MSc in WILDLIFE AND BIODIVERSITY CONSERVATION (2025-2026 onwards)

Semester Pattern Examination
Choice Based Credit System (CBCS)

MAHARAJA SRIRAM CHANDRA BHANJA DEOUNIVERSITY (ERSTWHILE NORTH ORISSA UNIVERSITY)
SRIRAM CHANDRA VIHAR, TAKATPUR
BARIPADA-757003

P. G. Department of Wildlife & Biodiversity Conservation
Maharaja Sriram Chandra Bhanja Deo University (Erstwhile North Orissa University), Takatpur, Baripada-757003

M.Sc. WLBC Course structure under CBCS
(For the Academic Session 2025-26 onwards)

The entire PG syllabus of Wildlife & Biodiversity Conservation is spread over in four semesters consisting of 100 credits. The Department offers one open elective in Semester-II for the students other than department of Wildlife & Biodiversity Conservation of the University.

Semester	Paper Code	Paper Title	Credit	Full Mark	Internal Assessment	End Sem Exam
I	WLBC 101	Wildlife and Taxonomy	5	100	40	60
	WLBC 102	Ecology	5	100	40	60
	WLBC 103	Applied Wildlife	5	100	40	60
	WLBC 104	Biostatistics	5	100	40	60
	WLBC 105	Field and laboratory practical	5	100	30	70
	WLBC 106	Indian Knowledge System	2	50	20	30
	WLBC 107	Life Skills		50	20	30
	Total		**27**	**600**	**230**	**370**
II	WLBC 201	Biodiversity Conservation	5	100	40	60
	WLBC 202	Wildlife Management	5	100	40	60
	WLBC 203	Wildlife Health	5	100	40	60
	WLBC 204	Biogeography	5	100	40	60
	WLBC 205	Field and laboratory practical	5	100	30	70
	WLBC 206 Open Elective	Natural Resource Management	5	100	40	60
	Total		**30**	**600**	**230**	**370**
III	WLBC 301	Techniques in wildlife	5	100	40	60
	WLBC 302	Evolutionary Ecology	5	100	40	60
	WLBC 303	Animal Behaviour	5	100	40	60
	WLBC 304	Field and laboratory practical	5	100	30	70
	WLBC 305	SWAYAM MOOCS	3	100	40	60
	Total		**23**	**500**	**190**	**310**
IV	WLBC 401	Global Climate Change	5	100	40	60
	WLBC 402	Solid Waste Management	5	100	40	60
	WLBC 403	Field and laboratory practical	5	100	30	70
	WLBC 404	Dissertation Project	5	100	40	60
			20	**400**	**150**	**250**
	Grand Total		**100**	**2100**	**800**	**1300**

Course Outcomes

The goal of the course is to teach a critical and conceptual knowledge ofbiodiversity and wildlife in the context of natural landscape exploration, ecosystemdynamics, ecosystem functioning, and ecosystem service provision. The course designalso addresses the indiscriminate use of natural resources, particularly floral and faunalresources, as well as the diminishing of wild animal natural habitats. It is feasible tomanage the depletion of valuable resources at this time by increasing the knowledgebase of the students about the importance of diverse kinds of plant and animalpopulations, as well as the rules and regulations available to conserve them in theirnatural habitat. More specifically this course focuses on the fundamental principles,concepts and abilities associated with plant and animal conservation and management.Implementing habitat management strategies, identifying animal conflicts, and takingpart in personal and community leadership development activities and planning are allpart of this. Science and management views will be discussed in the context ofhistorical, current, and future initiatives aimed at preserving biological diversity. Thecourse work will also be guided by work on scientific papers and field experience.

Course Specific Outcomes

M. Sc. Degree in Wildlife and Biodiversity Conservation of this University has the following specific outcome:

1. Prepare students to have a good understanding of cellular and organism-level plantand animal structures, taxonomy and metabolic processes.
2. Equip students to identify plant vegetative and floral structures and be able toidentify native and non-native herbaceous and woody plants.
3. Enhance understanding of students on the general principles of ecology as how itrelated to terrestrial and aquatic plant and animal conservation and management.
4. Enhance the ability of students to identify species, characteristics, habitatrequirements and life cycles of birds, fish and mammalian wildlife species.
5. Impart field based training to students how it will be applicable to solve problemsrelated to wildlife conservation and management.
6. Students will be equipped with knowledge on wildlife conservation and management relates to the economy and environment, both currently and in the future.
7. Students will be able to critically evaluate current events and public informationrelated to wildlife conservation and management as being scientifically based oropinion based and contributes to the knowledge base of information.
8. Encourage the students to carry out the research works in frontier areas of Wildlife and Biodiversity Conservation.

Assignment/Seminar	**:10 Marks**
Quiz	**:10 Marks**
Mid Term	**:20 Marks**
End Term	**:60 Marks**

SEMESTER-I

WBLC 101Wildlife and Taxonomy (Credit: 05)

COURSE OUTCOME: To gain basic knowledge regarding the importance and scope of wildlife and study about the techniques used for identifying organisms. The students will gain fundamental knowledge regarding the phytogenic relationship between different taxonomic groups. The importance of microbes and their classification.

UNIT 1

Definition and basic concepts of wildlife, Scope of wildlife, importance of wildlife,Values of wildlife: Positive values (recreational, aesthetic, educational, scientific,ecological, utilitarian, commercial, cultural and game value) and negative values (accidents, life stock and cropdamage, disease reservoirs); measurement and attitudesurvey of wildlife values.

