UNIVERSITY OF JAMMU

(NAAC ACCREDITED 'A ++' GRADE' UNIVERSITY)
Baba Sahib Ambedkar Road, Jammu-180006 (J&K)

Academic Section
Email: academicsectionju14@gmail.com

NOTIFICATION
(25/June/Adp./11)

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the Academic Council, is pleased to authorize the adoption of the syllabi and courses of studies for **Post Graduate Programme in Zoology under NEP-2020** as per details given below:-

Two Year Post Graduate Programme under NEP-2020

Subject	Semester	For the examinations to be held in the year
Zoology	Semester-I	December 2025, 2026 and 2027
	Semester-II	May 2026, 2027 and 2028
	Semester-III	December 2026, 2027 and 2028
	Semester-IV	May 2027, 2028 and 2029

One Year Post Graduate Programme under NEP-2020

Subject	Semester	For the examinations to be held in the year
Zoology	Semester-I	December 2026, 2027 and 2028
	Semester-II	May 2027, 2028 and 2029

The Syllabi of the courses are also available on the University website: www.jammuuniversity.ac.in

DEAN ACADEMIC AFFAIRS

No. F. Acd/II/25/3521-61
Dated: 19/6/2025
Copy for information and necessary action to:

1. Dean, Faculty of Life Science
2. Convener, Board of Studies in **Zoology**
3. Director, Centre for IT Enabled services and Management, University of Jammu for information and for uploading on University Website.
4. All members of the Board of Studies
5. Joint Registrar (Evaluation/P.G. Exam.)
6. Programmer, Computer Section, Examination Wing

SYLLABI FRAMEWORK PG PROGRAMME ZOOLOGY (1 YEAR)

PG Syllabi 2025

S.No.	Course No.	Course Title	No. of Credits	Credits Level	Credit Points	Course Type Core/Elective /Any other	Marks Theory	Marks Practical	Nature of Course Global	National	Regional	Skill	SWAYAM/ MOOC	Vocational Course	Research Project/ Summer Internship/ Dissertation
1.	P1ZOTC101	Limnology and Aquatic Ecology	4	6.5	26	Core	100	-	✓	✓	✓	✓			
2.	P1ZOTC102	Cell Biology and Bio-Instrumentation	4	6.5	26	Core	100	-	✓	✓	✓	✓			
3.	P1ZOTC103	Applications of Microbiology	2	6.5	13	Core	50	-	✓	✓					
4.	P1ZOPC104	Practicals based on P1ZOTC101	2	6.5	13	Core	-	50	✓	✓	✓	✓			
5.	P1ZOPC105	Practicals based on P1ZOTC102 & P1ZOTC103	2+2	6.5	26	Core	-	100	✓	✓	✓	✓			
6.	P1ZOTE110	Aquaculture: Fundamentals and Practices	2*	6.5	13	Elective	50	-	✓	✓	✓	✓			
7.	P1ZOTE111	Basics of Insect Diversity	2	6.5	13	Elective	50	-	✓	✓	✓				
8.	P1ZOTE112	Elementary Immunology	2	6.5	13	Elective	50	-	✓	✓					
9.	P1ZOTE113	Understanding Biodiversity Preservation	2	6.5	13	Elective	50	-	✓	✓					
10.	P1ZORC120	Research Project/Dissertation	4	6.5	26	Core	100	-							
11.	P1ZOPE114	Practicals based on P1ZOTE110	2*	6.5	13	Elective	-	50	✓	✓	✓	✓			
12.	P1ZOPE115	Practicals based on P1ZOTE111	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
13.	P1ZOPE116	Practicals based on P1ZOTE112	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
14.	P1ZOPE117	Practicals based on P1ZOTE113	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
15.	P1ZOTC201	Fishery Science	4	6.5	26	Core	100	-	✓	✓	✓	✓			
16.	P1ZOTC202	Human Genomics and Cytogenetics	4	6.5	26	Core	100	-	✓	✓	✓	✓			
17.	P1ZOPC203	Practicals based on P1ZOTC201	4	6.5	26	Core	100	-	✓	✓	✓	✓			
18.	P1ZOPC204	Practicals based on P1ZOTC202	2+2	6.5	26	Core	-	100	✓	✓	✓	✓			
19.	P1ZOTE210	Nematode Biology	2*	6.5	13	Elective	-	50	✓	✓	✓				
20.	P1ZOTE211	Aquarium and Fish Keeping	2	6.5	13	Elective	50	-	✓	✓	✓	✓			
21.	P1ZOTE212	Fundamentals of Neuroscience	2	6.5	13	Elective	50	-	✓	✓	✓				
22.	P1ZOTE213	Basics of Bioinformatics and Biostatistics	2	6.5	13	Elective	50	-	✓	✓	✓	✓			
23.	P1ZOPE214	Practicals based on P1ZOTE210	2*	6.5	13	Elective	50	-	✓	✓	✓	✓			
24.	P1ZOPE215	Practicals based on P1ZOTE211	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
25.	P1ZOPE216	Practicals based on P1ZOTE212	2	6.5	13	Elective	-	50	✓	✓		✓			
26.	P1ZOPE217	Practicals based on P1ZOTE213	2	6.5	13	Elective	-	50	✓	✓		✓			
27.	P1ZORE225	Field Visit/Industrial Training/Practicals	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
28.	P1ZORC226	Research Project/Dissertation	8	6.5	52	Core	200	-		✓	✓	✓			Research Project/Dissertation

COURSE STRUCTURE FOR PG PROGRAMME ZOOLOGY (1 YEAR) (ANNEXURE-1B

CREDIT FRAMEWORK FOR SEMESTER-I		
Major Core [10(T)+6(P)]		
P1ZOTC101	**Limnology and Aquatic Ecology**	4
P1ZOTC102	**Cell Biology and Bio-Instrumentation**	4
P1ZOTC103	**Applications of Microbiology**	2
P1ZOPC104	Practicals based on P1ZOTC101	2
P1ZOPC105	Practicals based on P1ZOTC102 & P1ZOTC103	2+2
	Total Credits	**16**
Major Elective (any one*) (2T+2P)		
P1ZOTE110	**Aquaculture: Fundamentals and Practices**	2*
P1ZOTE111	**Basics of Insect Diversity**	2
P1ZOTE112	**Elementary Immunology**	2
P1ZOTE113	**Understanding Biodiversity Preservation**	2
P1ZOPE114	Practicals based on P1ZOTE110	2*
P1ZOPE115	Practicals based on P1ZOTE111	2
P1ZOPE116	Practicals based on P1ZOTE112	2
P1ZOPE117	Practicals based on P1ZOTE113	2
	Total Credits (Major Elective)	**4**
P1ZORC120	**Research Project/Dissertation**	4
CREDIT FRAMEWORK FOR SEMESTER-II		
Major Core [8(T)+4(P)]		
P1ZOTC201	**Fishery Science**	4
P1ZOTC202	**Human Genomics and Cytogenetics**	4
P1ZOPC203	Practicals based on P1ZOTC201	2
P1ZOPC204	Practicals based on P1ZOTC202	2
	Total Credits	**12**
Major Elective (any one*)(2T+2P)		
P1ZOTE210	**Nematode Biology**	2*
P1ZOTE211	**Aquarium and fish keeping**	2
P1ZOTE212	**Fundamentals of Neuroscience**	2
P1ZOTE213	**Basics of Bioinformatics and Biostatistics**	2
P1ZOPE214	Practicals based on P1ZOTE210	2*
P1ZOPE215	Practicals based on P1ZOTE211	2
P1ZOPE216	Practicals based on P1ZOTE212	2
P1ZOPE217	Practicals based on P1ZOTE213	2
	Total Credits (Major Elective)	**4**
P1ZORE221	**Field Visit/Industrial Training/Practicals**	-
P1ZORC222	**Research Project/Dissertation**	8
	Total credits earned by the students	**48**

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COURSE CODE	COURSE NAME	CREDITS
CREDIT FRAMEWORK FOR SEMESTER-I		
MAJOR CORE [12(T)+6(P)]		
P1ZOTC101	**Limnology and Aquatic Ecology**	4
P1ZOTC102	**Cell Biology and Bio-Instrumentation**	4
P1ZOTC103	**Applications of Microbiology**	2
P1ZOPC104	Practicals based on P1ZOTC101	2
P1ZOPC105	Practicals based on P1ZOTC102 & P1ZOTC103	2+2
	Total Credits	**16**
MAJOR ELECTIVE (ANY ONE*) (2T+2P)		
P1ZOTE110	**Aquaculture: Fundamentals and Practices**	2*
P1ZOTE111	**Basics of Insect Diversity**	2
P1ZOTE112	**Elementary Immunology**	2
P1ZOTE113	**Understanding Biodiversity Preservation**	2
P1ZOPE114	Practicals based on P1ZOTE110	2*
P1ZOPE115	Practicals based on P1ZOTE111	2
P1ZOPE116	Practicals based on P1ZOTE112	2
P1ZOPE117	Practicals based on P1ZOTE113	2
	Total Credits	**4**
P1ZORE120	**Research Project/Dissertation**	4
	Semester Credit Total	**24**

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Course No. P1ZOTC101

Course Title: Limnology and Aquatic Ecology

Credits: 4

Maximum Marks:100

Course Outcomes:

CO1: Students will understand the fundamental principles of limnology, including its history, scope, and relevance in the Indian context. The unit also covers the causes and consequences of dwindling freshwater availability and the importance of sustainable resource management.

CO2: Students will understand the origins and classifications of lentic water bodies like lakes and ponds. They will learn about the process of eutrophication, its impacts, and various restoration methods. The unit also covers the basic concepts and management techniques associated with wetland ecosystems.

CO3: Students will understand the origins and classifications of lotic water bodies like rivers and streams, including their unique physico-chemical and biotic characteristics. They will learn about the management strategies specific to riverine ecosystems. The unit also introduces transitional ecosystems like estuaries and their classification.

CO4: Students will understand the key physical features of freshwater systems, including light penetration, turbidity, and currents, and their influence on aquatic life. They will also learn about the chemical characteristics such as pH, dissolved oxygen, and carbon dioxide, and their significance. The unit further explores the composition and diversity of the bottom substrate and the phenomenon of thermal stratification.

