENDED:**

1. Research Methodology By – Ranjit Kumar, Sage- Publications
2. Writing your Thesis By- Paul diver
3. Writing the winning Thesis or Dissertation, By- Allan Glathorn & R. Joyner.
4. Measurement Error & Research design , By- Madhu Viswanathan
5. Presentation skill, By- P. Maccarthy & C Hatcher
6. Presenting at Conferences Seminars & meetings, By – Kerry Shephard
7. Dawson, Catherine. (2002). Practical Research Methods: A user friendly guide to mastering research. Howtobooks
8. Kothari, C.R. (2004). Research Methodology: Methods and Techniques. New Age
9. Kumar, R. (2011). Research Methodology: A step-by-step guide for beginners. Sage.
10. Summer M, Englewood and Cliffs (1988). Computers: Concepts and Uses (2nd ed.). Prentice Hall Inc., New Jersey.
11. Doing your Masters Dissertation, By-Chris Hart
12. Your Research Project, By-S. Nicholas & R. William
13. Designing & Managing a research Project, y- M. J. Polonsky.
14. Blending qualitative & quantitative research methods in Thesis & Dissertation By – R. M. Thomas.
15. Instrumental Methods for Environmental Analysis, By – Karan Sareen
16. Lab. Manual of Chemical and Bact. (Analysing of Water and Sewage), By – F.J. Theroxy & W.L. Mall
17. Statistical Methods for Environmental & Agricultural Sciences, By – A. Reza Hoshmund

## ENS-612 RECENT ADVANCES ENVIRONMENTAL SCIENCE RESEARCH

Total Marks = 100 (Internal-40 + End Term-60)

Credit Hour =8

### UNIT I: Ecosystem Dynamics

Ecosystem Productivity (primary and secondary production, gross and net production, net community production); Biotic potential and survivorship curves; population growth forms, carrying capacity and environmental resistance, r and k selection, Prey predator relationships; Theories of ecological successions, climax community and types of climax; Basic concepts of Bio-capacity, Ecological Deficit and Ecological reserve, Ecological foot print, Carbon foot print;

### UNIT II: Oxidative stress and Anti-oxidative Defence system

Concept of oxidative stress; Generation of reactive oxygen species (ROS) in plants; Reactivity of ROS and oxidative damage ; Lipid per-oxidation and membrane permeability; cellular defence against oxidative stress: Role of anti-oxidative enzymes in oxidative stress , role of low molecular weight anti-oxidants in anti-oxidative defence.

### UNIT III: Floristic survey and Biodiversity Conservation

Basic Principles of International Code of Botanical Nomenclature (ICBN) for Algae, Fungi and Plants (ICN); Determination of types and typification; Principle of priority and its limitations; Nomenclature of Hybrids; Characters of taxonomic significance, Botanical keys; Identification of plants with the help of the flora book; Assessment of threatened, rare, vulnerable and endangered species; Flora of Odisha including mangroves and their associates; Field collection and preservation of specimens, Herbarium methodology.

### UNIT IV: Water Pollution Management

Basics of water sampling, Basic concepts on water quality analytical parameters (Physical, Chemical and Biological); Advanced water treatment processes (Ion exchange, Reverse Osmosis, Ozonisation, Carbon Adsorption, Membrane Processes, UV treatment etc.); Anaerobic digestion and sludge treatment: Anaerobic digestion, Microbiology of anaerobic digestion, Reactor configuration, Methane production, First stage treatment of sludge, Second stage treatment of sludge, Sludge disposal.

### UNIT V: Microbial Biotechnology for Environmental Applications

Evolution and microbial phylogenetic diversity, Microbes of extreme environment and their significance; Role of microbes in nutrient cycling and Bio-fertilizers, Plant Growth Promoting Rhizobacteria (PGPR); Biodegradation of Lignocelluloses, Chlorinated compounds, Petroleum hydrocarbons; Microbial carbon sequestration (Biocalcification, CO<sub>2</sub> sequestration by microalgae and cyanobacteria); Biofuel from microbes (Biodiesel, Biogas, Bioalcohol, Biohydrogen; Microbial fuel cell)