UNIT II

Stages and importance of taxonomy, Newer trends in Taxonomy: Morphological approach, Numerical taxonomy, Embryological approach, Ecological approach, Behavioural approach, Cytological approach, Biochemical approach & Molecular approach, DNA Barcode, Phylocode.

UNIT III

Concept of species, and their criticism, sub-species, Nomenclature and Types (Holotype, Paratype, Neotype, Syntype, Lectotype, Lectoparatype, Isotype, Topotype, Allotype), Basic idea about the The International Code of Nomenclature for algae, fungi, and plants (ICBN) & Zoological Nomenclature (ICZN).

UNIT IV

Zoological Classification, Kinds of Classification (Phenetic, Natural, Phylogenetic, Evolutionary, Omnispective), Future of classification, Components of classification, Classification of Protozoans, Invertebrates & Vertebrates (General characteristics of cach Phylum, Classes and Orders).

UNIT V

Classification and diversity of Bacteria, Archea, alga and fungi (major classes), Application of genetics for wildlife conservation; Genotyping; characterizing genetic difference between populations, importance of genetic diversity, Loss of genetic diversity, Resolving taxonomic uncertainties. Molecular approaches to microbial taxonomy and phylogeny.

Suggested reading:

- E.O. Wilson. Biodiversity, Academic Press, Washington.
- G.G. Simpson. Principle of animal taxonomy, Oxford IBH Publishing Company.
- R. L. Kotpal. A Text Book Of Zoology: Invertibrates
- R. L. Kotpal. Modern Text Book Of Zoology: Vertibrates
- E.O. Wilson. The Diversity of Life (The College Edition), W.W. Northem& Co.
- V. C. Kapoor. Theory and Practice of Animal Taxonomy and Biodiversity.

Assignment/Seminar	**:10 Marks**
Quiz	**:10 Marks**
Mid Term	**:20 Marks**
End Term	**:60 Marks**

SEMESTER-I
WBLC 102: Ecology (Credit: 05)

COURSE OUTCOME: Students will acquire a theoretical understanding of population and community ecology to apply in the current issues in ecology and critically evaluate the value of long-term studies of populations and communities

UNIT I

Definition, Principle, Scope and history of Ecology, Basic Concepts of Structure and Function of Ecosystems. Concepts of food chain, food web and trophic levels, Ecological Pyramids. Concept of Productivity, Energy Flow models

UNIT II

Population Ecology: Population characteristics, Structure and Population growth pattern: exponential and logistic Survivorship Curve, Life-history Strategies and environmental resistance. Carrying Capacity, r and K selection.

UNIT III

Interactions between Populations: Types of Interactions, Intra-species Interactions and Interspecies relations (Concepts of Neutralism, Mutualism, Commensalism, Amensalism, Parasitism, Predation, Competition).

UNIT IV

Community Ecology: Community assembly: Habitat and Niche, Species coexistence, Gause's competitive exclusion principle. Concept of keystone Species, Fundamental and Realised Niche, Resource partitioning, Character Displacement.

UNIT V

Terrestrial and Aquatic Communities: Terrestrial Communities-Deserts, Grasslands, Forests: Tundras, Tropical rain forests, tropical moist deciduous forests, Tropical dry deciduous forest, tropical semi-evergreen forests, Temperate forests; Freshwater ecosystems (Classification, Types of Communities: Lotic and Lentic with examples); Marine ecosystems (Classification, Types of Communities); Estuarine ecosystems (Classification, Types of Communities).

Suggested Readings:

- Odum, E. and Barett, G. (2005). *Fundamentals of Ecology*. Thomson Brooks/Cole
- Case, T. J. (1999). Illustrated guide to theoretical ecology. *Ecology*, *80*(8), 2848-2848.
- Miller, G. T., &Spoolman, S. (2014). *Essentials of ecology*. Cengage Learning.
- Molles, M. (2015). *Ecology: concepts and applications*. McGraw-Hill Education.
- Begon, M., & Townsend, C. R. (2020). *Ecology: from individuals to ecosystems*. John Wiley & Sons.

Assignment/Seminar	**:10 Marks**
Quiz	**:10 Marks**
Mid Term	**:20 Marks**
End Term	**:60 Marks**

SEMESTER-I

WBLC 103: Applied Wildlife (Credit: 05)

COURSE OUTCOME: The students will be able to compare the structure and function of cells. Describe the chemical basis of life including the importance of water, gases and macromolecules, Explain energy movement, enzyme structure and function, respiration and photosynthesis. Illustrate DNA structure and replication, protein synthesis, mutations and genetic analysis.

UNIT I

Prokaryotic and eukaryotic cells; Structural organization and function of intracellular organelles: nucleus, Mitochondria, Golgi bodies, lysosomes, Endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton.

UNIT II

Introduction to Biomolecules: Structure, types, properties and function of carbohydrates, proteins, Lipids and Nucleic acids. DNA as genetic material.

UNIT III

Structure of genes and chromosomes; Replication, transcription, translation and their regulatory mechanisms; splicing and its mechanism.

UNIT IV

Regulation of gene expression; Mutations and mutagenesis; DNA damage and repair mechanisms.

UNIT V

Restriction and modification enzymes; Vectors-plasmids, bacteriophage and cosmids; Expression vectors; genomic DNA library; Gene isolation and cloning, strategies for production of recombinant proteins.