CO5: Students will understand the introduction and characteristics of wetland ecosystems and various management techniques employed for their conservation. They will learn about the concepts of translocations and acidification in aquatic environments. The unit emphasizes the critical issue of dwindling freshwater resources and strategies for their conservation and management.

UNIT-I: Introduction to Limnology and Freshwater Resources (12 hrs)

1.1 Limnology: History and scope; Limnology in India

1.2 The Water Cycle: An overview of water movement on, above, and below the Earth's surface

1. 3 Declining Availability of Freshwater: Causes and Protection Strategies

1.4 Freshwater resource management.

UNIT-II: Lentic Ecosystems: Lakes and Ponds (13 hrs)

2.1 Eutrophication: Understanding its Causes and Ecological Impacts

2.2 Strategies for the Remediation of Eutrophic Water Bodies

2.3 Origins and Different Kinds of Ponds

2.4 Lake: Origin and Classification.

UNIT-III: Lotic Ecosystems: Rivers and Streams (13 hrs)

3.1 Rivers: Origin and Classification

3.2 Water flow and Stream channels; Physico-chemical characteristics

3.3 Biotic characteristics of flowing waters

3.4 River Management

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Course No. P1ZOTC101 Course Title: Limnology and Aquatic Ecology

UNIT-IV: Wetlands and Transitional Ecosystems **(10 hrs)**

4.1 Wetlands: Introduction and Characteristics

4.2 Management techniques of wetlands

4.3 Estuaries: Definition, origin and classification

4.4 Bogs and marshes: Origin, types, abiotic and biotic characteristics

UNIT-V: Physical and Chemical Characteristics of Freshwater Systems **(12 hrs)**

5.1 Light: Sources, factors affecting light penetration, measurement and its relationship with aquatic organisms

5.2 Temperature: Effect on biological processes and thermal stratification

5.3 Dissolved oxygen and carbon dioxide: Sources, determination, distribution and significance

5.4 pH: Definition, distribution and significance

Scheme of Examination:

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

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Course No. P1ZOTC101 Course Title: Limnology and Aquatic Ecology

SUGGESTED BOOKS:

- Smith, R.L. 1978. Ecology and Field Biology. Harper & Row Publishers, USA.
- Begon, M., Townsend, C.R., and Harper, J.L. 2006. Ecology: From Individuals to Ecosystems. Blackwell Publishing, UK.
- Krebs, C.J. 2009. Ecology: The Experimental Analysis of Distribution and Abundance. Pearson Education.
- Tilman, D. 1982. Resource Competition and Community Structure. Princeton University Press, USA.
- Jorgensen, S.E. 2002. Ecological Modelling: An Introduction. Elsevier, Netherlands.
- Gaston, K.J., and Spicer, J.I. 2004. Biodiversity: An Introduction. Blackwell Science, UK.
- Wilson, E.O. 1992. The Diversity of Life. Belknap Press, USA.
- May, R.M. 1974. Stability and Complexity in Model Ecosystems. Princeton University Press, USA.
- Schlesinger, W.H. 1997. Biogeochemistry: An Analysis of Global Change. Academic Press, USA.
- DeAngelis, D.L., and Waterhouse, J.C. 1987. Equilibrium and Nonequilibrium Concepts in Ecological Models. Springer-Verlag, USA.
- Scheffer, M. 1998. Ecology of Shallow Lakes. Chapman & Hall, UK.
- Sanderson, E.W., et al. 2002. The Human Footprint and the Biodiversity Crisis. BioScience, USA.
- McKinney, M.L., and Lockwood, J.L. 1999. Biotic Homogenization. Springer-Verlag, USA.
- Giller, P.S. 2005. The Ecology of Freshwater Systems. Blackwell Publishing, UK.
- Tansley, A.G. 1935. The Use and Abuse of Vegetational Concepts and Terms. Ecology, USA.
- Franklin, J.F., and Forman, R.T.T. 1987. Creating Landscape Patterns by Forest Cutting. Ecology, USA.
- Sharma, P.B. 2020. Fundamentals of Ecology & Environment. Dhanpat Rai Publishers, India.

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Course No. P1ZOPC104

Practicals based on P1ZOTC101

Credits: 2

Maximum Marks:50

1. Comparison of the physical characteristics of water from different water bodies.
2. Comparison of the physical characteristics of soil.
3. Measurement of common pollutants such as oil, grease, and fluorides in water.
4. Qualitative analysis of water samples for phytoplankton.
5. Quantitative analysis of water samples for phytoplankton.
6. Qualitative analysis of water samples for zooplankton.
7. Quantitative analysis of water samples for zooplankton.
8. Collection and identification of macrobenthic fauna.
9. Quantitative and qualitative analysis of benthic macroinvertebrates.
10. Identification of local fish species based on morphometric characteristics.
11. Estimation and comparison of FCO_2 levels in water samples.
12. Estimation and comparison of dissolved oxygen (DO) levels in water samples.
13. Estimation and comparison of carbonate and bicarbonate concentrations in water.
14. Estimation and comparison of calcium (Ca^{++}) and magnesium (Mg^{+}) concentrations in water.
15. Estimation of sulphate levels in water samples.
16. Estimation of phosphorus levels in water samples.
17. Estimation of silica levels in water samples.
18. Estimation of nitrate concentrations in water samples.
19. Sediment analysis of elements (Na, K, Ca, Mg, Phosphorus, Nitrate).
20. Study of macrophytes in aquatic environments

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Practicals			
Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
Internal Examination	100%	Continuous evaluation	25
External Examination	100%	4 hours	25
Total			50

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Course No. P1ZOTC102 Course Title: Cell Biology and Bio-Instrumentation

Credits: 4 Maximum Marks:100

Course Outcomes:

CO1: Students will understand the fundamental structural organization of prokaryotic and eukaryotic cells, highlighting their key differences. They will learn about the intricate structure and diverse functions of the plasma membrane, including various models of organization. The unit also covers the mechanisms of transport across cellular membranes, encompassing both passive and active processes and the movement of macromolecules.

CO2: Students will understand the regulatory mechanisms that govern the progression through the cell cycle, including the stages of mitosis and meiosis. They will learn the general principles of cell communication, the roles of different cell adhesion molecules, and the function of intercellular junctions. The unit also covers the mechanisms of cell signaling through various cell surface receptors and their associated pathways.

CO3: Students will understand the process of programmed cell death (apoptosis) in mammals, including the involvement of key regulatory proteins and the intrinsic and extrinsic signaling pathways. They will learn about apoptotic pathways in model organisms like *C. elegans* and *Drosophila*. The unit also explores therapeutic strategies that target apoptosis and its role in diseases like cancer, with a focus on the p53 protein.

CO4: Students will understand the basic principles and applications of various electrophoretic techniques used for separating biomolecules. They will learn about different chromatographic methods, including thin layer, affinity, liquid, gas, paper, ion exchange, and size exclusion chromatography. The unit also covers the principles and types of centrifugation and provides an introduction to spectroscopic and structural analysis techniques.

CO5: Students will understand the principles and applications of different types of light and electron microscopy used for visualizing cellular structures. They will learn about the Polymerase Chain Reaction (PCR) and its various modifications. The unit also covers fundamental DNA sequencing methodologies and the principles behind different blotting techniques used for detecting specific biomolecules.

UNIT-I: Foundations of Cellular Architecture and Transport (12 hrs)

1.1 Eukaryotic and Prokaryotic Cell Structure: Comparative Analysis and Key Differences

1.2 The Plasma Membrane: Structural Models, Composition, and Diverse Functions

1.3 Mechanisms of Membrane Transport: Active and Passive Processes, Macromolecular Transport (Endocytosis, Exocytosis)

1.4 Intracellular Organization: Structure and Function of Major Cell Organelles (Golgi Apparatus, Mitochondria, Nucleus, Endoplasmic Reticulum)

UNIT-II: Cell Dynamics: Cycle, Communication, and Adhesion (10 hrs)

2.1 Orchestration of the Cell Cycle: Regulatory Mechanisms and Stages of Mitosis and Meiosis

2.2 Principles of Cell Communication: General Strategies, Hormonal Signaling, and Two-Component Systems

2.3 Cell Adhesion and Intercellular Junctions: Role of Adhesion Molecules, Extracellular Matrix, and Gap Junctions

2.4 Cell Surface Receptors and Initial Signaling Events: G-Protein Coupled Receptors, Ion Channel Receptors, and Enzyme-Linked Receptors

UNIT-III: Programmed Cell Death and its Significance (13 hrs)

3.1 Apoptosis in Mammals: Key Regulatory Proteins (Caspases, Bcl2 Family, IAPs) and Signaling Pathways (Intrinsic and Extrinsic)

Course No. P1ZOTC102 Course Title: Cell Biology and Bio-Instrumentation

3.2 Apoptotic Pathways in Model Organisms: Cell Death Mechanisms in *C. elegans* and *Drosophila*
3.3 Therapeutic Targeting of Apoptosis: Strategies and Applications in Disease Treatment
3.4 The Interplay of Apoptosis and Cancer: Role of Tumor Suppressor Protein p53

UNIT-IV: Fundamental Biochemical and Separation Techniques **(13 hrs)**

4.1 Electrophoretic Methods: Principles and Applications in Biomolecule Separation
4.2 Chromatographic Techniques: Exploration of Thin Layer, Affinity, Liquid, Gas, Paper, Ion Exchange, and Size Exclusion Chromatography
4.3 Principles and Categories of Centrifugation: Applications in Cellular and Molecular Biology
4.4 Spectroscopic and Structural Analysis: Introduction to Spectroscopy, Mass Spectrometry, and X-ray Crystallography

UNIT-V: Advanced Microscopy and Nucleic Acid Techniques **(12 hrs)**

5.1 Principles and Applications of Light and Electron Microscopy: Bright Field, Dark Field, Transmission, Scanning, and Fluorescence Microscopy
5.2 Polymerase Chain Reaction and its Variations: Nested, Quantitative Real-time, RT-PCR, Inverse, Anchored, and Touchdown PCR
5.3 DNA Sequencing Methodologies: Sanger Sequencing, Chemical Degradation Method, and an Overview of Next-Generation Sequencing
5.4 Blotting Techniques for Biomolecule Detection: Southern, Western, Northern, Slot, and Dot Blots

Scheme of Examination:

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

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Course No. P1ZOTC102 Course Title: Cell Biology and Bio-Instrumentation

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

SUGGESTED BOOKS:

1. Korenberg, (1974). DNA Replication. W.H. Freeman and Co., San Francisco.
2. Avers, C.J. (1976). Cell Biology. D. Van Nostrand Co., New York.
3. Dewitt, (1977). Biology of the Cell - An Evolutionary Approach. Saunders Co.
4. Jones and Bartlett, (1980). Cells: Principles of Molecular Structure and Function. Prescott.
5. De Robertis, E.D.F. and De Robertis, E.M.F. (1981). Cell and Molecular Biology. Saunders International Edition.
6. Alberts,(1983) Molecular Biology of the Cell.
7. Maniatis (1983). Molecular cloning
8. Garland, A. (1983). Molecular Biology of the cell A, Bestrisetical, Garland Pub. Inc. New York.
9. Watson et al. (1987) Molecular Biology of Genes Vol I and II.
10. Gene- Watson (1987) Molecular biology.
11. Smith and E.J. Wood, Chapman & Hall., HongKong (1992) Cell Biology
12. P.K. Gupta, Rastogi Publ. Merrut. (1994). Cytogenetics, Genetics and Evolution.
13. Bruce Melacinki & Freifelder, John and Bartlett Publ. Boston. (1998) Essentials of Molecular Biology.
14. Mousami Debnath, Shashi Jain Publ. Jaipur (2008) Cell and Molecular Biology
15. Thomas .D.Pollaed et.al.(2017).Cell biology.3rd Edn.Elsiver.
16. Alberts, Bruce, Hopkins Karen and Johnson , Alexander D. (2019). Essential Cell Biology (Fifth Edition).

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Course No. P1ZOTC103 Course Title: Applications of Microbiology

Credits: 2 Maximum Marks:50

CO1: Upon completion of this unit, students will be able to analyze the classification of medically significant microbes and their interaction with the human microbiota. They will understand the etiology and pathogenesis of key airborne diseases and their prophylaxis. Students will gain insight into food, water, and soil-borne diseases, identifying causative agents and methods for control and transmission. Additionally, they will evaluate significant viral pathogens and emerging threats in medical microbiology.

CO2: Students will explore the principles and processes of microbial fermentation, gaining skills in product recovery and the application of microbes in food and beverage production. They will understand the synthesis of pharmaceutical compounds by microorganisms, including antibiotics and enzymes, and learn about the innovation in pharmaceuticals. Moreover, students will critically assess regulatory aspects of pharmaceutical microbiology, including drug development, intellectual property rights, and biosensor technology.

CO3: This unit will enable students to comprehend the scope and significance of agricultural microbiology, focusing on the role of microbial communities in soil health. They will learn about biological nitrogen fixation mechanisms and the essential microorganisms involved. Students will also evaluate bioremediation techniques as strategies for pollution control in various environments. Finally, they will acquire knowledge in food microbiology, including spoilage, preservation methods, and the importance of safety regulations such as HACCP and FDA standards.

UNIT-I: Medical and Pharmaceutical Microbiology (10hrs)

1.1 Classification of Medically Important Microbes and the Human Microbiota

1.2 Etiology, Pathogenesis, and Prophylaxis of Key Airborne Diseases (Tuberculosis, Pneumonia, Diphtheria)

1.3 Causative Agents, Transmission, and Control of Select Food/Water/Soil Borne Diseases (Typhoid Fever, Cholera, Tetanus)

1.4 Viral Pathogens of Medical Significance (Hepatitis, Influenza Viruses, Encephalitis, HIV/AIDS, Emerging Viruses)

UNIT-2: Industrial and Pharmaceutical Applications of Microbes (10hrs)

2.1 Microbial Fermentation: Principles, Processes, and Product Recovery

2.2 Microbial Production of Food and Beverages (Milk Products, Wine, Beer)

2.3 Synthesis of Pharmaceutical Compounds by Microbes (Antibiotics, Organic Acids, Enzymes)

2.4 Regulatory Aspects and Innovation in Pharmaceutical Microbiology (Drug Development, Intellectual Property, Biosensors)

UNIT-3: Agricultural and Environmental Microbiology (10hrs)

3.1 Introduction and Scope of Agricultural Microbiology; Microbial Communities in Soil (Rhizosphere, Phyllosphere, Mycorrhiza)

3.2 Biological Nitrogen Fixation: Symbiotic and Non-Symbiotic Mechanisms and Microorganisms

3.3 Bioremediation: Microbial Strategies for Pollution Control (Water Pollution, Oil Spills, Superbugs)

3.4 Food Microbiology: Spoilage and Preservation, Sanitation, Safety Regulations, and Objectives (HACCP, FDA, EPA, FSA)

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Course No. P1ZOTC103 Course Title: Applications of Microbiology

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	Syllabus to be covered in examination	Time allotted for Exam	% Weightage (marks)
Minor Test I	upto 20%	1 hr.	10 (5+5)
Minor Test II	21% to 40%	1 hr.	10 (5+5)
Major Test	41% to 100%	2hrs.	30

Major test will have two sections (A & B). Section A is compulsory comprising of 10 questions of 1 mark each and be spread over entire syllabus. Section B comprises of 4 questions from remaining 2 units and candidate has to attempt one question fromeach unit of 10 marks each.

SUGGESTED BOOKS:

- Arora, M.P. (2005). Microbiology. Himalaya Publishing House, Mumbai.
- Crueger, W., & Crueger, A. (2005). Biotechnology: A Textbook of Industrial Microbiology (2nd Ed.). Panima Publishing Corporation, New Delhi.
- Escoll, P. (2017). Bacterial Evasion of the Host Immune System. Caister Academic Press.
- Gerard, J., Tortora, B.R., Funke, C.L., & Case, C.L. (2011). Microbiology: An Introduction (9th Ed.). Pearson Education.
- Jay, J.M. (2008). Modern Food Microbiology (6th Ed.). Aspen Publishers, Inc., Gaithersburg, Maryland.
- Joshi, V.K., & Pandey, A. (Eds.) (1999). Biotechnology: Food Fermentation (2 Vol. Set). Education Publishers, New Delhi.
- Levine, M.M., Kaper, J.B., Rappuoli, R., Liu, M.A., & Good, M.F. (2004). New Generation Vaccines (3rd Ed.). Informa Healthcare.
- Male, D., Brostoff, J., Roth, D.B., & Roitt, I. (2006). Immunology. Elsevier.
- Mitchell, R. (1992). Environmental Microbiology. John Wiley & Sons.
- Moore, L. (2019). Infectious Diseases, Microbiology, and Virology. Cambridge University Press.
- Pelczar, M.J., Chan, E.C.S., & Krieg, N.R. (1997). Microbiology: Concepts and Applications. Tata McGraw Hill.
- Rajeshwari, S., Sethi, S., & Sreekrishna, V. (2004). Biotechnology-2. New Age International Publishers, Delhi.
- Tauro, P., Kapoor, K.K., & Yadav, K.S. (1996). Introduction to Microbiology. Wiley Eastern.
- Wood, J.B. (1985). Microbiology of Fermented Foods. Volumes I and II. Elsevier Applied Science Publishers, London, England.

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Course No. P1ZOPC105 Practicals based on P1ZOTC102 and P1ZOTC103

Credits: 2 Maximum Marks:50

Practicals based on P1ZOTC102

1. Handling and operation of following apparatus and equipments: (a) Compound research microscope (b) Electrophoretic Unit (c) Thermocycler (d) Stereo-microscope
2. To study the process of mitosis from the onion root tip
3. Study of stained preparation of mitochondria and golgi bodies under the light microscope.
4. Isolation of DNA from Insect tissue
5. Quantification and qualification of DNA
6. Demonstration of polymerase chain reaction.
7. Bioinformatic tools online for analyzing DNA sequences
8. Demonstration of automated biochemical analyzer.
9. Electrophoresis of DNA.

Practicals based on P1ZOTC103

1. Learn about various bio-safety levels used in laboratories.
2. Understand the working principle of an autoclave.
3. Understand the working principle of laminar airflow.
4. Perform Gram staining of bacteria present in a given sample of curd.
5. Perform Gram staining of bacteria from a human throat sample.
6. Isolate and examine bacteria from a given soil sample using serial dilution, pour plate, and spread plate methods.
7. Apply different techniques of streaking in microbial culture.

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Practicals			
Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
Internal Examination	100%	Continuous evaluation	50
External Examination	100%	4 hours	50
Total			100

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Course No. P1ZOTE110 Course Title: Aquaculture:Fundamentals and Practices

Credits: 2 **Maximum Marks:50**

Course Outcomes:

CO1: Students will understand the fundamental concepts of aquaculture, including its definition, history, and importance, along with various systems and management practices. They will learn to evaluate site selection criteria and pond preparation for effective fish farming. This unit will equip them with essential farm management skills, including techniques for water quality management.

CO2: Upon completion of this unit, students will be able to identify the nutritional requirements of fish and formulate supplementary or artificial feeds, considering various feed types and preparation technologies. They will gain practical skills in manual and mechanical feeding techniques as well as understand the significance of feed storage conditions. Additionally, students will explore the eco-biology and seed production techniques of Indian Major Carps.

CO3: This unit will provide students with the knowledge necessary to select appropriate fish and shellfish species based on biological criteria. They will gain insights into the culture techniques for various species, including freshwater prawns, trout, and catfish, as well as marine species like seaweed and pearls. The focus will be on sustainable practices that enhance aquaculture productivity and environmental stewardship.

