Academic Council Meeting No. and Date: 8 / September 04, 2023

Agenda Number: 2 Resolution Number: 34, 35/2.18 & 2.39

Vidya Prasarak Mandal's

B. N. Bandodkar College of Science (Autonomous), Thane

Syllabus for

Programme Code: BPBW

Programme: Master of Science

Specific Programme:

BIODIVERSITY, WILDLIFE CONSERVATION & MANAGEMENT

[BWCM]

[M.Sc. (Semester I and II)]

Level 6.0

CHOICE BASED GRADING SYSTEM

Revised under NEP

From academic year 2023-24

This page is intentionally left blank

Sr. no	Heading	Particulars
1	**Title of the course**	**M.Sc. in Biodiversity, Wildlife Conservation and Management**
2	**Eligibility for Admission**	● B.Sc. in ANY subject or its equivalent. ● B.Sc. Veterinary science or its equivalent. ● B.Sc. Agriculture or Forestry or its equivalent
3	**Passing Marks**	**40%**
4	**Ordinances/Regulations (if any)**	**Nil**
5	**No of Years/Semesters**	**Two years, Four semesters**
6	**Level**	**P.G.**
7	**Pattern**	**Semester**
8	**Status**	**Revised under Autonomy as per NEP 2020**
9	**To be Implemented from Academic Year**	**2023-24**

BOS Chairperson: Dr. Sandhya Pawale

B. N. Bandodkar College of Science, (AUTONOMOUS)-Thane

Master program in Biodiversity, Wildlife Conservation and Management

Year (2 Yrs)	LEVEL	SEMESTER	Major			Research Methodology	On Job Training / Field project	Research project	Cum Credits	Degrees
			Mandatory		Electives anyone					
I	6.0	SEM-I	**3*4 + 2 = 14**		Credits 4	**Credits 4**	NA	NA	22	PG Diploma in Biodiversity, Wildlife Conservation and Management (After 3 Yrs. degree UG)
			Course 1	Credits 4	Course 1= Credits 4					
			Course 2	Credits 4	**OR**					
			Course 3	Credits 4	Course 2 = Credits 4					
			Course 4	Credits 2	**OR**					
		SEM-II	Course 1	Credits 4	Course 1 = Credits 4	NA	**Credits 4**	NA	**22**	
			Course 2	Credits 4	**OR**					
			Course 3	Credits 4	Course 2 = Credits 4					
			Course 4	Credits 2	**OR**					
Cum Cr.for 1 Yr. PG Diploma			**28**		8	4	4		44	
II	6.5	SEM- III	Course 1	Credits 4	Course 1 Credits 4	NA	NA	**Credits 4**	22	Master program in Biodiversity, Wildlife Conservation and Management (After 3 Yrs. degree UG)
			Course 2	Credits 4	**OR**					
			Course 3	Credits 4	Course 2 Credits 4					
			Course 4	Credits 2	**OR**					
		SEM IV	Course 1	Credits 4	Course 1 Credits 4	NA	NA	**Credits 6**	**22**	
			Course 2	Credits 4	**OR**					
			Course 3	Credits 4	Course 2 Credits 4					
					OR					
Cum Cr. for integrated 1 Yr. PG Degree				**26**	**8**			**10**	**44**	
Cum Cr. for 2 Yr. PG Degree				**44**	**16**	**4**	**4**	**10**	**88**	

PREAMBLE

The potential source of income for the nation is its biodiversity, which is woefully underutilized. The shortage of skilled laborers is one of the causes of underutilization. Taxonomists and ecologists who prefer the field and functional and molecular biologists who prefer the lab make up the majority of the current generation of biologists. This gap has grown to be a barrier to understanding biodiversity. By concurrently encouraging expertise in field and lab biology, the current approach aims to close the gap. This capacity-building activity will contribute to the creation of wealth through making responsible and sustainable use of the nation's bio resources. The two-year postgraduate program M. Sc. Biodiversity Wildlife Conservation and Management consists of four semesters. The vitally important subject of biodiversity is covered comprehensively in the syllabus proposed below.

The course is divided into four semesters: the first year, which consists of two semesters, is heavily focused on the field, while the second year is focused on the lab as well as field.

First semester consists of ecology and plant and animal diversity. Second semester focuses on conservation biology which is a need of an hour. It will help students become a competent naturalist and ecologist because they place equal emphasis on conceptual and empirical knowledge of how natural systems function.

Third and Fourth semester comprises crucial topics like study of ecotourism, acts and laws of environment and wildlife, environmental journalism etc. It will expose students to apply and utilize the knowledge gained in the first year of the course and learn some new techniques for future use.

➢ PROGRAMME OUTCOMES (POs) OF MASTERS IN SCIENCE (M.Sc.)

The Postgraduate Programmes of Science are intended to cater quality education and attain holistic development of learners through the following programme outcomes:

PO1 – Domain Knowledge
Comprehend and demonstrate domain knowledge in specialized branch of science. Instil ability to apply it in upgrading professional, social and personal life.

PO2 – Development of Research Competence
Imbibe skills related to identification of research problem, formulating hypothesis, execution of research process, analysing data, interpreting the data, drawing conclusion and presenting research work. Encourage learners for doctoral studies.

PO3 - Digital Literacy
Enhance ability to access, select and use a variety of relevant information e-resources for creating new knowledge resources.

PO4 - Sensitization towards Environment
Build cohesive bond with nature by respecting natural resources, encouraging eco-friendly practices and creating awareness about sustainable development.

PO5 - Individuality and Team work
Encourage learner to work independently or in collaboration for achieving effective results through practical experiments, project work and research activities.

PO6 – Competence for Employment
Promote field work, internships, industrial training, research projects, research paper presentations and publications to develop competence for adapting towards dynamic socio-economic changes and make learner employable.

Eligibility:

- B.Sc in ANY subject or its equivalent.
- B.Sc. Veterinary Science or its equivalent.
- B.Sc. Agriculture OR Forestry or its equivalent.

Duration: 2 years (Level 6.0 and 6.5)

Mode of Conduct: Laboratory practicals / Offline lectures / Online lectures

Total Credits for the Program: 88

Starting year of implementation: 2023-24

➢ PROGRAM SPECIFIC OUTCOMES (PSOS) FOR MSC BIODIVERSITY, WILDLIFE CONSERVATION AND MANAGEMENT

PSO1: Comprehend Fundamental Concepts in Biodiversity and Ecology (linked to PO1) Recall and understand foundational concepts related to biodiversity, ecological dynamics, environmental regulations, and plant and animal diversity to establish a strong knowledge base. **[Bloom's Level:** L1 (Remembering), L2 (Understanding)]

PSO2: Apply Scientific Principles, Technological Tools, and Conservation Strategies (linked to PO3, PO6)
Utilize field techniques, bioanalytical tools, digital technologies such as GIS and RS, and wildlife management strategies to implement effective and practical conservation practices. **[Bloom's Level:** L3 (Applying)]

PSO3: Develop Research and Analytical Competence (linked to PO2) Formulate research hypotheses, design experiments, analyze data using biostatistical methods, and interpret results to address biodiversity and conservation challenges effectively. **[Bloom's Level:** L3 (Applying), L4 (Analyzing)]

PSO4: Analyze and Mitigate Conservation and Human-Wildlife Conflict Issues (linked to PO4) Assess ecological patterns, human-wildlife conflicts, and socio-economic challenges, and propose evidence-based solutions through the evaluation of relevant data and scenarios. **[Bloom's Level:** L4 (Analyzing), L5 (Evaluating)]