Suggested reading:

- Karp, Gerald. *Cell and molecular biology: concepts and experiments*. John Wiley & Sons, 2009.
- Cooper, Geoffrey M., Robert E. Hausman, and Robert E. Hausman. *The cell: a molecular approach*. Vol. 4. Washington, DC, USA: ASM press, 2007.
- Khanna, Pragya. *Cell and molecular biology*. IK International Pvt Ltd, 2013.
- Flotte, Terence R., and Kenneth I. Berns, eds. *Laboratory techniques in biochemistry and molecular biology*. Vol. 31. Elsevier, 1969.
- Lodish, H., Berk, A., Kaiser, C.A., Kaiser, C., Krieger, M., Scott, M.P., Bretscher, A., Ploegh, H. and Matsudaira, P., 2008. *Molecular cell biology*. Macmillan.
- Elliott, William H., Daphne C. Elliott, and John R. Jefferson. *Biochemistry and molecular biology*. Vol. 2001. Oxford: Oxford University Press, 1997.

Assignment/Seminar	**:10 Marks**
Quiz	**:10 Marks**
Mid Term	**:20 Marks**
End Term	**:60 Marks**

SEMESTER-I

WBLC 104: Biostatistics (Credit: 05)

COURSE OUTCOME: The student will be able to restate the principal concepts about biostatistics, collect data relating to variable/variables which will be examined and calculate descriptive statistics from these data, identify data relating to variable/variables, identify convenient sample by using sampling theory, identify distribution form relating to the variable/variables and will be able to apply hypothesis testing via some of the statistical distributions.

UNIT I

Basic introduction to Statistics, terms used in sampling; methods of collection biological data; Sampling, techniques- random sampling and non-random sampling. Classification of data- primary and secondary data. Graphical representation of data- bar diagram, pie diagram, histogram, Ogive. Measures of central tendancy- Mean, Median, Mode.

UNIT II

Measures of Dispersion, Skewness and Kurtosis: hypothesis and procedure for testing hypothesis. Range, Mean deviation, standard deviation and coefficient of variation, Skewness (positive and negative), Karlpearson's measures of skewness, Coefficients of Skewness, Kurtosis (Mesokurtic, Leptokurtic and Platykurtic).

UNIT III

Test of significance based on small samples and large samples ('t' test and 'z' test), Chi-square test, Analysis of variance- One-way and Two-way ANOVA.

UNIT IV

Correlation and regression: Use of correlation in biological science – purpose, positive correlation, negative correlation, calculating correlation coefficient, significance. Use of Regression in Biological Sciences – purpose, coefficient of regression (b), Regression line (Y on X and X on Y). Principal Component analysis.

UNIT V

Probability and Distribution: Axiomatic definition of probability and properties, conditional probability, Multiplication rule, Bayes' theorem and independence of events. Generalized Linear Models (Normal, Binomial, Poison and Gamma).

Suggested reading:

- Gerstman, B. Burt. *Basic biostatistics*. Jones & Bartlett Learning, LLC, 2014.
- Pagano, M., Gauvreau, K., & Mattie, H. (2022). Principles of biostatistics.
- Antonisamy, Belavendra, Prasanna S. Premkumar, and Solomon Christopher. *Principles and Practice of Biostatistics-E-book*. Elsevier Health Sciences, 2017.
- J. H. Zar (1999). Biostatistical analysis. Pearson Education India.
- Norman, Geoffrey R., and David L. Streiner. *Biostatistics: the bare essentials*. PMPH USA (BC Decker), 2008.

Internal Assessment: 30 Marks
End Term : 70 Marks

SEMESTER I

WLBC 105: FIELD AND LABORATORY PRCATICAL

(Credit: 05)

I. Major experiment **(30 Marks)**

a. Determine the required size of quadrat to study the vegetation by species area curve method.
b. Forest biomass calculation by allometric method
c. Determination of carbon stock of woody plant species.
d. Student's t-test for comparing the means of two samples.
e. Chi-square test
f. Data analysis in excel, PAST and in R program (Measures of central tendency)

II. Minor Experiment **(20 Marks)**

a. Preparation of solutions for molecular biology experiment(s).
b. Estimation of protein
c. Morphological measurements and analysis of plants and animals
d. Estimating the species diversity of plants of animals of campus
e. Downloading genetic dataset from GenBank
f. Gene Blast and species identification using genes
g. Estimating genetic distance
h. Phylogenetic tree building

III. Spotting and identification **(20 Marks)**

a. Study and identification of museum specimens (Pisces, amphibians, reptiles)

b. Study of dry skeleton (dis-articulated bones of reptiles, birds and mammals)

IV. Seminar **(10 marks)**

V. **Field study and report** **(10 Marks)**

VI. Lab Record and Viva **(10 Marks)**

Mid Term	**:20 Marks**
End Term	**:30 Marks**

SEMESTER-I
WBLC 106: INDIAN KNOWLEDGE SYSTEM(Credit: 02)

Course Outcomes

To equip students with the concepts of Indian traditional knowledge and nature-based solutions, enabling them to understand the significance of the Indian knowledge system's foundations and the role of nature-based solutions in ensuring future sustainability.

Unit I

Introduction to Indian Knowledge System (IKS), Definition, Concept and Scope of IKS

Unit II

Historical context of Traditional Ecological Knowledge (TEK), characteristics, scope and importance of TEK, community based TEK and its origin, Benefits of TEK.

Unit III

Role of Traditional Ecological Knowledge (TEK) in Biodiversity Conservation and economic Stability, in ethnomedicine; in ecosystem rehabilitation /management; TEK in nutrition with proper case studies and examples.

Unit IV

Basic concept of Nature based Solution (NbS), Nature based solutions and local communities, Role of NbS in sustainable development.

Unit V

Protection, preservation, conservation and Management of Indian Knowledge System: Documentation and Preservation of IKS: concept of Traditional Knowledge Digital Library (TKDL).

