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

Syllabus of

Post Graduation (ZOOLOGY)

For two years (as per NEP-2020)

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	P2ZOTC101	Ecosystem and Environmental Management	4	6.5	26	Core	100	-	✓	✓	✓				
2	P2ZOTC102	Diversity and Functionality in Fishes	4	6.5	26	Core	100	-	✓	✓	✓	✓			
3	P2ZOTC103	Cytogenetics and Molecular Biology	4	6.5	26	Core	100	-	✓	✓	✓	✓			
4	P2ZOPC104	Practicals based on P2ZOTC101 & P2ZOTC102	4	6.5	26	Core	-	100	✓	✓	✓	✓			
5	P2ZOPC105	Practicals based on P2ZOTC103	2	6.5	13	Core	-	50	✓	✓	✓	✓			
6	P2ZOTE110	Fundamentals of Fishery Science-I	4	6.5	26	Elective	100	-	✓	✓	✓				
7	P2ZOTE111	Limnology-I	4	6.5	26	Elective	100	-	✓	✓	✓				
8	P2ZOTE112	Human Molecular Genetics & Cytogenetics-I	4	6.5	26	Elective	100	-	✓	✓	✓				
9	P2ZOTE113	Advanced Cancer Genetics	4	6.5	26	Elective	100	-	✓	✓	✓				
10	P2ZOPE114	Practicals based on P2ZOTE110	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
11	P2ZOPE115	Practicals based on P2ZOTE111	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
12	P2ZOPE116	Practicals based on P2ZOTE112	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
13	P2ZOPE117	Practicals based on P2ZOTE113	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
14	P2ZOTC201	Comparative Animal Anatomy	4	6.5	26	Core	100	-	✓	✓	✓				
15	P2ZOTC202	Evolutionary Biology and Systematics	4	6.5	26	Core	100	-	✓	✓	✓	✓			
16	P2ZOTC203	Biomolecules and Metabolic Functions	4	6.5	26	Core	100	-	✓	✓	✓	✓			
17	P2ZOPC204	Practicals based on P2ZOTC201 & P2ZOTC202	4	6.5	26	Core	-	100	✓	✓	✓	✓			
18	P2ZOPC205	Practicals based on P2ZOTC203	2	6.5	13	Core	-	50	✓	✓	✓	✓			
19	P2ZOTE210	Fundamentals of Fishery Science-II	4	6.5	26	Elective	100	-	✓	✓	✓				
20	P2ZOTE211	Limnology-II	4	6.5	26	Elective	100	-	✓	✓	✓				
21	P2ZOTE212	Human Molecular Genetics & Cytogenetics-II	4	6.5	26	Elective	100	-	✓	✓	✓				
22	P2ZOTE213	Population and Behavioral Genetics	4	6.5	26	Elective	100	-	✓	✓	✓				
23	P2ZOPE214	Practicals based on P2ZOTE210	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
24	P2ZOPE215	Practicals based on P2ZOTE211	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
25	P2ZOPE216	Practicals based on P2ZOTE212	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
26	P2ZOPE217	Practicals based on P2ZOTE213	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
27	P2ZOVC251	Laboratory Techniques in Biochemistry and Physiology	-	-	-	Vocational	-	-						✓	
28	P2ZOVC252	Basic Molecular Biology Techniques	-	-	-	Vocational	-	-						✓	
29	P2ZOVC253	Aquarium Setting and Management	-	-	-	Vocational	-	-						✓	
30	P2ZOTC301	Advanced Cellular Analysis and Research Methodology	4	6.5	26	Core	100	-	✓	✓	✓	✓			
31	P2ZOTC302	Fundamentals of Endocrinology	4	6.5	26	Core	100	-	✓	✓	✓				
32	P2ZOTC303	Functional Physiology of Animals	4	6.5	26	Core	100	-	✓	✓	✓				
33	P2ZOTC304	Clinical and Food Microbiology	4	6.5	26	Core	100	-	✓	✓	✓				
34	P2ZOTC305	Fundamentals of Immunology	4	6.5	26	Core	100	-	✓	✓	✓				
35	P2ZOPC306	Practicals based on P2ZOTC301 & P2ZOTC302	4	6.5	26	Core	-	100	✓	✓	✓				
36	P2ZOPC307	Practicals based on P2ZOTC303 & P2ZOTC304	4	6.5	26	Core	-	100	✓	✓	✓	✓			
37	P2ZOPC308	Practicals based on P2ZOTC305	2	6.5	13	Core	-	50	✓	✓	✓	✓			
38	P2ZOMO351	MOOC/SWAYAM	4	6.5	26	Core	100	-	✓	✓	✓	✓	✓		
39	P2ZOTC401	Reproduction and Developmental Biology	4	6.5	26	Core	100	-	✓	✓					
40	P2ZOPC402	Practicals based on P2ZOTC401	2	6.5	13	Core	-	50	✓	✓	✓	✓			
41	P2ZOTE410	Nematode Biology and Management	2	6.5	13	Elective	50	-	✓	✓		✓			
42	P2ZOTE411	Aquarium Fish Management	2	6.5	13	Elective	50	-	✓	✓		✓			
43	P2ZOTE412	Basics of Neuroscience	2	6.5	13	Elective	50	-	✓	✓					
44	P2ZOTE413	Bioinformatics and Biostatistics Essentials	2	6.5	13	Elective	50	-	✓	✓		✓			
45	P2ZORE425	Field Visit / Industrial Training	2	6.5	13	Elective	-	-	✓	✓	✓	✓			
46	P2ZORC426	Research Project / Dissertation	16	6.5	104	Core	400	-	✓	✓	✓	✓			✓

Programme Specific Outcomes (PSOs) – M.Sc. Zoology (As per PG Syllabus 2025)

The M.Sc. Zoology programme is structured to provide an in-depth and holistic understanding of the animal sciences, integrating theoretical foundations, laboratory skills, field-based learning, vocational exposure, and research aptitude. In alignment with the National Education Policy (NEP) 2020, the following Programme Specific Outcomes are expected:

- Develop a comprehensive understanding of core areas including ecosystem management, fish diversity, cytogenetics, evolutionary biology, endocrinology, physiology, immunology, developmental biology, and more, enabling students to interpret and apply biological principles across taxonomic groups.
- Acquire hands-on experience through extensive practicals and vocational courses such as biochemistry techniques, molecular biology methods, and aquarium management, using advanced tools and techniques to solve biological problems and manage real-world situations.
- Train students in research methodology, data collection, statistical analysis, cellular analysis, and experimental design, enabling them to undertake meaningful research projects, dissertations, and industrial internships related to contemporary issues in zoology.
- Promote experiential learning through field visits, limnology modules, fishery sciences, and industrial training that expose students to real-life environments, biodiversity assessment, and conservation practices.
- Build competency in interdisciplinary and emerging areas such as bioinformatics, cancer genetics, neuroscience, behavioral genetics, and microbiology, fostering the ability to adapt to advancements in biological research and healthcare applications.
- Inculcate ecological literacy and sensitivity towards environmental challenges, wildlife conservation, and sustainable development, while also understanding ethical practices in animal handling and scientific research.
- Equip students with skills relevant to academia, industry, wildlife management, fisheries, biotechnology, and healthcare sectors, supported by elective and vocational courses designed to meet regional, national, and global job market demands.
- Promote digital literacy and self-learning through SWAYAM/MOOC courses integrated into the curriculum, empowering students to continue learning beyond the classroom and stay updated with global trends in zoological sciences.
- Foster critical thinking, scientific inquiry, and effective communication skills that allow students to engage with the scientific community and society at large in a responsible and impactful manner.

COURSE STRUCTURE FOR PG PROGRAMME ZOOLOGY (2 YEAR) (ANNEXURE-1A)

CREDIT FRAMEWORK FOR SEMESTER-I

Course	Course Code	Course Name	Credits
Major Core [12(T) + 6(P)]			
	P2ZOTC101	Ecosystem and Environmental Management	4
	P2ZOTC102	Diversity and Functionality in Fishes	4
	P2ZOTC103	Cytogenetics and Molecular Biology	4
	P2ZOPC104	Practicals based on P2ZOTC101 & P2ZOTC102	2+2
	P2ZOPC105	Practicals based on P2ZOTC103	2
Total Core Credits			**18**
Major Elective (Any One*) [4(T) + 2(P)]			
	P2ZOTE110	Fundamentals of Fishery Science-I	4
	P2ZOTE111	Limnology-I	4
	P2ZOTE112	Human Molecular Genetics & Cytogenetics-I	4
	P2ZOTE113	Advanced Cancer Genetics	4
	P2ZOPE114	Practicals based on P2ZOTE110	2
	P2ZOPE115	Practicals based on P2ZOTE111	2
	P2ZOPE116	Practicals based on P2ZOTE112	2
	P2ZOPE117	Practicals based on P2ZOTE113	2
Total Elective Credits			**6**
Semester Credit Total			**24**

CREDIT FRAMEWORK FOR SEMESTER-II

Course	Course Code	Course Name	Credits
Major Core [12(T) + 6(P)]			
	P2ZOTC201	Comparative Animal Anatomy	4
	P2ZOTC202	Evolutionary Biology and Systematics	4
	P2ZOTC203	Biomolecules and Metabolic Functions	4
	P2ZOPC204	Practicals based on P2ZOTC201 & P2ZOTC202	2+2
	P2ZOPC205	Practicals based on P2ZOTC203	2
Total Core Credits			**18**
Major Elective (Any One*) [4(T) + 2(P)]			
	P2ZOTE210	Fundamentals of Fishery Science-II	4
	P2ZOTE211	Limnology-II	4
	P2ZOTE212	Human Molecular Genetics & Cytogenetics-II	4
	P2ZOTE213	Population and Behavioral Genetics	4
	P2ZOPE214	Practicals based on P2ZOTE210	2*
	P2ZOPE215	Practicals based on P2ZOTE211	2
	P2ZOPE216	Practicals based on P2ZOTE212	2
	P2ZOPE217	Practicals based on P2ZOTE213	2
Total Elective Credits			**6**

Exit Option: Vocational Course (Any One*) [4 Credits]			
	P2ZOVC251	Laboratory Techniques in Biochemistry and Physiology	-
	P2ZOVC252	Basic Molecular Biology Techniques	-
	P2ZOVC253	Aquarium Setting and Management	-
Semester Credit Total			24

CREDIT FRAMEWORK FOR SEMESTER-III

Category	Course Code	Course Name	Credits
Major Core [20(T) + 10(P)]			
	P2ZOTC301	Advanced Cellular Analysis and Research Methodology	4
	P2ZOTC302	Fundamentals of Endocrinology	4
	P2ZOTC303	Functional Physiology of Animals	4
	P2ZOTC304	Clinical and Food Microbiology	4
	P2ZOTC305	Fundamentals of Immunology	4
	P2ZOPC306	Practicals based on P2ZOTC301 & P2ZOTC302	2+2
	P2ZOPC307	Practicals based on P2ZOTC303 & P2ZOTC304	2+2
	P2ZOPC308	Practicals based on P2ZOTC305	2
Total Core Credits			30
Other Components			
	P2ZOMO351	MOOC/SWAYAM	4
Semester Credit Total			30

CREDIT FRAMEWORK FOR SEMESTER-IV

Course	Course Code	Course Name	Credits
Major Core [4(T) + 2(P)]			
	P2ZOTC401	Reproduction and Developmental Biology	4
	P2ZOPC402	Practicals based on P2ZOTC401	2
Total Core Credits			6
Major Elective (Any Two) [4(T)]			
	P2ZOTE410	Nematode Biology and Management	2
	P2ZOTE411	Aquarium Fish Management	2
	P2ZOTE412	Basics of Neuroscience	2
	P2ZOTE413	Bioinformatics and Biostatistics Essentials	2
Total Elective Credits			4
	P2ZORE425	Field Visit / Industrial Training	2
	P2ZORC426	Research Project / Dissertation	16
Semester Credit Total			28

OVERALL TOTAL CREDITS: 106

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

COURSE CODE	COURSE NAME	CREDITS
CREDIT FRAMEWORK FOR SEMESTER-I		
MAJOR CORE [12(T)+6(P)]		
P2ZOTC101	**Ecosystem and Environmental Management**	4
P2ZOTC102	**Diversity and Functionality in Fishes**	4
P2ZOTC103	**Cytogenetics and Molecular Biology**	4
P2ZOPC104	Practicals based on P2ZOTC101 & P2ZOTC102	2+2
P2ZOPC105	Practicals based on P2ZOTC103	2
	Total Credits	**18**
MAJOR ELECTIVE (ANY ONE*)		
P2ZOTE110	**Fundamentals of Fishery Science-I**	4*
P2ZOTE111	**Limnology-I**	4
P2ZOTE112	**Human Molecular Genetics & Cytogenetics-I**	4
P2ZOTE113	**Advanced Cancer Genetics**	4
P2ZOPE114	Practicals based on P2ZOTE110	2*
P2ZOPE115	Practicals based on P2ZOTE111	2
P2ZOPE116	Practicals based on P2ZOTE112	2
P2ZOPE117	Practicals based on P2ZOTE113	2
	Total Credits	**6**
	Semester Credit Total	**24**

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

Course No. P2ZOTC101 Course Title: Ecosystem and Environmental Management

Credits: 4 **Maximum Marks:100**

Course Outcomes:

CO1: Students will understand fundamental ecological principles, including ecosystem structure, ecological niches, and major biomes. They will learn about the hydrological cycle, energy flow, and key nutrient cycles. The unit also covers methods for measuring primary and secondary productivity.

CO2: Students will understand the structure and classification of ecological communities, including species dominance, diversity, and succession. They will study ecotones, edge effects, and climax concepts. The unit also introduces soil composition, formation, and conservation.

CO3: Students will learn key population parameters such as size, density, natality, and mortality. They will construct life tables, explore metapopulations, and understand ecades and ecotypes. The unit covers species interactions like competition, predation, mutualism, and parasitism.

CO4: Students will explore sustainable development and non-conventional energy sources. They will understand remote sensing, bio-indicators, and the role of bioremediation. The unit emphasizes environmental monitoring and pollution control methods.

CO5: Students will study pollutants, ecotoxicology, and their effects on ecosystems. They will understand ecological risk assessment and mitigation strategies. The unit highlights Environmental Impact Assessment and environmental governance practices.

UNIT-1: Fundamentals of Ecology and Ecosystem (12 hrs)

1.1 Ecology: branches and scope; Concept of ecosystem: Ecological habitat ,niche and Ecological equivalents; Major terrestrial biomes

1.2 Hydrological cycle and its impact on environment and biota

1.3 Energy flow in an ecosystem; Mineral cycling: Carbon, Nitrogen, Phosphorus

1.4 Primary and Secondary productivity and their methods of determination

UNIT-2: Community Ecology and Environmental Dynamics (13 hrs)

2.1. Organization of communities: Biotic community concept; Intra-community classification; Patterns in communities; Terrestrial biota and permeants

2.2 Ecological dominance, species diversity, ecotones and edge effect

2.3 Succession: Types, Mechanism; Concept of climax and theories

2.4 Soil: composition, texture, profile, pedeogenesis and conservation

UNIT-3: Population Ecology and Species Interactions (10 hrs)

3.1 Characteristics of population: Size, Density; Dispersal, Dispersion; Age structure, Natality, Mortality; Life tables

3.2 Concept of Meta population

3.3 Ecades and ecotypes

3.4 Species interactions: Negative: competition, predation, parasitism; Positive: commensalism, mutualism

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

Course No. P2ZOTC101 Course Title: Ecosystem and Environmental Management

UNIT-4: Environmental Sustainability and Monitoring Techniques (13hrs)

4.1 Sources and uses of non-conventional energy; Sustainable development: definition and goals
4.2 Remote sensing: definition, importance and application
4.3 Bio-indicators
4.4 Bio-remediation

UNIT-5: Ecotoxicology, Risk Management, and Environmental Governance (12hrs)

5.1 Ecotoxicology: Pollutants and their effects; Pesticides, Heavy metals
5.2 Ecological risk management: Hazard identification, Exposure assessment, Risk characterization
5.3 Environmental Impact Assessment: assessment methods, mitigation measures
5.4 Environment policies and governance: International agreements (Paris agreement, Convention on biological diversity); Environmental laws: National regulations, enforcement mechanism

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

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

Course No. PZ OTC101 Course Title: Ecosystem and Environmental Management

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:

- Smith, R.L. 197 Ecology and Field Biology. Harper & Row Publishers, USA.
- Begon, M., Tow end, C.R., and Harper, J.L. 2006. Ecology: From Individuals to Ecosystems. Blackwell Publishing, UK.
- Krebs, C.J. 200 Ecology: The Experimental Analysis of Distribution and Abundance. Pearson Education, USA.
- Tilman, D. 1982 Resource Competition and Community Structure. Princeton University Press, USA.
- Jorgensen, S.E. 002. Ecological Modelling: An Introduction. Elsevier, Netherlands.
- Gaston, K.J., Spicer, J.I. 2004. Biodiversity: An Introduction. Blackwell Science, UK.
- Wilson, E.O. The Diversity of Life. Belknap Press, USA.
- May, R.M. 19 tability and Complexity in Model Ecosystems. Princeton University Press, USA.
- Schlesinger, 1997. Biogeochemistry: An Analysis of Global Change. Academic Press, USA.
- DeAngelis, D.L nd Waterhouse, J.C. 1987. Equilibrium and Nonequilibrium Concepts in Ecological Models. Spri Verlag, USA.
- Scheffer, M. Ecology of Shallow Lakes. Chapman & Hall, UK.
- Sanderson, E et al. 2002. The Human Footprint and the Biodiversity Crisis. BioScience, USA.
- McKinney, M nd Lockwood, J.L. 1999. Biotic Homogenization. Springer-Verlag, USA.
- Giller, P.S. 2 The Ecology of Freshwater Systems. Blackwell Publishing, UK.
- Tansley, A.G 5. The Use and Abuse of Vegetational Concepts and Terms. Ecology, USA.
- Franklin, J.F Forman, R.T.T. 1987. Creating Landscape Patterns by Forest Cutting. Ecology, USA.
- Sharma, P.D . Fundamentals of Ecology & Environment. Dhanpat Rai Publishers, India.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

Course No. P2ZOTC102 Course Title: Diversity And Functionality In Fishes

Credits: 4 **Maximum Marks:100**

Course Outcomes:

CO1: Students will develop a solid understanding of fish morphology, classification, and evolutionary concepts, gaining insights into the structural adaptations of various fish species. They will explore the evolution of fish, understanding how these organisms have diversified over time.