UNIT-1: Introduction to Aquaculture and Farm Management (10 hrs)

1.1 Definition, History, Importance, and Status of Aquaculture

1.2 Types of Aquaculture: Pen Water, Semi-closed, Closed Systems

1.3 Aquaculture Practices: Traditional, Extensive, Semi-extensive, Intensive; Criteria for Site Selection for Fish Farms;

1.4 Types of Ponds: Preparation and Management, Liming, Fertilization, Control of Aqua Insects, Algae, Weeds, and Water Quality Management

UNIT-2: Fish Feeding and Nutrition (10 hrs)

2.1 Nutritional Requirements: Proteins, Lipids, Vitamins, Minerals

2.2 Feed Formulation and Preparation of Supplementary/Artificial Feeds: Ingredients and Additives, Types of Feed, Preparation Technology

2.3 Feeding Techniques: Manual and Mechanical Distribution; Feed Storage and Factors Affecting It

2.5 Eco-biology of Indian Major Carps (IMC) and Seed Production Techniques in Laboratory

UNIT-3: Species Selection and Culture Techniques (10 hrs)

3.1 Biological Criteria for Selection of Cultivable Fish and Shellfish Species

3.2 Culture Methods: Freshwater Prawn, Trout, Catfish

3.3 Marine Cultures: Seaweed and Pearl Farming

3.4 Effectiveness of Various Culture Techniques for Sustainable Aquaculture

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Course No. P1ZOTE110 Course Title: Aquaculture: Fundamentals and Practices

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	Syllabus to be coveredin examination	Time allotted for Exam	% Weightage (marks)
Minor Test I	upto 20%	1 hr.	10 (5+5)
Minor Test II	21% to 40%	1 hr.	10 (5+5)
Major Test	41% to 100%	2hrs.	30

Major test will have two sections (A & B). Section A is compulsory comprising of 10 questions of 1 mark each and be spread over entire syllabus. Section B comprises of 4 questions from remaining 2 units and candidate has to attempt one question fromeach unit of 10 marks each.

SUGGESTED BOOKS:

- Chakraborty, R.K. (2001), Introduction to Aquaculture, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Jhingran, V.G. (1991), Fish and Fisheries of India, Hindustan Publishing Corporation, Delhi.
- Santhanam, R. (1990), Manual of Aquaculture, Oxford & IBH Publishing Co. Pvt. Ltd.
- Munilkumar, S. (2008), Aquaculture Development and Management, Dominant Publishers & Distributors, New Delhi.
- Kar, D. (2007), Fundamentals of Limnology and Aquaculture Biotechnology, Daya Publishing House, New Delhi.
- Balasubramaniam, R. (2000), Advances in Aquaculture Technology, Pointer Publishers, Jaipur.
- Peter, T. (2005), Aquaculture Systems and Practices, Discovery Publishing House, New Delhi.
- Roy, S. and Gupta, A. (2011), Essentials of Fish Nutrition and Feed Technology, Narendra Publishing House, Delhi.
- Patra, B.C. (2010), Aquaculture Science and Technology, Dominant Publishers, New Delhi.
- Michael, B.N. (2014), Modern Aquaculture: Principles and Practices, Biotech Books, Delhi.

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Course No. P1ZOPE114

Practicals based on P1ZOTE110

Credits: 2

Maximum Marks:50

1. Study of the eco-biology of Indian Major Carps: Catla, Mrigal, and Rohu.
2. Study of the eco-biology of exotic carps: Silver carp, Grass carp, and Common carp.
3. Preparation and understanding of layout plans for major finfish culture farms.
4. Examination of the structure and design of aquaculture systems: cages, rafts, tray culture, etc.
5. Formulation of fish meal using Pearson's square method.
6. Identification and study of common seaweed species and their culture techniques.
7. Study of the life cycle and culture aspects of freshwater prawn.
8. Study of the life cycle and culture aspects of trout.
9. Study of catfish culture techniques and cage farming practices.

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Practicals			
Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
Internal Examination	100%	Continuous evaluation	25
External Examination	100%	4 hours	25
Total			50

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Course No. P1ZOTE111
Credits: 2

Course Title: Basics of Insect Diversity
Maximum Marks:50

Course Outcomes:

CO1: Students will be able to identify and classify various insect groups based on their general characteristics, distinguishing between the subclasses Apterygota and Pterygota while understanding the significance of their diversity in ecosystems.

CO2: Students will demonstrate knowledge of the external morphology of insects, including the structure and function of the head, thorax, and abdomen, while identifying sensory structures and their roles in insect behavior and ecology.

CO3: Students will gain an understanding of insect physiology and development, including the processes of metamorphosis and diapause, along with specialized adaptations such as stridulation and defense mechanisms, illustrating their importance in survival and reproduction.

UNIT-1: Insects – General Organization and Classification (10 hrs)

1.1 General characters, classification of insects.

1.2 Subclass Apterygota: Thysanura, Collembola.

1.3 Subclass Pterygota - Exopterygota: Odonata, Orthoptera, Dictyoptera, Dermaptera, Hemiptera, Homoptera.

1.4 Subclass Pterygota - Endopterygota: Lepidoptera, Diptera, Coleoptera, Hymenoptera.

UNIT-2: External Morphology and Sensory Structures (10 hrs)

2.1 Head: Structure, mouthparts and their diversity, types of antennae, compound eye.

2.2 Thorax: Structure, leg modifications, wings, and wing coupling mechanism.

2.3 Abdomen and reproductive structures.

2.4 Chemoreceptors and mechanoreceptors.

UNIT-3: Insect Development and Physiology (10 hrs)

3.1 Insect integument: Structure and function.

3.2 Metamorphosis: Its types and regulation.

3.3 Diapause in insects

3.4 Stridulation mechanisms, defense mechanisms

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Course No. P1ZOTE111 Course Title: Basics of Insect Diversity

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	Syllabus to be coveredin examination	Time allotted for Exam	% Weightage (marks)
Minor Test I	upto 20%	1 hr.	10 (5+5)
Minor Test II	21% to 40%	1 hr.	10 (5+5)
Major Test	41% to 100%	2hrs.	30

Major test will have two sections (A & B). Section A is compulsory comprising of 10 questions of 1 mark each and be spread over entire syllabus. Section B comprises of 4 questions from remaining 2 units and candidate has to attempt one question fromeach unit of 10 marks each.

SUGGESTED BOOKS:

- Horowitz, A.R., & Ishaya, I. (2004). *Insect Pest Management*. Springer. Rajkamal Electric Press.
- Timothy, M. (2007). *Insect Ecology*. Elsevier Inc.
- Klowden, M.J. (2007). *Physiological Systems in Insects*. Elsevier Inc.
- Waldbauer, G. (2007). *The Handy Insect G.K. Book*. Jaico Publishing House.
- Pedigo, L.P., & Rice, M.E. (2009). *Entomology and Pest Management*. PHI Learning Pvt. Ltd.
- Chapman, R.F. (2013). *The Insect: Structure and Function* (2nd ed.).
- Gullan, P.J., & Cranston, P.S. (2014). *The Insects: An Outline of Entomology* (5th ed.). Wiley-Blackwell.
- Rivers, D.B. (2017). *Insects*. Jaico Publishing House.
- Lanham, U. (2018). *The Insects*. GeneTech Books.
- Foottit, R.G., & Adler, P.H. (2018). *Insect Biodiversity: Science and Society*. Wiley-Blackwell.
- Laichattiwar, M.A. (2020). *Introduction to Insects and Their Diversity*. Delve Publishing House.

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Course No. P1ZOPE115

Practicals based on P1ZOTE111

Credits: 2

Maximum Marks:50

1. Identify, classify, and describe the orders of subclass Apterygota: Thysanura and Collembola.
2. Examine and differentiate the orders of subclass Exopterygota: Odonata, Orthoptera, Dictyoptera, Dermaptera, and Homoptera.
3. Observe and interpret the key features of subclass Endopterygota: Lepidoptera, Diptera, Coleoptera, and Hymenoptera.
4. Analyze the diversity and structural adaptations of insect mouthparts using examples like cockroach, grasshopper, mosquito, butterfly, bug, housefly, and honeybee.
5. Explore various types of antennae found in insects.
6. Examine and compare the different types of leg modifications in insects.
7. Distinguish among the different forms of insect larvae and pupae.
8. Understand the mechanism and types of metamorphosis across insect groups.

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Practicals			
Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
Internal Examination	100%	Continuous evaluation	25
External Examination	100%	4 hours	25
Total			50

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Course No. P1ZOTE112 Course Title: Elementary Immunology

Credits: 2 Maximum Marks:50

Course Outcomes:

CO1: Students will understand the foundational concepts and historical context of the immune system, differentiating between innate and adaptive immunity while identifying key immune cells and organs. They will grasp the mechanisms of B-cell and T-cell activation and the functional roles of cytokines and chemokines.

CO2: Students will explore the mechanisms of humoral immunity, including the structure and function of antibodies, the role of MHC in antigen presentation, and the implications of hypersensitivity and complement systems. They will also gain insights into advanced techniques in antibody production and applications.

CO3: Students will gain an understanding of transplantation immunology, including types of grafts and the principles of immunosuppression, along with a thorough knowledge of various immunological techniques used in research and clinical diagnostics. This will enable them to appreciate their application in both therapeutic and research settings.

UNIT I: Introduction to the Immune System **(10 hrs)**

1.1 Historical Background

1.2 Innate Immunity: Phagocytosis, Inflammation, Toll-Like Receptors (TLRs), etc.

1.3 Adaptive Immunity: B and T cells

1.4 Immune Cells and Organs: Primary and Secondary Tissues

1.5 B-cell and T-cell Activation, Differentiation, and Memory

1.6 General Properties and Structure of Cytokines and Chemokines

UNIT II: Humoral Immunity and Cell-Mediated Immunity **(10 hrs)**

2.1 Antigens: Antigenicity and Immunogenicity

2.2 Antibodies: Types, Structure, Function, and Generation of Diversity; Monoclonal Antibodies and Hybridoma Technology

2.3 Major Histocompatibility Complex (MHC) and Antigen Processing and Presentation

2.4 Hypersensitivity: Types and Mechanisms; The Complement System

UNIT III: Transplantation, Immunosuppression, and Immunological Techniques **(10 hrs)**

3.1 Transplantation Terminology: Autograft, Isograft, Allograft, Xenograft; Graft-Versus-Host (GVH) Reaction

3.2 Mechanisms of Immunosuppression and Overview of Immunosuppressive Drugs (e.g., Azathioprine, Cyclosporine, Cyclophosphamide, Betamethasone)

3.3 Advanced Immunological Techniques: Immunoprecipitation, Immunoassays (including RIA, ELISA), Immunofluorescence, and Luminex

3.4 Immunoelectrophoresis and its Types

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Course No. P1ZOTE112

Course Title: Elementary Immunology

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	Syllabus to be coveredin examination	Time allotted for Exam	% Weightage (marks)
Minor Test I	upto 20%	1 hr.	10 (5+5)
Minor Test II	21% to 40%	1 hr.	10 (5+5)
Major Test	41% to 100%	2hrs.	30

Major test will have two sections (A & B). Section A is compulsory comprising of 10 questions of 1 mark each and be spread over entire syllabus. Section B comprises of 4 questions from remaining 2 units and candidate has to attempt one question fromeach unit of 10 marks each.