Reference

1. Amit Jha, 2009. Traditional Knowledge System in India
2. Mohanta, B. K.,and V. K. Singh (2012).Traditional Knowledge System and Technology in India, Pratibha Prakashan.
3. Kapil Kapoor, Avadesh Kumar Singh, (2005). Knowledge Traditions and Practices of India, Vol. 1, , DK Print World (P) Ltd., ISBN 81-246-0334
4. Mahadevan, B., & Bhat, V. R. (2022). Introduction to Indian knowledge system: concepts and applications.
5. Brears, R. C. (2020). Nature-based solutions to 21st century challenges. Routledge.
6. Kabisch, N., Korn, H., Stadler, J., & Bonn, A. (2017). Nature-based solutions to climate change adaptation in urban areas: Linkages between science, policy and practice. Springer Nature.

Assignment/Seminar	**:10 Marks**
Quiz	**:10 Marks**
Mid Term	**:20 Marks**
End Term	**:60 Marks**

SEMESTER II

WLBC 201: Biodiversity Conservation (Credit: 05)

COURSE OUTCOME: Students will get to know about the applied aspects of the ecology and biodiversity and will know about conservation aspects and strategies along with their legal issues.

UNIT I

Biodiversity Concepts and introduction to different scales of biodiversity (genetic diversity, species diversity, ecosystem diversity). Biodiversity hotspots with special reference to biodiversity hotspots in India. Importance of biodiversity in the living world. Why tropics are so biodiverse?

UNIT II

Biodiversity: Measurement of Biodiversity: Concepts of Species richness, Species evenness, Species Diversity, Diversity Indices. Importance of biodiversity indices.

UNIT III

Valuation of Biodiversity (Direct Use value- Consumptive use value and Productive use value), Indirect Use Values- Ecological Value, Social value, Ethical /Moral value, Aesthetic Value, Option Value and Intrinsic Value.

UNIT IV

Threats to Biodiversity: Habitat Destruction, Habitat Fragmentation, Environmental Degradation and Pollution, Overexploitation of Natural Resources, Global Climate Change, Invasive Species (Each cause to be discussed in details).

UNIT V

Conservation Strategies: Conserving Species; Population and Landscapes. Conservation Strategies (ex-situ- Zoos, Aquariums, Botanical Gardens, DNA storage, Seed Banks). In situ conservation strategies. Protected Areas (PAs), protected area size and Characteristics. Protected area Management and Conservation outside PAs-Community based management practices (examples and successful case studies and conservation of Species, landscapes and overall biodiversity to be discussed in explicit details).

Suggested reading

- Van Dyke, Fred. *Conservation biology: foundations, concepts, applications*. Springer Science & Business Media, 2008.
- Primack, Richard B., Anna Sher, and Anna A. Sher. *Introduction to conservation biology*. Sinauer Associates, Incorporated, Publishers, 2016.
- Sodhi, Navjot S., and Paul R. Ehrlich, eds. *Conservation biology for all*. Oxford University Press, 2010.
- Lindenmayer, David, and Mark Burgman. *Practical conservation biology*. CSIRO publishing, 2005.
- Sutherland, William J., ed. *Conservation science and action*. John Wiley & Sons, 2009

Assignment/Seminar	**:10 Marks**
Quiz	**:10 Marks**
Mid Term	**:20 Marks**
End Term	**:60 Marks**

SEMESTER II

WLBC 202: Wildlife Management (Credit: 05)

COURSE OUTCOME: Students can work in several consultancy projects pertaining to wildlife and environmental management after gaining knowledge on wildlife management, wildlife acts and Environmental Impact Assessment

UNIT I

Concept of Wildlife Management, Goals of wildlife management. Techniques of Wildlife Management. Problems in wildlife management, Biological basis of wildlife management (Concept of home range and territory; environmental resistance,carrying capacity, Forest and Wildlife Corridors). Case studies of Human-Wildlife Conflict (e.g. Human-Elephant; Human-bear; Human-Crocodile; Human-Snake; Road kills).

UNIT II

Wildlife Policies and Act: Wildlife Protection Act, 1972 amended 2022; Forest Conservation Act, 1980; Indian Forests Act revised and rule 1982. The scheduled Tribes and other traditional forest dwellers act 2006; Environment protection Act 1986.

UNIT III

Human Dimensions in Wildlife Management. Ecodevelopment programs. Community participation and conservation development linkage. Ecotourism and its role in wildlife conservation- Balancing visitors and wildlife protection (Bird watching, Adventure Tourism and Agrotourism).

UNIT IV

Wildlife and Conservation Areas: IUCN Categories of Landscapes Conservation (I, II, III, IV, V, VI), Ramsar Convention, CBD/Agenda 21, Red Data Book and CITES.

UNIT V

National and International bodies in protecting wildlife and wilderness Areas, Government Organisations (GTF); Non-Government Organisations (BNHS, SSC, WWF, WTI, WCS), Concepts of Corporate Social responsibility (CSR) and Corporate Environment Responsibility (CER).

Suggested Readings:

- Rajesh, G. Fundamentals of Wildlife Management, Justice Home, Allahabad
- Decker, Daniel J., Shawn J. Riley, and William F. Siemer, eds. Human dimensions of wildlife management. JHU Press, 2012.
- Ryder, Thomas J., ed. State wildlife management and conservation. JHU Press, 2018.
- Adams, Clark E. Urban wildlife management. CRC press, 2009.
- Krausman, Paul R., and James W. Cain, eds. Wildlife management and conservation: contemporary principles and practices. JHU Press, 2013.
- Wathern, Peter, ed. Environmental impact assessment. Routledge, 1995

Assignment/Seminar	**:10 Marks**
Quiz	**:10 Marks**
Mid Term	**:20 Marks**
End Term	**:60 Marks**

SEMESTER II

WLBC 203: Wildlife Health (Credit: 05)

COURSE OUTCOME: To gain basic fundamentals of genetics and their application in wildlife. The various disease outbreak in the wildlife along with their diagnosis and the application of wildlife to common man.