CO2: Learners will explore the incredible diversity of fish species and the adaptive strategies they employ to survive in a variety of habitat conditions. This will include studying the ecological niches they occupy, the impact of environmental factors, and the unique adaptations that enable fish to thrive in different aquatic environments.

CO3: Students will delve into the physiological processes that govern fish biology, including respiration, digestion, and circulation. They will examine how these processes are adapted to meet the needs of different fish species, considering both the evolutionary and ecological pressures that shape their physiological functions.

CO4: This unit will focus on the excretory, osmoregulatory, and reproductive physiology of fish. Students will explore how fish maintain internal balance in a constantly changing environment, including the mechanisms they use to regulate water and salt levels. They will also study the reproductive strategies of fish, understanding the hormonal and physiological processes that govern reproduction in aquatic species.

CO5: Students will investigate the sensory adaptations of fish. They will examine how these adaptations enhance survival, from communication and predator avoidance to buoyancy control and sound perception, highlighting the specialized features that allow fish to interact with their environment effectively.

UNIT-1: Essentials of Fish Biology (12 hrs)

1.1 Morphological Adaptations in Fishes: General body forms and morphological diversity in fishes, Structure, types, and modifications of paired and unpaired fins.

1.2 Skeletal support of fins in fishes and theories of fin origin

1.3 Systematic Classification and Diversity of Fishes: Outline classification of fishes with distinctive features, geographical distribution, and representative examples of major groups: Chondrichthyes, Actinopterygii, Crossopterygii, and Dipnoi.

1.4 Phylogeny and Evolutionary Importance of Early Fishes: Phylogenetic significance of Ostracoderms and Placoderms; evolutionary trends and significance of primitive fish groups in vertebrate evolution.

UNIT-2: Diversity and Adaptations in Specialized Fish Groups (13 hrs)

2.1 Exotic Fishes: Introduction, Exotic Species, Merits, and Impacts.

2.2 Hillstream and Deep-sea Fishes: Habitat characteristics, morphological adaptations, ecological importance, major threats, and conservation measures.

2.3 Poisonous, Venomous, and Electric Fishes: Identification, examples, and adaptations of poisonous and venomous fishes; nature and function of fish toxins

2.4 Electric fishes—mechanism of electric organ discharge and ecological significance.

UNIT-3: Digestive and Respiratory Physiology in Fishes (12 hrs)

3.1 Feeding and Digestion: Categories of food and feeding habits, Structure of the digestive system in different fishes, associated digestive glands, modifications of the digestive system

3.2 Respiratory System: Structure and function of gills, Air-breathing organs and their functions; Swim Bladder and Its Functions (Buoyancy, Respiration, Sound production)

Course No. P2ZOTC102 **Course Title: Diversity And Functionality In Fishes**

3.3 Circulatory System: Hematology and cardiovascular physiology, Gas transport and acid-base balance, Adaptations for oxygen transport

3.4 Comparative Aspects of Fish Circulation: Variations in circulatory patterns among fish groups

UNIT-4: Excretory, Osmoregulatory, and Reproductive Physiology in Fishes **(10 hrs)**

4.1 Excretory System: Comparative kidney anatomy, Role of the rectal gland and chloride cells

4.2 Osmoregulation in Freshwater and Marine Teleosts: Mechanism of Osmoregulation, Physiological adaptations to different environments

4.3 Reproductive System: Structure and physiology of the reproductive system, Types of eggs, Oviparity, viviparity (Aplacental and Placental)

4.4 Nest building and Parental Care, Hatching, Metamorphosis

UNIT-5: Sensory and Structural Adaptations in Fishes **(13 hrs)**

5.1 Bioluminescence: mechanism, significance, and examples

5.2 Lateral Line System: Structure, function and modifications

5.3 Scales in Fishes: placoid, ganoid, cycloid, ctenoid—structure, growth patterns, functions, and importance.

5.4 Weberian Ossicles and Hearing Mechanism: Structure, arrangement, and functions of Weberian ossicles; their role in sound transmission and enhancement of hearing capacity in 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:

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.**

SUGGESTED BOOKS:

- S.F. Harmer, W.A. Herdman, T.W. Bridge, G.A. Boulenger. Discovery Publishing House, New Delhi (1999). Classification of Fishes, Volume.
- Lynwood S. Smith. Narendra Publishing House, Delhi (2003). Introduction to the Fish Physiology.
- Albert C.L.G. Gunther. Arihant Publishing House, Jaipur (2004). Study of Fishes.
- Arvind Kumar and Pushaplata Dubey. Daya Publishing House, Delhi (2006). Fish Management and Aquatic Environment.
- Lagler, Bardock, Miller & Possino. John Wiley & Sons, New York, London (2012). Ichthyology, 2nd Edition.
- K.C. Badapanda. Narendra Publishing House, Delhi (2012). Fishery Biology.
- Vasanth Kumar. Daya Publishing House, New Delhi (2013). Advances in Aquatic Ecology.
- B.N. Yadav. Daya Publishing House, Delhi (2016). Fish and Fisheries.
- K.C. Jayaram. Narendra Publishing House, Delhi (2017). Fundamentals of Fish Taxonomy.
- R. Hamilton. Forgotten Books Publisher (2018). Ichthyology.
- D.K. Mukherjee and J.V.S. Rauthan. Medtech Publisher (2019). Ichthyology: An Introduction to Fish Science.
- S.S. Khanna. Random Publications, New Delhi (2012). A Text Book of Fish Biology and Fisheries.
- Lagler, Karl F., John E. Bardach, Robert R. Miller, and Dora R. May Passino. 1977. *Ichthyology*. 2nd ed. New York: Wiley.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

Course No. P2ZOPC104 **Practicals based on P2ZOTC101 and P2ZOTC102**

Credits: 4 **Maximum Marks:100**

Practicals based on P2ZOTC101

1. Determine the minimum size of quadrat required for studying a community.
2. Determine the minimum number of quadrats required for a valid study of a community.
3. Analyze and determine the texture of different soil types.
4. Estimate the temperature and moisture content at different soil profiles
5. Measure physical characteristics of water samples, including temperature, depth, velocity, pH
6. Determine the amount of carbondioxide present in a water sample.
7. Measure the amount of dissolved oxygen in a water sample.
8. Estimate the concentration of Calcium in a water sample.
9. Determine the levels of Carbonates and Bicarbonates in a water sample.
10. Estimate the concentration of Calcium (Ca^{2+}) and Magnesium (Mg^{2+}) ions in a water sample.
11. Measure the amount of Total Dissolved Solids (TDS) in a water sample.
12. Determine the amount of Total Suspended Solids (TSS) in a water sample.
13. Identify common local macrophytes found in aquatic ecosystems.
14. Estimate primary productivity in an aquatic or terrestrial ecosystem using appropriate methods.
15. Determine the amount of Soil Organic Matter (SOM) in a soil sample.
16. Measure the Biochemical Oxygen Demand (BOD) of a water sample.
17. Estimate the amount of dissolved organic matter in a water sample.

Practicals based on P2ZOTC102

1. Observe and describe the general characters, morphology, and classification of fishes.
2. Examine and differentiate various body forms and adaptations in fishes.
3. Identify and analyze modifications in paired and unpaired fins
4. Investigate the structure and function of the lateral line system in fishes.
5. Classify and identify common ornamental fish species used in aquaculture and the aquarium trade.
6. Study and interpret the skeletal system of a teleost fish through specimen observation.
7. Observe and understand the structure and function of electric organs in selected electric fish species.
8. Identify and describe poisonous and venomous organs and fish species
9. Examine and classify Dipnoi fishes, highlighting their general characters with examples.

10. Study and compare different types of gills, accessory respiratory organs, and gill rakers in fishes.
11. Identify and interpret morphological and physiological adaptations in hill stream fishes.
12. Observe and differentiate various types and modifications of the swim bladder in fishes.
13. Examine the structure, arrangement, and function of Weberian ossicles (models/specimens/slides).
14. Observe common parasitic, bacterial, and viral diseases in fishes using slides, photographs
15. Study and classify different types of fish scales under the microscope.
16. Examine and describe the reproductive organs and secondary sexual characters in fishes.
17. Conduct a comparative analysis of feeding habits in fishes through gut content examination.
18. Compare the alimentary canals of herbivorous and carnivorous fishes.
19. Perform hematological analysis to study various blood parameters of 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	50
External Examination	100%	4 hours	50
Total			100

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

Course No. P2ZOTC103 **Course Title: Cytogenetics and Molecular Biology**

Credits: 4 **Maximum Marks:100**

Course Outcomes:

CO1: Students will study the structure of chromatin, including heterochromatin and euchromatin, and the nucleosome model. They will explore chromosome structures in prokaryotes and eukaryotes, including telomeres, centromeres, and kinetochores. Additionally, learners will examine specialized chromosomes and mitochondrial and chloroplast genomes.

CO2: Learners will explore numerical chromosomal changes such as polyploidy and aneuploidy, along with their genetic implications. They will study structural chromosomal alterations like deletions, duplications, inversions, and translocations. Students will also investigate disorders in humans associated with both numerical and structural chromosomal variations.

CO3: Students will understand the structure of DNA, its role as genetic material, and the various DNA types and models. They will explore mutation types, causes, and detection methods, as well as DNA repair mechanisms. Additionally, learners will study the role of transposons in both prokaryotes and eukaryotes and their impact on genetic variation.

CO4: Students will study the processes of DNA replication and recombination, including the enzymes involved and mechanisms in both prokaryotes and eukaryotes. They will explore RNA synthesis, processing, and the roles of transcription factors. Additionally, learners will examine RNA processing mechanisms like splicing, polyadenylation, and editing.

CO5: Learners will explore the structure and types of ribosomes, as well as the formation of the initiation complex in translation. They will study the genetic code, the processes of elongation, termination, and post-translational modifications. Additionally, students will examine the regulation of gene expression in both prokaryotes and eukaryotes, with a focus on chromatin's role in gene silencing.

UNIT-I: Structure and organization of chromosomes **(13 hrs)**

1.1 Structure of chromatin; heterochromatin, euchromatin, Nucleosome model
1.2 Chromosome structure: Prokaryotes, Eukaryotes, Telomere structure, Centromere, Kinetochore
1.3 Specialized chromosomes: Lampbrush chromosomes, Polytene chromosomes
1.4 Mitochondrial Genome and Chloroplast Genome

UNIT-2: Numerical and structural chromosomal Variations in Human **(10 hrs)**

2.1 Numerical Changes and their genetic implications: Polyploidy, Aneuploidy
2.2 Numerical Change associated disorders in humans
2.3 Structural chromosome alterations; Deletions, Duplications, Inversions, Translocations
2.4 Structural changes associated disorders in humans

UNIT-3: DNA, Mutation, DNA repair and Transposons **(13 hrs)**

3.1 DNA; Historical Milestone, DNA as genetic material, Structure of DNA: nucleotides and various models,Types of DNA, Repetitive DNA
3.2 Mutation: Types, causes and detection, Loss of function, gain of function, Germinal versus somatic mutants, Insertional mutagenesis

Course No. P2ZOTC103 Course Title: Cytogenetics and Molecular Biology

3.3 DNA Repair and Mechanisms
3.4 Transposons; Transposons in prokaryotes,Transposons in eukaryotes

UNIT-4: Fundamental Processes-I **(12 hrs)**

4.1 DNA replication and Recombination; Origin of replication, enzymes involved and replication fork, DNA replication in eukaryotes and prokaryotes
4.2 Extra chromosomal replicons, Homologous and site-specific recombination
4.3 RNA synthesis and processing; Transcription factors, Transcription in Prokaryotes and Eukaryotes
4.4 RNA processing: RNA splicing, polyadenylation, RNA editing, Types of RNA

UNIT-5: Fundamental Processes-II **(12 hrs)**

5.1 Ribosome; Structure and types
5.2 Formation of initiation complex, Genetic Code
5.3 Elongation and termination, Activation of tRNA, Translational inhibitors, Post-translational modifications
5.4 Control of gene expression; Regulation of gene expression in prokaryotes and eukaryotes, Role of chromatin in gene expression and gene silencing

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

Course No. P2ZOTC103 **Course Title: Cytogenetics and Molecular Biology**

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.**

SUGGESTED BOOKS:

- Sinnett, E.W., Dunn, L.C., and Debzhanski, Th. (1958). Principles of Genetics. Kugakusha Co. Inc. Ltd., Japan.
- Burnham, C.R. (1962). Discussions in Cytogenetics. Burgess Publ. Co., Minneapolis.
- Swanson, R.C.P., Mertz, T., and Young, W.J. (1967). Cytogenetics. Prentice Hall of India, Pvt. Ltd.
- Garber, G.B. (1972). Cytogenetics. McGraw Hill Pub. Co. Ltd.
- Strickbarger, M.W. (1976). Genetics. McMillan Publ. Co. Inc., New York.
- Gardner and Snustad, J.W. & Sons. (1981). Principles of Genetics.
- A.G. Atherly, J.R. Girton, & J.F. McDonald. (1999). The Science of Genetics. Saunders College Publ., USA.
- Miglani. (2011). Fundamentals of Genetics. Narosa Publ. House, New Delhi.
- Terry Brown. (2012). Introduction to Genetics: A Molecular Approach. Taylor and Francis Group, USA.
- Hartland Ruvolo. (2012). Analysis of Genes and Genomes, 8th Edition.
- E.J. Gardner, M.J. Simmons, and D.P. Srustad. (2012). Principles of Genetics, 8th Edition. J.W. Sons Publ., Singapore.
- William Klug. (2016). Essentials of Genetics, 9th Edition. Pearson Education Ltd.
- D. Peter Snustad. (2019). Principles of Genetics, 7th Edition. Publisher: John Wiley.
- Daniel and Bruce. (2019). Genetics: Analysis of Genes and Genomes. Publisher: Jones and Bartlett Learning, LLC.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

Course No. P2ZOPC105 **Practicals based on P2ZOTC103**

Credits: 2 **Maximum Marks:50**

1. Study of different parts and working principles of a brightfield microscope.
2. Study of general principles and BSL guidelines for working in a molecular genetics lab.
3. Study of general morphology of Chironomus larva.
4. Preparation of a temporary mount of the salivary gland of Chironomus larvae and study of polytene chromosome structure.
5. Study of morphological differences between male and female grasshoppers.
6. Dissection of a male grasshopper to expose its testicular tubules and study different stages of meiosis.
7. Study of blood sample collection and storage procedures from different individuals.
8. DNA extraction from stored blood samples using the organic method.
9. Qualitative and quantitative analysis of extracted DNA samples.
10. Agarose gel electrophoresis of provided DNA samples.

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

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

Course No. P2ZOTE110 **Course Title: Fundamentals of Fishery Science-I**

Credits: 4 **Maximum Marks:100**

Course Outcomes:

CO1: Students will gain an in-depth understanding of the ecological roles of plankton and benthos in freshwater ecosystems. They will explore how these organisms contribute to the food web, nutrient cycling, and overall ecosystem health, emphasizing their importance in supporting aquatic life and maintaining biodiversity.

CO2: Learners will analyze the impact of various environmental factors, such as temperature, pH, oxygen levels, and pollutants, on aquatic ecosystems and fish biology. They will study how these factors influence fish behavior, growth, and survival, and understand the broader implications for aquatic ecosystem stability and conservation.

CO3: This unit will examine the endocrine and reproductive systems of fish, focusing on the hormonal regulation of reproductive processes. Students will explore the mechanisms behind fish reproduction, that influence reproduction, with a particular focus on how these systems ensures species survival.

CO4: Students will assess fish nutrition, spoilage, processing, and packaging techniques, understanding the importance of proper handling to maintain the quality and safety of fish products. They will explore the biochemical aspects of fish spoilage, as well as modern methods in food processing and packaging that extend shelf life and ensure consumer health.

CO5: Students will gain an understanding of morphometric and meristic characters in fish, including their significance in growth studies and fish biology. Additionally, learners will examine traditional fishing methods used in India for both inland and marine waters, while also exploring recent technological advancements in fishing.

UNIT-I: Ecology of Fishery Science **(12 hrs)**

1.1 Introduction to Fishery Science: Definition, scope, and significance, Interdisciplinary nature of fishery science

1.2 Introduction to Plankton and Their Types: Meaning and definition of plankton; Types of plankton: Phytoplankton and Zooplankton; Characteristics and classification of plankton

1.3 Introduction to Benthos and their Classification: Definition and characteristics of benthos; Classification of benthic organisms

1.4 Role of Plankton and Benthos in Freshwater ecosystems

UNIT-2: Aquatic Environmental Dynamics **(13 hrs)**

2.1Thermal Factors: Influence of temperature on essential biological functions (metabolism, growth, reproduction); Thermal layering (stratification) in aquatic systems and its ecological impact.

2.2 Light Factors: Light sources and variables affecting light penetration (turbidity, depth, dissolved substances); Techniques for measuring light intensity in water; Impact of light on aquatic life (photosynthesis, vision, behavior).