PSO5: Demonstrate Proficiency in Legal, Ethical, and Forensic Aspects (linked to PO5, PO6) Apply legal frameworks, including Intellectual Property Rights (IPR), wildlife forensics, and environmental regulations, alongside ethical principles to ensure integrity and accountability in conservation practices. **[Bloom's Level:** L5 (Evaluating)]

PSO6: Innovate and Promote Sustainability through Multidisciplinary Approaches (linked to PO4, PO6)
Synthesize knowledge from biodiversity, transgenics, artificial intelligence, and environmental science to design initiatives for eco-literacy, sustainable development, and innovative conservation efforts. **[Bloom's Level:** L5 (Evaluating), L6 (Creating)]

ASSESSMENT: WEIGHTAGE FOR ASSESSMENTS (IN PERCENTAGE) FOR MANDATORY AND ELECTIVE COURSE

Type of Course	Formative Assessment / Internal Assessment	Summative Assessment
Theory	40%	60%
Practical	-	100%

Internals Based on Unit 1 / Unit 2 / Unit 3/ Unit 4

Assignments/ Tutorials	Seminar	Ppt/video Presentation	Group discussion	Active Participation & Leadership qualities	Total
10	10	10	05	05	40

VPM's B. N. Bandodkar College of Science (Autonomous), Thane
M.Sc. in Biodiversity, Wildlife Conservation and Management
Structure of Programme (Part I)

Class	Semester	Course type	Course Code	Course Title	Credits
Part 1	SEM 1	**MANDATORY**	23BPBW1T01	Basics of Plant and Animal Diversity	4
			23BPBW1T02	Fundamentals of Ecology and Ecosystems	4
			23BPBW1T03	Essentials of Field study	4
			23BPBW1P01	Practicals based on 23BPBW1T01, 23BPBW1T02, 23BPBW1T03	2
		ELECTIVE	23BPBW1T04	Adaptations	2
			23BPBW1P02	Practicals based on 23BPBW1T04	2
			OR		
			23BPBW1T05	Agricultural Diversity	2
			23BPBW1P03	Practicals based on 23BPBW1T05	2
			23BPRM1T03	Research Methodology for Biodiversity, Wildlife Conservation & Management	4
				Total	22
	SEM 2	**MANDATORY**	23BPBW2T01	Population Dynamics & Behavioral Ecology	4
			23BPBW2T02	Habitat Ecology	4
			23BPBW2T03	Implementing Conservation	4
			23BPBW2P01	Practicals based on 23BPBW2T01, 23BPBW2T02, 23BPBW2T03	2
		ELECTIVE	23BPBW2T04	Bioanalytical techniques	2
			23BPBW2P02	Practicals based on 23BPBW2T04	2
			OR		
			23BPBW2T05	Evolution	2
			23BPBW2P03	Practicals based on 23BPBW2T05	2
			23BPBW2P04	On-job Training / Field project related to Biodiversity, Wildlife Conservation & Management	4
				Total	22
TOTAL SEM 1 & SEM 2					44

VPM's B.N. Bandodkar College of Science (Autonomous), Thane

Curriculum Structure for the Post Graduate Degree Programme M.Sc. Biodiversity, Wildlife Conservation and Management (Part I)

	SEMESTER - I	**Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)**			**Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)**			
Course Code	**Mandatory Course Title**	**EM**	**EN**	**SD**	**PE**	**GE**	**HV**	**ES**
23BPBW1T01	Basics of Plant and Animal Diversity	-	-	✓	-	-	-	-
23BPBW1T02	Fundamentals of Ecology and Ecosystems	-	-	✓	-	-	-	✓
23BPBW1T03	Essentials of Field study	✓	-	✓	-	-	-	✓
23BPBW1P01	Practicals based on 23BPBW1T01, 23BPBW1T02, 23BPBW1T03	✓	-	✓	-	-	-	-
	Elective Course Title							
23BPBW1T04	Adaptations	-	-	-	-	-	-	-
23BPBW1P02	Practicals based on 23BPBW1T04	-	-	-	-	-	-	-
	OR							
23BPBW1T05	Agricultural Diversity	-	-	✓	-	-	-	✓
23BPBW1P03	Practicals based on 23BPBW1T05	-	-	✓	-	-	-	✓
	Research Methodology							
23BPRM1T03	Research Methodology for Biodiversity, Wildlife Conservation and Management	✓	-	✓	✓	-	-	✓
09	Total	03	00	07	01	00	00	05

	SEMESTER - II	Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)			Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)			
Course Code	**Mandatory Course Title**	**EM**	**EN**	**SD**	**PE**	**GE**	**HV**	**ES**
23BPBW2T01	Population Dynamics & Behavioral Ecology	-	-	✓	-	-	-	-
23BPBW2T02	Habitat Ecology	-	-	✓	-	-	-	✓
23BPBW2T03	Implementing Conservation	✓	✓	✓	-	-	-	✓
23BPBW2P01	Practicals based on 23BPBW2T01, 23BPBW2T02, 23BPBW2T03	✓	-	✓	-	-	-	✓
	Elective Course Title							
23BPBW2T04	Bioanalytical techniques	✓	-	✓	-	-	-	-
23BPBW2P02	Practicals based on 23BPBW2T04	✓	-	✓	-	-	-	-
	OR							
23BPBW2T05	Evolution	-	-	✓	-	-	-	-
23BPBW2P03	Practicals based on 23BPBW2T05	✓	-	✓	-	-	-	-
	On-Job Training / Field Project							
23BPBW2P04	On-job Training / Field project related to Biodiversity, Wildlife Conservation and Management	✓	-	✓	-	-	-	✓
09	Total	06	01	09	00	00	00	04

Dr. Sandhya Pawale
BOS Chairman & Coordinator, Dept. of Biodiversity, Wildlife Conservation & Management

NOTE:

- In teaching learning case study need to illustrate wherever required.
- Current scenario should be collaborate with the syllabus
- Field visits to nearby zoo, museum/forest/sea- shore/ nursery/ aquaria/ or any other relevant site The report of these visits will be submitted as part of the practical work.

SEMESTER I
MANDATORY

Course Code 23BPBW1T01	Course Title Basics of Plant and Animal Diversity	Credits 04	No. of lectures 60

Course Outcomes:

At the end of the course students will be able to:

CO 1	Classify cryptophytes and lichens using G.M. Smith's classification system	L4/L2
CO 2	Categorize among types of seed plants	L4
CO 3	Explain the classification and phyla of non-chordate animals	L5
CO 4	Illustrate the classification of chordate animals	L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	0	1	0	1
CO 2	3	1	0	1	0	1
CO 3	3	1	0	1	0	1
CO 4	3	1	0	1	0	1

Unit I:	**Introduction to Plant Pioneers**	**15**
	• Classification of Algae and Fungi (G. M. Smith) • Classification of Bryophytes (G. M. Smith) • Classification of Pteridophytes (G. M. Smith) (classification up to major groups)	
Unit II:	**Taxonomy of Seed Plants**	**15**
	• Classification of Gymnosperms (Chamberlain) • Classification of Angiosperms (Bentham & Hooker) • Basics of angiosperm morphology: Types of leaf, flower, fruit, seed • Angiosperm morphology: Arrangement - phyllotaxy, aestivation, placentation, other modifications • Major families – Magnoliaceae, Rhamnaceae, Myrtaceae, Combretaceae, Umbelliferae, Asteraceae, Labiateae, Euphorbiaceae, Orchidaceae (classification up to major groups)	

Unit III:	**Basics of Non-chordate Taxonomy**	**15**
	● Classification of Protozoans ● Classification of Non-chordates (major phyla up to classes) ● Phylum: Porifera, Coelenterata, Platyhelminthes ● Phylum: Nematoda, Annelida, Arthropoda ● Phylum: Mollusca, Echinodermata	
Unit IV:	**Basics of Chordate Taxonomy**	**15**
	● Classification of Protochordates and Chordates (up to major orders) ● Phylum: Hemichordata, Urochordata, Cephalochordata ● Phylum: Cyclostomata. and Chondrichthyes. ● Phylum: Osteichthyes and Amphibia. ● Phylum: Reptilia and Aves. ● Phylum: Mammalia.	