UNIT I

Introduction to disease and epizootiology, Determinants of disease and disease transmission, Major viral, bacterial, protozoan, fungal and parasitic diseases of Indian wild animals.

UNIT II

Non-infectious diseases- nutritional diseases, poisoning, stress, shock, capture myopathy, physical trauma. Emerging and re-emerging diseases. Planning and management of wildlife health programmes.

UNIT III

Chemical capture techniques; Drug delivery system, basic physiological and biological concepts related to chemical capture, nature and classification of drugs used in chemical operations, factors affecting chemical capture.

UNIT IV

Fundamentals of wildlife forensic. Significance of wildlife forensic. Protected and endangered species of animals and plants. Illegal trading in wildlife items. Identification of physical evidence pertaining to wildlife forensics. Identification of pug marks of various animals.

UNIT V

GMOs and their applications (Agriculture & Animal husbandry), Ecological effects, Potential threats. Eco-Tourism and its importance.

Suggested Readings:

- Conner, Jeffrey K., and Daniel L. Hartl. *A primer of ecological genetics*. Vol. 425. Sunderland, MA: Sinauer Associates, 2004.
- Li, Ching Chun. "Population genetics." *Population genetics.* (1955).
- Pierce, Benjamin A. *Genetics essentials: concepts and connections*. WH Freeman, 2018.
- Waddington, Conrad Hal. *An introduction to modern genetics*. Routledge, 2016.
- Huffman, Jane E., and John R. Wallace. *Wildlife forensics: methods and applications*. John Wiley & Sons, 2012.
- Hardy, Christopher R., and David S. Martin. "Plants and wildlife forensics." *Wildlife forensics: methods and applications* (2012): 145-159.
- Walker, Danny N., and William J. Adrian. "Wildlife forensic investigation principles and practice." *Journal of Wildlife Diseases* 50, no. 1 (2014): 154-156.

Assignment/Seminar	**:10 Marks**
Quiz	**:10 Marks**
Mid Term	**:20 Marks**
End Term	**:60 Marks**

SEMESTER II
WLBC 204 Biogeography (Credit: 05)

COURSE OUTCOME: This paper will have a comprehensive understanding of biogeography, including its history, geological time scale, species distribution, adaptation, and gene flow. It will explore dispersal mechanisms, speciation, extinction, biodiversity conservation, and the biogeographic regions of India, with a focus on invertebrates, amphibians, reptiles, birds, and mammals.

UNIT I

What is Biogeography? History of biogeography,geological time scale and development of life, factors influencing distribution of plants and animals. The geographic range, boundary of single species, the distribution of populations, aadaptation and gene flow, Phylogeography, Phytogeography.

UNIT II

Ecology of dispersal and faunal exchange, barriers, mode of dispersal, origins and radiation; island biogeography theory. Extent and causes of glaciation, glacial cycles and extinctions. Biogeographical processes:refugia, endemism, provincialism, and disjunction, dispersal and vicariance biogeography; dispersal mechanisms and dispersal barriers.theory of continental drift.

UNIT III

Biogeographical realms, provinces and ecoregions.Microevolution, Macroevolution, Speciation and Extinction, mechanism of speciation, diversification, species selection. The distribution of communities in space and time, cladistic biogeography.

UNIT IV

Classifying biodiversity (evolutionary classifications, phylogenetic systematics). The biodiversity crisis and the Linnaean shortfall, Applications of biogeographic theory in biodiversity conservation, Applied biogeography: Focal species patterns and approaches for conserving biodiversity. Species responses to global climate change.

UNIT V

Zoogeography of amphibians, reptiles, birds and mammals: Factors affecting distribution andabundance of amphibian, reptilian, avian and mammalian fauna of the Indian sub-continent. The biogeographic affinities of the fauna and flora of the Peninsular India. Biogeographic Regions of India.

Suggested Reading:

- J. Brown and M. V. Lomolino. Biogeography
- Briggs, John C. *Global biogeography*. Elsevier, 1995.
- E. O. Wilson& R. H. MacArthur. The theory of island biogeography
- R. J. Ladle, and R.J. Whittaker. Conservation biogeography.
- M. S. Mani. The Ecology and Biogeography of India.
- M.V. Lomolino, J. H. Brown & D. F. Sax. Island biogeography theory.

Mid Term	**: 30 Marks**
End Term	**: 70 Marks**

Semester II
WLBC 205 FIELD AND LABORATORY PRCATICAL
(Credit: 05)

I. Major Experiment: (30 Marks)

a. Determines the species diversity indices for plants and animals
b. Examination of bio-geographical pattern in different taxonomic units
c. Culture of bacteria from water and soil samples
d. Sterilization and preparation of culture media
e. Techniques of pure culture
f. Measurement of biodiversity in PAST and in R program (Shannon, Simpson index)

II. Minor Experiment (20 Marks)

a. Identification and inventory of selected wild medicinal plant
b. Identification of different biogeographical units from species distribution map using software
c. Examination of dispersal and vicariance events in a taxonomic group

III. Seminar (20 Marks)
IV. Field Tour Report (20 Marks)
V.Lab record and Viva (10 Marks)

Assignment/Seminar	**:10 Marks**
Quiz	**:10 Marks**
Mid Term	**:20 Marks**
End Term	**:60 Marks**