SUGGESTED BOOKS:

- Paul, W. E. (1984). Fundamental immunology.
- Kuby, J., & Osborne, B. A. (1992). Immunology.
- Abbas, A. K., & Lichtman, A. H. (2001). Basic immunology: Functions and disorders of the immune system.
- Sompayrac, L. (2001). How the immune system works.
- Helbert, M., & Nairn, R. (2002). Immunology for medical students.
- Murphy, K., Travers, P., & Walport, M. (2008). Janeway's immunobiology (7th ed.).
- Arumugan, N., & Fatima, D. (2015). Immunology. Saras Publications.
- Abbas, A. K., Lichtman, A. H., & Pillai, S. (2018). Cellular and molecular immunology. Elsevier.
- Collins, A. (2019). Transplantation immunology. Foster Academics.

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Course No. P1ZOPE116

Practicals based on P1ZOTE112

Credits: 2

Maximum Marks:50

1. To study the different types of cells involved in the immune system of human beings.
2. To study the different types of immunoglobulins.
3. To perform hemagglutination assay for ABO blood group typing determination and Rh factor.
4. To learn the techniques of immune electrophoresis.
5. Amplification of Interleukin-28b gene using Polymerase Chain Reaction (PCR) assays.
6. Electrophoresis of Interleukin-28 gene PCR product.
7. To determine the concentration of antigen by sandwich ELISA method.
8. To determine Total Leukocyte Count (TLC) of the given sample.
9. To determine Differential Leukocyte Count (DLC) of the given sample.
10. To study the 3D structural organization of various proteins by using bioinformatics tools.

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Practicals			
Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
Internal Examination	100%	Continuous evaluation	25
External Examination	100%	4 hours	25
Total			50

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Course No. P1ZOTE113 Course Title: Understanding Biodiversity Preservation

Credits: 2

Maximum Marks:50

Course Outcomes:

CO1: Students will gain a foundational understanding of biodiversity's definitions, types, and significance. They will also evaluate the pressing threats to biodiversity and appreciate its ecological, economic, and cultural values

CO2: Students will explore diverse conservation strategies and practices, critically analyze specific conservation programs, and understand the importance of community involvement in effective biodiversity conservation.

CO3:Students will learn to utilize indicators for measuring biodiversity and apply various field techniques for biodiversity assessment. They will also understand ethical considerations and the legislative framework that governs biodiversity conservation.

UNIT 1: Introduction to Biodiversity and Its Significance **(10 hrs)**

1.1 Biodiversity: Definition, types (genetic, species, ecosystem), and uses of biodiversity in ecological health and human well-being.

1.2 Biodiversity Across Levels: Biodiversity at global, national, and local levels with a focus on India as a megadiverse country and the concept of biodiversity hotspots.

1.3 Threats to Biodiversity: Identifying and analyzing major threats such as habitat loss, climate change, pollution, and invasive species, including their ecological consequences.

1.4 Importance of Biodiversity: Ecological, economic, cultural, and aesthetic values of biodiversity, including its role in ecosystem services and human livelihoods.

UNIT 2: Conservation Strategies and Practices **(10 hrs)**

2.1 Conservation Approaches: Differentiating between in-situ and ex-situ conservation strategies, including examples such as wildlife reserves, botanical gardens, and gene banks.

2.2 Protected Areas and Legal Framework: Reviewing the IUCN categories, Red Data Book, and the significance of protected area networks, including national parks and biosphere reserves.

2.3 Specific Conservation Programs: Project Tiger, Project Hangul, and efforts for endangered species such as vultures and the Great Indian Bustard.

2.4 Community Involvement in Conservation: Role of indigenous knowledge, sustainable practices, and community-based initiatives in enhancing conservation outcomes.

UNIT 3: Research, Assessment, and Legislation in Biodiversity **(10 hrs)**

3.1 Biodiversity Indicators and Measurement: Use of biodiversity indicators, including surrogate species, taxon-based indicators and ecological function indicators

3.2 Field Techniques for Biodiversity Assessment: Learning various field survey methodologies, including sampling techniques, transects, quadrats, and non-intrusive observation methods.

3.3 Ethics and Permit Requirements in Field Studies: Discussing ethical guidelines, regulatory permissions needed for fieldwork, and best practices for field studies and preservation techniques.

3.4 Legislation for Biodiversity Conservation: Exploring important legislation such as the National Wildlife (Protection) Act, 1972, the Indian Biodiversity Act, 2002, and key international treaties for wildlife conservation.

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Course No. P1ZOTE113 Course Title: Understanding Biodiversity Preservation

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	Syllabus to be coveredin examination	Time allotted for Exam	% Weightage (marks)
Minor Test I	upto 20%	1 hr.	10 (5+5)
Minor Test II	21% to 40%	1 hr.	10 (5+5)
Major Test	41% to 100%	2hrs.	30

Major test will have two sections (A & B). Section A is compulsory comprising of 10 questions of 1 mark each and be spread over entire syllabus. Section B comprises of 4 questions from remaining 2 units and candidate has to attempt one question fromeach unit of 10 marks each.

SUGGESTED BOOKS:

- Odum, E.P. (1971). Fundamentals of Ecology. W.B. Saunders, USA.
- Kormondy, E.T. (1971). Concept of Ecology. Prentice Hall of India, New Delhi.
- Scuthwick, C.H. (1976). Ecology and the Quality of Our Environment. D. Van Nostrand.
- Sinha, M.P., Dey, S., & Singh, B.S. (2004). Conservation of Biodiversity and Natural Resources. Daya Publishing House, Delhi.
- Wilkinson, D.M. (2007). Fundamental Resources in Ecology: An Earth System Approach. Oxford University Press, UK.
- Grant, W.E., & Swanmack, T.M. (2008). Ecological Modeling. Blackwell Publishing House.
- Singh, S.K. (2009). Textbook of Wildlife Management (2nd ed.). International Book Distributing Co.
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- Chitkara, M.G. (2012). Wildlife. APH Publishing Corporation, New Delhi.
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- Dar, G.H., & Khuroo, H. (2020). Biodiversity of the Himalaya: Jammu and Kashmir State. Springer (e-Book).

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Course No. P1ZOPE117

Practicals based on P1ZOTE113

Credits: 2

Maximum Marks:50

1. To survey the National Parks in India.
2. To study the Biosphere Reserves in India.
3. To study the protected area network and its significance with respect to Jammu division of J&K .
4. To study the protected area network and its significance with respect to Kashmir division of J&K .
5. To study and calculate the diversity indices from the given biological data set.
6. To study the community by quadrant method on basis of frequency and density.
7. To study the Zoo-diversity of J&K in context to their IUCN status: Reptiles Birds Mammals
8. To study the Plankton diversity of different Aquatic ecosystems.
9. Fish diversity of different lentic and lotic water bodies of Jammu region.
10. Field visits will be integral part of the Practical. Visits to nearby Zoo, Museum, Sea-shore, Nursery aquaria or any other relevant site must be arranged. The report of these visits will be submitted as part of the Practical work.

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows

Practicals			
Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
Internal Examination	100%	Continuous evaluation	25
External Examination	100%	4 hours	25
Total			50

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SYLLABUS FOR PG PROGRAMME ZOOLOGY (1 YEAR) AS PER NEP-2020
SEMESTER – I
(Syllabus for the examination to be held in December 2026, 2027 and 2028)

Course No. P1ZORE120 **Course Title: Research Project/Dissertation**

Credits: 4 **Maximum Marks:100**

Research (thesis/project/) examination

- Report on review of literature to be submitted

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SEMESTER – II
(Syllabus for the examination to be held in May 2027. 2028 and 2029)

COURSE CODE	COURSE NAME	CREDITS
CREDIT FRAMEWORK FOR SEMESTER-II		
Major Core [8(T)+4(P)]		
P1ZOTC201	**Fishery Science**	4
P1ZOTC202	**Human Genomics and Cytogenetics**	4
P1ZOPC203	Practicals based on P1ZOTC201	2
P1ZOPC204	Practicals based on P1ZOTC202	2
	Total Credits	**12**
MAJOR ELECTIVE (ANY ONE*) (2T+2P)		
P1ZOTE210	**Nematode Biology**	2*
P1ZOTE211	**Aquarium and Fish Keeping**	2
P1ZOTE212	**Fundamentals of Neuroscience**	2
P1ZOTE213	**Basics of Bioinformatics and Biostatistics**	2
P1ZOPE214	Practicals based on P1ZOTE210	2*
P1ZOPE215	Practicals based on P1ZOTE211	2
P1ZOPE216	Practicals based on P1ZOTE212	2
P1ZOPE217	Practicals based on P1ZOTE213	2
	Total Credits	**4**
P1ZORE225	**Field Visit/Industrial Training/Practicals**	2
P1ZORE226	**Research Project/Dissertation**	8
	Semester Credit Total	**24**

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Course No. P1ZOTC201

Course Title: Fishery Science

Credits: 4

Maximum Marks:100

Course Outcomes:

CO1: Students will understand the definition, scope, and interdisciplinary nature of fishery science. They will recognize the importance of fisheries in ensuring food security and economic growth. Students will identify and differentiate among lacustrine, riverine, and marine fisheries. They will also explore the ecological significance of plankton and benthos in aquatic systems.

CO2: Students will analyze how temperature, light, pH, CO_2, and DO influence aquatic environments. They will gain practical knowledge of measuring abiotic factors in freshwater and marine ecosystems. Learners will understand how these variables affect fish metabolism, growth, and health. They will assess the relationship between environmental conditions and fishery productivity.

CO3: Students will identify the nutritional components of fish and their role in human diets. They will understand spoilage mechanisms such as rigor mortis, oxidation, and microbial activity.Knowledge of post-harvest handling, sanitation, and hygiene will be emphasized. They will evaluate various fish preservation methods used in the fishing industry.

CO4: Students will learn the structure and hormonal regulation of fish reproductive systems. They will compare natural and artificial breeding methods, including bund and hatchery techniques. The principles and advantages of induced breeding through hypophysation will be covered. Learners will understand the role of selective breeding and hybridization in aquaculture.