Course Code 23BPBW1T02	Course Title Fundamentals of Ecology & Ecosystems	Credits 04	No. of lectures 60

Course Outcomes:

At the end of the course students will be able to:

CO 1	Explain the fundamental concepts of ecology & biodiversity	L5/L2
CO 2	Classify the types of biomes with its characteristics	L4/L2
CO 3	Illustrate the aquatic ecosystems and its threats	L2
CO 4	Outline forest and grassland ecosystem and its threats	L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	0	2	0	2
CO 2	3	1	0	3	0	2
CO 3	3	1	0	3	0	2
CO 4	3	1	0	3	0	2

Unit I:	**Fundamentals of Ecology & Biodiversity**	**15**
	• Concept of Ecology, Biotic & Abiotic factors • Species, Populations, Communities, Ecosystems, Ecological succession, Energy flow • Climatic Zones and Biodiversity - Global & Indian • Biodiversity - Concept & Types • Vegetation Types: Tropical Evergreen, Deciduous, Dry Deciduous, Desert, Tidal and Mountain Forests. • Phytogeographic & Zoogeographic Realms: Palearctic Realm, Nearctic Realm, Neotropical Realm, Ethiopian Realm, Oriental Realm, Australian Realm.	
Unit II:	**Biomes**	**15**
	• Concept of biomes • Biomes of the world • Biomes of India • Characteristic flora and fauna in each biome • Hotspots - Global and Indian	

Unit III:	**Freshwater, Coastal & Marine: Biodiversity & Management**	**15**
	• Zonation of the lake, river, sea and related distribution of species • Diversity of intertidal zones, mangroves, swamps, wetlands • Overexploitation of marine resources, bycatch and discards • Protected marine areas in India • Endangered species of freshwater, coastal and marine ecosystems • Threats to freshwater and marine biodiversity	
Unit IV:	**Forest and Grassland: Biodiversity & Management**	**15**
	• Diversity in Forest and Grassland • Importance of Forest and Grassland Ecosystems • Significance of managing forest and grassland • Threats (overpopulation, deforestation, agricultural activities, wastelands, wildfires)	

Course Code 23BPBW1T03	Course Title Essentials of Field study	Credits 04	No. of lectures 60

Course Outcomes:

At the end of the course students will be able to:

CO 1	Explain sampling and observing techniques used in field surveys	L5/L2
CO 2	Outline the importance of field essentials	L2
CO 3	Compare the types of animal signs and tracks	L2
CO 4	Summarise the modeling techniques used for field studies	L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	1	2	0	3
CO 2	3	1	0	2	0	2
CO 3	3	1	0	3	0	2
CO 4	3	3	2	2	0	3

Unit I:	**Field surveys & Field Ethics**	**15**
	• Sampling methods and identifying study sites • Techniques of field observation Camouflages & observation stations • Non-intruding / non-interfering techniques of field observations • Methods of observing and recording animal behaviors • Sampling Behaviors, methods of observing Behavior; • Time- activity budgets, Ethograms, Social interaction matrices and their analysis • Ethics in Field Studies • Regulatory permissions for field observations	
Unit II:	**Recording & Evaluation of Data**	**15**
	• Qualitative & Quantitative data • Field note book and its records • Field kit and its usage • Cameras, binoculars, field scopes, camera traps, cellphones, etc. • Different methods of recording field observations, field traps. • Field collections & preservations	

Unit III:	**Analysis of animal tracks & signs (General concepts)**	**15**
	● Tracking large mammals ● Studying & analyzing animal tracks & signs ● Scat analysis and evaluation of food, feeding and health ● Enumeration using tracks & signs, nest census	
Unit IV:	**Modeling techniques**	**15**
	● Various software platforms for modeling ● Analytical models & simulations ● Collecting data for modeling ● Applications of modeling ● Basic understanding of Remote sensing and GIS techniques and their applications	

Course Code 23BPBW1P01	PRACTICALS BASED ON 23BPBW1T01, 23BPBW1T02, 23BPBW1T03	Credits 02	No. of lectures 60

Course Outcomes:

At the end of the course students will be able to:

CO 1	Identify and classify plant and animal taxa.	L3
CO 2	Evaluate the impact of abiotic factors on plants and animals	L5
CO 3	Distinguish the sampling techniques used in field study	L4
CO 4	Demonstrate field observation types and approaches	L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	0	2	0	2
CO 2	3	2	0	3	0	2
CO 3	3	2	1	2	0	3
CO 4	3	2	1	2	1	3

1. Using photographs / paintings / coloured drawings identify and study the classification & characteristics (representative species only) from;
   - Protista – protozoans
   - Non-chordates – Porifera to Hemichordata - upto classes
   - Insecta – Orthoptera, Coleoptera, Lepidoptera, Hymenoptera, Diptera, Odonata
   - Pisces – Agnatha, Chondrichthyes, Osteichthyes,
   - Amphibia – Anura, Gymnophiona and Urodela
   - Reptilia – Chelonia (Testudinia), Squamata, Crocodilia
   - Aves – Passeriformes, Anseriformes, Falconiformes, Struthioniformes, Galliformes, Psittaciformes, Strigiformes, Columbiformes, Ciconiformes,
   - Mammalia – Proboscidea, Sirenia, Primates, Rodentia, Chiroptera, Perissodactyla, Artiyodactyla, Pholidota, Carnivora
2. Using photographs / paintings / coloured drawings identify and study the classification & characteristics (representative species only) from;
   - Monera – bacteria, cynobacteria, spirochetes
   - Algae – Chlorophyta, Rhodophyta, Phaeophyta, Cyanophyta: Study of different fresh water and marine algae; common species only.
   - Fungi (upto orders) – molds, mushrooms, yeasts, mildews, smuts
   - mosses, ferns, gymnosperms
3. Study of morphology of plants (use photographs / paintings / coloured drawings / preserved specimen/ herbarium / in field);
   Leaf – morphology, modifications and phyllotaxy
   Flower – morphology & modifications
   floral formula (*Hibiscus* & *Pancratium*)
   Fruit – types & its morphology
   Seed – types, morphology and modifications for dispersal

4. Description of morphological characters of Angiosperm families prescribed in theory

5. Separate and identify different foraminifera from sand samples.

6. Estimation of stomatal index in leaves (at least three different leaf types representing at least two different micro-climatic conditions e.g. sun loving, shade loving).

7. Uv-Visible spectrophotometer scan of extracted plant pigments; spinach leaves, marigold petals and *Tradescantia* leaves. Evaluate the spectral characteristics.

8. Study of some pioneer communities in succession;
Lichen and their types, mosses and their types, coral and their types.

9. Using photographs / paintings / colored drawings identify and study ecological roles of characteristic plant & animal species (major representative species only) of various Biomes.

10. Using suitable diagrams / pictures identify zonations in a pond, sea-shore, forest and grassland ecosystem and study the species distribution.

11. Construct a habitat model of grassland/wetland/forest - evergreen, deciduous, dry/desert/aquatic

12. Application of transects and quadrants in simulated pictures / photographic sheets for data collection. Record & tabulate the data.

13. Instruments for sampling; water sampling bottles, plankton samplers, core samplers, bottom samplers, air samplers – construction, working and application (photographs of specimens and diagrams).