2.3 Carbon Dioxide: sources, assessment techniques, and ecological importance.

2.4 Dissolved Oxygen: Availability and factors affecting dissolved oxygen levels; Measurement methods for dissolved oxygen; Critical role of oxygen in sustaining aquatic ecosystem.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

Course No. P2ZOTE110 Course Title: Fundamentals of Fishery Science-I

UNIT-3: Endocrine and Reproductive System of Fishes **(10 hrs)**

3.1 Introduction to Endocrine System: Definition and importance of endocrine regulation in fishes, Comparison of endocrine systems in fishes and other vertebrates, Major Endocrine glands

3.2 Structure and Function of Reproductive Organs: Male Reproductive System: Testes structure, spermatogenesis, role of hormones; Female Reproductive System: Ovarian structure, oogenesis, egg maturation; Gametogenesis and hormonal control of reproduction

3.3 Sexual Maturity and Breeding Cycles: Maturation stages in male and female fishes, Environmental factors influencing sexual maturity

3.4 Secondary Sexual Characteristics and Breeding Behavior: Sexual dimorphism and secondary sexual traits, Territoriality and parental care strategies

UNIT-4: Nutritional Value and Fish Processing **(13 hrs)**

4.1 Biochemical Composition and Nutritional Importance: proteins, lipids, vitamins, minerals, and their nutritional significance in human diets

4.2 Fish Spoilage: Chemical spoilage- Lipid oxidation, enzymatic degradation; Microbial spoilage - spoilage bacteria, fish microbes, and their impact on quality

4.3 Fish Processing and Preservation Techniques: drying, salting, smoking, fermentation, freezing, canning, irradiation and vacuum packaging.

4.4 Packaging of Fish Products: Introduction, Role of Packaging, Types of Fish Packaging- Bulk packaging, Wholesale packaging, Retail packaging, Air freight packaging, Packaging of Fish Products

UNIT-5: Fish Growth and Fishing Techniques **(12 hrs)**

5.1 Morphometric Characters: Definition and Overview, Measurable physical attributes of fish, significance in fish growth studies.

5.2 Meristic Characters: Definition and Overview, Types of Meristic Characters, Significance, Differences between morphometric and meristic characters

5.3 Traditional Fishing methods used in India for fishing in Inland and Marine waters

5.4 Recent advances in fishing methods: Light fishing, Electric Fishing, Sonar/Echosounders

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

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

Course No. P2ZOTE110 Course Title: Fundamentals of Fishery Science-I

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.**

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.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

Course No. P2ZOPE114 **Practicals based on P2ZOTE110**

Credits: 2 **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.
14. Observe traditional fishing methods used in India for inland and marine 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:

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

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

Course No. P2ZOTE111
Credits: 4

Course Title: Limnology -I
Maximum Marks:100

Course Outcomes:

CO1: Students will gain an understanding of limnology, its history, and scope, with a focus on its significance in India. They will explore the hydrological cycle and the growing concerns regarding dwindling freshwater resources

CO2: Learners will study the physical characteristics of freshwater systems, including the causes and types of currents. They will explore the impact of turbidity on aquatic organisms, methods of measuring light penetration, and how temperature affects biological processes in aquatic environments.

CO3: Students will explore key chemical parameters in freshwater ecosystems, such as dissolved oxygen, carbon dioxide, and pH, and their significance. They will also examine the sources and impact of nitrates, nitrites, ammonia, silicates, phosphates, calcium, and magnesium on aquatic life and water quality.

CO4: This unit will introduce students to wetland ecosystems and management techniques, as well as the origin and classification of lakes and ponds. Learners will study eutrophication, its impact, and restoration methods for lakes, alongside the different types and origins of ponds.

CO5: Students will examine river and estuarine ecosystems, focusing on their origin, classification, and physico-chemical characteristics. They will also explore the abiotic and biotic features of bogs, marshes, and vernal pools, understanding their significance in maintaining biodiversity and ecosystem health.

UNIT-1: Introduction to Limnology and Freshwater Resources **(13 hrs)**

1.1 Limnology, its history and scope; Limnology in India
1.2 Hydrological cycle
1.3 Dwindling fresh water resources and their conservation
1.4 Freshwater resource management.

UNIT-2: Physical Characteristics of Freshwater Systems **(12 hrs)**

2.1 Current: Causes, types and significance
2.2 Turbidity: Causes and impact on aquatic organisms; Bottom: Composition, sources and diversity
2.3 Light Sources, factors affecting light penetration, methods of measuring light penetration and its relationship with aquatic organisms
2.4 Temperature: Effect on various biological processes and thermal stratification.

UNIT-3: Chemical Parameters in Freshwater Ecosystems **(12 hrs)**

3.1 Dissolved oxygen and carbon dioxide: Sources, methods of determination, distribution and significance, pH: definition, distribution and significance.
3.2 Nitrates, Nitrites and Ammonia: Sources and significance.
3.3 Silicates and phosphates: Sources and impact on aquatic organisms.
3.4 Calcium and Magnesium: Sources, methods of determination, distribution and significance.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

Course No. P2ZOTE111 Course Title: Limnology-I

UNIT-4: Wetlands, Lakes, and Ponds Management **(10 hrs)**

4.1 Wetland-Introduction; Management techniques of wetlands.
4.2 Lakes: Origin and Classification.
4.3 Eutrophication and restoration methods.
4.4 Ponds: Origin and Types

UNIT-5: River, Estuarine, and Wetland Ecosystems **(13 hrs)**

5.1 Rivers: Origin, Classification, Water flow and Stream channels, Physico-chemical characteristics; Biotic characteristics of flowing waters.
5.2 Estuaries: Definition, origin and classification.
5.3 Bogs and marshes; Origin, types, abiotic and biotic characteristics
5.4. Vernal pools: Definition 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.**

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

Course No. P2ZOPE115 **Practicals based on P2ZOTE111**

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

Course No. P2ZOTE111 **Course Title: Limnology -I**

SUGGESTED BOOKS:

- Cole, A.A. (1974). Text book of Limnology. The G.V. Moshy Company Saint Louis.
- Hutchinson, G.E. (1975). Limnological Botany John Willey and Sons, New York
- Hutchinson, G.E. (1977).A treatise on Limnology Vol. I John Willey and Sons, New York
- Hutchinson, G.E. (1977). A treatise on Limnology Vol. II John Willey and Sons, New York.
- Hutchinsonl, G.E. (1977). A treatise on Limnology Vol. I John Willey and Sons, New York
- Olepper, H. (1979). Careers in conservation. A Ronaldn Press publication John Wiley and Sons, New York.
- Hybes, H.B. N. (1979). 'The Ecology of running waters. Liver Pool University Press.
- Jhingran, V.G. (1982). Fish and Fisheries of India. Hindustan Publishing corporation, India.
- Goldman, C.R. and Horne, A.J.(1983).Limnology. McGraw Hill International Book Company,New Delhi .
- Davies, B.R. and Walker, K.F. (1986). The Ecology of River Systems. Dr. W. Junk Publishers, Bostan
- Brian Moss. Blackwell Science. (1998). Ecology of Freshwaters 3rd Ed.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

Course No. P2ZOTE112 Course Title: Human Molecular Genetics and Cytogenetics-I

Credits: 4 **Maximum Marks:100**

Course Outcomes:
CO1: Students will learn the foundations of human genetics, including Mendelian inheritance, pedigree analysis, gene mapping, and population genetics. They will explore the chromosomal theory of inheritance and human variation.
CO2: Learners will study human cytogenetics, chromosome morphology, and classification. They will explore the structure of sex chromosomes, dosage compensation, and X-inactivation mechanisms.
CO3: Students will explore banding techniques, chromosomal aberrations, and human karyotyping methods. They will also learn about syndromes associated with chromosomal abnormalities and their clinical relevance.
CO4: Learners will study the structure of the human genome, DNA replication, and mechanisms of transcription and translation. They will also understand mutations and DNA repair processes.
CO5: Students will study single-gene and multifactorial disorders, including case studies on autosomal and X-linked disorders. They will also explore pharmacogenomics and the genetic basis of drug response.

UNIT-I: Introduction to Human Genetics and Classical Concepts (13 hrs)

1.1 Overview of Human Genetics: Historical developments and milestones, Mendelian genetics and extensions, Chromosomal theory of inheritance

1.2 Human Pedigree Analysis: Symbols and patterns of inheritance, Autosomal dominant/recessive, X-linked, Y-linked traits, Mitochondrial inheritance

1.3 Linkage and Gene Mapping in Humans: Linkage concept and recombination, LOD scores and linkage analysis, Physical vs genetic maps

1.4 Population Genetics and Human Variation: Hardy-Weinberg equilibrium, Genetic drift, gene flow, mutation, selection

UNIT-2: Human Karyotyping and Chromosomal Architecture (13 hrs)

2.1 Introduction to Human Cytogenetics: Historical background and scope, Importance in medical genetics and diagnostics, Cell cycle phases relevant to cytogenetics

2.2 Chromosome Morphology and Classification: Metacentric, submetacentric, acrocentric chromosomes, Centromere, telomere, secondary constrictions, Chromosome nomenclature (ISCN standards)

2.3 Sex Chromosomes: X and Y chromosome structure

2.4 Dosage Compensation: Lyon's hypothesis and X-inactivation, Barr bodies and sex chromatin

UNIT-3: Studying Human Chromosomes (10 hrs)

3.1 Banding Techniques: Metaphase chromosome preparation, G, Q, R, C banding techniques, Karyotyping and idiogram construction

3.2 Chromosomal Aberrations: Structural (deletions, duplications, inversions, translocations), Numerical (aneuploidy, polyploidy), Mosaicism and chimerism

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

Course No. P2ZOTE112 Course Title: Human Molecular Genetics and Cytogenetics-I

3.3 Human Karyotyping Techniques: Peripheral blood lymphocyte culture technique, Hypotonic treatment, fixation, slide preparation, Harvesting, staining, and photographic karyotype analysis

3.4 Syndromes Associated with Chromosomal Abnormalities: Down, Turner, Klinefelter, Patau, Edwards syndromes, Clinical karyotyping in diagnosis, Case studies and genetic counseling aspects

UNIT-4: Molecular Basis of Inheritance **(12 hrs)**

4.1 Structure and Organization of the Human Genome: Gene structure and types, Coding vs non-coding regions, Repetitive DNA and transposable elements

4.2 Mechanism of DNA replication in prokaryotes and eukaryotes

4.3 Transcription and Translation: Mechanisms and enzymes involved

4.4 Mutations and DNA Repair Mechanisms

UNIT-5: Human Genetic Disorders and Clinical Applications **(12 hrs)**

5.1 Single-Gene Disorders: Inborn errors of metabolism (e.g., PKU, Tay-Sachs), Hemoglobinopathies (e.g., Sickle cell, Thalassemia),

5.2 Case studies on autosomal/X-linked disorders

5.3 Multifactorial and Complex Disorders:Diabetes, cardiovascular diseases, cancer genetics, Twin studies and heritability

5.4 Pharmacogenomics and Personalized Medicine:Genetic basis of drug response

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

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

Course No. P2ZOTE112 Course Title: Human Molecular Genetics and Cytogenetics-I

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**

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.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

Course No. P2ZOPE116 **Practicals based on P2ZOTE112**

Credits: 2 **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			
Internal Examination	100%	Continuous evaluation	25
External Examination	100%	4 hours	25
Total			50

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

Course No. P2ZOTE113 **Course Title: Advanced Cancer Genetics**

Credits: 4 **Maximum Marks:100**

Course Outcomes:

CO1: Students will study the molecular pathways involved in carcinogenesis, including RAS, p53, MYC, and Wnt signaling. They will explore the role of epigenetics, metastasis, angiogenesis, and the tumor microenvironment in cancer progression.

CO2: Learners will explore advanced genomics techniques such as next-generation sequencing (NGS) and whole genome analysis in cancer research. They will also study transcriptomics, proteomics, artificial intelligence applications, and single-cell genomics in cancer detection.

CO3: Students will examine hereditary cancer syndromes like BRCA1/BRCA2 and Lynch syndrome, and learn about polygenic risk scores and the differences between germline and somatic mutations in cancer. They will also explore the role of gene-environment interactions in cancer development.

CO4: Learners will study tumor biomarkers such as ctDNA and microRNAs, and understand pharmacogenomics and personalized cancer therapy. They will explore the applications of CRISPR in cancer research and molecular targets for small molecule inhibitors in cancer treatment.

CO5: Students will explore emerging cancer therapies, including immuno-oncology, CAR-T cell therapy, RNA-based therapeutics, and cancer nanomedicine. They will focus on advancements in drug delivery and theranostics for more effective cancer treatment.

UNIT-1: Molecular and Genetic Basis of Cancer **(12 hrs)**

1.1 Molecular Pathways of Carcinogenesis: RAS, p53, MYC, RB, and Wnt Signaling Pathways
1.2 Epigenetics in Cancer: DNA Methylation, Histone Modifications, and miRNA Regulation
1.3 Metastasis and Angiogenesis: Mechanisms and Genetic Regulation
1.4 Tumor Microenvironment and its Role in Cancer Progression

UNIT-2: Advanced Genomics and Cancer **(12 hrs)**

2.1 Next-Generation Sequencing (NGS) and Whole Genome Analysis in Cancer Research
2.2 Transcriptomics and Proteomics Approaches in Cancer Diagnosis
2.3 Artificial Intelligence and Deep Learning Applications in Cancer Genomics
2.4 Single-Cell Genomics and Liquid Biopsy in Cancer Detection

UNIT-3: Hereditary and Familial Cancers **(10 hrs)**

3.1 Hereditary Cancer Syndromes: BRCA1/BRCA2, Lynch Syndrome, Li-Fraumeni Syndrome
3.2 Polygenic Risk Scores and Genetic Predisposition to Cancer
3.3 Germline vs. Somatic Mutations in Cancer Progression
3.4 Gene-Environment Interactions in Cancer Development

UNIT-4: Cancer Biomarkers and Precision Medicine **(13 hrs)**

4.1 Tumor Biomarkers: Circulating Tumor DNA (ctDNA), microRNAs,Exosomes, use of molecular techniques for cancer diagnosis.
4.2 Pharmacogenomics and Personalized Cancer Therapy

Course No. P2ZOTE113 Course Title: Advanced Cancer Genetics

4.3 CRISPR and Genome Editing in Cancer Research
4.4 Molecular Targets and Small Molecule Inhibitors in Cancer Therapy

UNIT-5: Emerging Therapeutic Strategies in Cancer Treatment **(13 hrs)**

5.1 Immuno-oncology: Immune Checkpoint Inhibitors, Monoclonal Antibodies
5.2 CAR-T Cell Therapy: Advances and Challenges
5.3 RNA-Based Therapeutics: siRNA, mRNA Vaccines, and Antisense Oligonucleotides
5.4 Cancer Nanomedicine: Drug Delivery and Theranostics

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.**

SUGGESTED BOOKS:

- Thompson & Thompson Genetics in Medicine, 8th edition, Imprint: Saunders, 2015.
- Alberts, B., et al. Molecular Biology of the Cell. 6th edition, Garland Science, USA.
- The Biology of Cancer, Weinberg R.A., 2nd edition, Garland Science, 2013.
- Cancer Genomics: From Bench to Personalized Medicine, Graham Dellaire et al., 2014.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – I
(Syllabus for the examination to be held in December 2025, 2026 and 2027)

Course No. P2ZOPE117 **Practicals based on P2ZOTE113**

Credits: 2 **Maximum Marks:50**

1. To study the principle of Western Blot analysis.
2. To identify mutations in cancer genomes using bioinformatics tools.
3. To identify differentially expressed genes in tumor vs. normal tissues using transcriptome analysis.
4. To identify hereditary breast and ovarian cancer markers using PCR and sequencing.
5. To study Polygenic Risk Score Calculation using GWAS data for cancer susceptibility.
6. To study the principle of ELISA.
7. To study the principle of Flow Cytometry.
8. To study the principle of the Comet assay for measuring DNA damage caused by carcinogens.

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			
Internal Examination	100%	Continuous evaluation	25
External Examination	100%	4 hours	25
Total			50

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

COURSE CODE	COURSE NAME	CREDITS
	CREDIT FRAMEWORK FOR SEMESTER-II	
	MAJOR CORE [12(T)+6(P)]	
P2ZOTC201	**Comparative Animal Anatomy**	4
P2ZOTC202	**Evolutionary Biology and Systematics**	4
P2ZOTC203	**Biomolecules and Metabolic Functions**	4
P2ZOPC204	Practicals based on P2ZOTC201 & P2ZOTC202	2+2
P2ZOPC205	Practicals based on P2ZOTC203	2
	Total Credits	**18**
	MAJOR ELECTIVE (ANY ONE*)	
P2ZOTE210	**Fundamentals of Fishery Science-II**	4*
P2ZOTE211	**Limnology -II**	4
P2ZOTE212	**Human Molecular Genetics & Cytogenetics-II**	4
P2ZOTE213	**Population and Behavioral Genetics**	4
P2ZOPE214	Practicals based on P2ZOTE210	2*
P2ZOPE215	Practicals based on P2ZOTE211	2
P2ZOPE216	Practicals based on P2ZOTE212	2
P2ZOPE217	Practicals based on P2ZOTE213	2
	Total Credits (Major Elective)	**6**
	EXIT OPTION: VOCATIONAL COURSE (ANY ONE*) 4-CREDITS	
P2ZOVC251	Laboratory techniques in Biochemistry and Physiology	-
P2ZOVC252	Basic Molecular Biology Techniques	-
P2ZOVC253	Aquarium setting and management	-
	Semester Credit Total	**24**

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOTC201 **Course Title: Comparative Animal Anatomy**
Credits: 4 **Maximum Marks:100**

Course Outcomes:
CO1: Students will understand fundamental animal body plans, including symmetry, germ layers, coelom, and segmentation. They will explore hydrostatic skeletons and coelomic roles in locomotion across invertebrate groups.A comparative understanding of vertebrate skeletal systems will highlight structural adaptations and functions.
CO2: Learners will examine various feeding strategies and digestive mechanisms across animal phyla. They will compare digestive system designs from simple to complex animals including symbiotic digestion. The course will also cover open vs. closed circulatory systems and the evolution of neurogenic and myogenic hearts.
CO3: Students will identify excretory products and relate them to habitat and physiology in different animal groups. They will compare structures like flame cells, nephridia, and kidneys across invertebrates and vertebrates. Respiratory adaptations including gills, tracheae, lungs, and skin respiration will be studied comparatively.
CO4: Learners will analyze the organization of primitive and advanced nervous systems in invertebrates. They will study the central nervous system across vertebrate taxa with emphasis on brain development. Structural and functional evolutionary advancements in nervous systems will be interpreted comparatively.
CO5: Students will classify and understand the significance of larval forms in crustaceans, insects, and echinoderms.They will study metamorphosis and larval development in different phyla and their ecological importance. Flight mechanisms and structural adaptations enabling flight in insects, birds, and mammals will be compared.