Semester II

OE-WLBC-206 Natural Resource Management (Credit: 05)

COURSE OUTCOMES: On completion of this paper, students will be able to understand ecologicalprinciples underpinning the management of resources, populations, communities, andecosystems. They will also be familiar with the use of data collection and analysis toolssuch as field methods, GIS modelling and statistics to develop resource managementplans, as well as learn about biological, chemical, physical, and social scienceprinciples to apply them in environmental resource management issues

UNIT I:

Natural resources: Introduction, Natural resources, Biota-Microbes, plants and animals and Abiotic -Air (Oxygen, Carbon dioxide and other useful gases), Water (Seas, oceans, freshwater, sources, ponds and rivers), Soil (Rocks, ores and minerals). Classification of natural resources based on renewability. Classification on the basis of origin. Classification of natural resources based on their stage of development

UNIT II:

Energy: Introduction, growing energy needs, use of energy, sources of energy: Coal, Petroleum and Natural gases, Nuclear energy, hydroelectric energy, solar energy, Wind energy, Biomass, Geothermal energy, Tidal power and Hydrogen Energy. (Each of the energy resources, their origin, advantages and its disadvantages shall be discussed in details).

UNIT III:

Growing energy demands and problems associated with over exploitation of natural resources; Pollution-Air, Water, Soil, Noise.

UNIT IV

Waste generation and its management with special reference to solid waste (municipal solid waste, plastic waste and e-waste).

UNIT V:

Sustainability and Sustainable Development, Sustainable Development goals by UNESCO, Concepts of ecological footprint and carbon foot print; concept of Environmental Sustainability Index (ESI) and Environmental Performance index (EPI); International Sustainability development programs- UNCED, CSD, and WSSD.

Suggested Reading:

- Conroy, Michael J., and James T. Peterson. *Decision making in natural resource management: a structured, adaptive approach*. John Wiley & Sons, 2013.
- Kaplan, Daniel Moshe, and Christopher Gerard White. *Integrating landscape ecology into natural resource management*. No. 1. Cambridge University Press, 2002
- Anderson, David A. *Environmental economics and natural resource management*. Routledge, 2010.
- Rydin, Yvonne. *Networks and institutions in natural resource management*. Edward Elgar Publishing, 2006.

Assignment/Seminar	**:10 Marks**
Quiz	**:10 Marks**
Mid Term	**:20 Marks**
End Term	**:60 Marks**

SEMESTER III

WLBC 301: Techniques in Wildlife (Credit: 05)

COURSE OUTCOME: Perspectives of science and management will be elucidated in the context of molecular techniques and bioinformatics tools for current and future strategies designed to conserve the diversity of life.

UNIT I

Extraction and Evaluation of DNA form plant and animal samples, DNA amplification by PCR: RT-PCR, RAPD, RFLP, DNA fingerprinting, Southern blotting and its application, Electrophoresis.

UNIT II

Extraction and evaluation of proteins, Protein Fingerprinting, Western Blotting and its applications, Protein characterization techniques.

UNIT III

Bioinformatics resources and search tools; Sequence and structure databases; Sequence analysis-sequence file formats, scoring matrices, alignment, phylogeny, alignment, tree construction in MEGA and other online tools and phylogenetic reconstruction methods (maximum likelihood, parsimony, UPGMA, bayesian inference).

UNIT IV

Different kind of wildlife survey methods: Direct observation, Point count survey, camera trapping, mark-recapture, distance sampling, aerial surveys, acoustic, track and sign, nest surveys, radio telemetry, GPS tracking, dung count, pitfall traps, baited traps, mist netting, nocturnal surveys, underwater surveys, citizen science surveys, hair / fur traps, environmental DNA sampling (water, air, soil) and metabarcoding.

UNIT V

Field techniques employed to enumerate plant (trees, shrubs, herbs and grasses); quadrat, transect, point-centered quarter, species-area curve, vegetation profiling, plotless sampling, random sampling, tree ring sampling, herbarium specimen collection.

Suggested Readings:

- Walker, John M., and Ralph Rapley, eds. *Molecular biomethods handbook*. No. 577.2. 08 MOL. Totowa, NJ: Humana Press, 2008.
- Kumar, Pranav. *Fundamentals and Techniques of Biophysics and Molecular biology*. Pathfinder Publication unit of PAPL, 2016.
- Leake, Mark C. *Biophysics: tools and techniques*. CRC Press, 2016.
- Baxevanis, Andreas D., Gary D. Bader, and David S. Wishart, eds. *Bioinformatics*. John Wiley & Sons, 2020.
- Xia, Xuhua. *Bioinformatics and the Cell*. Springer Science+ Business Media, LLC, 2007.
- Misener, Stephen, and Stephen A. Krawetz, eds. "Bioinformatics methods and protocols." (2000)

Assignment/Seminar	**:10 Marks**
Quiz	**:10 Marks**
Mid Term	**:20 Marks**
End Term	**:60 Marks**

SEMESTER III
WLBC 302 Evolutionary Ecology (Credit: 05)

COURSE OUTCOME: The course provides the key to understanding the principles governing the origin and extinction of species. It provides causal explanations, based on history and on processes of genetic change and adaptation, for the full sweep of biological phenomena, ranging from the molecular to the ecological perspective.

UNIT I

What is Evolutionary Ecology, Origins of genetic variation, Mendelian genetics; Mutations, Foundational population genetic concepts, Hardy Weinberg equilibrium; Genetic drift, selection; population genetic structure (panmixia, gene flow, FST); gene-environment interactions (phenotypic plasticity); Lamarck-Darwin–concepts of variation, adaptation, struggle, fitness, natural selection, types of natural selection (stabilizing, directional, disruptive).