14. Using Vernier calipers make morphological measurements of Specimens (Any insect / fish / bird etc.), Skull, scales of reptiles, Wing and wing feathers etc. and record morphological data. Make a report and evaluate parameters like age, sex, species characteristics, etc.

15. Estimate primary production using water samples from different aquatic habitats.

16. Preparation of herbaria using suitable invasive plant samples (spreading, drying, pressing and labeling)

SEMESTER I
ELECTIVE I

Course Code 23BPBW1T04	Course Title Adaptations	Credits 02	No. of lectures 30

Course Outcomes:

On completion of the course, the students will be able to –

CO 1	Illustrate plant adaptations to extreme environments	L2
CO 2	Determine plant adaptations to light, temperature and biotic factors	L5
CO 3	Identify physiological animal adaptations to harsh conditions	L3
CO 4	Explain the role of the endocrine system of animals for adaptations	L5/L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	0	3	0	2
CO 2	3	2	0	3	0	2
CO 3	3	1	1	2	0	3
CO 4	3	1	0	2	0	2

Unit I:	**Plant Adaptations**	**15**
	• Plant adaptations to water, light, temperature, salinity • Adaptations for association between plants & animals • Concept of photoperiodism and thermo-periodism in plants • Seed dormancy	
Unit II:	**Animal adaptations**	**15**
	• Physiological Basis of Animal adaptations to water, temperature, salinity • Deep sea & diving adaptations in animals • Role of blubber in marine mammals • Adaptations for association between animals Hibernation, aestivation • Hypothalamo- Hypophyseal Axis and its role Pineal gland and its role	

Course Code 23BPBW1P02	PRACTICALS BASED ON 23BPBW1T04	Credits 02

Course Outcomes:

On completion of the course, the students will be able to –

CO 1	Justify ecological adaptations as seen in plant and animal specimens	L5
CO 2	Identify poisonous and venomous plants and animals	L3
CO 3	Discover adaptations in flora and fauna during field visit	L4
CO 4	Interpret the role of seed banks during visit.	L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	0	3	0	2
CO 2	3	1	0	3	0	2
CO 3	3	2	1	3	1	3
CO 4	3	1	1	3	1	2

1. Adaptations in hydrophytes:
   Pistia – offset & leaf; *Eichhornia* – leaf & petiole; *Nymphaea* – leaf & petiole
2. Adaptations in xerophytes:
   Opuntia – phylloclade; *Nerium* – leaf; *Casaurina* – leaf
3. Insectivorous plants: identification, morphological adaptations and ecological distribution.
4. Adaptations in animals: use pictures or photographs with suitable labels.
5. Identification and study of venomous & poisonous plants and animals, action of their venom - Stinging nettle, *Mucuna pruriens*, Physalia, scorpion, tarantula, honey-bee, *Conus*, scorpion fish First aid for snake bites - Cobra (spectacled & monocled), Common krait, Banded krait, Russell's Viper, Saw scaled Viper, Pit vipers (Bamboo, Green, Malabar)
6. Visit to seed bank
7. Nature trail to study plant and animal adaptations
8. Resin art making of plant species

SEMESTER I
ELECTIVE II

Course Code 23BPBW1T05	Course Title Agricultural Diversity	Credits 04	No. of lectures 30

Course Outcomes:

On completion of the course, the students will be able to –

CO 1	Outline major diseases for wild and domestic plants and animals	L2
CO 2	Determine the control measures of diseases.	L5
CO 3	Appraise the role of conserving native breeds for agriculture	L5
CO 4	Summarise the significance of conservation and effective hybridization in agriculture	L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	0	3	0	2
CO 2	3	2	0	3	0	3
CO 3	3	2	0	3	1	0
CO 4	3	1	0	3	1	3

Unit I:	**Wildlife diseases**	**15**
	• Major diseases (Plant & Animal) and their control • Domestic animals & wildlife diseases • Governmental role in control of wildlife diseases • Sick animal refuges in protected areas	
Unit II:	**Agricultural conservation**	**15**
	• Conserving indigenous agricultural species • Conservation of Live Stock species /varieties • Conservation of economically important aquatic species • Significance of gene banks, seed banks and germplasm conservation • Use of wild species for producing improved hybrid varieties Artificial seeds in conservation	

Course Code 23BPBW1P03	PRACTICALS BASED ON 23BPBW1T05	Credits 02

Course Outcomes:

On completion of the course, the students will be able to –

CO 1	Identify symptoms and control measures of plant and animal diseases	L3
CO 2	Plan and execute agricultural techniques such as artificial pollination and composting	L6/L3
CO 3	Discover the routine of animal maintenance during visit to goshala and rescue centre	L4
CO 4	Illustrate the role of agriculture or aquaculture institute during visit	L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	0	3	0	3
CO 2	3	2	0	3	1	3
CO 3	3	1	0	3	2	2
CO 4	3	1	1	3	1	3

1. Identification of plant diseases

(Plant diseases: Powdery Mildew, Tobacco mosaic virus, leaf spot, canker)

2. Identification of Animal diseases

(Animal diseases: Lumpy, Pruritus, Rabies, Botulism)

3. Artificial pollination techniques (emasculation, pollen harvesting, bagging and tagging)
4. Prepare a biocomposting setup
5. Visit to aquaculture facility / agricultural and allied institute
6. Farm/orchard visit
7. Visit to local vegetable market for wild vegetables survey
8. Visit to animal rescue center / hospital
9. Visit to Goshala
10. Indigenous Crop Diversity (millets)
11. Training of angling techniques with fishing equipments

Course Code 23BPRM1T03	Course Title Research Methodology for Biodiversity, Wildlife Conservation & Management	Credits 04	No. of lectures in hrs. 60

Course Outcomes:

On completion of the course, the students will be able to –

CO 1	To create awareness about various sites for literature review from digital and journal sources.	L6
CO 2	To understand primary, secondary data, copyrights, patents IPR ,trademarks etc	L1
CO 3	To know the scientific correlation of data. analysis, writing and presentation of scientific papers	L1
CO 4	Explain history and philosophy of natural science with implications and ethics.	L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	3	0	0	2
CO 2	3	2	2	0	0	3
CO 3	3	3	2	0	1	3
CO 4	3	2	0	2	1	2

Unit I	**Print: [5L]** Primary, Secondary and Tertiary sources. **Journals:** Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books, current contents, Introduction to Chemical Abstracts and Beilstein, Subject Index, Substance Index, Author Index, Formula Index, and other Indices with examples. **Digital: [5L]** Web sources, E-journals, Journal access, TOC alerts, Hot articles, Citation Index, Impact factor, H-index, E-consortium, UGC infonet, E-books, Internet discussion groups and communities, Blogs, preprint servers, Search engines, Scirus, Google Scholar, ChemIndustry, Wiki-databases, ChemSpider, Science Direct, SciFinder, Scopus. **Information Technology and Library Resources: [5L]** The Internet and World wide web, Internet resources for Chemistry, finding and citing published information.	**[15]**
Unit II	**DATA ANALYSIS [15L]** **The Investigative Approach:** Making and recording Measurements, SI units and their use, Scientific methods and design of experiments. **Analysis and Presentation of Data**: Descriptive statistics, choosing and using statistical tests, Chemometrics, Analysis of Variance (ANOVA), Correlation and regression, curve fitting, fitting of linear equations, simple linear	**[15]**