UNIT-1: Anatomical Framework and Skeleton **(13hrs)**

1.1 Animal Architecture: Body symmetry, levels of organization, germ layers, coelom and metamerism.
1.2 Hydrostatic Skeleton: Principles and locomotion based on hydrostatic skeleton with examples (Coelenterates, Planaria, Nemertina)
1.3 Functional role of coelom in locomotion of Echinodermata and Mollusca
1.4 Comparative Skeletal System in Vertebrates: Axial skeleton (skull and vertebral column) and appendicular skeleton (limbs and girdles).

UNIT-2: Comparative Digestive and Circulatory Systems **(10hrs)**

2.1 Food Intake and Digestive Mechanisms: Modes of food intake – fluid/liquid feeding and particulate solid feeding; basic digestive processes – intracellular and extracellular digestion; symbiotic digestion
2.2 Nutritional Adaptations in Invertebrates: Intracellular digestion in *Paramecium* (food vacuole), gastrovascular cavity in Hydra; Filter Feeding mechanism in Polychaetes, Crustaceans
2.3 Comparative Digestive Systems: Canal system in Porifera; complete alimentary canal in Cockroach, Earthworm, Mammals
2.4 Comparative Study of Circulatory Systems: Open and closed vascular systems; Patterns of circulation; Neurogenic heart in invertebrates (*Daphnia*, Cockroach, Earthworm) and Myogenic heart in Molluscs and Vertebrates (Fish, Frog, Reptiles, Mammals).

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOTC201 Course Title: Comparative Animal Anatomy

UNIT-3: Comparative Excretory and Respiratory Systems **(13hrs)**

3.1 Excretory Modes and Invertebrate Structures: Ammonotelism, Ureotelism, Uricotelism; Excretory organs: Flame cells (Platyhelminthes), Nephridia (Annelids), Malpighian tubules (Arthropods), Green glands (Crustaceans).

3.2 Vertebrate Kidneys and Excretory Ducts: Structure and origin of Archinephros, Pronephros, Mesonephros and Metanephros.

3.3 Respiratory Adaptations in Invertebrates: Branchial respiration via gills (crustaceans, molluscs); Tracheal respiration in arthropods (insects, myriapods).

3.4 Respiratory Adaptations in Vertebrates: Pulmonary respiration through lungs (amphibians to mammals) and cutaneous respiration (amphibians).

UNIT-4: Nervous System Evolution **(12hrs)**

4.1 Primitive Nervous Systems: Nerve net in Coelenterata, nervous systems in Echinodermata and Hemichordata.

4.2 Advanced Nervous Systems: Nervous systems in Arthropods and Mollusca.

4.3 Comparative Vertebrate Nervous Systems: Central nervous system in vertebrates (fish to mammals) with special reference to the brain.

4.4 Evolutionary Trends in Nervous Systems: Structural and functional advancements in nervous system organization

UNIT-5: Larval Forms and Flight Adaptations **(12hrs)**

5.1 Larval Forms in Crustaceans: Nauplius, Zoea, Megalopa, and their significance.

5.2 Larval Forms in Insects and Echinoderms: Holometabolous and hemimetabolous larvae in insects; bipinnaria and brachiolaria in echinoderms.

5.3 Principles of Flight: Mechanics and adaptations of flight in insects, birds, and mammals.

5.4 Comparative Flight Adaptations: Structural modifications enabling flight in different animal 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:

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

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOTC201 Course Title: Comparative Animal Anatomy

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.**

SUGGESTED BOOKS:

- Frederic Martini (1986). *Fundamentals of Anatomy and Physiology*. Prentice-Hall Publishing House.
- Karel Lilium, William Bemis, Wallen F. Walker and Lancer (2000). *Functional Anatomy of Vertebrates: An Evolutionary Perspective*.
- Gerald J. Tortora, Sandra R. and Bonnie (2000). *Principles of Anatomy and Physiology*.
- R. McNeill Alexander (2006). *Principles of Animal Locomotion*.
- Gunther Von Hagens and Angelina Whalley (2011). *Body Worlds: The Anatomy of Animals - Catalogue*.
- J. Ruth Lawson (2011). *Anatomy and Physiology of Animals*. Platypus Global Media.
- Saurav Singh (2013). *A Textbook of Comparative Anatomy of Vertebrates*. Centrum Press
- Gerard J. Tortora and Bryan H. Derrickson (2014). *Principles of Anatomy and Physiology* (15th Edition). Wiley Online Library.
- Kotpal, R. L. (2022). *A Textbook of Invertebrate Zoology*. Rastogi Publications.
- Kotpal, R. L. (2022). *A Textbook of Vertebrate Zoology*. Rastogi Publications.
- R. K. Saxena and Sumitra Saxena (2015). *Comparative Anatomy of Vertebrates*. Viva Books Pvt. Ltd.
- Piper Treuting et al. (2017). *Comparative Anatomy and Histology* (2nd Edition). Elsevier.
- Kino Kenneth and V. Kardong (2018). *Vertebrates: Comparative Anatomy, Function, Evolution*. McGraw-Hill, Higher Education.
- George Kent and Bob Carr (2019). *Comparative Anatomy of Vertebrates* (9th Edition).
- Weichert, C. K. and Preesch, W. *Elements of Chordate Anatomy* McGraw-Hill Book Co., New York.
- Tortora, G. J. and Grabowski, S. (2006). *Principles of Anatomy and Physiology* John Wiley & Sons.
- Kardong, K. V. (2018). *Vertebrates: Comparative Anatomy, Function, Evolution*. McGraw-Hill Education.
- Kent, G. C., & Carr, R. K. (2018). *Comparative Anatomy of the Vertebrates* .McGraw-Hill Education.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOTC-202 **Course Title: Evolutionary Biology and Systematics**

Credits: 4 **Maximum Marks:100**

Course Outcomes:

CO1: Students will gain a comprehensive understanding of systematics, species concepts, and factors influencing species diversity, enabling analysis of the scope and history of classification systems.
CO2: Modern taxonomic techniques such as chemotaxonomy, cytotaxonomy, and molecular taxonomy will be introduced, highlighting the importance of taxonomic curation and identification methods.
CO3: Evolutionary concepts, mechanisms like natural selection and genetic drift, and historical theories such as Darwinism and Neo-Darwinism will be explored to understand the processes driving evolutionary change.
CO4: The geological time scale, major evolutionary milestones, and speciation processes will be examined to comprehend the history of life on Earth and significant evolutionary transitions.
CO5: Biological, paleontological, and biogeographical evidence of evolution, including the origins of human evolution, will be analyzed using fossil and genetic data to explore evolutionary relationships and adaptations.

UNIT-I: Fundamentals of Systematics and Species Diversity **(13hrs)**

1.1 Concepts and Scope of Systematics; Definition, history, and importance.
1.2 Species Concepts; Typological, Nominalistic, Biological, and Evolutionary species concepts.
1.3 Hierarchical Classification of Species; Species, subspecies, superspecies, sibling species.
1.4 Biodiversity and Species Richness; Factors influencing species diversity and distribution.

UNIT-2: Advances in Taxonomy and Classification **(12hrs)**

2.1 Modern Trends in Taxonomy; Chemotaxonomy, Cytotaxonomy, Molecular taxonomy.
2.2 Taxonomic Collection and Curation; Preservation techniques and digital taxonomic databases.
2.3 Taxonomic Keys and Identification Methods; Types, merits, and limitations.
2.4 International Codes of Nomenclature; Principles and importance of ICZN.

UNIT-3: Theories and Mechanisms of Evolution **(10hrs)**

3.1 Evolutionary Concepts and Mechanisms Natural selection, genetic drift, and speciation.
3.2 Historical Theories of Evolution; Lamarckism, Neo-Lamarckism, Darwinism, and Neo-Darwinism.
3.3 Mutation and Evolutionary Change; Mutation theory, chromosomal evolution, and polyploidy.
3.4 Sexual Selection and Adaptations; Evolution of mating strategies and reproductive success.

UNIT-4: Evolutionary Timeline and Major Transitions **(12hrs)**

4.1 Geological Time Scale and Evolutionary Eras; Eras, periods, and epochs.
4.2 Major Evolutionary Milestones: Origin of unicellular and multicellular organisms.
4.3 History of Life on Earth; Fossil records and evolutionary transitions.
4.4 Speciation and Adaptive Radiations; Allopatric and sympatric speciation, isolating mechanisms.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOTC-202 Course Title: Evolutionary Biology and Systematics

UNIT-5: Evidence of Evolution and Human Origins **(13hrs)**

5.1 Biological Evidence of Evolution; Comparative anatomy, morphology, vestigial organs, atavism.
5.2 Paleontological Evidence; Fossil formation, types, and significance in evolution.
5.3 Biogeography and Evolutionary Links; Missing links and their evolutionary implications.
5.4 Human Evolution; Fossil evidence, genetic studies, and evolutionary adaptations.

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.**

SUGGESTED BOOKS:

- Mayr, E. (1982). The Growth of Biological Thought. The Belknap Press of Harvard University, Massachusetts.
- Mayr, E. (1983). Principles of Animal Systematics. Tata McGraw-Hill Publishing.
- Jha, A. P. (1983). Genes and Evolution. John Publication, New Delhi.
- Merrell, D. J. (1993). Evolution and Genetics. Holt, Rinehart and Winston, Inc.
- Wilson, E. O. (1999). The Diversity of Life. W. W. Norton & Co.
- Strickberger, M. W. (2000). Evolution. Jones and Bartlett Publishers, Boston, London.
- Dobzhansky, T. (2005). The Genetics and Origin of Species. Columbia University Press.
- King, M. (2009). Species Evolution: The Role of Chromosomal Change. Cambridge University Press, Cambridge.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOPC204 **Practicals based on P2ZOTC201 and P2ZOTC202**

Credits: 4 **Maximum Marks:100**

Practicals based on P2ZOTC201

1. Observation of metamerism in earthworm/annelids.
2. Examination of placoid, cycloid, and ctenoid scales.
3. Exploration of the skull structure of frog, rabbit, *Varanus*, and fowl.
4. Analysis of vertebrae in frog, rabbit, *Varanus*, and fowl.
5. Observation of ribs in *Varanus*, fowl, and rabbit.
6. Comparative study of the pectoral girdle in frog, Varanus, fowl, and rabbit.
7. Examination of the pelvic girdle in frog, *Varanus*, fowl, and rabbit.
8. Detailed observation of forelimbs in frog, *Varanus*, fowl, and rabbit.
9. Examination of hindlimbs in frog, *Varanus*, fowl, and rabbit.
10. Investigation of the nervous system in Coelenterates, Echinodermata, Arthropoda, and Mollusca.
11. Observation of larval forms in Crustacea and Echinodermata.
12. Demonstration of the circulatory system through models.
13. Demonstration of the respiratory system through models.
14. Examination of prawn appendages.
15. Observation of the filter-feeding apparatus in Cladoceran zooplankton.
16. Analysis of insect mouthparts and feeding adaptations in vertebrates.
17. Observation of feeding behavior in fluid feeders like leech.
18. Examination of various liquid feeding adaptations in insects.
19. Observation of filter-feeding adaptations in Polychaetes (*Chaetopterus*).
20. Examination of gills in crustaceans and molluscs.
21. Observation of larval forms through prepared slides/models.

Practicals based on P2ZOTC202

1. Study of Phylum Porifera – Examination of general characters and classification with specimen observation.
2. Study of Phylum Coelenterata – Identification of key characteristics and classification through preserved specimens and slides.
3. Study of Phylum Annelida – Observation of general morphological features and classification with specimens.

4. Study of Phylum Platyhelminthes – Microscopic examination of representative members and classification.
5. Study of Phylum Aschelminthes – Identification of distinguishing characteristics and classification through microscopic slides.
6. Study of Phylum Mollusca – Study of shell morphology, soft body parts, and classification using available specimens.
7. Study of Phylum Echinodermata – Observation of external and internal structures with classification of key specimens.
8. Evidences of Evolution – Examination of fossil specimens, homologous and analogous structures, and comparative anatomy.
9. Discontinuous Distribution of Animals – Case studies and map-based analysis of animal distribution patterns.

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

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOTC203 **Course Title: Biomolecules and Metabolic Functions**
Credits: 4 **Maximum Marks:100**

Course Outcomes:

CO1: Students will understand pH, buffers, reaction kinetics, and molecular interactions like hydrogen bonding and van der Waals forces.They will study water's structure, the concept of acids and bases, buffering in biological systems, and thermodynamic principles. Emphasis will be on entropy, free energy, chemical potential, and their biological applications.

CO2: Students will explore enzyme properties, kinetics, inhibition mechanisms, and catalytic behavior including allosteric regulation. They will learn about coenzymes, isoenzymes, and principles of enzyme activity regulation. Protein structure, folding, and analysis through tools like Ramachandran plots will also be covered.

CO3: This unit covers carbohydrate classification, glucose isomerism, and structural variants like epimers and anomers. Students will study biologically important molecules like hexosamines, glycoproteins, and glycophorins. It includes metabolic disorders, tolerance tests, and the significance of carbohydrate derivatives.

CO4: Students will understand lipid types including saturated and unsaturated fatty acids, and their classification. They will study simple, complex, and derived lipids like steroids, phospholipids, and prostaglandins. The functional roles of lipids in cellular structures and metabolic processes will be emphasized.

CO5: Students will learn metabolic pathways including glycolysis, TCA cycle, gluconeogenesis, and fatty acid oxidation. They will explore hormonal regulation of lipolysis, ketogenesis, and adipose tissue metabolism.The unit also covers oxidative phosphorylation and ATP generation through the electron transport chain.

UNIT-1: Basics of Biophysical Chemistry **(13hrs)**

1.1 Principles of biophysical chemistry (pH, buffer, reaction kinetics, colligative properties)
1.2 Stabilizing interactions (Vanderwaals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.)
1.3 Water- Physical properties and Structure of water, hydrogen bonding, ionization of water. pH scale concept of acids-bases & buffers, buffer ionization behaviour of amino acids and proteins. Henderson-Hasselbalch equation, biological buffering system. Principle of osmosis, Electroendomosis, Donan-membrane equilibrium and its biological applications.
1.4 Thermodynamics- Open, closed & isolated system, first and second laws of thermodynamics and their applications in living organisms. Molecular basis of entropy, Helmholtz & Gibbs free energy, equilibrium constant. Chemical potential, Phosphate group transfer potential coupled reactions.

UNIT-2: Enzymes and Proteins **(10hrs)**

2.1. General properties, kinetics and classification
2.2 Coenzymes and their types, Isoenzymes and Principles of catalysis
2.3 Mechanism and inhibition of enzyme activity (Irreversible inhibition and Reversible inhibition: Competitive, Non-competitive and Uncompetitive; Feedback inhibition: Allosteric site – a concept, Allosteric inhibition
2.4 Proteins: classification and Conformation (Ramachandran plot, secondary structure, domains, motifs, folds).

UNIT-3: Carbohydrates: Structure and Function **(12hrs)**

3.1 General features and classification.
3.2 Isomerism in Glucose (Optical isomerism, Ring structure, Anomers, Epimers; Aldose, Ketose)
3.3 Hexosamines, Glycoproteins and Glycophorins.
3.4. Carbohydrate tolerance tests, glycogen storage diseases

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOTC203 Course Title: Biomolecules and Metabolic Functions

UNIT-4: Lipids: Structure and Function **(12hrs)**

4.1 Definition, classification, Nomenclature and forms of fatty acids (Saturated & Unsaturated fatty acids)
4.2 Simple lipids: Triacylglycerols, waxes
4.3 Complex Lipids: Phospholipids, Glycolipids
4.4 Derived Lipids: Steroids, Lipoprotein, Prostaglandins

UNIT-5 Metabolism of Carbohydrates & Lipids **(13hrs)**

5.1 Fatty acid oxidation (Biosynthesis of fatty acids), hormonal control of Adipose tissue, Lipolysis and Ketosis.
5.2 Carbohydrates: Glycolysis, Oxidation of pyruvate to acetyl Co A, Citric acid cycle
5.3. Glycogenesis, Glycogenolysis and Gluconeogenesis
5.4. Respiratory chain, oxidative phosphorylation and its mechanism

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.**

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOTC203 Course Title: Biomolecules and Metabolic Functions

SUGGESTED BOOKS:

- Zubay, G.L., Parsons, W.W., and Vance, D.E. (1995). Principles of Biochemistry.
- Gumport, R.I., Deis, F.H., Gerber, N.C., and Rager. (2002). Biochemistry, 5th Edition. W.H. Freeman & Co., New York.
- Horton, R., Moran, L., Scrimgeour, G., Perry, M., and Rawn, J. (2006). Principles of Biochemistry, 4th Edition. Pearson International.
- Voet, D., Voet, J.G., and Pratt, C.W. (2008). Principles of Biochemistry. Wiley Plus.
- Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., and Rodwell, V.W. (2009). Harper's Illustrated Biochemistry. McGraw Hill Publishing House.
- Lehninger, A.L., Cox, M.M., and Nelson, D.L. (2010). Principles of Biochemistry. W.H. Freeman & Co., New York.
- Sulochana, R.H. (2010). Principles of Biochemistry.
- Devlin, T.M. (2011). Textbook of Biochemistry, 7th Edition.
- Tymoczko, J.L., Berg, J.M., and Stryer, L. (2013). Biochemistry, 2nd Edition.
- Berg, J.M., Tymoczko, J.L., and Stryer, L. (2013). Biochemistry, 7th Edition.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOPC205 **Practicals based on P2ZOTC203**

Credits: 2 **Maximum Marks:50**

1. Detection and identification of carbohydrates (monosaccharides, disaccharides, polysaccharides) by Molisch's, Benedict's, Barfoed's, Iodine, and Fehling's tests.
2. Detection of proteins and amino acids by Biuret, Ninhydrin, and Xanthoproteic tests.
3. Detection of lipid solubility tests.
4. Quantitative estimation of carbohydrates using Anthrone method.
5. Quantitative estimation of proteins using Lowry's method or Bradford assay.
6. Determination of saponification number of fats and oils.
7. Demonstration of enzyme activity (e.g., salivary amylase or urease activity).
8. Determination of the effect of pH and temperature on enzyme activity.
9. To determine the presence of antibodies in a given sample by using the technique ELISA.
10. Estimation of the amount of moisture content in the provided sample.
11. Quantification of the ash content in the provided sample.
12. Quantification of the amount of lipids in the provided sample using Folch method.