CO5: Students will differentiate between morphometric and meristic characters used in fish growth studies.They will gain skills in aquarium setup and care of ornamental fish species. Various fish diseases and their causes, symptoms, and treatments will be examined. Students will understand both traditional and modern fishing techniques, including sonar and electric fishing.

UNIT I: Introduction to Fishery Science (13 hrs)

1.1 Definition, scope, and interdisciplinary nature of Fishery Science

1.2 Importance of Fishery Science and its role in food security and econom

1.3 Plankton and Their Classification: Definition of plankton; Characteristics and classification.

1.4 Benthos and Their Classification: Definition and characteristics; Classification of benthic organisms.

UNIT II: Aquatic Environmental Dynamics (13 hrs)

2.1 Thermal and Light Factors: Stratification, biological effects, measurement techniques

2.2 CO_2 and pH: Sources, methods of assessment, and ecological significance

2.3 Dissolved Oxygen (DO): Factors affecting levels, measurement, and role in aquatic life

2.4 Abiotic and Biotic influences on aquatic productivity and fish health

UNIT III: Nutrition, Spoilage, and Fish Processing (12 hrs)

3.1 Biochemical composition of fish – Proteins, lipids, vitamins, and minerals

3.2 Spoilage: Rigor mortis, lipid oxidation, enzymatic and microbial degradation

3.3 Post-harvest technology: Fish sanitation, handling, and hygiene

3.4 Fish processing and preservation methods: Drying, salting, smoking, refrigeration, canning

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Course No. P1ZOTC201 Course Title: Fishery Science

UNIT IV: Fish Reproduction and Breeding Techniques **(12 hrs)**

4.1 Introduction to Endocrine System: Definition, importance, comparison with vertebrates, major endocrine glands.

4.2 Structure and Function of Reproductive Organs: Male and female reproductive systems, gametogenesis, hormonal control.

4.3 Natural Breeding of Indian Major carps: Location of breeding grounds and seed collection, Factors responsible for Natural breeding

4.4 Induced breeding (Hypophysation): Principles, techniques, and benefits

UNIT V: Fish Growth, Disease Management, and Fishing Techniques **(10 hrs)**

5.1 Morphometric and Meristic characters – definition, types, and importance in growth studies

5.2 Aquarium management: Setup, maintenance, and common ornamental fishes

5.3 Fish diseases: Bacterial, viral, protozoan, and helminth – symptoms and treatments

5.4 Traditional and advanced fishing methods: Electric fishing, sonar, light fishing

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

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Course No. P1ZOTC201

Course Title: Fishery Science

SUGGESTED BOOKS:

- Sinha, V. R. P., & Khanna, B. S. (1998). Fisheries Science: A Manual for Fish Farmers. Daya Publishing House.
- Pillay, T. V. R. (1990). Aquaculture: Principles and Practices. Wiley-Blackwell.
- Sahoo, L., & Sahu, S. (2008). Fisheries Ecology and Management in India. Daya Publishing House.
- Evans, D. J., Biswas, S. R. B. L. A., & Fernandis, J. C. G. Y. (Eds.). (2009). *Reproductive Biology and Phylogeny of Fish.* Science Publishers.
- Jhingran, V. G. (1982). Fish and Fisheries of India. Hindustan Publishing Corporation.
- Radhakrishnan, V. (1994). Aquaculture and Fisheries. Allied Publishers.
- King, M. (1995). Fisheries Biology, Assessment, and Management. Blackwell Publishing.
- Harris, J. E. (2003). Aquaculture Science. Cengage Learning.
- Pitcher, T. J., & Hart, P. J. B. (1997). Fisheries Ecology and Management. Blackwell Science.
- Allen, M. S., & Hightower, J. E. (2002). Fish Population Dynamics: Mortality, Growth, and Recruitment. American Fisheries Society.
- Badapanda, K. C. *(2017). Basics of fisheries science: A complete book on fisheries aquaculture* Narendra Publishing House.

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Course No. P1ZOPC203
Credits: 2

Practicals based on P1ZOTC201
Maximum Marks:50

1. Measure water temperature at different depths.
2. Measure light penetration in water using a light meter and analyze its impact.
3. Measure dissolved oxygen levels in water and analyze its ecological significance.
4. Measure carbondioxide levels in water and analyze its ecological significance.
5. Collect and identify plankton samples (zooplankton) from aquatic habitats.
6. Collect and identify benthic organisms
7. Observe and document the process of ovulation and fertilization in fish.
8. Study the stages of embryonic development in fish.
9. Study the stages of larval development and growth in fish.
10. Analyze the biochemical composition (proteins, lipids, vitamins) of fish.
11. Study fish spoilage by observing rigor mortis and enzymatic degradation
12. Measure and analyze the growth of fish using morphometric characters.
13. Study meristic characters in different fish species.

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Practicals			
Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
Internal Examination	100%	Continuous evaluation	25
External Examination	100%	4 hours	25
Total			50

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Course No. P1ZOTC202 Course Title: Human Genomics and Cytogenetics

Credits: 4 Maximum Marks:100

Course Outcomes:

CO1: Students will understand the basic principles of human genetics, Mendelian inheritance, and chromosomal theory. They will gain knowledge in human pedigree analysis, chromosome morphology, and sex chromosome structure. This includes understanding dosage compensation mechanisms. The course will also cover inheritance patterns and population genetics.

CO2: Students will learn various chromosome banding techniques and their significance in genetic analysis. They will gain expertise in advanced cytogenetic methods. Additionally, students will become proficient in human karyotyping techniques. The course will also explore the application of microscopy and computer-assisted analysis.

CO3: Students will study the structure and organization of the human genome, including the distinction between nuclear and mitochondrial genomes. They will learn about gene families, repetitive DNA, and molecular genetics processes such as DNA replication, transcription, and translation. The course will also cover mutation mechanisms and DNA repair systems.

CO4: Students will gain knowledge about chromosomal aberrations and syndromes associated with genetic disorders. They will be equipped to perform genetic disease diagnosis through DNA-based methods and biochemical tests. The course will cover prenatal diagnostics and the principles of genetic counseling and treatment for various disorders.

CO5: Students will explore the advancements of the Human Genome Project and its implications in epigenetics. They will understand gene-environment interactions and their role in complex diseases. The course will also cover stem cells, therapeutic cloning, and the ethical considerations involved. Additionally, students will study gene therapy and personalized medicine applications in treating genetic disorders.

UNIT I: Foundations of Human Genetics and Chromosome Structure (12hrs)

1.1 Overview of Human Genetics: Historical milestones, Mendelian principles, and chromosomal theory

1.2 Human Pedigree Analysis and Population Genetics: Inheritance patterns, Hardy-Weinberg equilibrium, genetic drift

1.3 Chromosome Morphology and Classification: Types, centromere positions, ISCN standards, karyotype basics

1.4 Sex Chromosomes and Dosage Compensation: X/Y chromosome structure, Lyon's hypothesis, Barr bodies

UNIT II: Human Chromosome Analysis and Cytogenetic Techniques (13hrs)

2.1 Chromosome Banding Techniques: G, Q, R, C, high-resolution banding – significance and applications

2.2 Advanced Cytogenetic Methods: FISH (Q-FISH, F-FISH), CGH, spectral and multicolor karyotyping

2.3 Human Karyotyping Techniques: Lymphocyte culture, hypotonic treatment, staining, idiogram construction

2.4 Computer-Assisted Chromosome Analysis and Microscopy: Light, fluorescence, and confocal microscopy

UNIT III: Genome Organization and Molecular Genetics (12hrs)

3.1 Human Genome Organization: Nuclear vs mitochondrial genome, gene structure, coding vs non-coding regions

3.2 Human Gene Families and Repetitive DNA: Homologs, orthologs, paralogs, contigs, transposable elements

3.3 DNA Replication, Transcription, and Translation in Eukaryotes: Key enzymes and molecular mechanisms

3.4 Mutations and DNA Repair Mechanisms: Mutation types, repair systems, and implications

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Course No. P1ZOTC202 Course Title: Human Genomics and Cytogenetics

UNIT IV: Genetic Disorders, Diagnosis, and Applications **(10 hrs)**

4.1 Chromosomal Aberrations and Syndromes: Structural, numerical, mosaicism, chimerism
4.2 Diagnosis of Genetic Diseases: DNA-based diagnostics, biochemical tests, preimplantation,population screening
4.3 Prenatal Diagnosis: Invasive (CVS, amniocentesis), non-invasive (ultrasound, fetal cells in maternal blood)
4.4 Treatment and Genetic Counseling: Management of genetic disorders, counseling approaches, eugenics and euphenics

UNIT V: Advances in Human Genetics and Therapeutics **(13hrs)**

5.1 Human Genome Project and Epigenetics: Goals, outcomes, ELSI, and role of epigenetic regulation
5.2 Gene and Environment Interactions: Complex disorders (diabetes, cancer, CVD), twin studies, heritability
5.3 Stem Cells and Therapeutic Cloning: Types, sources, uses in medicine, and associated ethical issues
5.4 Gene Therapy and Personalized Medicine: Pharmacogenomics, treatment strategies, and disorder-specific applications (e.g., Huntington's, Cystic Fibrosis, Thalassemia, DMD)

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

Test I and Test II

The Subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

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Course No. P1ZOTC202 Course Title: Human Genomics and Cytogenetics

SUGGESTED BOOKS:

- Gardner, E.J., Simmons, M. J., & Snustad, D. P. (2008). Principles of Genetics (8th ed.).Wiley-India.
- Strachan, T., & Read, A. P. (2018). Human Molecular Genetics (5th ed.). Garland Science.
- Turnpenny, P. D., & Ellard, S. (2017). Emery's Elements of Medical Genetics (15th ed.). Elsevier.
- Jorde, L. B., Carey, J. C., Bamshad, M. J., & White, R. L. (2020). Medical Genetics (6th ed.). Elsevier.
- Verma, I. C., & Agarwal, S. (2010). Principles of Medical Genetics. CBS Publishers & Distributors.
- Bhatnagar, S. (2015). Human Genetics. Pearson Education India.
- Gangane, S. D. (2021). Human Genetics (5th ed.). Elsevier India.
- Lewin, B. (2011). Genes XI. Jones & Bartlett Learning