### Recommended Books

1. Plant physiology-by F.B Salisbury and C.W Ross, CBS publishers and Distributors, Delhi
2. Plant physiology- by Lincoln Taiz and Eduardo Zeiger ,Benjamin/Cummings publishing company Inc., California
3. Free radicals in biology and medicine –by B. Halliwell and J.M.C Guttetridge, Oxford University press, New York
4. Responses of plants to environmental stresses-by J. Levitt, Academic Press, New York
5. Environmental physiology of plants –by A. H Fitter and Robert K.M Hay, Academic Press , New York
6. Physiology of Abiotic stress in plants –by P. Dwivedi and R.S Dwivedi (Eds.), Agrobios (India) , Jodhpur
7. Industrial Effluents by Mani Vasakam, Shakti publ.
8. Industrial Pollution by VP Kudesia & RK Kudesia, Himalaya Publishing House
9. Introduction to Environmental Engineering and Science by Gilbert M. Masters, Pearson Education
10. Environmental Engineering and Safety by BK Nanda & T Biswal, BK publications
11. Environmental Engineering by SK Garg, Khanna Publ.
12. Mining Environment in India by SC Joshi et. al. Himalaya Research Publ.
13. Pollution Control and Management in Industries by Trivedi
14. A Textbook of Physical Chemistry, K L Kapoor, Volume I–IV, 3rd Edition, Macmillan, 2012.
15. Advanced Physical Chemistry, D.N. Bajpai, 2nd Edition, S. Chand & Sons, 2001.
16. Essential of Physical Chemistry, A. Bahl, B.S. Bahl, and G.D. Tuli, 19th Edition, S. Chand & Sons, 2012.
17. Microbiology by Lansing M Prescott, John P.Harley and Donald A. Klein, Mc Graw Hill publication.
18. Brock Biology of Microorganisms, by MT. Madigan et. al. Prentice Hall publication.
19. Soil Microbiology by NS Subba Rao, Oxford & IBH publ.
20. Gene cloning and DNA analysis: an introduction by T.A. Brown; Wiley-Blackwell publication.
21. Principles and techniques of Practical Biochemistry by Wilson and Walker, Cambridge Univ. Press



## **ENS 613: RESEARCH AND PUBLICATION ETHICS (RPE)**

Total Marks = 50 (Internal-20 + End Term-30)

Credit Hour =2

### **Unit I: Philosophy and Ethics (Theory) [4 Hours]**

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

### **Unit II: Scientific Conduct (Theory) [4 Hours]**

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

### **Unit III: Publication Ethics (Theory) [7 Hours]**

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

### **Unit IV: Open Access Publishing (Practice) [4 Hours]**

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.

### **Unit V: Publication Misconduct and Databases and Research Metrics (Practice) [11 Hours]**

#### **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 reference management software like Mendeley, Zotero etc. and anti-plagiarism software like Turnitin, Urkund

#### **C. Databases (4 hrs)**

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

#### **D. Research Metrics (3 hrs)**

1. Impact factor of journal as per Journal Citation Report, SNIP, SJR, IPP, CiteScore
2. Metrics: h-index, g-index, i-10 index, altmetrics

**Suggested Readings:**

Beall, J. (2012). Predatory publishers are corrupting open access. *Nature*, 489(7415), 179-179. <https://doi.org/10.1038/489179a>

Bird, A. (2006). *Philosophy of Science*. Routledge.

Chaddah, P. (2018). *Ethics in Competitive Research: Do not get Scooped; do not get Plagiarized*. ISBN: 978-938748086

Indian National Science Academy (INSA) (2019). *Ethics in Science Education, Research and Governance*. ISBN: 978-81-939482-1-7. [http://www.insaindia.res.in/pdf/Ethics\\_Book.pdf](http://www.insaindia.res.in/pdf/Ethics_Book.pdf)

MacIntyre, Alasdair (1967). *A Short History of Ethics*. London.

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.

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>

## **ENS-614 LABORATORY AND FIELD TECHNIQUES/PRACTICAL; AND COMPUTER APPLICATION**

Total Marks = 50

[End Term: Experiment 25 Marks + Computer Application 15 Marks + Practical Record 5 Marks  
+ Viva-Voce 5 Marks]

Credit Hour =2

Based on the compulsory and elective papers, the students have to carry out a series of practical experiments. The examination of the paper will be done at the end of second semester which will be combinedly evaluated by an internal examiner and an external examiner.

