

## **SYLLABUS**

### **PRE- Ph. D. COURSE IN HIMALAYAN AQUATIC BIODIVERSITY**



**Department of Himalayan Aquatic Biodiversity**

**School of Life Sciences**

**HNB Garhwal University**

**(A Central University)**

**Srinagar (Garhwal), Uttarakhand**

### Structure of the Course Work;

The Course Work consists of the following:

1. Core Course
2. Elective Course

Total number of credit for the core and elective courses will be **15** with the following pattern

- (a) Core Course- 4 +2+01 credits (three courses) 7 credits  
(b) Elective Course – 4+4 credits (Two courses) 8 credits

Core course (Compulsory)		
Code	Course	(credit)
PHABC-01	RESEARCH METHODOLOGY	4
PHABC-02	REVIEW OF LITERATURE	01
PHABC-03	RESEARCH AND PUBLICATION ETHICS	02
Elective- Courses (Any Two)		
PHABE-04	POPULATION AND CONSERVATION BIOLOGY	04
PHABE -05	BIODIVERSITY AND BIOSYSTEMATICS	04
PHABE -06	APPLIED ANALYTICAL TECHNIQUES AND INSTRUMENTATION	04
PHABE -07	PERSPECTIVES IN BIODIVERSITY	04
PHABE -08	FRESHWATER BIOLOGY	04

### **Examination and Evaluation of the course- work**

(a) Evaluation shall be done on a continuous basis. For the purpose of uniformity, there will be two sessional tests and one End-semester examination. Sessional tests (of one hour's duration) may employ one or more assessment tools such as objective tests, assignments, paper presentation, laboratory work, etc suitable to the course.

(b) Students shall compulsorily attend the two sessional tests, failing which they will not be allowed to appear for the end semester examination. In case of students who could not attend any of the sessional tests due to medical reason or under extraordinary circumstances, a separate test shall be conducted before the End Semester Examinations with the permission of the Dean of the School on recommendation of the Head of the Department.

(c) The Sessional tests will carry 40% of total marks for the course. The marks of the two Sessional Tests shall be taken into account for the computation of Grades.

There shall be one End semester examination of 2 hours duration carrying 60% of Marks in each course covering the entire syllabus prescribed for the course at the end of the semester only. The End semester examination shall be normally a written /laboratory -based examination. The End semester examination and evaluation shall be conducted by the University.

(d) A candidate who has less than 75% attendance shall not be permitted to sit in examination however, it shall be open to the Dean to grant exemption to a candidate who has failed to obtain the prescribed 75% attendance for valid reasons on payment of prescribed fee and such exemptions shall not under any circumstances be granted for attendance below 65%.

(e) The Dean through the Head of the Department shall announce the names of all students who will not be eligible to take the examinations and send a copy of the same to the Registrar and Controller of Examination.

### **Marks and Grading of the course-work**

(a) A candidate has to secure a minimum of 50 percent of marks (Two Sessional Tests marks plus End-Semester examination mark) in the course taken together, to pass in that course. A candidate who has not secured a minimum of 50 percent of marks in a course shall be deemed to have failed in that course. A failed student shall be allowed to repeat the semester examinations for a maximum of three times and he/she has to pass the Pre Ph.D course before submission of the Ph.D. thesis. The Sessional Marks obtained by the student shall be carried over for declaring the result.

(b) The percentage of marks obtained by a student in a course will be indicated by a grade point and a letter grade. A Six (6) point scale shall be used for the evaluation of the performance of the student as given below:



MARKS	GRADE POINT	LETTER GRADE
75-100	5.50-6.00	O
65-74	4.50-5.49	A+
60-64	4.00-4.49	A
55-59	3.50-3.99	B+
50-54	3.00-3.49	B
Below 50 %	0.00-2.99	F

(c) The system of evaluation shall be transparent and students shall have the right to examine their marked answer scripts. The teacher of a course shall give the attendance and performance sheets for Sessional Test I and Sessional Test II to the Head of the Department, who in turn shall consolidate all such sheets and the same shall be forwarded to the Controller of Examinations through the Dean. The Controller of Examinations shall issue the Mark and the Grade Statements to the Students.

