

# **Pre Ph. D. Course Work ENVIRONMENTAL SCIENCE**

## **SYLLABUS**

**(2019-2020)**



**P. G. DEPARTMENT OF ENVIRONMENTAL SCIENCE,  
FAKIR MOHAN UNIVERSITY, VYASA VIHAR  
BALASORE-756020  
ODISHA**

**Dept. of Environmental Science**  
**Pre Ph. D. Environmental Science**  
**COURSE STRUCTURE**

<b>Paper Code</b>	<b>Paper Name</b>	<b>Marks</b>	<b>Credit</b>
<b>Paper I (Compulsory)</b>			
ENS-711	Research Methodology & Computer Application	80+20	4
<b>Paper II (Elective: Students to opt one from the following elective papers)</b>			
ENS-712-A	Advances in Environmental Physiology	80+20	4
ENS-712-B	Pollution Ecology and Waste Management	80+20	4
ENS-712-C	Plant Taxonomy and Biodiversity Conservation	80+20	4
ENS-712-D	Water Pollution and Management	80+20	4
ENS-712-E	Microbial Biotechnology for Environmental Applications	80+20	4
<b>Paper III (Review paper)</b>			
ENS-713	Review work	100	4
Total		300	12

**Semester I**  
***Paper I (Compulsory)***

**ENS-711 RESEARCH METHODOLOGY & COMPUTER APPLICATION**

Total Marks = 100 (End Term-80 + Internal-20)

Credit Hour =4

**UNIT-I: Integrated Research Methodology and Writing of Research Report**

Research as a creative and strategic thinking process, Developing research aptitude, Literature survey, Challenge of writing up, Preparing the Research Proposals and starting to write, Skills and Tips for successful projects from start to finish, Writing for Journals and Edited Books, Journal impact factor, Citation Index; Presenting papers at Conferences (Poster and Oral Presentations), Thesis writing, Honesty and Research ethics, Plagiarism, IPR, Patenting.

**UNIT-II: Experimental Design, 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-III: 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;

**UNIT-IV: Computer Application in Research**

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); Use of scientific search engines and Databases; Use of power-point for preparation of a scientific presentation. 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 and f test).

**Paper II (Elective)**

**ENS-712-A ADVANCES IN ENVIRONMENTAL PHYSIOLOGY**

Total Marks = 100 (End Term-80 + Internal-20)

Credit Hour =4

**UNIT 1: Physiology of water stress**

Definition of stress; Causes of water stress and examples of stressful environment; Modification in plant to adapt water stress; Effects of water stress on growth and productivity in plants; Mechanisms of drought resistance; Decreased leaf area, leaf abscission, root extension, stomata closure and CAM metabolism, cellular osmotic adjustment, wax deposition; Gene action during water deficit, Water stress and ABA- regulated gene expression.

**UNIT 2: Physiology of salt stress**

Major salt affected areas of the world ; Manifestation of salt stress in plants: Effects of salt on plants and soil ; Physiology of salt tolerance; Strategies adopted by plants to avoid salt injury; Criteria for screening salt stress tolerance: morphological, physio- biochemical and molecular approaches; Management of salt affected areas for cultivation of crop plants.

**UNIT 3: Physiology of Heavy Metal stress**

Properties of heavy metals; Non-essential heavy metals and essential heavy metals ; sources in the environment and toxic effects of non-essential heavy metals (cadmium, chromium, mercury and lead); and essential heavy metals (zinc, copper, iron and manganese) in plants. Heavy metal tolerance in plants; Eco-friendly approaches for remediation of sites contaminated with heavy metals.

**UNIT 4: 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; Genetics of oxidative stress .

**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 Gutteridge, 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

***Paper II (Elective)***

**ENS-712-B POLLUTION ECOLOGY AND WASTE MANAGEMENT**

Total Marks = 100 (End Term-80 + Internal-20)

Credit Hour =4

**UNIT – I: Pollution of Atmosphere and Paedosphere**

Primary and Secondary Air Pollutants, their effect on Ecosystems. Eco friendly abatement of Air Pollution; Urban Heat Island; RSPM, SPM, Black Clouds, Threats from Global Implication of Aerosols, Meteorology of Air Pollution, Global Warming; Soil contamination by Synthetic Chemicals and their Remediation techniques, Landfills and their Environmental Impact.