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

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOTE210 **Course Title: Fundamentals of Fishery Science-II**

Credits: 4 **Maximum Marks:100**

Course Outcomes:

CO1: Understand the natural breeding processes of Indian Major Carps, including breeding grounds, wet and dry bund breeding techniques, and the principles of induced breeding, focusing on hypophysation and hormone usage for breeding management.

CO2: Gain knowledge on aquarium setup, maintenance, and biological aspects of aquarium fish, alongside aquaculture practices for Indian Major Carps, trout, and freshwater prawns, emphasizing pond preparation, breeding, health management, and harvesting.

CO3: Learn the processes of fertilization, embryonic development, gastrulation, and larval growth in fishes, exploring the stages of development from ovulation to hatching, and understanding the significance of different developmental stages.

CO4: Identify common fish diseases caused by bacterial, viral, protozoan, and parasitic agents, and learn about their symptoms, transmission, prevention, and treatment to ensure better fish health management.

CO5: Understand the principles of fish population dynamics, including recruitment, fecundity, growth measurement, and age assessment, and their significance in managing sustainable fisheries and evaluating the health and productivity of fish populations.

UNIT-1: Natural Breeding of Indian Major Carps **(12hrs)**

1.1 Natural Breeding of Indian Major Carps: Location of Breeding Grounds, Factors Responsible for Natural Breeding

1.2 Wet Bund Breeding Technique: Detailed process of the wet bund breeding method, advantages of wet bunds for breeding, Challenges faced during wet bund breeding

1.3 Dry Bund Breeding Technique: Description and method of dry bund breeding, Advantages and challenges of dry bund breeding, and its comparison to wet bund breeding

1.4 Induced Breeding: Hypophysation – pituitary gland structure, collection, preservation, extract preparation, injection methods, and dosage, brood stock management and transportation. Synthetic hormones used for induced breeding of carps.

UNIT-2: Aquarium and Aquaculture Techniques **(13hrs)**

2.1 Aquarium Setup, Maintenance, and Biological Aspects of Aquarium Fish: Aquarium Setup, Aquarium Maintenance, Aquarium Accessories, Biological Aspects of Aquarium Fish

2.2 Culture of Indian Major Carps: Ecological and Biological Aspects, Pond Preparation and Management for IMC, Breeding and Larval Rearing of IMC, Feeding, Health Management, and Harvesting

2.3 Trout Culture: Introduction to Trout Species, Biological Aspects and Life Cycle of Trout, Trout Culture Practices, Pond and Tank Management, Feeding and Nutrition, Health Management, Disease Control, Harvesting and Market Considerations

2.4 Freshwater Prawn Culture: Introduction to Freshwater Prawns, Biological Aspects and Life Cycle of Freshwater Prawns, Culture Practices for Freshwater Prawns, Pond Preparation and Management, Feeding and Nutrition, Harvesting and Marketing

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOTE210 Course Title: Fundamentals of Fishery Science-II

UNIT-3: Fertilization, Development, and Larval Growth in Fishes (12hrs)

3.1 Ovulation and Fertilization: Process of ovulation in fishes, Mechanism of fertilization, Factors affecting fertilization

3.2 Embryonic Development: Stages of embryonic development, Cleavage and its significance, Fate Map of the Blastula

3.3 Gastrulation: Process and significance of gastrulation, Morphogenetic movements, Formation of germ layers

3.4 Hatching and Larval Development: Hatching process in fishes, Post-embryonic development, Different stages of larval development

UNIT-4: Fish Diseases: Causative agent, symptoms, transmission, prevention, treatment (10hrs)

4.1 Bacterial Diseases: Aeromoniasis, Columnaris, *Vibrio* Disease, and Mycobacteriosis

4.2 Viral Diseases: Infectious Hematopoietic Necrosis (IHN), Infectious Pancreatic Necrosis (IPN), Koi Herpes virus (KHV) Disease, and Spring Viremia of Carp (SVC).

4.3 Protozoan Diseases: White spot disease, Trichodina, Costiasis and Chilodonellosis.

4.4 Parasitic Diseases: Argulosis, Black spot disease, Gyrodactylosis and Nematodiasis

UNIT-5: Population Dynamics and Growth (13hrs)

5.1 Fish Population Dynamics and Recruitment: Population Structure- Year class recruitment, estimation methods; Population dynamics

5.2 Fish Fecundity and Reproductive Potential: Fecundity- Definition and types, Methods for fecundity estimation, Factors influencing fecundity in fishes

5.3 Growth Measurement and Marking Techniques: Length-weight relationships and condition factor

5.4 Fish Age Assessment and Its Significance: Age determination through hard parts (scales, otoliths, vertebrae), Importance of age and growth studies in fisheries

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

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOTE210 Course Title: Fundamentals of Fishery Science-II

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.**

SUGGESTED BOOKS:

- Srivastava, C. B. L. (1985). A Text Book of Fishery Science and Indian Fisheries
- Badapanda, K. C. (2013). Basics of Fisheries Science: Vol II Fisheries Biology
- Yadav, N. K., Lal, J., & Vaishnav, A. (2024). Innovations in Fisheries Science and Aquaculture
- Sharma, L., Agrawal, R., Bagde, P. S., Tade, M. S., Pandit, S., & Ansari, M. N. (2024). Quest on Fisheries Science
- Pandey, K. C. (1988). Concepts of Indian Fisheries
- Dholakia, B. H., & Dholakia, R. H. (1991). Fishery Sector of India
- Nandeesha, M. C., Das, S. K., Nathaniel, D. E., & Varghese, T. J. (1990). Breeding of Carps with Ovaprim in India
- American Fisheries Society. (1990). Methods for Fish Biology. Edited by C. B. Schreck and P. B. Moyle. American Fisheries Society.
- Gulland, J. A. (1983). Fish Population Dynamics, 2nd Edition. Wiley-Blackwell.
- Mrityunjoy M and Shailendra Singh S. (2017). *Fish Diseases*. Arts & Science Academic Publishing
- Bailey, M., & Sandford, G. (2023). *Aquariums & aquarium fish: A practical guide to identifying and keeping freshwater and marine fishes* (1st ed.). Anness Publishing.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOPE214 **Practicals based on P2ZOTE210**

Credits: 2 **Maximum Marks:50**

1. Study endocrine glands in fishes.
2. Study male and female reproductive organs of fish.
3. Observe sexual maturity stages and breeding cycles in fishes.
4. Study sexual dimorphism in fish species.
5. Study sexual dimorphism in crab species.
6. To study various fish diseases caused by bacteria and viruses.
7. To study the life cycle of Prawn.
8. To study the life cycle of Trout.
9. To study the eco-biology of Indian major Carps-Catla, Mrigal and Rohu.
10. To study various parts and accessories of aquaculture.
11. To study different ornamental fishes-both freshwater and marine.

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

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOTE211 **Course Title: Limnology-II**
Credits: 4 **Maximum Marks:100**

Course Outcomes:

CO1: Students will gain an understanding of plankton classification, distribution, and their roles in aquatic ecosystems. They will explore the seasonal dynamics of phytoplankton, the influence of light and temperature on growth, and the ecological importance of macrophytes in freshwater environments.

CO2: This unit will equip students with knowledge of zooplankton composition, classification, and their seasonal and spatial distribution. Students will also study polymorphism in zooplankton and their significant role in aquaculture and aquatic food webs.

CO3: Students will explore the classification of macrobenthic fauna, their ecological roles, and their seasonal distribution in lakes, rivers, and ponds. They will also understand the interrelationships between benthos, vertebrates, and various invertebrates in aquatic ecosystems.

CO4: Students will learn about the human use and management of freshwater systems for purposes such as domestic use, aquaculture, irrigation, and hydroelectricity. The unit also covers the importance of fisheries, particularly in Indian riverine, lacustrine, and reservoir ecosystems, and the integration of freshwater resources.

CO5: This unit focuses on the impact of climate change on freshwater ecosystems and the role of waste management, including e-waste, biomedical waste, and hazardous waste. Students will also discuss global environmental challenges, such as acidification, global warming, and the principles of eco-tourism.

UNIT-1: Plankton and Macrophytes

1.1 Plankton: Definition and classification, Distribution of plankton in aquatic ecosystem
1.2 Phytoplankton: Seasonal periodicity, Horizontal and vertical distribution, Floating adaptation in phytoplankton, Phytoplanktonic associations
1.3 Role of light and temperature in phytoplantonic growth, Role of organic nutrients in phytoplanktonic growth,
1.4 Macrophytes: Composition and ecological classification, Seasonal dynamics, Economic importance and control measures

UNIT-2: Zooplankton in Aquatic Ecosystems

2.1 Zooplankton: Composition and classification, Seasonal variations in lakes and in rivers
2.2 Horizontal and vertical distribution
2.3 Polymorphism in Zooplankton
2.4 Role of zooplankton in aquaculture

UNIT-3: Macrobenthic Fauna and Ecosystems

3.1 Macrobenthic fauna: classification and their role in aquatic ecosystems.
3.2 Seasonal variations and distribution of macro benthos in Lakes, Rivers and Ponds
3.3 Interrelationship between benthos and vertebrates
3.4 Interrelationship between fish and invertebrates with special reference to: Protozoa, Rotifers, Coelenterates, Worms, Crustaceans

UNIT-4: Freshwater Systems and Utilization

4.1 Limnology and Human Water Use; Domestic, Aquaculture, Irrigation, Industrial, Navigation, Recreation, Hydroelectricity

Course No. P2ZOTE211 Course Title: Limnology -II

4.2 Fisheries; Indian riverine fisheries
4.3 Indian lacustrine and reservoir fisheries
4.4 Integration of freshwater uses

UNIT-5: Environmental Challenges and Solutions

5.1 Climate Change; Factors Affecting Climate Change, Impact of climate change & its mitigation, Climate Change Management Conventions, International Organizations
5.2 Waste management; e-waste Management, Importance of the e-Waste Management, E-waste (Management & Handling) Rules, 2016; Biomedical Waste, Hazards Associated with Waste Management, Bio-Medical Waste Management Rules, 2016; Hazardous Waste, Hazardous Waste Treatment
5.3 International problems and future; Translocation, Acidification, Global warming, the future of freshwaters
5.4 Eco-tourism – Advantages & Disadvantages of Eco-tourism

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.**

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOTE211 **Course Title: Limnology -II**

SUGGESTED BOOKS:

- Cole, A.A. 1974. text book of Limnology. The G.V. Moshy Company Saint Louis.
- Olepper, H. 1979. Careers in conservation. A Ronaldn Press publication John Wiley and Sons, New York. .
- Davies, B.R. and Walker, K.F. 1986. The Ecology of River Systems. Dr. W. Junk Publishers, Bostan
- Goldman, C.R. and Horne, A.J. 1983. Limnology. Mc Graw Hill International Book Company, New Delhi.
- Hutchinson, G.E. 1977. A treatise on Limnology Vol. I John Willey and Sons, New York
- Hutchinson, G.E. 1977. A treatise on Limnology Vol. II John Willey and Sons, New York.
- Hutchinson, G.E. 1975. Limnological Botany John Willey and Sons, New York
- Hybes, H.B. N. 1979. 'The Ecology of running waters. Liver Pool University Press.
- Jhingran, V.G. 1982. Fish and Fisheries of India. Hindustan Publishing corporation, India.
- Hutchinson, G.E. 1977. A treatise on Limnology Vol. I John Willey and Sons, New York
- Jorgenson, S.E., Loffler, H, rast, W and Straskraba, M. 2005. Lakes and Reservoir Management.
- Hutchinson. 2004. A Treatise on Limnology. John Willey & Sons, Canada.
- Arvind Kumar. 2005. Fundamentals of Limnology Welch, P.S. 2011. Limnology. N.H.P.
- Brian Moss. Blackwell Science. 1998. Ecology of Freshwaters 3rd Ed.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOPE216 **Practicals based on P2ZOTE211**

Credits: 2 **Maximum Marks:50**

1. Collect and identify plankton samples from different aquatic ecosystems (pond, lake, river) using plankton nets.
2. Classify plankton into various groups (phyto- and zooplankton) using a microscope.
3. Count the concentration of phytoplankton in water samples.
4. Observe the seasonal changes in phytoplankton abundance in local water bodies over time.
5. Collect and identify various macrophytes from aquatic ecosystems (lakes, ponds).
6. Classify macrophytes into their ecological types (emergent, submerged, and floating).
7. Collect zooplankton from freshwater bodies and identify common species.
8. Identify and classify zooplankton into major groups such as protozoa, rotifers, and crustaceans.
9. Monitor and record the seasonal variations of zooplankton populations in a given aquatic system.
10. Conduct sampling at different depths and locations to study zooplankton distribution.
11. Collect macro benthos from different aquatic environments (lakes, rivers, ponds)
12. Identify and classify macrobenthic organisms like worms, crustaceans, mollusks, and insects.
13. Study the distribution and seasonal variations of macrobenthic organisms in different freshwater habitats.
14. Conduct physical, chemical, and biological water quality tests in freshwater bodies for human use, aquaculture, or irrigation.
15. Study the impact of waste on water quality and aquatic life.

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

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOTE212 Course Title: Human Molecular Genetics and Cytogenetics-II

Credits: 4 **Maximum Marks:100**

Course Outcomes:

CO1: Students will gain a detailed understanding of chromosome banding, learning how these methods are used in the analysis and identification of chromosomal abnormalities. They will also explore advanced cytogenetic techniques which aid in the detection of genetic disorders at the chromosomal level.

CO2: Learners will explore the organization of the human genome, covering both nuclear and mitochondrial genomes. They will understand the significance of gene families and how repetitive DNA elements contribute to genomic stability and function. Additionally, the course will focus on the evolution of the human nuclear genome and its implications for human genetics.

CO3: Students will be introduced to various diagnostic techniques used in genetic diseases and will also cover population screening methods and both invasive and non-invasive prenatal diagnostics, equipping learners with the knowledge to understand and manage genetic conditions.

CO4: The course will examine the Human Genome Project, its historical significance, and the key goals and accomplishments, including the ethical, legal, and social implications. Students will understand the advancements made in genomic research post-Human Genome Project and explore the role of genetic counseling in supporting individuals with genetic conditions, as well as the ethical considerations of eugenics and euphenics.

CO5: Learners will explore stem cell biology, including the basics of stem cell types, potency, and isolation methods, as well as their therapeutic applications in human welfare. The course will also cover therapeutic cloning, gene therapy, and the genetic basis of major inherited disorders helping students understand the potential of gene therapy in treating these conditions.

UNIT-I: Analyzing Human Chromosomes (13 hrs)

1.1 Chromosome Banding Techniques: G-Banding, C-Banding, R- Banding, High resolution Banding, Q-Banding, Significance and applications of chromosome banding techniques

1.2 Advanced Cytogenetic Techniques: In-situ hybridization (ISH), Fluorescent in situ hybridization (FISH) and its types (Q FISH and F FISH), Comparative genomic hybridization (CGH)

1.3 Spectral karyotyping, Computer Assisted Chromosome Analysis

1.4 Light microscopy, Fluorescence microscopy and Confocal microscopy

UNIT-2: Human Genome and its evolution (12 hrs)

2.1 Organization of human genome; Nuclear genome, Mitochondrial genome

2.2 Human gene families, Homolog, paralogs, orthologs and contings

2.3 Types of repetitive DNA; Role and implications of single nucleotide polymorphisms (SNPs).

2.4 Evolution of human nuclear genome

UNIT-3: Genetic Diagnosis and Treatment of Genetic diseases (10 hrs)

3.1 DNA based diagnosis

3.2 Biochemical diagnostics

3.3 Pre-implantation diagnosis

3.4 Population screening, Prenatal diagnosis: Invasive and Non-Invasive, Treatment of genetic diseases

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOTE212 Course Title: Human Molecular Genetics and Cytogenetics-II

UNIT-4: Human Genome Project and Genetic Counseling **(12 hrs)**

4.1 Human Genome Project: History, organization and goals of the Human Genome Project, ESLI
4.2 Post Human Genome Project Era
4.3 Genetic counselling, role of genetic counselor
4.4 Eugenics and Euphenics

UNIT-5: Stem Cell Biology, gene therapy and genetic disorders **(13 hrs)**

5.1 Stem cell research and therapeutic cloning; Stem cell basics: types, potency, Source and isolation of stem cells, Use of stem cells in human welfare
5.2 Therapeutic Cloning
5.3 Gene therapy
5.4 Genetic basis of: Huntington's disease, Cystic fibrosis, Thalassemia, Haemophilia, Duchenne Muscular Dystrophy, Fragile-X

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.**

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOTE212 Course Title: Human Molecular Genetics and Cytogenetics-II

SUGGESTED BOOKS:

- T.A. Brown (2002). Genome, Second Edition, Bios Scientific Publishers Ltd.
- David P. Clark (2005). Molecular Biology, Elsevier Academic Press.
- T.A. Brown (2006). Genome, Third Edition, Garland Science.
- Benjawin Lewin (2008). Gene IX, Jones and Bartlett Publishers.
- Ricki Lewis (2009). Human Genetics - Concepts and Applications, Second Edition, WCB-McGraw Hill.
- Judith Goodship, Patrick Chinnery, and Tom Strachan (2010). Genetics and Genomics in Medicine.
- F. Vogel, A.G. Motulusky (2010). Human Genetics: Problems and Approaches, Third Completely Revised Edition, Springer-Verlag.
- D. Peter Snustad and Michael J. Simmons (2012). Principles of Human Genetics, Fifth Edition, John Wiley & Sons, Inc.
- Thomas Mueller-Reichert and Paul Verkade (2017). Methods in Cell Biology, Academic Press Books - Elsevier.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOPE216 **Practicals based on P2ZOTE212**

Credits: 2 **Maximum Marks:100**

1. To study the different symbols used in pedigree analysis.
2. To prepare the pedigree of your own family.
3. Pedigree analysis of various inheritance patterns.
4. Study of inheritance pattern of various genetic diseases through micro-photographs.
5. To study the Alu Indel polymorphism in humans.
6. To detect the human-specific *Alu* elements by using polymerase chain reaction.
7. Study the Hardy-Weinberg analysis in human population.
8. To prepare the karyotype of various human genetic syndromes viz. Down's syndrome, Klinefelter syndrome, Turner syndrome, etc.
9. To prepare karyotype of normal male and female.