**UNIT-I** Research Formulation – Definition, scope and objective, types, approaches, significance; scientific investigation. The research process – The broad problem area, preliminary data collection, problem, selection and definition, theoretical framework, hypothesis development and elements of research design. Types of research: Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, and Conceptual vs. Empirical Experimental design – The laboratory experiment, variables, validity, Types of experimental Designs, Instrumental methods of Environmental analysis.

**UNIT-II** Data collection – Sources of data; data collection methods; Methods for selecting sampling locations and times; Simple random sampling, Stratified random sampling, Systematic sampling Processing and Analysis of Data.

**UNIT-III:** Measurement of central tendency (mean, median and mode), Measures of dispersion including Coefficients of variation, differences between standard, deviations, standard errors, covariance.

Normal distribution and its application, deviation from normality. Parametric vs. Nonparametric methods, skewness and kurtosis.

Correlation and Regression: Correlation analysis, Spearman's rank correlation and its applications. Regression, Differences between correlation and regression.

Test of significance: Students t distribution, test of significance of single mean, two means (2t) and paired t test, Z test, Chi square test, goodness of fit, F test and ANOVA, one way and Two way ANOVA.

**UNIT-IV Presenting and Publishing paper:** Format, choosing Journal, Title, Running Title, Writing Abstract, Keywords, Introduction section, Materials and Methods selection, Result section, Figures, tables, graphs, Discussion Section, References, Preparing posters for scientific presentation, Preparing and delivering of oral presentation, Research Grant Funding Agencies,

**UNIT-V** Technical writing and Report Generation: Basic concept of paper/thesis writing, Ethical issues, Copy right, Intellectual property rights and patent law – Trade Related aspects of Intellectual Property Rights – Reproduction of published material – Plagiarism; Citation and acknowledgement.

#### References :

1. Kothari, C.R (2009) Research Methodology and Techniques, Delhi: New Age international Publisher.
2. Donald H.McBurney(2006) Research Methods, 5th Edition, Thomson Learning.
3. Donald R. Cooper, Pamela S. Schindler (2006) Business Research Methods, 8/e, Tata McGraw-Hill Co.Ltd.
4. P. Oliver,(2004) Writing Your Thesis, New Delhi: Vistaar Publications,.
5. Gregory(2005) Ethics in Research, Continuum, 2005.
6. Malkote, S.R. (1991), Communication for Development, New Delhi: Sage Publication.

As per the academic ordinances relating to the Ph.D. course work, paper-II shall comprise of content of the topic of his/her research. The following shall be the course contents of this paper.

1. The candidate shall be required to write a critical review on his/her assigned subject of research.
2. The candidate shall present seminar on a research theme related topic before the committee.



**Course Title:**

- **Research and Publication Ethics (RPE)**-Course for awareness about the publication ethics and publication misconducts.

**Course Level:**

- 2 Credit course (30 hrs.)

**Eligibility:**

- M.Phil., Ph.D. students and interested faculty members (It will be made available to post graduate students at later date)

**Fees:**

- As per University Rules

**Faculty:**

- Interdisciplinary Studies

**Qualifications of faculty members of the course:**

- Ph.D. in relevant subject areas having more than 10 years' of teaching experience

**About the course**

**Course Code: CPE- RPE**

**Overview**

- This course has total 6 units focusing on basics of philosophy of science and ethics, research integrity, publication ethics. Hands-on-sessions are designed to identify research misconduct and predatory publications. Indexing and citation databases, open access publications, research metrics (citations, h-index, Impact Factor, etc.) and plagiarism tools will be introduced in this course.

**Pedagogy:**

- Class room teaching, guest lectures, group discussions, and practical sessions.

**Evaluation**

- Continuous assessment will be done through tutorials, assignments, quizzes, and group discussions. Weightage will be given for active participation. Final written examination will be conducted at the end of the course.

## Course structure

- The course comprises of six modules listed in table below. Each module has 4-5 units.