**UNIT –II: Pollution of Lotic and Lentic Ecosystems**

Pollution of Lotic ecosystem due to discharge of waste water and Self Purification Strategy; Zones of Pollution in a Riverine Ecosystem; Pollution of Lentic ecosystems, cause and control and remedial measures; Surface Water Quality Standards, Eutrophication of water bodies, cause and control.

**UNIT – III: Biotechnology of Liquid Waste Management**

Cell Immobilization, Active Sludge process, Rotating Biological Contactors, Fluidised Bed Reactors, Bioremediation of Metal Chelation and Detoxification, Vermifiltration, Environmental Application of Biosensors, Bioremediation techniques and applications.

**UNIT – IV: Vermitechnology and Solid Waste Management**

Solid waste types, sources and generation; Solid waste pollution; Composition and Separation of Municipal Solid Wastes, Biomedical wastes; Biodegradable Industrial Wastes, Agricultural Wastes, Vermiculture, Vermicomposting, Eco friendly and Integrated Solid Waste Management.

***Paper II (Elective)***

**ENS-712-C PLANT TAXONOMY AND BIODIVERSITY CONSERVATION**

Total Marks = 100 (End Term-80 + Internal-20)

Credit Hour =4

**UNIT-I: Identification and Classification of plants**

Characters of taxonomic significance, morphological, anatomical, cytological, embryological, palynological and phytochemical data having taxonomical significance, Botanical keys, Identification of plants with the help of the flora book.

Different Systems of classification of plants: Artificial, Natural and Phylogenetic system of classification. Bentham and Hookers system of classification, Hutchinson's and Takhtajans system of classification.

**UNIT-II: Plant nomenclature**

Basic Principles of International Code of Botanical Nomenclature( ICBN), Determination of types and typification, Principle of priority and its limitations. Nomenclature of Hybrids.

### **UNIT -III: Floristic survey and Herbarium methodology**

Floristic survey: Field collection and preservation of specimens, phytography, 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  
Herbarium methodology, Role of Herbarium in Plant Taxonomy, Changing nature of herbarium, Preservation of specimens and maintenance, Important herbaria of the world.

### **UNIT -IV: Biodiversity Conservation**

Biodiversity hotspots, Factors causing loss of Biodiversity. Conservation of Biodiversity (In-situ and Ex-situ Conservation), Threatened, rare, vulnerable and endangered species. Sanctuaries, National parks and Biosphere reserves of India.

### ***Paper II (Elective)***

### **ENS-712-D WATER POLLUTION AND MANAGEMENT**

Total Marks = 100 (End Term-80 + Internal-20)

Credit Hour =4

#### **UNIT – I: Water Pollution**

Physicochemical properties of water; Sources of pollution (for surface water, ground water and marine water); Effects of water pollution on aquatic organisms and human health; Basic concepts on water quality analytical parameters (Physical: temperature, turbidity, colour, odor; Chemical: pH, DO, BOD, COD, TOC, O&G, conductivity, TS,TDS,TSS, hardness, alkalinity, mineral nutrients such as N, P, K, Ca, Mg, trace metals, pesticides; Bacteriological: fecal coliform, total coliform); Standards of water quality (US-EPA, CPCB and BIS guidelines); Basics of water sampling.

#### **UNIT – II: Waste water treatment process and Policies for Water Pollution Management**

Waste water treatment processes (Characteristics of domestic, industrial and municipal waste water, primary, secondary and tertiary treatment methods); Sludge digestion processes; Drinking water treatment processes (Ion exchange, Reverse Osmosis, Ozonisation, Carbon Adsorption, Membrane Processes, UV treatment and other advanced treatment methods); Genesis, powers and functions of Central and State pollution control boards; the Water (Prevention and control of pollution) Act 1974.

#### **UNIT - III: Industrial water pollution control and management**

Waste water from some typical industries, sources, characteristics, effect and treatment option: textiles, refinery, leather, foods, sugar, fermentation, paper and pulp, fertilizer, soap and detergents, electroplating and pharmaceuticals.

#### **Unit – IV: Industrial solid wastes pollution control and management**

Characteristics of solid wastes from food; fish processing unit; sugar industry; pulp and paper industries; coal based Thermal power plants, Aluminum industries; Hospital solid waste and Municipal solid waste collection; treatment; disposal and management of industrial Solid waste and related problems; Hazardous Waste Management & Handling rules-1989.