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Course No. P1ZOPC204 — Practicals based on P1ZOTC202

Credits: 4 — Maximum Marks:50

1. Study of Mendelian traits in humans (e.g., tongue rolling, widow's peak, earlobe type)
2. Analysis of human pedigree charts for different inheritance patterns
3. Calculation of allele and genotype frequencies using Hardy-Weinberg equation
4. Identification of normal male and female human karyotypes
5. Identification of chromosomal abnormalities in Down, Turner, Klinefelter, Patau, and Edwards syndromes
6. Demonstration of peripheral blood lymphocyte culture technique
7. Demonstration of metaphase chromosome preparation and G-banding
8. Extraction of DNA from human buccal cells or saliva samples
9. Simulation or demonstration of agarose gel electrophoresis for DNA analysis
10. Case study analysis of single-gene and chromosomal genetic disorders
11. Observation of Barr bodies in buccal smears for sex chromatin
12. Use of online bioinformatics tools (e.g., OMIM, NCBI) to study human genes and disorders

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Practicals			
Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
Internal Examination	100%	Continuous evaluation	25
External Examination	100%	4 hours	25
Total			50

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Course No. P1ZOTE210 Course Title: Nematode Biology

Credits: 2 Maximum Marks:50

Course Outcomes:

CO1: Students will gain a foundational understanding of nematodes, including their general characteristics, classification, and structural morphology. They will learn to identify key reproductive structures and their functions. The course enables recognition of important plant and animal parasitic nematodes, along with the diseases and symptoms they cause in hosts.

CO2: Learners will explore the ecological significance of entomopathogenic nematodes (EPNs) as biological control agents. They will understand the symbiotic relationship between EPNs and bacteria, their life cycle stages, and the development of infective juveniles. The course will also cover practical application strategies and examine real-world case studies across various plant systems.

CO3: This unit introduces students to integrated pest management (IPM) and its role in sustainable agriculture. It explains the steps involved in implementing IPM and emphasizes non-chemical methods such as traps and physical controls. Students will also evaluate the disadvantages of chemical pest control, including environmental and health concerns.

UNIT I: Introduction to Nematology and Morphology (10hrs)

1.1 General Characteristics of Nematodes: Occurrence, habit, and habitat

1.2 Classification of Nematodes up to Family Level: Major taxonomic groups

1.3 Morphology and Reproductive Structures: Size, shape, cuticle, stylet, spicules, gubernaculum, bursa

1.4 Nematode-Associated Diseases and Symptoms: Plant parasitic: Root Knot, Soybean Cyst, Lesion Nematodes - Animal/human parasitic: *Trichinella spiralis*, *Ascaris spp.*

UNIT II: Entomopathogenic Nematodes (EPNs) (10hrs)

2.1 Nematodes as Biological Control Agents: Ecological role, symbiotic relationship with bacteria

2.2 Life Cycle of EPNs: First and second-generation males/females, Infective Juveniles (IJs)

2.3 EPN Formulations and Application Strategies: Aqueous suspension, sponges, gels, clay, and powder forms

2.4 Case Studies of EPN Use: Applications in horticulture, floriculture, and medicinal plants

UNIT III: Integrated Pest Management (IPM) (10hrs)

3.1 Introduction to IPM: Concept, advantages, and disadvantages

3.2 Implementation of IPM: Steps—inspection, planning, prevention, treatment, monitoring, documentation

3.3 Non-Chemical Control Methods: Physical tools and traps—spring, sticky, pheromone, fly/wasp traps

3.4 Drawbacks of Chemical Pest Control: Resistance, environmental impact, non-target effects, health risks

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Course No. P1ZOTE210 Course Title: Nematode Biology

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	Syllabus to be coveredin examination	Time allotted for Exam	% Weightage (marks)
Minor Test I	upto 20%	1 hr.	10 (5+5)
Minor Test II	21% to 40%	1 hr.	10 (5+5)
Major Test	41% to 100%	2hrs.	30

Major test will have two sections (A & B). Section A is compulsory comprising of 10 questions of 1 mark each and be spread over entire syllabus. Section B comprises of 4 questions from remaining 2 units and candidate has to attempt one question fromeach unit of 10 marks each.

SUGGESTED BOOKS:

- Sivaramakrishnan, S., & Razia, M. (2021). Entomopathogenic nematodes and their symbiotic bacteria – a laboratory manual.
- Raja, R. K., Padmanaban, K., & Sivaramakrishnan, S. (2011). Entomopathogenic nematodes: A best bio-control agent for insect pest.
- Perry, R. N., & Wharton, D. A. (2011). Molecular and physiological basis of nematode survival.
- Nguyen, K., & Hunt, D. (2007). Entomopathogenic nematodes: Systematic, phylogeny and bacterial symbionts.
- Singh, J. (2022). Technology manual: Mass production of entomopathogenic nematodes.
- Shapiro-Ilan, D. I., & Lewis, E. E. (Eds.). (2024). Entomopathogenic nematodes as biological control agents. CABI.
- Gaugler, R. (1990). Entomopathogenic nematodes in biological control (Vol. 227). H. K. Kaya (Ed.). CRC Press.
- Gaugler, R. (Ed.). (2002). Entomopathogenic nematology. CABI Publishing.
- Rajak, R. L., Muthaiyan, M. C., Kumarasamy, M., & Manickam, P. (1987). Plant parasitic nematodes: A checklist.
- Molinari, S. (2024). Plant nematode interactions.
- Bauchan, G. (2022). The systematics, morphology and molecular characterization of economically important plant parasitic nematodes.
- https://nemaindia.org.in/wp-content/uploads/2024/04/Book-of-Abstract-2024-with-Gr-Photo.pdf
- https://imanema.ugent.be/wp-content/uploads/2024/09/Introduction-to-Nematology_FULL-BOOK.pdf
- https://www.cabidigitallibrary.org/doi/10.1079/9781789246230.0010
- https://new.rlbcau.ac.in/wp-content/uploads/2024/10/APE-323-Management-of-beneficial-insects-min.pdf
- https://imanema.ugent.be/wp-content/uploads/2024/09/CHAPTER-11.-Nematodes-as-bioindicators.pdf
- https://nemaindia.org.in/wp-content/uploads/2024/08/NSI-Symposium-AGM-Proceedings_2024.pdf

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Course No. P1ZOPE214

Practicals based on P1ZOTE210

Credits: 2

Maximum Marks:50

1. Observation of nematode morphology under the microscope – study of body shape, cuticle, and stylet.
2. Mounting of nematodes for morphological studies of reproductive structures: spicules, gubernaculum, and bursa.
3. Collection and extraction of nematodes from soil or plant roots
4. Culturing of entomopathogenic nematodes (EPNs) using insect larvae (e.g., *Galleria mellonella*).
5. Observation of EPN life cycle stages – identification of infective juveniles, males, and females.
6. Preparation and demonstration of EPN formulations – aqueous suspension, gel, sponge, and clay-based types.
7. Diseases caused by Nematodes in Plants and animals
8. Comparative study of chemical vs. non-chemical pest control methods; effectiveness and side effects.
9. Beneficial nematodes and their host range

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Practicals			
Test	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Internal Examination	100%	Continuous evaluation	25
External Examination	100%	4 hours	25
Total			50

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Course No. P1ZOTE211 Course Title: Aquarium and Fish keeping

Credits: 2 Maximum Marks:50

Course Outcomes:

CO1: Learners will understand the construction and structural aspects of aquaria, including material selection and ideal setup. They will gain practical knowledge on choosing suitable locations and maintaining optimal tank conditions. They will also become familiar with appropriate stocking densities based on fish types and tank sizes. This will enable them to design and maintain aesthetic, healthy aquarium systems.

CO2: Students will be able to evaluate key abiotic and biotic factors influencing aquarium water quality. They will learn to identify common fish diseases and recognize their symptoms effectively. Treatment and prevention strategies will be emphasized for maintaining fish health. This knowledge will help ensure the well-being of aquatic life in captive conditions.

CO3: Students will gain a biological understanding of ornamental fish species in both freshwater and marine systems. They will be able to identify species based on physical traits and learn their feeding behaviors. Knowledge of breeding and spawning will help in managing life cycles of ornamental fishes. Overall, they will be equipped to handle ornamental fish care with scientific insight and responsibility.

Unit I: Aquarium Construction and Setup **(10hrs)**

1.1 Aquarium Fabrication: Materials, frame types, glass size and thickness

1.2 Site Selection and Setup: Placement, environmental factors, aesthetic considerations

1.3 Stocking Capacity: Guidelines for fish load based on tank size and species

1.4 Aquarium Accessories and Decor: Heaters, filters, aerators, thermostat, and decorative elements

Unit II: Water Quality and Fish Health **(10hrs)**

2.1 Abiotic Components: Dissolved oxygen, pH, carbon dioxide, ammonia

2.2 Biotic Components: Aquarium plants – rooted, branched, and floating types

2.3 Common Aquarium Diseases: Symptoms of white spot, gill flukes, fin rot, mouth fungus

2.4 Fish Health Management: Preventive care and treatment strategies

Unit III: Biology of Ornamental Fishes **(10hrs)**

3.1 Freshwater Ornamental Fishes: Key species, characteristics, and identification

3.2 Feeding and Breeding (Freshwater): Feeding habits, reproduction, and spawning behavior

3.3 Marine Ornamental Fishes: Notable species, traits, and identification methods

3.4 Feeding and Breeding (Marine): Dietary needs and reproductive patterns

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Course No. P1ZOTE211 Course Title: Aquarium and Fish keeping

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	Syllabus to be coveredin examination	Time allotted for Exam	% Weightage (marks)
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Minor Test II	21% to 40%	1 hr.	10 (5+5)
Major Test	41% to 100%	2hrs.	30

Major test will have two sections (A & B). Section A is compulsory comprising of 10 questions of 1 mark each and be spread over entire syllabus. Section B comprises of 4 questions from remaining 2 units and candidate has to attempt one question fromeach unit of 10 marks each.