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

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOTE213 **Course Title: Population And Behavioral Genetics**
Credits: 4 **Maximum Marks:100**

Course Outcomes:
CO1: Students will understand the principles of population genetics, including genetic variation, allele and genotype frequencies, and the Hardy-Weinberg equilibrium. They will learn how forces of evolution such as mutation, natural selection, genetic drift, gene flow, and non-random mating shape population structure.
CO2: Learners will explore evolutionary and ecological genetics by studying neutral and selection theories, speciation mechanisms, and human population genetics. They will understand the role of migration, ancestry, and founder effects, and how genomic tools like GWAS and phylogenetics contribute to evolutionary genetics.
CO3: Students will examine the genetic basis of behavior, focusing on Mendelian and polygenic traits, neurogenetics, and the influence of epigenetics on behavioral traits. They will explore how animal models are used to study behavior genetics.
CO4: The course will delve into the genetic foundations of human behavior and psychiatric genetics, exploring cognitive abilities, personality traits, and social behavior. Students will study the genetics of mental health disorders while addressing the ethical and social implications in these fields.
CO5: Learners will gain insights into advanced techniques in population and behavior genetics, including Next-Generation Sequencing (NGS) and GWAS. They will study gene-environment interactions in behaviors like stress and addiction, and explore the role of artificial intelligence and machine learning in genetics research.

UNIT-I: Principles of Population Genetics **(13 hrs)**
1.1 Genetic Variation and Structure of Populations: Allele and Genotype Frequencies
1.2 Hardy-Weinberg Equilibrium: Assumptions, Deviations, and Applications
1.3 Forces of Evolution: Mutation, Natural Selection, Genetic Drift, Gene Flow, and Non-Random Mating
1.4 Molecular Population Genetics: DNA Sequence Variation, Linkage Disequilibrium, and Coalescent Theory

UNIT-2: Evolutionary and Ecological Genetics **(12 hrs)**
2.1 Neutral Theory and Selection Theory: Balancing, Directional, and Disruptive Selection
2.2 Speciation and Adaptation: Molecular Evolutionary Mechanisms
2.3 Human Population Genetics: Ancestry, Migration, and Founder Effects
2.4 Genomic Approaches to Evolutionary Genetics: Genome-Wide Association Studies (GWAS) and Phylogenetics

UNIT-3: Fundamentals of Behaviour Genetics **(10 hrs)**
3.1 Genetic Basis of Behaviour: Mendelian and Polygenic Traits in Behavioral Phenotypes
3.2 Neurogenetics: Role of Genes in Brain Development and Neural Function
3.3 Epigenetics and Behaviour: Environmental Influence on Gene Expression and Behavioural Traits
3.4 Animal Models in Behaviour Genetics: Drosophila, Mice, and Primate Studies

UNIT-4: Human Behavior and Psychiatric Genetics **(12 hrs)**
4.1 Genetic Basis of Cognitive Abilities and Intelligence: Twin and Adoption Studies
4.2 Genetics of Personality Traits and Social Behavior: Aggression, Altruism, and Risk-Taking
4.3 Psychiatric Genetics: Schizophrenia, Bipolar Disorder, Autism Spectrum Disorders (ASD), Depression
4.4 Ethical, Legal, and Social Implications (ELSI) in Behavioural and Psychiatric Genetics

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOTE213 Course Title: Population And Behavioral Genetics

UNIT- 5: Advances in Population and Behaviour Genetics (13 hrs)

5.1 Genomic Technologies in Population Genetics: Next-Generation Sequencing (NGS) and Genome-Wide Association Studies (GWAS)
5.2 Gene-Environment Interactions in Behavior: Stress, Addiction, and Mental Health
5.3 Artificial Intelligence and Machine Learning in Population and Behavior Genetics
5.4 Evolution of Human Cognition and Social Behavior: Genetic and Epigenetic Perspectives

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.**

SUGGESTED BOOKS:

- Hartl, D. L., & Clark, A. G. (2007). Principles of Population Genetics (4th ed.). Sinauer Associates.
- Fox, C. W., & Wolf, J. B. (2019). Evolutionary Genetics: Concepts and Case Studies. Oxford University Press.
- Plomin, R., DeFries, J. C., Knopik, V. S., & Neiderhiser, J. M. (2020). Behavioural Genetics (7th ed.). Worth Publishers.
- McGowan, F. J. (2021). Neurogenetics: Scientific and Clinical Advances. Springer.
- Templeton, A. R. (2020). Population Genetics and Microevolutionary Theory. Wiley-Blackwell.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – II
(Syllabus for the examination to be held in May 2026, 2027 and 2028)

Course No. P2ZOPE217 **Practicals based on P2ZOTE213**

Credits: 2 **Maximum Marks:50**

1. Calculation of allele and genotype frequencies in a given population.
2. Application of the Chi-square test to determine if a population meets Hardy-Weinberg equilibrium conditions.
3. Amplification and visualization of genetic polymorphisms through molecular techniques.
4. Use of bioinformatics tools to analyze genetic relationships and construct phylogenetic trees.
5. Analysis of Genetic Drift and Gene Flow using population genetics software.
6. Genotyping of Polymorphisms Related to Behavior in populations.
7. Animal Model Studies on Aggression and Cooperation
8. Examination of SNPs linked to schizophrenia and bipolar disorder.

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

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – III
(Syllabus for the examination to be held in December 2026, 2027 and 2028)

CREDIT FRAMEWORK FOR SEMESTER-III

Category	Course Code	Course Name	Credits
Major Core [20(T) + 10(P)]			
	P2ZOTC301	Advanced Cellular Analysis and Research Methodology	4
	P2ZOTC302	Fundamentals of Endocrinology	4
	P2ZOTC303	Functional Physiology of Animals	4
	P2ZOTC304	Clinical and Food Microbiology	4
	P2ZOTC305	Fundamentals of Immunology	4
	P2ZOPC306	Practicals based on P2ZOTC301 & P2ZOTC302	2+2
	P2ZOPC307	Practicals based on P2ZOTC303 & P2ZOTC304	2+2
	P2ZOPC308	Practicals based on P2ZOTC305	2
Total Core Credits			**30**
	P2ZOMO351	MOOC/SWAYAM	4
Semester Credit Total			**30**

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – III
(Syllabus for the examination to be held in December 2026, 2027 and 2028)

Course No. P2ZOTC301 **Course Title: Advanced Cellular Analysis and Research Methodology**

Credits: 4 **Maximum Marks:100**

Course Outcomes:

CO1: Students will understand the structure and function of cell organelles, including mechanisms of transport across the plasma membrane, protein transport in the endoplasmic reticulum and Golgi apparatus, and targeting of mitochondrial and nuclear proteins.

CO2: Learners will gain knowledge of the regulation and steps in mitosis and meiosis, the principles of cell communication, adhesion molecules, and cell signaling mechanisms, including receptor types and two-component signaling systems in bacteria.

CO3: Students will explore the mechanisms of cell death, focusing on apoptosis, the roles of caspases, Bcl2 family proteins, and IAPs, and how apoptosis pathways are involved in disease conditions such as cancer.

CO4: The course will provide hands-on knowledge of various laboratory techniques such as electrophoresis, chromatography, centrifugation, and spectroscopy, with a focus on their principles and applications in molecular biology.

CO5: Learners will study advanced techniques like different types of microscopy, polymerase chain reaction, DNA sequencing, and blotting techniques, gaining insights into their applications in genetic analysis and research.

UNIT-I: Cell: Structure and Function **(12 hrs)**

1.1 Transport across plasma membrane: Active Transport, Passive Transport, transport of macromolecules (endocytosis, micropinocytosis, Exocytosis).

1.2 Endoplasmic Reticulum: transport of proteins across the ER membrane, transport of proteins from ER to Golgi; Golgi Apparatus: transport of proteins through Golgi, transport of proteins from the Golgi to lysosomes; mechanism of vesicle fusion.

1.3 Lysosomes; Mitochondria: Targeting of mitochondrial proteins across all membranes.

1.4 Nucleus: Nuclear envelope and nuclear matrix, transport between nucleus and cytoplasm; Nucleolus.

UNIT-2: Cell Cycle, Cell Communication and Cell Signaling **(12 hrs)**

2.1 Mitosis and Meiosis: their regulation, steps in the cell cycle, regulation and control of cell cycle.

2.2 Cell Communication: general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins.

2.3 Cell Signaling: Hormones and their receptors, cell surface receptors; signaling through G-protein-coupled receptors, Ion channel receptors, and enzyme-linked receptors.

2.4 Two-component signaling systems, chemotaxis in bacteria and Quorum Sensing.

UNIT-3: Cell Death: Apoptosis **(10 hrs)**

3.1 Cell death in mammals, Role of caspases, Bcl2 family proteins and IAP's.

3.2 Intrinsic and Extrinsic Pathways and Cell death in *C. elegans*.

3.3 Cell death in Drosophila and Apoptosis targeted therapies.

3.4 Apoptosis and Cancer, Role of p53.

UNIT-4: Tools and Techniques - I **(13 hrs)**

4.1 Electrophoretic techniques.

4.2 Chromatography techniques: thin layer chromatography, Affinity chromatography, Liquid and gas chromatography, Planar/Paper chromatography, Ion exchange chromatography, and Size Exclusion Chromatography.

Course No. P2ZOTC301 Course Title: Advanced Cellular Analysis and Research Methodology

4.3 Centrifugation: principles and types.
4.4 Spectroscopy, Mass Spectrometry, and X-ray Crystallography.

UNIT-5: Tools and Techniques - II (13 hrs)

5.1 Bright Field Microscopy, Dark Field Microscopy, Electron microscopy: Transmission Electron microscopy, Scanning Electron microscopy, and Fluorescence Microscopy (Principle and Types).
5.2 Various types of PCR: Nested PCR, Quantitative Real-time PCR, RT-PCR, Inverse PCR, Anchored PCR, and Touch PCR, along with DNA sequencing methods like Sanger Sequencing and the Chemical Degradation Method; DNA sequencing Techniques: Sanger Sequencing and Chemical Degradation method.
5.3 Basics of Next Generation Sequencing, different platforms and data analysis
5.4 Southern Blotting, Western Blotting, Northern Blotting, Slot Blots, and Dot Blot.

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.**

SUGGESTED BOOKS:

- Korenberg, (1974). *DNA Replication*. W.H. Freeman and Co., San Francisco.
- Avers, C.J. (1976). *Cell Biology*. D. Van Nostrand Co., New York.
- Dewitt, (1977). *Biology of the Cell - An Evolutionary Approach*. Saunders Co.
- Jones and Bartlett, (1980). *Cells: Principles of Molecular Structure and Function*. Prescott.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – III
(Syllabus for the examination to be held in December 2026, 2027 and 2028)

Course No. P2ZOTC302 **Course Title: Fundamentals of Endocrinology**

Credits:4 **Maximum Marks:100**

Course Outcomes:

CO1:Students will understand the fundamental concepts of endocrinology, including hormone classification, signalling mechanisms, biosynthesis, and various techniques for hormone assay and receptor binding studies.

CO2: Students will gain knowledge of the role of hormones in regulating insect growth, development, and reproduction, as well as the impact of endocrine disruption and recent advances in insect endocrinology.

CO3: Students will explore the hypothalamo-hypophysial system, pituitary gland function, and the hormonal regulation of the thyroid and parathyroid glands, along with their pathophysiology in vertebrates.

CO4: Students will understand the structure, function, and hormone regulation of the adrenal glands, pancreas, gastrointestinal hormones, and the mechanisms of homeostasis in vertebrates.

CO5: Students will study the pineal and thymus glands, urophysis, and caudal neurosecretory system, along with the role of pheromones in animal behaviour, and the techniques used for hormonal regulation research.

UNIT-1: Introduction to Endocrinology **(13hrs)**

1.1 Endocrine System Overview: Definition and Scope of Endocrinology; Hormones: Classification and Functions; Hormone-Target Relationship

1.2 Hormonal Signalling Mechanisms: Signal Transduction Pathways; Receptors: Types and Mechanisms; Feedback Mechanisms in Hormone Regulation

1.3 Hormones and Their Biosynthesis: Peptide Hormones; Steroid Hormones; Amine Hormones; Precursor Conversion and Transport of Hormones

1.4 Hormone Assays: Radioimmunoassay (RIA) and Enzyme-Linked Immunosorbent Assay (ELISA); Immunohistochemistry for Hormone Localization; Mass Spectrometry in Hormonal Profiling; Receptor Binding Studies: Radio ligand Binding Assays; Scatchard Plot Analysis for Receptor Affinity; Evaluation of Receptor Density and Specificity

UNIT-2: Insect Endocrinology **(13hrs)**

2.1 Introduction to Insect Endocrinology: Scope and importance of endocrinology in insects; Overview of insect physiology and the role of hormones in regulating growth, development, and reproduction

2.2 Endocrine Glands in Insects: Structure and function of major endocrine glands: Corpora allata, Corpora cardiaca, Prothoracic glands, Endocrine cells and tissues in the gut, brain, and reproductive organs, Hormones synthesized and secreted by these glands

2.3 Hormonal Control of Development, Molting and Reproduction: Role of hormones in regulating development, metamorphosis and reproduction; Mechanism of action of ecdysteroids (molting hormones)and their role in initiating molting; Hormonal interactions in controlling the transition between larval, pupal, and adult stages

2.4 Endocrine Disruption in Insects and Recent Advances in Insect Endocrinology: Mechanisms of endocrine disruption by environmental factors (e.g., pesticides, pollutants); Impact of endocrine disruptors on insect development, reproduction, and behaviour

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – III
(Syllabus for the examination to be held in December 2026, 2027 and 2028)

Course No. P2ZOTC302 Course Title: Fundamentals of Endocrinology

UNIT-3: Vertebrate Endocrinology-I (10hrs)

3.1. Hypothalamo-hypophysial System:General organization of Hypothalamus: Localization, and action of hypophysiotropic hormones, Hypothalamo-hypophyseal portal system

3.2. Pituitary gland: Origin of pituitary gland;Morphology, anatomy and histology of the gland;Neural and vascular supply of hypophysis

3.3. Hormones of neurohypophysis and adenohypophysis; Pathophysiology of pituitary hormones,comparative morphology of pituitary in vertebrates

3.4. Thyroid Gland: Morphology, anatomy and histology of the gland,hormones released; Biosynthesis of Thyroid hormones; Pathophysiology; Parathyroid Gland: Morphology, anatomy, histology and function of the gland,pathophysiology of parathyroid gland

UNIT-4: Vertebrate Endocrinology-II (12hrs)

4.1. Adrenal Gland: Morphology, anatomy and histology of the gland, types and functions ofhormones released by adrenal cortex and adrenal medulla, Renin-angiotensin system,Pathophysiology of adrenal hormones, comparative morphology in vertebrates

4.2. Pancreas: Morphology, anatomy and histology of the gland;Structure, role and regulation of Insulin and Glucagon,Pathophysiology of Pancreatic hormones

4.3. Gastro-intestinal hormones: types and functions

4.4. Homeostasis: Temperature and Water

UNIT-5: Neuroendocrine Systems and Endocrine Regulation (12hrs)

5.1. Pineal Gland and Thymus Gland: Development, Structure and Function of the Pineal Gland; Biosynthesis of Melatonin; Role of Melatonin in Circadian Rhythm and Seasonal Reproduction; Non-reproductive functions of melatonin; Melatonin and Aging; Structure and Function of the Thymus; Thymic hormones and role in endocrinology

5.2. Urophysisand Caudal Neurosecretory System:Structure and Function of the Urophysis in Fish; Role in Osmoregulation and Stress Response; Structure and Function of the Caudal Neurosecretory System in fishes and amphibians; Hormonal Regulation in Amphibians and Fish and Comparison of CNSS to the Hypothalamic-Pituitary System

5.3. Pheromones and Chemical Communication: Types of Pheromones; Mechanisms of Pheromone Detection and Signalling; Role of Pheromones in Animal Behaviour and Reproduction

5.4. Techniques for Hormonal Regulation Studies: Use of Transgenic and Knockout Models in Endocrine Research; Gene Expression Analysis in Endocrine Tissue; *in vivo* and *in vitro* Experimental Systems: Animal Models in Endocrinology (Mice, Fish, Birds).