Modules	Unit title	Teaching hours
<b>Theory</b>		
RPE 01	Philosophy and Ethics	4
RPE 02	Scientific Conduct	4
RPE 03	Publication Ethics	7
<b>Practice</b>		
RPE 04	Open Access Publishing	4
RPE 05	Publication Misconduct	4
RPE 06	Databases and Research Metrics	7
	<b>Total</b>	<b>30</b>

## Syllabus in detail

### THEORY

- RPE 01: PHILOSOPHY AND ETHICS (3 hrs.)**
  - Introduction to philosophy: definition, nature and scope, concept, branches
  - Ethics: definition, moral philosophy, nature of moral judgements and reactions
- RPE 02: SCIENTIFIC CONDUCT (5hrs.)**
  - 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
- RPE 03: PUBLICATION ETHICS (7 hrs.)**
  - Publication ethics: definition, introduction and importance
  - Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
  - Conflicts of interest
  - Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
  - Violation of publication ethics, authorship and contributorship
  - Identification of publication misconduct, complaints and appeals
  - Predatory publishers and journals

### PRACTICE

- RPE 04: OPEN ACCESS PUBLISHING(4 hrs.)**
  - 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
4. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

• **RPE 05: PUBLICATION MISCONDUCT (4hrs.)**

**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 (7hrs.)**

**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

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**Unit -I** Concept of community. Physical characteristics of community, Animal-habitat interactions. Effects of Inter and intra-specific competition, mechanism of competition within community; exclusion and co-existence. Concept of the niche; introduction and definition of niche, parameters of niche and factors affecting it. Niche separation and overlap. Measures of niche width.

**Unit-II** Population, its definition and concept, importance of population in wildlife studies, population attributes and their analysis, life tables; definition, construction and importance in wildlife management, concept of growth rate, exponential and logistic growth rates.

**Unit-III** Population regulation, density independent and density dependent population regulation, predator prey models, concept of carrying capacity, r and k selection theory. Animal movement, concept of home range and territory. Theories of population dispersal.

**Unit-IV** Definition of conservation biology; minimum viable populations, inbreeding and outbreeding depression, population vulnerability analysis and its components. Stochastic and deterministic extinction process, demographic, genetic and environmental stochastic ties.

**Unit-V** Inbreeding in natural populations of birds and mammals, heterozygosis, and fitness in natural populations. Co-adaptation and out-breeding depression, concept of diversity, rarity, endemism, impact of habitat fragmentation on diversity.

**Suggested Readings:**

1. Population Ecology: A unified study of Animals and Plants by M. Begon.
2. Population Ecology: Begon and Mortinur
3. Ecology of Populations by Boughy and S. Arthur
4. Viable Population for Conservation by Michael E. Soule
5. Ecology of Populations by Arthur S. and Boughey
6. An Introduction to Plant Population Ecology by J. Silvertown
7. Guide to the Study of Animal Population by J. T. Tanner
8. An Introduction to the Study of Animal Population by H. G. Andrewartha
9. Population Growth Estimation by E. S. Marks



**UNIT-I** Introduction to biodiversity: Definition, components, scope, and constraints of biodiversity (genetic diversity, species diversity, ecosystem diversity – agro-biodiversity, urban – peri-urban biodiversity), forest biodiversity; biodiversity indices, threats to biodiversity.

**UNIT-II** Plant and animal taxonomy and systematics: Brief history and definition, the importance of taxonomy in Natural Resource Management, national and international organizations associated with taxonomic studies.

**UNIT-III** Theory and practice of biological classification: Definition and problems of the species concept, intraspecific categories, super species, population structure and taxonomic challenges, phenetic, cladistic and evolutionary concepts involved in nomenclature, taxonomic hierarchy.

**UNIT-IV** Reference collections: Importance and all biological studies, collection methods, methods of specimen preservation and storage, identification and annotation histories, The International Rules of the Botanical and Zoological Nomenclature, the biosystematics and its future directions. Biodiversity Conservation – Approaches: Landscape approach to biodiversity conservation, Corridor approach, individual species approach, habitat conservation approaches, National Biodiversity Strategy and Action Plan.