UNIT II

Life History Evolution: reproductive systems evolution, sexual selection and mating system, Sex allocation, behavior and plasticity, generalization vs. specialization, antagonism vs. cooperation, Evolutionary ecomorphology, Evolution of Niches, species diversity and latitudinal gradients in diversity. Co-evolution (co-adaptations, arms race, Red Queen hypothesis, co-speciation)

UNIT III

Metapopulation ecology (colonization, persistence, extinction, patches, sources, sinks); age-structured populations. Types (mutualism, symbiosis, commensalism, competition, parasitism, predation, etc); ecophysiology (physiological adaptations to abiotic environment); prey-predator interactions (Lotka-Voltera equation).

UNIT IV

Concepts of neutral evolution, neutral theory, molecular divergence and molecular clocks; rates of evolution, ecological genetics, The genetics of evolutionary ecology. Life history strategies: major transitions in ecology, major transitions in evolution.

UNIT V

Origin of cells and unicellular evolution: origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; evolution of enaerobic metabolism, photosynthesis and aerobic metabolism. The geological past, earth's past physical environment, major determinants of climate, soil formation and primary succession.

Suggested Readings:

- Mayhew, P. J.. Discovering evolutionary ecology: bringing together ecology and evolution. Oxford University Press. 2008.
- Pianka, E. R. . Evolutionary ecology. 2011
- Sober, Elliott, ed. Conceptual issues in evolutionary biology. Mit Press, 1994.
- Keller, E. F., and E.A.Lloyd,. Keywords in evolutionary biology. Harvard University Press, 1994.

Assignment/Seminar	**:10 Marks**
Quiz	**:10 Marks**
Mid Term	**:20 Marks**
End Term	**:60 Marks**

SEMESTER III
WLBC 303 Animal Behavior (Credit: 05)

COURSE OUTCOME: Students will get a deep understanding of how human beings have evolved and how certain behaviour they have inherited from animal world. They can opt for higher research in this field as per their interest.

UNIT I

Ethology, Concepts of Imprinting, Habituation and Sensitization; Pattern of Behaviour: Innate behaviour (tropism, taxes, reflexes, instincts); Learned behaviour (Learning and Reasoning), Fixed action Pattern, Proximate and Ultimate Causes of Behaviour.

UNIT II

Foraging ecology, search and handling time, Optimization (Optimal Foraging Theory), Generalisation and specialization.

UNIT III

Social Behaviour and Eusociality, Group Living (Advantages and Disadvantages), Concepts of Kin selection Altruism and Reciprocity. Dominance Behaviour, Territorial Behaviour, Aggressive behaviour.

UNIT IV

Communication in Animals: Visual, Auditory and Olfactory, Chemical and Tactile.

UNIT V

Reproductive behaviour, neural control of behaviour and Hormonal Control of behaviour; Mate choice, mating systems in animals, cooperative breeding behaviour in birds and mammals.

Suggested Reading:

- Alcock, John. "A textbook history of animal behaviour." (2003): 3-10.
- Morgan, Conwy Lloyd. *Animal behaviour*. E. Arnold, 1900.
- Shettleworth, Sara J. "Animal cognition and animal behaviour." *Animal behaviour* 61, no. 2 (2001): 277-286.
- Manning, Aubrey, and Marian Stamp Dawkins. *An introduction to animal behaviour*. Cambridge University Press, 1998.
- Barnard, Christopher J. *Animal behaviour: mechanism, development, function and evolution*. Pearson Education, 2004.

Mid Term	**: 30 Marks**
End Term	**: 70 Marks**

SEMESTER III
WLBC 304: FIELD AND LABORATORY PRCATICAL
(Credit: 05)

I. Major Experiment (30 Marks)

a. Extraction of total genomic DNA from plant and animal samples
b. Agarose gel electrophoresis of genomic DNA

II. Minor Experiment (20 Marks)

a. Calculation of genetic divergence between members of given taxonomic units
b. DNA sequence alignment using aligner (MUSCLES)
c. Building phylogenetic Trees (using different software)
d. Enumerate plant (trees, shrubs, herbs and grasses);
e. Line transect method
f. point-centered quarter for birds
g. vegetation profiling
h. plotless sampling
i. random sampling
j. Bioacoustics of different calling animals using software (call investigation and identification of ppecies)

III. Field tour report (**20 Marks**)
IV. Seminar and Technical Writing (**20 marks**)
V. Lab record and Viva (**10 Marks**)

SEMESTER III
WLBC 305: SWYAM MOOCS (Credit: 03)

Assignment/Seminar	**:10 Marks**
Quiz	**:10 Marks**
Mid Term	**:20 Marks**
End Term	**:60 Marks**

SEMESTER IV
WLBC 401: Global Climate Change (Credit: 05)

COURSE OUTCOME: To understanding the nature of problem to be studied and identifying the related area of knowledge. Reviewing literature to understand how others have approached or dealt with the problem.

UNIT I

Definition and Basic Concept: Climate, Weather and climate, Climate of the world, Indian climates, Climatic Zones, Factors responsible for change of climate , tools to study climate change.