	cases, weighted linear case, analysis of residuals, general polynomial fitting, linearizing transformations, exponential function fit, r and its abuse, basic aspects of multiple linear regression analysis.	
Unit III	**METHODS OF SCIENTIFIC RESEARCH AND WRITING SCIENTIFIC PAPERS [15L]** Reporting practical and project work, Writing literature surveys and Reviews, organizing a poster display, giving an oral presentation. **Writing Scientific Papers:** Justification for scientific contributions, bibliography, description of methods, conclusions, the need for illustration, style, publications of Scientific work, writing ethics, avoiding plagiarism.	**[15]**
Unit IV	**INTRODUCTION TO SCIENTIFIC ENQUIRY AND ETHICS** History of Science - what is science? origins of science, trends in natural sciences Transition from natural history to enquiry based study in biology Philosophy of Science - general introduction, difference in discipline specific philosophy Social implications of research. Animal experimentation ethics Wildlife ethics Human experimentation ethics Ethics in Science and research - data fudging, plagiarism	**[15]**
	References: 1. Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J., & Jones, A., (2011), Practical skills in Chemistry, 2 nd Ed., Prentice Hall, Harlow. 2. Hibbert, D. B. & Gooding, J. J. (2006) Data Analysis for Chemistry Oxford University Press. 3. Topping, J., (1984) Errors of Observation and their Treatment 4 thEd., Chapman Hill, London. 4. Harris, D. C. (2007) Quantative Chemical Analysis 6th Ed., Freeman Chapters 3-5 5. Levie, R. De. (2001) How to use Excel in Analytical Chemistry and in general scientific data analysis Cambridge University Press. 6. Iltis, A. MacKay, D. (2020) The Oxford Handbook of Research Ethics, Oxford University Press	

SEMESTER II
MANDATORY

Course Code 23BPBW2T01	Course Title Population Dynamics & Behavioral Ecology	Credits 04	No. of lectures 60

Course Outcomes:

On completion of the course, the student will be able to -

CO 1	Summarise central concepts of population dynamics	L2
CO 2	Illustrate the types and impact of plant-animal interactions	L2
CO 3	Explain behavioural peculiarities in animals	L2
CO 4	Classify innate and acquired animal behaviours and behavioural ecology	L4

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	2	3	0	2
CO 2	3	1	2	3	1	3
CO 3	3	1	2	2	0	1
CO 4	3	1	2	3	0	2

Unit I:	**Population dynamics**	**15**
	• Age & Sex distribution • Recruitment ratio & population sustenance (e.g. herbivores, fish & prawns) • Effect of natality, mortality & migration • Exponential & logistic growth curves, Survivorship curves, k & r selected species Interaction between populations; • Types of interactions Predator – prey interactions • Fluctuations in populations.	
Unit II:	**Plant – Animal interactions**	**15**
	• Shelter & Nesting by animals • Effect of grazing & browsing • Protection strategies of plants for sustaining populations • Obligate plant – animal dependence – e.g. Fig wasp, Orchid mantis.	

Unit III:	**Behavioral Ecology – I**	**15**
	● Biological clock ● Behavior of embryos ● Animal Communication ● Sexual conflict and selection ● Social behaviors and parental care ● Kin selection, altruism, reciprocal altruism, Hamilton's rule ● Experience, learning and motivation ● Orientation	
Unit IV:	**Behavioral Ecology - II**	**15**
	● Definition & types of behaviors (including innate & learned). ● Cues / triggers to behavior, Optimal Foraging theory (OFT), Kohler experiment ● Competition and Predation, Commensalism, Parasitism, mutualism, amensalism ● Genetic basis of behavior Sociobiology ● Anti-predator defenses ● Facial expression ● Zoopharmacognosy (Self medicating behavior in animals)	

Course Code 23BPBW2T02	Course Title Habitat Ecology	Credits 04	No. of lectures 60

Course Outcomes:

On completion of the course, the student will be able to –

CO 1	Explain the basis of habitat selection in animals	L2
CO 2	Illustrate the diversity and impacts of flora and fauna found in urban areas	L2
CO 3	Relate wildlife habitat management with human welfare	L2/L1
CO 4	Summarise the contributions of ecosystems towards public wellbeing	L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	2	3	0	2
CO 2	3	1	2	3	1	2
CO 3	3	2	2	3	1	3
CO 4	3	1	0	3	0	2

Unit I:	**Habitat selection in animals**	**15**
	• Concept of home range, familiar areas • Concept of niches, its realization & its continuity • Micro-habitats: fallen log, treetop-puddles etc. • Territoriality and habitat utilization in animals	
Unit II:	**Urban Biodiversity**	**15**
	• Biodiversity in cities & towns • Concept of opportunistic, Invasive, Indigenous and Exotic species • Strays and feral populations • Impact of human activities on urban biodiversity: e.g. Effect of plastic and mobile radiation • Conservation practices of Urban Biodiversity • Role & Maintenance of Avenue plantation in urban areas (plantation, transplantation, reasonable pruning)	

Unit III:	**Wildlife habitats and human welfare**	**15**
	● Concept of carrying capacity ● Limiting factors in habitats ● Improving carrying capacity in wildlife areas e.g. Wildlife management for Game hunting & Fishing ● Biomimetics ● The Economics of Ecosystem and Biodiversity (TEEB) ● Biodiversity as an Economic resource and its consideration in the national economic plans	
Unit IV:	**Ecosystem Services**	**15**
	● Definition and Significance ● Provisioning and Regulating Ecosystem services ● Cultural and Supporting Ecosystem services ● Evaluating Outstanding Universal Value of Ecosystems ● Natural Heritage sites in India	

Course Code 23BPBW2T03	Course Title Implementing Conservation	Credits 04	No. of lectures 60

Course Outcomes:

On completion of the course, the student will be able to -

CO 1	Evaluate the importance of protected areas for conservation	L5
CO 2	Discuss the importance of tribal and traditional knowledge for conservation	L6
CO 3	Outline the contributions of major institutions towards conservation	L5/L2
CO 4	Explain the role of important NGOs pioneering in the conservation of nature and wildlife	L5/L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	2	3	0	2
CO 2	3	1	2	3	1	2
CO 3	3	2	2	3	0	3
CO 4	3	1	0	3	1	2

Unit I:	**Major protected areas & their importance**	**15**
	• Wildlife parks, wildlife reserves, privately owned wildlife reserves & Biosphere reserves • Concept of buffer zones, core areas, wildlife corridors • Single species / single habitat-based conservation programmes (e.g. Project tiger, Valley of flowers)	
Unit II:	**People and conservation**	**15**
	• Traditional knowledge: Ethnobiology & Ecosystem people • Traditions & cultures • Tribes of Andaman & Nicobar, Arunachal Women in conservation • Traditional societies (e.g. Bishnois)	
Unit III:	**Major institutes for conservation**	**15**
	• Important international conventions & treaties on nature & conservation India's role & contribution (including VISION 2040) • Ex- situ & in-situ conservation • Conservation breeding (e.g. Vulture, Pygmy hog, Gharial etc.) • Institutions and their role in conservation; Zoos, Botanical gardens, aquaria, natural history museums & collections • Zoological survey of India, Botanical survey of India, Wildlife Institute of India, Forest Research Institute, Survey of India, Central Marine Fisheries Research Institute, SACON	

Unit IV:	**Role of NGOs in conservation**	**15**
	• International NGOs; UNEP, GEF, WCS, Bird Life International Important NGOs in India & their contributions - Paryavaran Dakshata Mandal, Hariyali, WWF, ATREE, BNHS, WTI, Kalpavriksha • Important NGO movements Chipko movement, Apiko movement, Narmada Bachao Andolan, Pani Panchayats, Seed Movement, Save Aarey movement • Recent organizations and movements	

Course Code 23BPBW2P01	PRACTICALS BASED ON 23BPBW2T01, 23BPBW2T02, 23BPBW2T03	Credits 02

Course Outcomes:

On completion of the course, the student will be able to -

CO 1	Identify and describe deep sea, intertidal and benthic flora and fauna.	L3
CO 2	Examine the animal habitat parameters to assess ecosystem health	L4
CO 3	Illustrate the threats to ecosystem due to introduced species	L2
CO 4	Take part in field visits to monitor protected areas and natural heritage sites	L4

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	0	3	0	2
CO 2	3	2	0	3	0	2
CO 3	3	1	0	3	0	2
CO 4	3	2	0	3	3	3

1. On a phytogeographic map of India locate & demarcate major sanctuaries / national parks.
2. Mount and identify zooplankton (preserved samples may be used).
3. Study of deep sea and intertidal flora and their ecological role (pictures / diagrams only).
4. Study of animal architecture (photographs / diagram / abandoned specimen); Hive of honey bee, nest of paper wasp, nest of potter wasp, mount of termite, nests of weaver bird and bowerbird, sand martin bird.
5. Using photographs / paintings / colored drawings identify and study distribution and ecological role of common bivalves and gastropods that occur along a sea-shore.
6. Determination of LC50 of a suitable toxicant (e.g. CuSO4 / neem leaf extract) using a suitable model e.g. *Daphnia*, *Cyclops*, mosquito larvae, Chironomous larvae, rice weevil, Brine shrimp, *Lemna*). Compare two or more different toxicants and compare their lethality.
7. Collect an **abandoned** nest of a bird (made of twigs /grass preferably collected after the breeding season). e.g. Bulbul or Crow or Warbler. Carry out the following analysis; Record the weight of the nest. Gently separate the nesting material one by one and segregate them as per their lengths. Weight each length group separately and note their group total weights. Note down any cushioning material /artificial materials used. Make a frequency table of nesting material lengths & weights. Depict your observations using suitable statistical tools and evaluate your data. Make interpretations regarding preferences in nesting material.

	8. Identify and study specifications & applications of various ringing & tagging devices (photographs or models or working models and diagrams). 9. Visit to an NGO/institute/field visit for macro photography. 10. Identification, biology & ecological role of following introduced species; *Parthenium*, *Eichhornea*, *Lantana camara.* 11. Visit to Natural heritage site 12. Visit to a Zoological park / National park / Wildlife sanctuary	

SEMESTER II
ELECTIVE I

Course Code 23BPBW2T04	Course Title Bioanalytical techniques	Credits 02	No. of lectures 60

Course Outcomes:

On completion of the course, the student will be able to –

CO 1	Outline general concepts, techniques and applications of genomics	L2
CO 2	Compare DNA-based techniques for extraction, PCR, sequencing, blotting and barcoding	L2
CO 3	Summarise general concepts, techniques and applications of proteomics	L2
CO 4	List out protein-based techniques for extraction, evaluation, characterisation and fingerprinting	L4/L1

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	1	1	0	2
CO 2	3	3	2	1	0	2
CO 3	3	2	1	1	0	2
CO 4	3	3	2	1	0	2

Unit I:	**Molecular Techniques – I**	**15**
	• Genomics (General concepts & applications) • Extraction of DNA from samples • PCR & RT PCR • DNA sequencing, Sanger's & Maxam Gilbert methods, DNA fingerprinting, DNA barcoding • Southern Blotting and its applications	
Unit II:	**Molecular Techniques – II**	**15**
	• Proteomics - General concepts & applications in phylogenetic analysis • Extraction & evaluation of proteins • Protein fingerprinting (e.g. venom proteins, plant proteins) Western Blotting and its applications • Protein characterization (X-ray crystallography, Mass spectrometry)	

Course Code 23BPBW2P02	PRACTICALS BASED ON 23BPBW2T04	Credits 02

Course Outcomes:

On completion of the course, the student will be able to –

CO 1	Estimate DNA, RNA and protein from biological sample	L6
CO 2	Make use of bioinformatics tool to analyse sequence data	L3
CO 3	Illustrate analytical techniques used for separation	L2
CO 4	Explain working and application of PCR & Southern Blotting	L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	1	1	0	3
CO 2	3	2	3	1	0	2
CO 3	3	2	1	1	0	2
CO 4	3	2	2	1	0	2

1. Separate (serum / milk / pulses, etc.) proteins using PAGE and identify protein sizes using a protein ladder.

2. Extraction of DNA from a suitable mammalian blood / human cheek smear / Tissue or Plant sample (use kits / phenol-chloroform – isoamyl alcohol method / SDS – Ethanol method). Evaluate the purity of the extracted DNA with spectrophotometry. Comment on the results.

3. Extraction of RNA by Orcinol reagent.

4. Bioinformatics – using BLAST / FASTA tools, compare / analyze proteins

5. column chromatography
6. TLC
7. AGE
8. PCR
9. Blotting techniques

SEMESTER II
ELECTIVE II

Course Code 23BPBW2T05	Course Title Evolution	Credits 02	No. of lectures 60

Course Outcomes:

On completion of the course, the student will be able to –

CO 1	Summarise the major geological events of our planet	L2
CO 2	Recall the history of western ghats, major flora and fauna of India	L1
CO 3	Explain early, Darwinian and post Darwinian evolution theories	L2
CO 4	Relate evolution with ecological adaptations	L2/L1

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	2	2	0	2
CO 2	3	2	2	3	0	2
CO 3	3	2	2	1	0	2
CO 4	3	2	2	3	0	2

Unit I:	**Natural History**	**15**
	• Geological time scale • Continental drift, plate tectonics • Prehistoric migration and dispersal of species • Extinction, extinction events • Natural History of major Flora & Fauna of India • Natural History of Western Ghats	
Unit II:	**Evolution**	**15**
	• Theories of Evolution: Early Theories, Darwin's Theory, Modern Synthesis, Origin and evolution of life across various eras, Mutation and variation Mutation-Selection balance. • Hardy-Weinberg's Principle, Red Queen Hypothesis, Mechanism of Evolution (Genetic variation and recombination, Random genetic Drift, natural and sexual selection, Gene flow, Reproductive Isolation), Adaptation, Co-evolution, Speciation and its types: Allopatric and sympatric speciation with suitable examples, Neutral Mutation • Linking evolution to ecological adaptations and Behavioral adaptations; Examples: Darwin's finches, Insular fauna including plants	

Course Code 23BPBW2P03	PRACTICALS BASED ON 23BPBW2T05	Credits 02

Course Outcomes:

On completion of the course, the student will be able to –

CO 1	Identify fossils, connecting links and animal hybrids	L3
CO 2	Relate homologous and analogous parts with evolutions	L1
CO 3	Recall the major contributions of evolutionary biologists	L1
CO 4	Take part in educational tours and workshop	L4

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	0	2	0	2
CO 2	3	2	0	2	0	2
CO 3	3	1	0	1	0	1
CO 4	3	2	0	2	3	3

1. Study of plant and animal fossils (Stromatolites, *Rhynia, Lepidodendron, Trilobite, Ammonite, Glomerula, Colombia forbesi*)
2. Study of plant and animal connecting links (*Archaeopterix,* Lungfish, Platypus, *Gnetum,* Seed ferns, *Euglena*)
3. Study of animal hybrids (grizzly, mule, wholphin, liger, zorse, dzo)
4. Making of fossils using shadu clay
5. Identify animals with super senses (Octopus, Bat, Mantis Shrimp, Jewel beetles, Honey Bees)
6. Study of homologous and analogous animal parts.
7. Visit to a museum/science center
8. Taxidermy workshop
9. Contribution of evolutionary biologists – Darwin, Wallace, Dawkins

Course Code 23BPBW2P04	Course Title On Job Training / Field Project related to Biodiversity, Wildlife Conservation & Management	Credits 04	No. of Hours: 120

Course Outcomes:

On completion of the course, the student will be able to –

CO 1	Identify and categorise local flora and fauna to demonstrate their ecological role	L3
CO 2	Apply field data collection methods to assess biodiversity of selected habitats	L4
CO 3	Analyse the collected data to evaluate anthropogenic impacts on local wildlife	L4
CO 4	Develop comprehensive report and present recommendations for research and conservation	L5

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	1	3	1	2
CO 2	3	3	2	3	2	3
CO 3	3	3	2	3	2	3
CO 4	3	3	3	3	3	3

General Guidelines

1. The OJT/FP topic may be undertaken from any topic relevant to biodiversity, ecology, conservation and allied subject with precise objective
2. Each student has to undertake a/an FP/OJT individually based on field and/or laboratory work
3. Students must remain present at the time of review meeting scheduled by research guides
4. Structure of report should contain the following chapters: Title, Abstract, Aim, Objective and Rationale, Introduction, Literature review, Methodology, Study Area, Observations, Result, Conclusion, Discussion, Bibliography
5. Student should prepare a powerpoint presentation of research project and it should be presented in front of respective examiner
6. In case of OJT, detailed report with attendance record and acknowledgement from the employer is to be submitted
7. Duly signed hard copy of report and PPT should be submitted to the Department/college

SUGGESTED READINGS

Sr. No.	Title	Author	Publisher	Year
1.	Protected Area Update; Newsletter	---------	Kalpavriksh Environment Action Group, Pune , India	Periodical
2.	Zoos in India; Legislation, Policy, Guidelines and Strategy	----------	Central Zoo Authority, New Delhi	2007
3.	Wildlife ecology	Aaron, N.M.	W.H. Freeman Co. San Francisco, U.S.A.	1973
4.	The Book of Indian Birds	Ali, Salim	Oxford University Press, Mumbai	1997
5.	Wildlife Ecology, Conservation and Management	Anthony R.E. Sinclair, John M. Fryxell and Graeme Caughly	Blackwell Publishing, U.S.A.	2006
6.	The Book of Indian Shells.	Apte, Deepak.	Oxford University Press, Mumbai.	
7.	Colorful Atlas on Indian Wildlife Diseases and Disorders	Arora and Bipul Chakraborthy B.M.	IBDC, Lucknow.	2008
8.	Indian Wildlife Yearbook	Arora B. M., Editor	AIZ & WV, Bareilly and Central Zoo Authority, New Delhi	2002
9.	Dietary Husbandry of Wild Mammalia	Arora, B.M.	AIZ & WV, Bareilly and CZA, New Delhi.	2001
10.	Indian Wildlife Diseases and Disorders.	Arora, B.M.		
11.	Rehabilitation in free living wild animals	Arora, B.M.	AIZ & WV, Bareilly	2007
12.	Reproduction in Wild Mammalia & Conservation	Arora, B.M.	AIZ & WV, Bareilly.	2002
13.	A Text Book of Developmental Biology	Banerjee, S.	IBD, Dehradun	2001
14.	Remote Sensing for Hazard Monitoring and Disaster Assessment	Barett, E.C. and Anton Micallef	Taylor and Francis, London	1991
15.	Statistics in Research	Bernard Ostle and R.W.Mensing		
16.	Wild Animals in Central India	Brander, A.A	Natraj Publisher, Dehradun.	
17.	Method of Statistical Analysis	C.H. Goulden	John Wiley & Sons	
18.	Environmental Impact Assessment	Canter, L. W.	Graw, Mc, , Hill Publication, New York.	
19.	A TextBook of Agricultural Statistics	Chandel S.R.S,.	Achal Prakashan Mandir, Kanpur	1999

Sr. No.	Title	Author	Publisher	Year
20.	Introduction to Geographic Information Systems,	Chang – Kang, Tsung	Tata McGraw -Hill Publishing Company Limited, New Delhi	2002
21.	A guide to Chemical Restraint of Wild Animals.	Chowdhury, Sushant and Malik, Pradeep	Natraj Publishers, Dehradun.	
22.	EIA – A Biography	Clark, B. D., Bissel, B. D. and Watheam, P.	School of Forestry and Environment, SHIATS- Deemed University, Allahabad	
23.	The Temple Tiger.	Corbett, Jim	Oxford University Press, New Delhi	2007
24.	Asian Elephant,	Daniel, J.C.	Natraj Publishers, Dehradun	
25.	The Book of Indian Reptiles and Amphibians	Daniel, J.C.	Oxford University Press, Mumbai.	
26.	Resource and Environmental Economics	Fisher, A.C.	New York: John Wiley & Sons	1979
27.	The conservation of plant biodiversity.	Frankal, Otto H., Anthony, A., Brown, D. and Burdon, Jeremy J.	Cambridge University Press	1995
28.	Statistical Methods	G.W. Snedecor and W.G. Cochran		
29.	The Serengeti Lion	George B. Schaller		
30.	Fundamentals of Wildlife Management	Gopal, Rajesh	Justice Home, Allahabad, India.	1992
31.	Encyclopedia of mammals	Grzimek	McGraw Hill Publishing House, New Delhi.	1988
32.	Wild Animals, Their Minds and Manners	Hornaday, W.T.	IBD, Dehradun.	1989
33.	Concepts in Wildlife Management	Hosetti, B.B.	Daya Publishing House, Delhi.	1997
34.	Collection and preservation of animals	Jairajpuri M. S.	Zoological Survey of India	1990
35.	Statistical Ecology	John A. Ludwig & James F. Reynolds	John Wiley & Sons	1988
36.	Handbook of Environment, Forest and Wildlife Protection Laws in India	Justice Kuldip Singh	Natraj Publishers, Dehradun	1998
37.	Biodiversity conservation in managed and protected areas	Katwal/Banerjee	Agrobios, India	2002

Sr. No.	Title	Author	Publisher	Year
38.	Advances in Fish and Wildlife Ecology and Biology	Kaul, B.L.		1999
39.	A Vet in Wilderness	Khan Ali M. G.	Central Zoo Authority, New Delhi	
40.	Modern Textbook of Zoology, Vertebrates.	Kotpal, R.L.	Rastogi Publications, Merrut.	
41.	Remote Sensing and Image Interpretation	Lillesand, T.M. and Kieffer, R.W	John Wiley and Sons	
42.	Wild Animals of India, Burma, Malaya and Tibet	Lydekker, R.,	Natraj Publishers, Dehradun.	
43.	Wildlife Crime	Menon, Vivek and Kumar, Ashok	Natraj Publisher, Dehradun.	1999
44.	Wildlife Issues in a Changing World	Moulton, M. P. & J. Sanderson	St. Lucie Press	1997
45.	A handbook of forestry.	Negi, S.S.	International Book Distributor, Dehradun.	2005
46.	Biodiversity and its conservation in India	Negi, S.S.	Indus Publishing Co., New Delhi.	1993
47.	Manual for Wildlife Management in India	Negi, S.S.		
48.	Fundamentals of Ecology	Odum, Eugene P	Natraj Publishers, Dehradun.	
49.	Applied Anatomy of Domestic Animals.	Ommer, P.A. and Harshan, K.R.	Jaypee Brothers Medical Publishers (P) Ltd., New Delhi.	
50.	Natural Resource Information for Economic Development	Orris C. Herfindahl	Baltimore: The Johns Hopkins University Press	1969
51.	Watching and Conserving	Oxford Anthology of Indian Wildlife	Oxford University Press, New Delhi.	
52.	Aerial Photography and Image Interpretation for Resource Management.	Paine, D.P.	John Wiley and Sons.	
53.	The Ecology of Wildlife Diseases.	Peter J. Hudson, Annapaola Rizzoli, Bryan T. Grenfell, Hans Heestrbeek and Andy P. Dobson	Oxford University Press, Oxford	2002
54.	Book of Indian Animals.	Prater, S.H.	Bombay Natural History Society, Mumbai.	
55.	Essentials of Conservation Biology	Primack, R.B.	Sinauer Associates, Inc. Sunderland, MA	1998