**UNIT V** Taxonomic v/s taxic diversity, weighting schemes of taxic diversity, species centric v/s rank based indices. Ecological uses of biodiversity, relation with stability, productivity and invasibility of ecosystem. Invasive species and the factors of their success, elements of landscape ecology, indices of diversity, core and edge species, rare and generalist species, effect of patch shape on diversity, perimeter area ratio effects. Biodiversity as a resource for human welfare, conservation status of habitat and species, conservation efforts, important conventions and treaties.

**Recommended Books:**

1. Krishnamurthy, K.V. 2003. Textbook of Biodiversity. Science Publications.

2. Primack, R.2006.Essentials of Conservation Biology. Sinauer associates, Inc., USA

Reference Book: 1. Judd, W.S., C.S. Campbell, E.A. Kellogg, P.A. Stevens and M.C. Donoghue. 2008. Plant Systematics: A Phylogenetic Approach, 3rd edition. Sinauer.

2. Simpson, G.G. 1962. Principles of Animal Taxonomy. Oxford.

3. Mayr, E and P.D. Ashlock. 1991. Principles of Systematic Zoology. MacGraw-Hill.

4. Narendran, T.C. 2006.An Introduction to Taxonomy.Zoological Survey of India, Kolkata.



UNIT-I Microscopy : Introduction , Microscopes, Types Of Microscope : Optical Microscope- Simple And Compound Microscope, Electron Microscope – Scanning Electron Microscope (SEM) And Transmission Electron Microscope(TEM), Scanning Probe Microscope- Atomic Force Microscope(AFM) Scanning Tunnelling Microscope(STM), Near Field Scanning Optical Microscope(SNOM).

UNIT-II Chromatography: General Description, Definition, Terms And Parameter Used In Chromatography, Classification Of Chromatographic Methods and Criteria For Selection Of Stationary And Mobile Phase Nature Of Adsorbents, Rate Theory, And Band Broadening: Eddy Diffusion, Methodology For Selection Of Stationary Phase. Gas Liquid Chromatography (GLC), Thin Layer Chromatography (TLC), High Pressure Liquid Chromatography (HPLC), Paper Chromatography.

UNIT-III Fundamentals Of Photometry, Electro Analytical And Seperative Methods, Laws Governing Photometry, Flame Photometry; Principle, Construction Details, Fuel Gases, Atomiser, Burner, Optical System, Recording System.

UNIT-IV Spectroscopy, Atomic Absorption Spectrophotometer(AAS); Theoretical Concepts, Instrumentation, Hollow Cathode Lamps, Burners And Flames, Plasma Excitation Sources, Optical And Electronic Systems, Ultraviolet Visible Spectrophotometry(UV-VIS), Inductive Coupled Plasma Mass Spectrometry(ICP-MS), Gas Chromatography Mass Spectrometry(GC-MS), Coupled Plasma Atomic Emission Spectroscopy(TCP-AES), Fourier-Transform Infrared Spectroscopy(FTIR), Colorimeter.

UNIT-V Principle, Methodology and Applications: Electrophoresis, Polymerase Chain Reaction (PCR), Real time PCR

#### Books

1. D.A. Skoog,(2000), Principles of Instrumental analysis, fifth edition , Saunders college publication
2. D.H.Williams and J.Fleming(1995), Spectroscopic methods onn organic chemistry, Sixth edition , McGrawHill
3. B.K. Sharma (2007), Instrumental methods of chemical analysis, Krishna prakash media
4. J.Willard(1999), Instrumental methods of analysis, seventh edition , CBS publishers

Unit I. Concept of biosphere and biodiversity, relation between biodiversity, biogeography, physiography and stratigraphy. A review of the theories of continental drift and plate tectonics, glaciations of the geological past and effects on the living world. The phytogeographic provinces and districts of the world.