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – III
(Syllabus for the examination to be held in December 2026, 2027 and 2028)

Course No. P2ZOTC302 Course Title: Fundamentals of Endocrinology

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.**

SUGGESTED BOOKS:

- Hadley, M.E., & Levine, J.E. (2018). *Endocrinology* (6th ed.). Pearson Education.
- Gilbert, L.I.(Ed.). (2012). *Insect endocrinology*. Academic Press.
- Turner, C.D., &Bagnara, J.T. (1984). *General endocrinology* (6th ed.). W.B. Saunders Company.
- Hall, J.E. (2020). *Guyton and Hall textbook of medical physiology* (14th ed.). Elsevier.
- Melmed,S., Auchus, R.J., Goldfine, A.B., Rosen, C.J., & Kopp, P.A. (2024). *Williams Textbook of Endocrinology* (15th ed.). Elsevier.
- Norris, D.O., & Carr, J. A. (2020). *Vertebrate Endocrinology* (6th ed.). Academic Press.
- Norris, D.O., & Lopez, K.H. (Eds.). (2024). *Hormones and Reproduction of Vertebrates, Volume 1: Fish* (2nd ed.). Academic Press.
- Norris, D.O., & Lopez, K.H. (Eds.). (2024). *Hormones and Reproduction of Vertebrates, Volume 5: Mammals* (2nd ed.). Academic Press.

Course No. P2ZOTC302 Course Title: Fundamentals of Endocrinology

- Nelson, R.J., &Kriegsfeld, L.J. (2022). *An introduction to behavioral endocrinology* (6th ed.). Oxford University Press.
- Litwack, G. (2022). *Hormones* (4th ed.). Academic Press
- Bolander, F.F. (2004). *Molecular endocrinology (3rd Edition)*. Academic Press
- Robertson, R.P. (Ed.). (2022). *DeGroot's endocrinology: Basic science and clinical practice* (8th ed.) (2 Volume Set). Elsevier
- Jameson, J.L. (Ed.). (2017). *Harrison's endocrinology* (4th ed.). McGraw-Hill Education.
- Fink, G., Pfaff, D.W., & Levine, J. (Eds.). (2011). *Handbook of neuroendocrinology*. Academic Press.
- Utiger, R.D., & Williams, R.H. (Eds.). (2007). *Neuroendocrinology in physiology and medicine*. Humana Press.
- Wilkinson, M. (2016). *An introduction to neuroendocrinology* (2nd ed.). Cambridge University Press.
- Squires, E. J. (2024). *Applied animal endocrinology* (3rd ed.). CABI.
- Kumar, V., Abbas, A.K., & Aster, J.C. (2020). *Robbins and Cotran pathologic basis of disease* (10th ed.). Elsevier.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – III
(Syllabus for the examination to be held in December 2026, 2027 and 2028)

Course No. P2ZOPC306 **Practicals based on P2ZOTC301 & P2ZOTC302**

Credits: 4 (2+2) **Maximum Marks:100**

Practicals based on P2ZOTC301

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 P2ZOTC302

1. To study the Endocrine glands through histological slides:
   - Pituitary gland
   - Adrenal gland
   - Thymus gland
   - Thyroid gland
   - Parathyroid gland
   - Testis
   - Ovary
   - Pancreas
   - Pineal gland
   - Urophysis of Fish
   - Corpuscle of Stannius
2. Neuroendocrine system of Prawn
3. Neuroendocrine system of insects
4. Ultrastructure of Neurosecretory cells

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course o 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

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – III
(Syllabus for the examination to be held in December 2026, 2027 and 2028)

Course No. P2ZOTC303 **Course Title: Functional Physiology of Animals**

Credits: 4 **Maximum Marks:100**

Course Outcomes:

CO1: This unit explores nutritional strategies in animals and the physiology of digestion involving salivary, gastric, and intestinal enzymes. It covers the absorption of carbohydrates, lipids, and proteins in the gastrointestinal tract and provides insight into common digestive disorders and their physiological basis.

CO2: Students will understand the components and functions of blood, blood cell formation, and the basics of coagulation and blood groups. The unit covers heart structure, cardiac impulse conduction, and cardiac output regulation. It also introduces ECG interpretation and mechanisms controlling heart rate and blood pressure.

CO3: This unit covers respiratory anatomy, mechanics of breathing, and gas exchange, along with the regulation of respiration. It explains external and internal respiration and introduces the respiratory quotient. Students also explore how mammals adapt their respiratory systems to extreme environments like high altitudes and temperature variations.

CO4: Students will study nitrogen excretion strategies in vertebrates and their environmental adaptations. The unit covers the structure and function of the mammalian kidney, focusing on nephron activity, urine formation, and acid-base balance. It also highlights hormonal regulation of renal function through the renin-angiotensin-aldosterone system.

CO5: This unit explores the structure and function of the nervous system, neural transmission, and brain-spinal pathways. It introduces key neurological disorders to contextualize concepts. Students learn muscle contraction via the sliding filament theory and ATP's role, along with the physiology of vision and hearing.

UNIT-1: Nutrition and Gastrointestinal Physiology **(10 hrs)**

1.1 Overview of different nutritional modes in animals: autotrophic, heterotrophic, saprophytic, parasitic, holozoic, symbiotic nutrition.

1.2 Physiology of the digestive system and its control: salivary digestion, gastric digestion, intestinal digestion, and digestive enzymes.

1.3 Absorption in the Gastro-intestinal tract (GIT): carbohydrates, lipids, and proteins

1.4 Physiology of gastrointestinal disorders.

UNIT-2: Blood and Heart Physiology **(12 hrs)**

2.1 Functions and composition of blood: plasma and formed elements; study of RBCs, WBCs, platelets, haemopoiesis, and types of anaemias (nutritional, pernicious, hemorrhagic, hemolytic, aplastic, sickle cell).

2.2 Mechanism of blood coagulation: factors, pathways, thrombosis, fibrinolysis, and study of ABO and Rh blood groups with transfusion significance.

2.3 Physiology of the Heart: structure, coronary circulation, origin and conduction of cardiac impulses, cardiac cycle, cardiac output, and Frank-Starling law.

2.4 Regulation of cardiac activity: blood pressure and its regulation, nervous and chemical regulation of heart rate, and electrocardiogram (ECG).

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – III
(Syllabus for the examination to be held in December 2026, 2027 and 2028)

Course No. P2ZOTC303 Course Title: Functional Physiology of Animals

UNIT-3: Respiration and Environmental Adaptations (13 hrs)

3.1 Respiratory Structures and Mechanism of Breathing: Lungs, trachea, alveoli; mechanism of breathing; pulmonary ventilation; respiratory volumes and capacities; gas exchange in the lungs.

3.2 Regulation of Respiration: Nervous and chemical regulation of respiration (in mammals); external and internal respiration; respiratory quotient

3.3 Environmental Adaptations in Respiration: Environmental influences on the respiratory process in mammals

3.4 Extreme temperatures and limits to life: Tolerance to cold and freezing, tolerance to high temperatures.

UNIT-4: Excretion and Renal Physiology (13 hrs)

4.1 Nitrogen Excretion and Excretory Strategies: Ammonotelism, Ureotelism, Uricotelism, Guanotelism; excretory modes in relation to habitat and adaptation.

4.2 Vertebrate (Mammalian) kidney: structure and function; detailed structure of the nephron

4.3 Glomerular and tubular functions in urine formation, Mechanism of Urine Formation and Regulation: counter-current mechanism; regulation of water and acid-base balance.

4.4 Hormonal Regulation of Renal Function: Renin-angiotensin system and aldosterone function; hormonal control of kidney activity and maintenance of water-electrolyte balance.

UNIT-5: Nervous System, Muscle Physiology, and Sensory Physiology (12 hrs)

5.1 Neurophysiology and Disorders: brain, spinal cord, neuron structure and classification, nerve impulse generation, synapse structure, transmission, and neurotransmitters

5.2 Overview of neurodevelopmental, neuropsychological, and neurodegenerative diseases.

5.3 Muscle Tissue: types, structure, and characteristics; skeletal muscle organization; ultrastructure and chemical composition of myofibrils; Muscle Contraction sliding filament theory, role of ATP

5.4 Physiology of sense organs- vision and hearing.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – III
(Syllabus for the examination to be held in December 2026, 2027 and 2028)

Course No. P2ZOTC303 Course Title: Functional Physiology of Animals

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.**

SUGGESTED BOOKS:

- Dennis, W. W. (1970). Principles of Animal Physiology. Arnold Publishers Ltd., London.
- Malcolin, & Gorden. (1977). Animal Physiology: Principles and Adaptation. Macmillan Publishing Co., New York.
- Nagabhushnam. (1993). Textbook of Animal Physiology. Oxford & IBH Publishing Co. Pvt. Ltd.
- Louw. (1993). Physiological Animal Ecology. Langman House, Burnt Mill, Harlow, England.
- Randall, D., Burggren, W., & French, K. (2000). Eckert Animal Physiology: Mechanisms and Adaptations. W.H. Freeman and Co., New York.
- Guyton, A. C., & Hall, J. E. (2013). Textbook of Medical Physiology. Elsevier.
- Sembulingam, K., & Sembulingam, P. (2016). Essentials of Medical Physiology (7th ed.). Jaypee Brothers Medical Publishers.
- Costanzo, L. S. (2018). Physiology (7th ed.). Wolters Kluwer.
- Rastogi, S. C. (2019). Essentials of Animal Physiology. New Age International Publishers.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – III
(Syllabus for the examination to be held in December 2026, 2027 and 2028)

Course No. P2ZOTC304 **Course Title: Clinical and Food Microbiology**

Credits: 4 **Maximum Marks:100**

Course Outcomes:

CO1: Learners will gain an understanding of medical microbiology, including the classification of microorganisms and the causes, pathogenesis, and prophylaxis of airborne, foodborne, waterborne, and viral diseases. They will explore the role of normal microflora in human health and the pathogens responsible for diseases.

CO2: Students will develop knowledge of pharmaceutical microbiology, including the mechanisms of antibiotics and synthetic antimicrobial agents. They will understand the regulatory practices in pharmaceuticals, the financing of R&D, and the roles of drug carriers and biosensors in drug delivery, with an understanding of key standards like IP, BP, and USP.

CO3: Learners will study food microbiology, focusing on the preservation and spoilage of various foods, food safety, and sanitation practices. They will explore the microbiological criteria for food safety and understand key food legislation and regulatory practices, including FDA, EPA, HACCP, and FSA.

CO4: Students will develop knowledge of knowledge of fermentation technology, including fermenter design, scale-up, and process control. They will understand the microbial production processes for primary and secondary metabolites (organic acids, biofertilizers, biopesticides etc.).

CO5: Students willlearn the techniques for collection, transport, and processing of clinical specimens. They will explore and understand conventional and modern microbiological tests.

UNIT-1: Medical Microbiology **(10 hrs)**

1.1. Classification of microbes. Early discovery of pathogenic micro-organisms, Classification of medically important micro-organisms, Normal micro-flora of human body (skin, respiratory tract and gastro-intestinal tract)

1.2. Causative Agents, Etiology, Pathogenesis and Prophylaxis of Airborne diseases: TB, Pneumonia, Diphtheria

1.3. Food/water/Soil borne diseases: Typhoid fever, Cholera, Tetanus

1.4. Disease caused by viral agents: Hepatitis, H1N1infection, SARS-CoV, Swine Flu, Lumpi disease, Japanese Encephalitis Virus, Zika

UNIT-2: Pharmaceutical Microbiology **(12 hrs)**

2.1 Definition and scope

2.2 Antibiotics and synthetic antimicrobial agents: Antibiotics and its mechanism (Inhibitors of cell wall synthesis, nucleic acid and protein synthesis), synthetic antimicrobial agents (Aminoglycosides, beta lactam, tetracyclines, ansamycins, macrolid antibiotics)

2.3 Regulatory practices, Financing R&D capital and market outlook. IP, BP, USP.

2.4 Drug carriers and Biosensors in pharmaceuticals

UNIT-3: Food Microbiology **(13 hrs)**

3.1 Introduction and scope

3.2 Preservation and spoilage of different kinds of food

3.3 Food sanitation, control and inspections, microbiological criteria and food safety

3.4 Food safety objectives (FSO), food legislation: Enforcement and Govt. Regulatory practices and policies. FDA, EPA, HACCP, FSA act (basic concept in brief).

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – III
(Syllabus for the examination to be held in December 2026, 2027 and 2028)

Course No. P2ZOTC304 Course Title: Clinical and Food Microbiology

UNIT-4: Industrial Microbiology **(13 hrs)**

4.1 Scope and importance of industrial microbiology in biotechnology, pharmaceuticals, food, and environmental sectors

4.2 Industrially important microorganisms: bacteria, fungi, yeast, actinomycetes, algae; Types of fermentation: submerged fermentation, solid-state fermentation

4.3 Components and design of a fermenter/bioreactor, Downstream processing: cell harvesting, product recovery, purification and formulation, Biofertilizers, Biopesticides

4.4 Microbial production of biofuels (biogas, biodiesel), Probiotics and fermented foods (yogurt, cheese, sauerkraut)

UNIT-5: Diagnostic Microbiology **(12 hrs)**

5.1. Collection, transport, and processing of clinical specimens (blood, urine, sputum, swabs, CSF, stool)

5.2 Microscopy: Gram staining, acid-fast staining, fluorescent staining;Culture media and culture methods for clinical specimens

5.3 Biochemical tests for bacterial identification

5.4 Molecular diagnostic tools – PCR, RT-PCR, ELISA, sequencing, MALDI-TOF MS

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.**

Course No. P2ZOTC304 Course Title: Clinical and Food Microbiology

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.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – III
(Syllabus for the examination to be held in December 2026, 2027 and 2028)

Course No. P2ZOPC307 **Practicals based on P2ZOTC303 & P2ZOTC304**

Credits: 4 (2+2) **Maximum Marks:100**

Practicals based on P2ZOTC303

1. Demonstration of salivary amylase action on starch and the effect of pH and temperature on enzyme activity.
2. Enumeration of RBC count in human blood using a hemocytometer.
3. Differential count of WBCs in human blood smear
4. Estimation of bleeding and clotting time of human blood.
5. Preparation of Haemin crystals from human blood.
6. Identification of ABO and Rh blood groups and determination of Rh factor.
7. Estimation of Hematocrit (PCV) value in blood samples.
8. Recording of blood pressure (BP) using a sphygmomanometer
9. Demonstration of salivary amylase action and effect of acid and heat on its activity.
10. Emulsification of fats.
11. Preparation of blood smear and Arneth count of polymorphs.
12. Study of haemocytometer structure.

Practicals based on P2ZOTC304

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

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – III
(Syllabus for the examination to be held in December 2026, 2027 and 2028)

Course No. P2ZOTC305 Course Title: Fundamentals of Immunology

Credits: 4 Maximum Marks:100

Course Outcomes:

CO1: Learners will develop an understanding of the innate and adaptive immune systems, including immune cells and organs, and the processes of B-cell and T-cell activation, differentiation, and memory. They will also explore the structure and function of cytokines and chemokines essential for immune responses.

CO2: Students will gain insights into humoral immunity and cell-mediated immunity, covering key concepts like antibody structure, and function. They will also explore the generation of antibody diversity, the role of the major histocompatibility complex (MHC), antigen processing and presentation, and the complement system.

CO3: Learners will explore the concepts of transplantation, immunosuppression, and immunosuppressive drugs, as well as immunotechniques. They will also gain practical knowledge of immunoelectrophoresis and immunoprecipitation techniques used in immune system research and diagnostics.

CO4: Learners will critically assess the current immunotherapeutic strategies for cancer treatment, including immune checkpoint inhibitors (PD-1/PD-L1, CTLA-4), CAR-T cell therapy, and cancer vaccines.

CO5:Learners will explore the concepts of transplantation, immunosuppression, and immunosuppressive drugs, as well as immunotechniques such as ELISA, radioimmunoassay, and immunofluorescence. They will also gain practical knowledge of immunoelectrophoresis and immunoprecipitation techniques used in immune system research and diagnostics.

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

1.1 Innate (Phagocytosis, Inflammation, TLR, etc.) and adaptive immunity (B and T cells).
1.2 Immune cells and organs (Primary and Secondary) of the immune system.
1.3 B-cell and T-cell Activation, Differentiation and Memory
1.4 General Properties and Structure of Cytokines and Chemokines

UNIT-2: Humoral Immunity and Cell Mediated Immunity (12hrs)

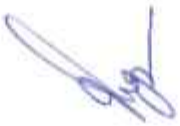
2.1 Antigen, Antigenicity and Immunogenicity.
2.2 Antibodies: Types, Structure, Function, and Generation of Diversity; Monoclonal Antibodies, Hybridoma Technology, and Their Applications.
2.3 Major Histocompatibility Complex and Antigen Processing and Presentation
2.4 Hypersensitivity and its types; The complement System.