Sr. No.	Title	Author	Publisher	Year
56.	Principles and Procedures of Statistics (with special reference to Biological Sciences)	R.G. Steel and J.H. Torrie		
57.	A TextBook of Agricultural Statistics	R.Rangaswamy		
58.	Birds of Wetlands and Grasslands	Rahmani, Asad R. & Ugra, Gayatri	Bombay Natural History Society, Mumbai.	
59.	A Handbook of the Management of Animals in Captivity.	Ram Brahma Sanyal		1995
60.	Hunting and Shooting	Rangarajan, Mahesh	The Oxford Anthology of Indian Wildlife.	1999
61.	The ecology and evolution of animal behavior	Robert, A.W	Good Year Pub. Co. California, U.S.A.	1979
62.	Wildlife management.	Robert, G.H.	W.H. Freeman and Co., San Francisco, U.S.A.	1978
63.	The Care and Feeding of Infant Orphaned Wild Birds.	S.M.L. Grose.	IBD, Dehradun	
64.	Remote Sensing: Principles and Applications	Sabbins, F.E., Freeman		
65.	Manual of wildlife techniques for India.	Sale, J.B. and Bergmuller, K.	WII, FAO, DehraDun, India	1988
66.	A Handbook of the Management of Animals in Captivity.	Sanyal, Ram Brahma		1995
67.	Indian Wildlife Resources Ecology and Development	Sharma, B.D	Daya Publishing House, Delhi	1999
68.	A New Approach to Linear Programming	Sharma, S.D.	Kedarnath, Ramnath and Co. Meerut	1975
69.	Wildlife Ecology, Conservation and Management	Sinclair, Anthony R.E., Fryxell, John M. and Caughey, Graeme	Blackwell Publishing, U.S.A.	2006
70.	Economics of PA's and its effect on biodiversity.	Singh and Vijaykumar.	APH Publishing Corporation, New Delhi.	2001
71.	Text Book of Wildlife Management.	Singh, S.K.	IBDC, Lucknow.	2005

Sr. No.	Title	Author	Publisher	Year
72.	Conserving India's Natural Heritage	Singh, Samar	Natraj Publication, DehraDun.	1987
73.	Wildlife and Forest Conservation	Sinha, P.C.	Anmol Publishing Pvt. Ltd., New Delhi.	1998
74.	Mammals Skin.	Sokolov, V.E.	IBD, Dehradun.	1982
75.	Wildlife research and management. Asian and American Approaches	Stephen, H.B. and V.B. Saharia	Oxford University Press, Delhi	1995
76.	Zoogeography of India and Asia.	Tiwari, S.K.	CBS Publisher and Distributors, New Delhi.	
77.	Natural Resource and Environmental Economics	Tony Prato,	Iowa State University Press	1998
78.	Environmental and social impact assessment	Vanclay F. and Bronstein, D.A.	John Wiley & Sons, New York.	1995
79.	Guide for Planning Wildlife Management in Protected Areas and Managed Landscapes	Vishwas Sawarkar	Natraj Publisher. Dehradun	
80.	Experimental Designs	W.G. Cochran and G.M.Cox		
81.	Parasitic Diseases of Wild Animals.	W.M. Samuel, M.J. Pybus and A.A. Kocan		2005
82.	Vertebrate Zoology and Evolution.	Yadav, B.N.	IBD, Dehradun.	2000
83.	On the Origin of Species	Charles Darwin		
84.	Invertebrates, Chordate Zoology	Jordan & Verma		
85.	Apala Paryavaran	Paryavaran Dakshata Mandal		

Theory Examinations: For Paper 1, Paper 2, Paper 3 and Research Methodology
Suggested Format for MAJOR Question paper

23BPBW_T0_/0_/20__				
Duration: 02 hr. 30 min				**Total Marks: 60**
N.B.				
1.	**All questions are compulsory**			
2.	**Draw neat labeled diagram wherever necessary**			
3.	**All questions carry equal marks**			
Q.1.	**(A)**		**Attempt any one**	**8**
		(I)	Based on Unit 1	
		(II)	Based on Unit 1	
Q.1.	**(B)**		**Attempt any one**	**7**
		(I)	Based on Unit 1	
		(II)	Based on Unit 1	
Q.2.	**(A)**		**Attempt any one**	**8**
		(I)	Based on Unit 2	
		(II)	Based on Unit 2	
Q.2.	**(B)**		**Attempt any one**	**7**
		(I)	Based on Unit 2	
		(II)	Based on Unit 2	
Q.3.	**(A)**		**Attempt any one**	**8**
		(I)	Based on Unit 3	
		(II)	Based on Unit 3	
Q.3.	**(B)**		**Attempt any one**	**7**
		(I)	Based on Unit 3	
		(II)	Based on Unit 3	
Q.4.	**(A)**		**Attempt any one**	**8**
		(I)	Based on Unit 4	
		(II)	Based on Unit 4	
Q.4.	**(B)**		**Attempt any one**	**7**
		(I)	Based on Unit 4	
		(II)	Based on Unit 4	
			**********	

Theory Examinations: For ELECTIVE Paper

23BPBW_T0_/0_/20__				
Duration: 01 hr. 30 min				**Total Marks: 30**
N.B.				
1) All questions are compulsory				
2) Draw neat labeled diagram wherever necessary				
3) All questions carry equal marks				
Q.1.	**(A)**		**Attempt any one**	**8**
		(I)	Based on Unit 1	
		(II)	Based on Unit 1	
Q.1.	**(B)**		**Attempt any one**	**7**
		(I)	Based on Unit 1	
		(II)	Based on Unit 1	
Q.2.	**(A)**		**Attempt any one**	**8**
		(I)	Based on Unit 2	
		(II)	Based on Unit 2	
Q.2.	**(B)**		**Attempt any one**	**7**
		(I)	Based on Unit 2	
		(II)	Based on Unit 2	
			**********	

Semester End Practical Examination:
Practical examination of each paper for 50 marks will be held for three and half hours

Semester ____ Practical Examination "Month & Year"
Paper Code:- _____

Total Duration: - 03.½ hrs. **Total Marks**: - 50

Distribution of marks
Question 1 - (performance & result/identification) – 20 marks
Question 2 - (performance & result/identification) – 10 marks
Question 3 - (identification) – 10 marks
Question 4 - (viva voce) – 05 marks
Question 5 - (journal/field report) – 05 marks

Marks Distribution and Passing Criterion for Each Semester

Theory						**Practical**		
Course Code SEMI / SEM II	Internal	Min marks for passing	Theory Examination	Min marks for passing	Total	Course Code	Practical Examination	Min marks for passing
23BPBW1T01/2T01	40	16	60	24	100	-	-	-
23BPBW1T02/2T02	40	16	60	24	100	-	-	-
23BPBW1T03/2T03	40	16	60	24	100	-	-	-
Laboratory 1	-	-	-	-	-	23BPBW1P01 /2P01	**50**	**20**
23BPBW1T04 or 1T05/2T04 or 2T05	20	08	30	12	50			
Laboratory 2	-	-	-	-	-	23BPBW1P02 or 1P03/2P02 or 2P03	**50**	**20**
23BPRM1T03 / 23BPBW2P04	40	16	60	24	100	-	-	-

Pedagogy for student engagement is predominantly lectures. However, other pedagogies enhancing better student engagement to be recommended for each course. The list includes active learning/ course projects/ problem or project-based learning/case studies/self-study like seminar, term paper or MOOC

****