SUGGESTED BOOKS:

- Swann, L. (1993). A Basic Overview of Aquaculture: Aquarium Systems. Illinois-Indiana Sea Grant Program, USA.
- Jhingran, V.G. (1991). Fish and Fisheries of India. Hindustan Publishing Corporation, New Delhi.
- Kumar, D. & Jena, J. (2006). Ornamental Fish Breeding and Culture. Narendra Publishing House, New Delhi.
- Natrajan, A.V. (2009). Aquarium Keeping. ICAR Publication, New Delhi.
- Das, P. & Ayyappan,S. (2000). Fish Genetics and Aquaculture Biotechnology. Narendra Publishing House.
- Ghosh, A. (2005). Introduction to Fish Biology. Emkay Publications, Delhi.
- Swain, S.K. (2013). Textbook on Ornamental Fish Culture. Kalyani Publishers, Ludhiana.
- Sharma, B.K. (2012). A Handbook of Aquarium Fish Keeping. Saraswati Publishing, Jaipur.
- Axelrod, H.R. (1996). Encyclopedia of Aquarium Fish. TFH Publications, Inc., USA.
- Mills, D. (2006). Aquarium Fish. Dorling Kindersley, London.
- Andrews, C. (2010). Manual of Fish Health. Firefly Books, Canada.

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SEMESTER – II
(Syllabus for the examination to be held in May 2027. 2028 and 2029)

Course No. P1ZOPE215

Practicals based on P1ZOTE211

Credits: 2

Maximum Marks:50

1. Comparative estimation of amount of FCO_2 in water samples
2. Comparative estimation of amount of DO in water samples
3. Comparative estimation of amount of NH_3 in water samples
4. Study various fish diseases
5. Study different ornamental fishes-both fresh and marine water
6. Study different aquarium plants
7. Identification of common Aquarium fishes
8. Study of slides of parasites and diseases
9. Setting up of an aquarium
10. Aquarium accessories (Heaters, thermostat, aerators, water filters)
11. Biological notes on fresh water ornamental fishes
12. Biological notes on marine water ornamental fishes

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Practicals			
Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
Internal Examination	100%	Continuous evaluation	25
External Examination	100%	4 hours	25
Total			50

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Course No. P1ZOTE212 Course Title: Fundamentals of Neuroscience

Credits: 2 Maximum Marks:50

Course Outcomes:

CO1: Students will gain a deep understanding of the multidisciplinary nature of neuroscience and its application across various fields. They will explore the historical evolution and major milestones in the field of neuroscience. The course will also cover recent advances and innovations shaping modern neuroscience research. Students will appreciate how neuroscience intersects with other disciplines and its impact on society.

CO2: Students will develop an in-depth understanding of the structure, types, and functions of neurons, including their roles in neural communication. They will explore the different types of neurons and their distribution during neurulation. Knowledge of neurotransmitters, including their stimulatory and inhibitory effects, will be covered. Additionally, students will learn about synaptic transmission and its significance in neuronal functioning.

CO3:Students will analyze various neurological disorders, including brain tumors, epilepsy, and neurodegenerative diseases through case studies. They will explore structural and functional illnesses affecting the nervous system, enhancing their diagnostic and analytical skills. The course will provide insights into the latest therapeutic approaches used in treating neurological conditions. Students will learn the importance of therapeutic interventions in managing neurological disorders.

UNIT-1: Introduction to Neuroscience **(10hrs)**

1.1 The Multidisciplinary Nature of Neuroscience

1.2 The Scope and Key Fields of Neuroscience

1.3 Historical Milestones in Neuroscience

1.4 Recent Innovations and Advances in Neuroscience

UNIT-2: Neuronal Structure, Types, and Functions **(10hrs)**

2.1 Structure and Function of Neurons

2.2 Types of Neurons and Their Distribution During Neurulation

2.3 Neurotransmitters: Types and Functions (Excitatory and Inhibitory)

2.4 The Synaptic Mechanism

UNIT-3: Disorders of the Nervous System **(10hrs)**

3.1 Case Studies: Brain Tumors and Epilepsy

3.2 Structural and Functional Disorders of the Nervous System

3.3 Neurodegenerative Conditions and Their Impact

3.4 Therapeutic Approaches in Neurological Treatment

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Course No. P1ZOTE212 Course Title: Fundamentals of Neuroscience

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	Syllabus to be coveredin examination	Time allotted for Exam	% Weightage (marks)
Minor Test I	upto 20%	1 hr.	10 (5+5)
Minor Test II	21% to 40%	1 hr.	10 (5+5)
Major Test	41% to 100%	2hrs.	30

Major test will have two sections (A & B). Section A is compulsory comprising of 10 questions of 1 mark each and be spread over entire syllabus. Section B comprises of 4 questions from remaining 2 units and candidate has to attempt one question fromeach unit of 10 marks each.

SUGGESTED BOOKS:

1. Squire, Fundamental Neuroscience (4th Edition and latest Edition), Elsevier,2013
2. Kandel, Principles of Neural Science (5th editionand latest Edition), McGraw Hill,2013
3. Banich, Cognitive neuroscience (3rd Edition) Wordsworth,2011
4. Gazzaniga, Cognitive Neuroscience (4th Edition) Norton,2014
5. Siegel, Basic Neurochemistry (8th Edition) Academic Press,2015
6. Friefelder: Practical Biochemistry

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Course No. P1ZOPE216

Practicals based on P1ZOTE212

Credits: 2

Maximum Marks:50

1. Studying the nervous system in invertebrates and vertebrates.
2. Studying the nervous system of the rat as an experimental model.
3. Processing and handling of tissue for microanatomy of the brain.
4. PAGE for various proteins from brain tissue.
5. Immunocytochemistry: Tissue processing, Immuno-enzymatic methods.
6. Fluorescence microscopy and immunofluorescence methods.

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Practicals			
Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
Internal Examination	100%	Continuous evaluation	25
External Examination	100%	4 hours	25
Total			50

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Course No.P1ZOTE213 Course Title: Basics of Bioinformatics and Biostatistics

Credits: 2 Maximum Marks:50

Course Outcomes:

CO1: Students will understand the principles of bioinformatics and its applications in biological research. They will gain proficiency in using biological databases like NCBI, EMBL, and UniProt. Sequence alignment techniques such as BLAST and FASTA will be applied in genomics and proteomics.

CO2: Students will learn fundamental biostatistical methods and their applications in biology. They will develop skills in handling different data types, calculating measures of central tendency and dispersion. Basic probability concepts will be applied in biological data analysis.

CO3: Students will gain expertise in hypothesis testing, including t-tests and Chi-Square tests, for analyzing biological data. They will develop skills in correlation and regression analysis for biological variables. Familiarity with statistical tools like MS Excel, GraphPad Prism, and R will be achieved.

UNIT-1: Introduction to Bioinformatics and Databases (10hrs)

1.1 Overview of Bioinformatics: Definition, scope, and real-world applications

1.2 Biological Databases: Exploration of key databases such as NCBI, EMBL, UniProt, and PDB

1.3 Sequence Alignment Basics: Techniques for comparing DNA and protein sequences (BLAST, FASTA)

1.4 Introduction to Genomic and Proteomic Analysis

UNIT-2: Fundamentals of Biostatistics (10hrs)

2.1 Introduction to Biostatistics: Significance and role of statistics in biological studies

2.2 Types of Biological Data: Qualitative vs. Quantitative data and sampling methods

2.3 Measures of Central Tendency and Dispersion: Understanding mean, median, mode, and standard deviation

2.4 Fundamentals of Probability: Exploring probability distributions and their biological relevance

UNIT-3: Statistical Tools and Techniques for Biological Research (10hrs)

3.1 Hypothesis Testing: Understanding concepts, t-tests, and Chi-Square tests in biological studies

3.2 Correlation and Regression Analysis: Assessing the relationship between biological variables

3.3 Introduction to Statistical Software: Basics of MS Excel, GraphPad Prism, and R for data analysis

3.4 Ethical Considerations in Data Analysis and Scientific Research

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Course No.P1ZOTE213 Course Title: Basics of Bioinformatics and Biostatistics

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	Syllabus to be coveredin examination	Time allotted for Exam	% Weightage (marks)
Minor Test I	upto 20%	1 hr.	10 (5+5)
Minor Test II	21% to 40%	1 hr.	10 (5+5)
Major Test	41% to 100%	2hrs.	30

Major test will have two sections (A & B). Section A is compulsory comprising of 10 questions of 1 mark each and be spread over entire syllabus. Section B comprises of 4 questions from remaining 2 units and candidate has to attempt one question fromeach unit of 10 marks each.

SUGGESTED BOOKS:

- Lesk, A. M. (2002). Introduction to Bioinformatics. Oxford University Press.
- Rosner, B. (1995). Fundamentals of Biostatistics (4th ed.). Cengage Learning.
- Mount, D. W. (2004). Bioinformatics: Sequence and Genome Analysis (2nd ed.). Cold Spring Harbor Laboratory Press.
- Pezzullo, J. (2013). Biostatistics for Dummies. Wiley.
- Waterman, M. S. (1995). Introduction to Computational Biology: Maps, Sequences and Genomes. Chapman & Hall.

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Course No. P1ZOPE217

Practicals based on P1ZOTE213

Credits: 2

Maximum Marks:50

1. Study types of data in biostatistics.
2. Retrieve biological sequence data from NCBI, EMBL, and UniProt databases.
3. Explore protein 3D structures using the Protein Data Bank (PDB).
4. Understand and handle biological sequence formats such as FASTA.
5. Perform nucleotide sequence alignment using NCBI BLAST and interpret results.
6. Explore genomic data using genome browsers like Ensembl or UCSC.
7. PCR Primer Designing
8. Explore proteomic data using databases such as ExPASy and ProteomeXchange.
9. Classify and present biological data using tables, charts, and graphs in MS Excel.
10. Calculate measures of central tendency: mean, median, and mode.
11. Calculate measures of dispersion: range, variance, and standard deviation.
12. Study probability distributions and plot normal and binomial curves using MS Excel or GraphPad Prism.
13. Perform hypothesis testing using t-test and chi-square test in MS Excel or GraphPad Prism.
14. Study the correlation and regression relationship between biological variables.

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

Practicals			
Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
Internal Examination	100%	Continuous evaluation	25
External Examination	100%	4 hours	25
Total			50

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Course No. P1ZORE226 **Course Title: Research Project/Dissertation**
Credits: 8 **Maximum Marks:200**

External Practical/ Research (thesis/project/patent) examination

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/dissertation of the students