### **Books Recommended**

1. Industrial Effluents by Mani Vasakam, Shakti publ.
2. Industrial Pollution by VP Kudesia & RK Kudesia, Himalaya Publishing House
3. Introduction to Environmental Engineering and Science by Gilbert M. Masters, Pearson Education
4. Environmental Engineering and Safety by BK Nanda & T Biswal, BK publications
5. Environmental Engineering by SK Garg, Khanna Publ.
6. Mining Environment in India by SC Joshi et. al. Himalaya Research Publ.
7. Pollution Control and Management in Industries by Trivedi

### ***Paper II (Elective)***

#### **ENS-712-E MICROBIAL BIOTECHNOLOGY FOR ENVIRONMENTAL APPLICATIONS**

Total Marks = 100 (End Term-80 + Internal-20)

Credit Hour =4

#### **UNIT-I: Environmental Microbiology**

Evolution and microbial phylogenetic diversity, microbial adaptations to extreme environments (like arctic regions and hot springs), Geomicrobiology and role of microbes in nutrient cycling; Microbial metagenomics,

#### **UNIT-III: Microbial Technology for Pollution abatement**

Biodegradation of Lignocelluloses, Chlorinated compounds, Petroleum hydrocarbons; Microbial Bioleaching, Biosorption and Bioaccumulation; carbon sequestration (Biocalcification, CO<sub>2</sub> sequestration by microalgae and cyanobacteria);

#### **UNIT-IV: Microbial Technology for Agriculture and Energy Sector**

Development and utilization of Bio-fertilizers, Plant Growth Promoting Rhizobacteria (PGPR), Bio-pesticides; Biofuel from microbes: Biodiesel, Biogas, Bioalcohol, Biohydrogen; Microbial fuel cell

#### **UNIT-IV: Basic Tools and Techniques of Molecular Biology**

Isolation of DNA and Plasmids; Restriction Enzymes and their applications; Basic steps of Protein purification; Southern, Northern, Western Blotting; PCR, DGGE, TGGE.

### **BOOKS RECOMMENDED**

1. Microbiology by Lansing M Prescott, John P. Harley and Donald A. Klein, Mc Graw Hill publication.
2. Brock Biology of Microorganisms, by MT. Madigan et. al. Prentice Hall publication.
3. Soil Microbiology by NS Subba Rao, Oxford & IBH publ.
4. Gene cloning and DNA analysis: an introduction by T.A. Brown; Wiley-Blackwell publication.
5. Principles and techniques of Practical Biochemistry by Wilson and Walker, Cambridge Univ. Press

**Paper III (Review)**  
**ENS-713 REVIEW WORK**

Total Marks = 100

Credit Hour =4

*At the beginning of first semester (i.e. within 4 weeks) the students will select a topic of their interest pertaining to the theme of specialization/ elective paper in consultation with teacher (i.e. Research Supervisor) and will carry out an extensive literature review on it. They have to prepare a report following a standard format of report writing and will have to submit it in the Department. The students may 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.*

**GENERAL 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. Environmental Chemistry, By – I. Higin
8. Environmental Chemistry, By- B. K. Sharma
9. An Introduction to Air Pollution, By- R. K. Trivedy & P. K. Goel
10. Doing your Masters Dissertation, By-Chris Hart
11. Your Research Project, By-S. Nicholas & R. William
12. Designing & Managing a research Project, y- M. J. Polonsky.
13. Blending qualitative & quantitative research methods in Thesis & Dissertation By – R. M. Thomas.
14. Bio-renewable resources, By – Robert C. Brown
15. Ozone depletion & Environmental Impact, By – H. S. Sharma & T. I. Khan.
16. Green Technologies for Env'n. Management & Sustainable management By – Rajiv K. Sinha & Greneway, M, Pioneer publication.
17. Ground water Hydrology, By – D. K. Todd
18. Environmental Pollution, By-Anjali Gupta
19. Environmental Management, By – N. K. Uberoi
20. Environmental Accounting & Reporting, By A. K. Parmink
21. Intro. Env'n. Toxicology, By – W. Landis & M. Ho Yu
22. Water shade management, By – k. Palanisami, D. S. Kumar, B. Chandra Sekharan
23. Environmental management & Audit, By- P. Sasi B. Rao, P. M. Rao
24. Organic Farming for sustainable Agriculture, By – A. K. Dahawa
25. Fundamentals of Ecology, By – M. C. Dash
26. Fundamentals of Ecology, By – E. P. Odum
27. Technology of Water Management, By – R. A. Raju
28. Sewage Disposal & Air Pollution Engineering Vol. II, By – S. K. Garg