### **Computer Application in Research (15 Marks)**

Scope of computer and information technology in Research; Components of personal Computer - Input-Output Devices, CPU and other Hardware components; Software (Operating system software, application software); Preparation of line-graph, pie diagram, and histograms using MS Excel and Sigma-plot, Statistical analysis using MS Excel and sigma plot (correlation and regression analysis, comparison of data using ANOVA, t test).

### **List of Laboratory Experiments (25 Marks)**

1. Enumeration of bacteria in ambient air using Petri-air sampler
2. Enumeration of bacteria in Industrial effluent by Viable Plate Count Method
3. Morphological characterization of bacterial colonies isolated from waste water sample on nutrient agar plates.
4. Isolation of pure strain and calculation of its generation time by spectrophotometric method
5. Separation of Amino acids from Mixtures using paper chromatographic techniques.
6. Estimation of reducing sugars.
7. Estimation of soluble proteins.
8. Estimation of amino acids.
9. Estimation of total chlorophyll in etiolated and green seedlings.
10. Estimation of peroxidase activity in leaf tissues of different ages/in seedlings exposed to abiotic stress.
11. Isolation of bacterial DNA and performance of agrose gel electrophoresis.
12. Analysis of water samples (DO, BOD, Alkalinity, hardness) following standard methods
13. Analysis of soil samples (pH, Conductivity, texture, organic carbon content, bulk density, particle density, porosity, moisture content and degree of saturation) following standard methods
14. Analysis of Air quality (SO<sub>x</sub>, NO<sub>x</sub>, SPM/RSPM) using high volume air sampler.
15. Identification of earthworms (degrading and exotic varieties).
16. Estimation of glucose from the liver of bird.
17. Identification of monocot and dicot plants with the help of flora book

## **Semester II**

### **ENS-621 REVIEW WORK AND PROPOSAL PRESENTATION**

Total Marks = 50 (End Term: Presentation 10 + Report 30 + Viva-voce 10)  
Credit Hour =4

*At the beginning of second semester (i.e. within 4 weeks) the students will carry out an extensive literature review on a topic of their interest pertaining to the theme of specialization/ elective paper. They have to prepare a report following a standard format of report writing along with their proposal for Dissertation work. With regard to the proposal for Dissertation work, the students will select a topic for Dissertation work in consultation with teacher (i.e. Research Supervisor) assigned to him/her by the Department. The students will submit the proposal in form of a brief report narrating objective of the work, methodologies to be followed, expected outcome and relevance of the work. The report of the review work and proposal for Dissertation would be a combined one (i.e. in two parts: 1<sup>st</sup> part for Review work and 2<sup>nd</sup> part for Dissertation proposal) bearing one paper code and number, not separately. The students will have to give a presentation of this paper, the date of which will be decided by the teachers' council and notified by the Head of the Dept. and it will be evaluated by the Teachers' council of the Dept.*

### **ENS-622 PRESENTATION OF FINDING**

Total Marks = 50 (End Term: Presentation 10 + Report 30 + Viva-voce 10)  
Credit Hour =4

*The students will perform relevant literature review and carry out the Research Work and towards the end of the second semester will give a presentation, with a brief report giving emphasis on the findings only, which will be evaluated by the teachers of the Dept. The students will record due suggestions received during the presentation and will incorporate/rectify accordingly in their final Dissertation.*

### ***Paper III***

### **ENS-623 DISSERTATION SUBMISSION, PRESENTATION AND VIVA-VOCE**

Total Marks = 200 (End Term: Presentation 40 + Report 120 + Viva-voce 40)  
Credit Hour =16

*The students will compile their findings in the form of a thesis, giving due importance to the suggestions received during Pre- M.Phil. Presentation, which will be submitted to the Department. The thesis must be written following the standard format of thesis writing with proper reference citations. For evaluation, the student will present and defend his/her findings before a Board of Examiners constituting the respective Supervisor and one External Examiner. Basing on the thesis and performance in the presentation, the Board will award the mark.*