UNIT II

Introduction to Climate Change Science, Anthropogenic Drivers of Climate Change (Deforestation, industrialization, Urbanization, Pollution); Impacts of Climate Change on environment, agriculture, animals, plants and human health)

UNIT III

Developmental planning, identifying vulnerabilities and Disaster Rish Assesment, Adopting Climate change mitigation strategies **UNIT IV**

Sustainable Development: Basic concept, Goals of Sustainable Development, Concept of Ecological footprint and Carbon Footprint, International programmes on sustainable development (UNCED, CSD, WSSD),

UNIT V

International legal framework for Climate Change: First UN Climate Conferences, Intergovernmental Panel on Climate Change (IPCC), United Nations Environment Programme (UNEP), UN Framework Convention on Climate Change (UNFCCC), Kyoto Protocol, Paris Agreement, Montreal Protocol, COP.

Suggested Readings:

- Mishra, Shanti Bhushan, and Shashi Alok. "Handbook of research methodology." *Dimensions of Critical Care Nursing* 9, no. 1 (2017): 60.
- Nayak, Jayanta Kumar, and Priyanka Singh. *Fundamentals of research methodology problems and prospects*. SSDN Publishers & Distributors, 2021.
- Kumar, Ranjit. *Research methodology: A step-by-step guide for beginners*. Sage, 2018.
- Daniel, Ben Kei, and Tony Harland. *Higher education research methodology: A step-by-step guide to the research process*. Routledge, 2017.

Assignment/Seminar	**:10 Marks**
Quiz	**:10 Marks**
Mid Term	**:20 Marks**
End Term	**:60 Marks**

SEMESTER IV
WLBC 402: Solid Waste Management (Credit: 05)

COURSE OUTCOME: Through this course the students will get on broader understandings on various aspects of solid waste management (starting from its generation to processing with options for reuse and recycle, transport, and disposal) practiced in different municipalities.

UNIT I

Solid Waste Source**:** Sources of Solid Waste. Categories of Solid waste-Municipal Solid Waste, Industrial Waste, Agricultural Waste, Construction and demolition waste, Commercial Waste, Biomedical waste, e-waste.

UNIT II

Solid waste and its composition**:** Physical properties, Chemical properties and biological properties of Solid Waste (Municipal Solid Waste)

UNIT III

Solid Waste Handling: Generation of solid Waste, Transfer and Transport, Processing technique and equipment w.r.t (municipal waste, bio-medical waste and nuclear waste). Concept of Zero Waste generation Technology- Case study of Kalundborg in Germany.

UNIT IV

Solid Waste Treatment: Control of Solid Waste Pollution, techniques for solid waste treatment (Natural Attenuation, Bio-stimulation, Bio-augmentation, Bio-venting, Bio-sparging, Phytoremediation, Land farming, Composting, vermicomposting, Bio piles).

UNIT V

Solid Waste as energy Resource**:** Collection of Solid Waste; Recovery of resources; Conversion products and energy. Composting, Recycling, Incineration, pyrolysis. Disposal of Solid Waste including sanitary landfill Regulatory framework.

Suggested Readings:

- Fundamentals of ecology (W. B. Saunders). by Odum
- Ecology (W. H. Freeman & Co., NewYork).by R. E. Ricklefs & G. Miller.
- Environmental Science (W. B. Saunders) by Turk & Turk.
- Ecological concepts (Blackwell Sci. Publ., Oxford). By J. M. Cherrett.
- Population biology (Van Nostrand Co., New York).
- Fundamentals of ecological modelling (Elsevier, New York)

Mid Term	**: 30 Marks**
End Term	**: 70 Marks**

SEMESTER - IV

WLBC 403: FIELD AND LABORATORY PRCATICAL

(Credit: 05)

I. Major Experiment (30 marks)

a. Water analysis; Comparative water quality analysis of lentic and lotic water bodies,
b. Ground water quality analysis.
c. Study of quantitative and qualitative analysis of aquatic vegetation
d. Productivity of water bodies.
e. Soil and Sediment analysis.
f. GPS operation and data acquisition Map making using different tools (QGIS, Google earth Engine) and GPS data points

II. Visit to a sacred grove or a particular ecosystem to prepare a field report on the ecosystem (**20 Marks**)

III. Report on Field visit (**20 Marks**)

IV. Seminar and Technical Writing (**20 marks**)

V. Lab record and Viva (**10 Marks**)

Mid Term	**: 40 Marks**
End Term	**: 60 Marks**

SEMESTER - IV
WLBC 404: Dissertation Work (Credit: 05)

I.	Writing of synopsis, Literature survey, Methodology.	**(30 marks)**
II.	Presentation in the Seminar for discussion.	**(20 marks)**
III.	Improvement of Research design, Data collection, data analysis, and interpretation Preparation of thesis, Evaluation on the basis of the thesis.	**(30 marks)**
IV.	Viva-voce	**(20 marks)**

Development of the project (synopsis & literature survey), research design (methodology, work plan & data collection), data analysis & interpretation of results. (The dissertation work should be related to forest biodiversity, habitat, ecosystem, invertebrate or vertebrate biology, wildlife conservation, dependency on forests , socio-economic aspects etc.).

Note:

1. The Seminar presentation is to be completed within 90 days of the subject allotment. Dissertation works are to be assigned to the students, who are expected to conduct the study independently and under the guidance of a teacher/guide .The findings are to be submitted in the form of a report getting duly authenticated by the teacher/guide concerned. The completed study will be compiled at the end of final year, when the student will submit the final thesis.

The project work is to be completed within three months including dissertation writing. Viva-voce may be held any time within a month of thesis submission.

2. For the project work the students has to follow the rules as mentioned below

I. The work should be the original work to be done by the students independently.

II. The project work is to be done under the direct guidance of the faculty member (s) of the department.

III. If the work is to be carried out under the guidance other than the faculty member, the work is to be done under the joint supervision taking the faculty member(s) of the department.