Unit II. Biodiversity through time, major events in the evolution of living beings through the geological past, rates of diversification and phylogenetic splitting, geological and ecological causes of extinction, lifespan of species, background rates and mass extinctions, current extinction rates, causes and consequences, differential extinction rates in taxonomic groups, mass extinctions, evolutionary causes and significance of endemism.

Unit III. Within-habitat (alpha) level, species counts, species richness and species heterogeneity, probability theory and entropy theory based indices of species heterogeneity, equitability and evenness of distribution, SHE analysis. Relative density, frequency, abundance and dominance of species in community. Ranked abundance and importance value. Concepts and models of dominance diversity relationship, methods of fitting data to various models.

Unit IV. Between-habitat directionless beta diversity (heterogeneity) of habitats, directional (turnover) diversity through gradients of time (diachronic) and space (synchronic). Changes in species and composition along altitudinal and depth gradients of terrestrial and aquatic habitat, comparative study, indices after Jaccard, Sorensen, Whittaker, Cody, Wilson and Schmida, Colwell and Coddington.

Unit V. Landscape (gamma) level, exhaustive species count, the use of models of species area relationships in estimating landscape level diversity, scale dependence, homogenization and SAR curves. The evolutionary (historical) causes of biodiversity in specific areas. Concept and significance of functional and taxonomic diversity of habitats and landscapes, species-specific and community-specific indices of diversity.

#### References:

1. Dombois, D.M & Ellenberg, H. (1974). Aims and methods of vegetation ecology. John Wiley and Sons Inc, New York.
2. Gaston, K.J & Blackburn, M.J. (2000). Pattern and Process in Macroecology. Blackwell Sciences Limited, Oxford, UK.
3. Gaston, K.J. and Spicer J.I. (2004). Biodiversity: An Introduction. 2nd Edition. Blackwell Science Limited, U.S.A.
4. Hubbel, S.P. (2001). The unified neutral theory of biodiversity and biogeography. Princeton University Press, Princeton NJ.
5. Huston, M.A. (1994). Biological Diversity. Cambridge University Press, Cambridge, U.K.
6. Ludwig, J.A. and Reynolds J.F. (1988). Statistical Ecology: A primer on methods and computing. John Wiley & Sons, New York.



Unit-I

Freshwater Ecosystems, Brief description of freshwater resources of India, types of fresh water habitats and their zonation.

Unit-II

Introduction to Plankton (Zooplankton, Phytoplankton and Microplankton). Taxonomic classification of plankton in freshwater systems. General characters and species composition of major plankton. Qualitative and quantitative analyses of plankton and their periodicities. Phyto- and zooplankton relationships; importance of plankton in food chain of aquatic systems. Interactions of plankton with other organisms. Economic importance of diatoms.

Unit-III

Introduction to aquatic bacteria and fungi, general characteristics and classification of freshwater bacteria and fungi; type study of a bacteria (*Aeromonas*) and a fungi (*Saprolegina*), isolation and culture techniques, economic importance of bacteria and fungi and their role in fresh water ecosystems

Unit-IV

Classification and species composition of various freshwater invertebrates, influence of environmental factors on the abundance and distribution of benthic organisms, role of macro fauna in the aquatic ecosystem.

Unit-V

Introduction to macrophytes, characteristics, classification of common macrophytes, methods of identification and preservation; qualitative and quantitative analyses (quadrate, plotless and Bitterlich); concept of cover, abundance and productivity; influence of vegetation on aquatic biota; brief account of vegetation of saline and marshy areas; economic importance of macrophytes, control measures of aquatic weeds in ponds, lakes and reservoirs.

References:

- Pennak R.W. (1989). Freshwater Invertebrates of United States: Protozoa to Mollusca. Chapman and Hall Inc. New York.
- Caffrey J.M. and Dutartre, A. (2006). Macrophytes in Aquatic Ecosystem: from Biology to Management. Springer, USA.
- Pelczar, M.J. (1993). Microbiology: Application Based Approach. McGraw Hill, New York.
- Harris, G. (1986). Phytoplankton Ecology: Structure, Function and Fluctuation. Chapman & Hall, USA.