UNIT-3: Transplantation and Immunosuppression (13hrs)

3.1 Transplantation terminology: Autograft, Isograft, Allograft and Xenograft; GVH reaction.
3.2 Immunosuppression: Mechanism and Immunosuppressive Drugs (Azathioprine, Cyclosporin, Cyclophosphamide, and Betamethasone)
3.3 Immunotechniques: Immunoprecipitation, Immunoassays, Radioimmunoassay, ELISA, Immunofluorescence and Luminiex
3.4 Immunoelectrophoresis and its types; Immunoprecipitation

UNIT-4: Immunodeficiencies and Tumor Immunology (13hrs)

4.1 Primary immunodeficiencies: SCID, X-linked agammaglobulinemia, DiGeorge syndrome
4.2 Secondary immunodeficiencies: HIV/AIDS, malnutrition, therapy-induced
4.3 Tumor antigens and immune evasion
4.4 Cancer immunoediting and immune surveillance



UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – III
(Syllabus for the examination to be held in December 2026, 2027 and 2028)

Course No. P2ZOTC305 Course Title: Fundamentals of Immunology

UNIT-5: Transplantation and Immunosuppression (12hrs)

5.1 Transplantation terminology: Autograft, Isograft, Allograft and Xenograft; GVH reaction.
5.2 Immunosuppression: Mechanism and Immunosuppressive Drugs (Azathioprine, Cyclosporin, Cyclophosphamide, and Betamethasone)
5.3 Immunotechniques: Immunoprecipitation, Immunoassays, Radioimmunoassay, ELISA, Immunofluorescence and Luminiex
5.4 Immunoelectrophoresis and its types; Immunoprecipitation

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.**

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.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – III
(Syllabus for the examination to be held in December 2026, 2027 and 2028)

Course No. P2ZOPC308 **Practicals based on P2ZOTC305**

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

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR PG PROGRAMME-2YEAR IN ZOOLOGY AS PER NEP-2020
SEMESTER – III
(Syllabus for the examination to be held in December 2026, 2027 and 2028)

Course No. P2ZOMO351 **Course Title: MOOC through SWAYAM**

Credits: 4 **Maximum Marks:100**

One 04 credit MOOC (Massive Open Online Course) selected from SWAYAM (Study Webs of Active-Learning For Young Aspiring Minds) UGC (University Grant Commission) portal. SWAYAM is a programme initiated by Government of India to achieve the three cardinal principles of Education policy viz., access, equity and quality.

Course Objectives:

- To provide the students high quality learning experience using multimedia on anytime, anywhere basis.
- To acquaint the students with online mode of learning using ICT platform.
- To diverse the knowledge of students through open learning and help them to access different disciplines online and thus promoting interdisciplinary knowledge.
- To provide the students a hybrid model of learning that adds to the quality of classroom teaching.

Course Selection Guidelines for Students:

The students are required to enrol and qualify any one of the MOOC courses from SWAYAM (UGC) portal that should of 04 credits. The course can be selected from the SWAYAM platform depending upon the availability of courses as notified by UGC generally on predefined dates, 1st June or 1st November respectively every year. The students are required to enrol for the SWAYAM course immediately after the commencement of Semester as per notified dates by UGC for SWAYAM courses. The course should be completed before the completion of 3rd Semester of M.Sc. Student ideally should not select self-paced MOOCs, and the courses selected must be different from one offered in the course curriculum of semesters in order to duplication. The student must fill an undertaking form, as given in the brochure, and submit the same after duly filled form to their respective Departments/Colleges for future reviews and record purposes. SWAYAM Examination fees (if any), or any other fee prescribed, shall be borne by the students only.

Course Content: To be provided by the Course Coordinator of SWAYAM Course through online mode.

Examination: To be conducted by the host Institution offering SWAYAM course selected by the student. The students are required to submit the qualifying marksheet/certificate to the office of the Department of Zoology. The credits of this course will be over and above.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – IV
(Syllabus for the examination to be held in May 2027, 2028 and 2029)

CREDIT FRAMEWORK FOR SEMESTER-IV

Course	Course Code	Course Name	Credits
Major Core [4(T) + 2(P)]			
	P2ZOTC401	Reproduction and Developmental Biology	4
	P2ZOPC402	Practicals based on P2ZOTC401	2
Total Core Credits			**6**
Major Elective (Any Two) [4(T)]			
	P2ZOTE410	Nematode Biology and Management	2
	P2ZOTE411	Aquarium Fish Management	2
	P2ZOTE412	Basics of Neuroscience	2
	P2ZOTE413	Bioinformatics and Biostatistics Essentials	2
Total Elective Credits			**4**
	P2ZORE425	Field Visit / Industrial Training	2
	P2ZORC426	Research Project / Dissertation	16
Semester Credit Total			**28**

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – IV
(Syllabus for the examination to be held in May 2027, 2028 and 2029)

Course No. P2ZOTC401 Course Title: Reproduction and Developmental Biology

Credits: 4 **Maximum Marks:100**

Course Outcomes:

CO1: Students will gain a comprehensive understanding of male and female reproductive systems, focusing on spermatogenesis, oogenesis, and hormonal regulation of reproductive organs. They will also learn the process of fertilization and embryo implantation, exploring molecular and physiological aspects that underpin early development.

CO2: Learners will acquire knowledge of hormonal regulation during pregnancy, the role of the placenta as an endocrine organ, and the mechanisms underlying sexual differentiation and sex determination across various species. This unit emphasizes the intricate hormonal and molecular processes involved in reproduction.

CO3: Students will explore the neuroendocrine regulation of reproduction, focusing on the hypothalamic-pituitary-gonadal axis, the role of neurotransmitters and neuropeptides in reproductive behavior, and the influence of stress on reproductive function. Special attention will be given to seasonal and non-seasonal breeding mechanisms.

CO4: This unit will provide an in-depth understanding of early developmental stages, including cleavage, blastula formation, fate mapping, gastrulation, neurulation, and the development of extraembryonic membranes, eye, and heart. Students will learn the significance of these processes in the context of organogenesis and embryonic development.

CO5: Students will study the processes of organogenesis and metamorphosis, with examples from species. The regenerative abilities of various organisms will also be examined, with a focus on mechanisms in species like Hydra, flatworms, salamanders, and mammals.

UNIT-I: Reproductive Physiology and Early Development (13 hrs)

1.1. Male Reproductive System: Testis and regulation of testicular functions, spermatogenesis, structure and function of Sertoli and Leydig cells, organization and function of epididymis, epididymal maturation of spermatozoa.

1.2.Female Reproductive System: Ovary, follicular development and selection, role of extra- and intra-gonadal factors in folliculogenesis, oocyte maturation and its regulation, ovulation, factors involved in follicular rupture, follicular atresia, corpus luteum: structure and function, structure of zona pellucida.

1.3.Fertilization: Capacitation, acrosome reaction, fusion of genetic material and its regulation in sea urchins and mice, male sterility, azoospermia, oligozoospermia, asthenozoospermia, varicocele, genetic basis for male infertility.

1.4.Embryo Implantation: Morphological, physiological, and molecular aspects and mechanism of implantation, maternal physiology during pregnancy, maternal adaptation to pregnancy, fetal-placental physiology, decidualization, molecular and morphological markers of endometrial receptivity, endometriosis

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – IV
(Syllabus for the examination to be held in May 2027, 2028 and 2029)

Course No. P2ZOTC401 Course Title: Reproduction and Developmental Biology

UNIT-2: Reproductive Endocrinology and Sex Determination (13hrs)

2.1. Hormonal Regulation of Pregnancy: Hormones of pregnancy and their mechanism of action, prevention of menstruation during pregnancy, parturition and its hormonal regulation, lactation and its hormonal control.

2.2. Placenta as an Endocrine Organ: Structure and function of placenta, hormonal regulation during pregnancy, human chorionic gonadotropin (hCG), progesterone, estrogen, and placental lactogen, role in fetal development and pregnancy maintenance.

2.3. Sexual Differentiation: Differentiation of gonad and genital tract in mammals.

2.4. Sex Determination: Sex determination in insects, birds, and mammals and its mechanism.

UNIT-3: Neuroendocrinology of Reproduction and Breeding (12 hrs)

3.1. Neuroendocrine Control of Reproduction: Hypothalamic-pituitary-gonadal (HPG) axis, role of the hypothalamus in reproduction, hormonal signals (GnRH, KNDy neurons) from the brain to the gonads, neural and feedback regulation regulating the HPG axis.

3.2. Neuroendocrine Control in Seasonal and Non-Seasonal Breeders: Neuroendocrine control in seasonal breeders, mechanisms of seasonal reproduction and breeding cycles, neuroendocrine differences between seasonal and non-seasonal breeders, hormonal regulation of reproduction in different species.

3.3. Neurotransmitters, Neuropeptides and Reproduction: Role of neurotransmitters (serotonin, dopamine, GABA) in reproductive function, neuropeptides and their role in reproductive behaviors, reproductive cycles (estrous and menstrual), modulation of reproductive cycles by hormones and brain neurotransmitters.

3.4. The Role of Stress in Reproductive Function: The impact of stress on reproduction, cortisol and its effects on the HPG axis, stress-induced reproductive dysfunction, mechanisms of stress regulation and reproductive health.

UNIT-4: Early Developmental Biology (10 hrs)

4.1. Cleavage and Blastula: Characteristics and types of cleavage, difference between cell cycle in mitosis and cleavage, Planes and patterns of cleavage, Mechanism and significance of cleavage; Morula and Blastula Formation; Types of Blastulae

Course No. P2ZOTC401 Course Title: Reproduction and Developmental Biology

4.2. Fate Maps and Gastrulation: Techniques to study Fate Maps, fate Maps of Amphibians and chicks; General process of Gastrulation, different morphogenetic movements during gastrulation; gastrulation in amphibians, chick and mammals

4.3. Neurulation: Primary and Secondary Neurulation and its mechansim; Patterning of Central Nervous System

4.4. Extraembryonic membranes and development of eye and heart

UNIT-5: Organogenesis, Metamorphosis and Regeneration (10 hrs)

5.1 Organogenesis: Vulva formation in *Caenorhabditis elegans*; Axis formation in Drosophila development; tetrapod limb development

5.2 Development: Development of ear and excretory system

5.3 Metamorphosis: Metamorphosis in Amphibians

5.4 Regeneration: Regeneration in Hydra, Flatworms, Salamanders and Mammals.

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

SUGGESTED BOOKS:

- Strauss, J.F., Barbieri, R.L., Dokras, A., Williams, C.J., & Williams, S.Z. (Eds.). (2023). *Yen & Jaffe's reproductive endocrinology: Physiology, pathophysiology, and clinical management* (9th ed.). Elsevier.
- Leung, P.C.K., &Adashi, E.Y. (Eds.). (2019). *The ovary* (3rd ed.). Academic Press.
- Plant, T.M., & Zeleznik, A.J. (Eds.). (2014). *Knobil and Neill's physiology of reproduction* (4th ed.). Academic Press.

Course No. P2ZOTC401 Course Title: Reproduction and Developmental Biology

- Fusco, G., & Minelli, A. (2019). *The biology of reproduction*. Cambridge University Press.
- Johnson, M. H. (2018). *Essential reproduction* (8th ed.). Wiley-Blackwell.
- Skinner, M. K. (Ed.). (2018). *Encyclopedia of reproduction* (2nd ed., 6 vols.). Academic Press.
- Jones, R.E., & Lopez, K.H. (2013). *Human reproductive biology* (4th ed.). Academic Press.
- Prakash, G. (2007). *Reproductive biology*. Alpha Science International Ltd.
- Pawlina, W. (2024). *Histology: A text and atlas with correlated cell and molecular biology* (9th ed.). Lippincott Williams & Wilkins.
- Gilbert, S.F. (2023). *Developmental biology* (13th ed.). Sinauer Associates.
- Wolpert, L., Tickle, C., & Arias, A.M. (2022). *Principles of developmental biology* (4th ed.). Garland Science.
- Slack, J.M.W. (2021). *Essential developmental biology* (5th ed.). Wiley-Blackwell.
- Hill, C.S., & Schier, A.F. (2020). *Molecular mechanisms of development* (2nd ed.). Cambridge University Press.
- Martinez Arias, A., & Hayward, P. (2020). *Developmental biology: A very short introduction*. Oxford University Press.
- Kalthoff, K. O. (2001). *Analysis of biological development* (2nd ed.). McGraw-Hill.
- Sadler, T.W. (2018). Langman's Medical Embryology (14th ed.). Philadelphia: Wolters Kluwer.
- Roosevelt, L. (Ed.). (2017). *Textbook of developmental biology*. Callisto Reference.
- McGeady, T. A., Quinn, P. J., FitzPatrick, E. S., Ryan, M. T., Kilroy, D., & Lonergan, P. (2017). *Veterinary embryology* (2nd ed.). Wiley-Blackwell.
- Carlson, B.M. (2023). *Human embryology and developmental biology* (7th ed.). Elsevier.
- Verma, P.S., & Agarwal, V. K. (2010). *Chordate embryology*. S. Chand Publishing.
- Moody, S.A. (Ed.). (2014). *Principles of developmental genetics* (2nd ed.). Academic Press.
- Balinsky, B.I. (1981). *An introduction to embryology* (5th ed.). Saunders College Publishing.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – IV
(Syllabus for the examination to be held in May 2027, 2028 and 2029)

Course No. P2ZOPC402

Practicals based on P2ZOTC401

Credits: 2

Maximum Marks:50

1. Comparative anatomical examination of vertebrate gonads and their ducts in: Fish, Frog, Reptile, Mammal
2. Microscopic analysis of corpus luteum and corpus atreticum using prepared slides.
3. Detailed examination of Graafian follicles and associated ovarian structures.
4. Preparation and observation of chick embryo development stages up to 120 hours.
5. Observation and identification of different cleavage patterns in various organisms.
6. Identification and comparison of different types of blastulae: Sea urchin, Chick, Mammal
7. Microscopic examination of frog embryonic stages: Morula, Blastula, Gastrula
8. Analysis of gastrulation stages in chick embryo development.
9. Examination of longitudinal section (L.S.) of frog tadpole using prepared slides.

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

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – IV
(Syllabus for the examination to be held in May 2027, 2028 and 2029)

Course No. P2ZOTE410 **Course Title: Nematode Biology And Management**
Credits: 2 **Maximum Marks:50**

Course Outcomes:

CO1: This unit provides students with an understanding of the general characteristics, classification, and morphology of nematodes, including their habitats and ecological roles. Students will explore key structural features such as the body wall, cuticle, stylet, and specialized reproductive structures. The unit also covers the impact of plant parasitic nematodes, such as Root Knot Nematodes and Soybean Cyst Nematodes, as well as human and animal parasitic nematodes like *Trichinella spiralis* and *Ascaris* spp., focusing on the symptoms they cause.

CO2: In this unit, students will learn about the role of entomopathogenic nematodes as biological control agents, particularly in sustainable pest management. The life cycle of EPNs, including the development of infective juveniles and their role in controlling insect pests, will be discussed in detail. Students will also explore different EPN formulations and application strategies, including aqueous suspensions and clay-based powders, along with case studies on their use in horticulture, floriculture, and medicinal plant cultivation.

CO3: This unit introduces the concept of Integrated Pest Management (IPM) and its significance in sustainable agriculture. Students will examine the steps involved in implementing IPM, including planning, monitoring, and selecting appropriate control strategies. The unit highlights non-chemical control methods, such as physical traps and mechanical barriers, as alternatives to chemical pesticides. It also addresses the disadvantages of chemical control, such as environmental impact, pest resistance, and health risks associated with pesticide residues.

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

1.1 General characteristics of Nematodes: Occurrence, habits, and natural habitats of nematodes
1.2 Classification of Nematodes: Systematic classification of nematodes up to the family level; Introduction to major taxonomic groups of nematodes
1.3 Morphology and Reproductive Structures: Structural features: size, shape, body wall, and cuticle; Specialized structures: stylet, body regions, spicules, gubernaculum, and bursa
1.4 Nematode-Associated Diseases and Symptoms: Plant parasitic nematodes and the symptoms they cause:Root Knot Nematode, Soybean Cyst Nematode, Lesion Nematode; Human and animal parasitic nematodes: *Trichinella spiralis*, *Ascaris* spp.

UNIT-2: Entomopathogenic nematodes (EPNs) **(10hrs)**

2.1 Nematodes as Biological Control Agents: Role of nematodes in biological control, Ecological significance of nematodes in pest management, Symbiotic relationship between nematodes and bacteria
2.2 Life Cycle of Entomopathogenic Nematodes (EPNs): Life cycle stages of EPNs, First and second-generation males and females, Development and role of Infective Juveniles (IJs)
2.3 EPN Formulations and Application Strategies: Types of EPN formulations: Aqueous suspension, Synthetic sponges, Gels, Clay-based and powder forms
2.4 Case Studies on EPN Applications: Use of EPNs in horticulture, Applications in floriculture, Applications in medicinal plant cultivation

UNIT-3: Integrated pest Management strategies **(10hrs)**

3.1 Introduction to Integrated Pest Management (IPM): Concept and definition of IPM; Advantages and disadvantages of IPM
3.2 Goals and Steps in IPM Implementation: Key goals of IPM in sustainable agriculture; Implementation steps: inspection, planning, preventive strategies, analysis, treatment selection, monitoring, and documentation

Course No. P2ZOTE410 Course Title: Nematode Biology And Management

3.3 Non-Chemical Control Methods: Use of physical and mechanical control tools; Types of traps: spring traps, pheromone traps, sticky traps, fly and wasp traps
3.4 Disadvantages of Chemical Control of Insect Pests: Environmental impact, Pest resistance development, Non-target organism effects, Residue-related health risks

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

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – IV
(Syllabus for the examination to be held in May 2027, 2028 and 2029)

Course No. P2ZOTE411

Course Title: Aquarium Fish Management

Credits: 2

Maximum Marks: 50

Course Outcomes:

CO1: Students will learn the principles of aquarium fabrication, focusing on frame construction, glass type, and size selection. They will gain practical knowledge in site selection and environmental considerations for setting up an aquarium. The unit covers how to determine the stocking capacity, considering the number and type of fish. Additionally, students will be introduced to essential aquarium accessories and maintenance practices, including heaters, filters, and cleaning schedules.

CO2: This unit teaches students about the critical abiotic components of aquarium water, including dissolved oxygen, pH, ammonia levels, and carbon dioxide. They will also explore the role of biotic components like aquarium plants and their impact on water quality. The unit covers common fish diseases such as white spot, fin rot, and gill flukes, focusing on symptoms and diagnosis. Students will learn disease management strategies, including treatment methods and preventive care for maintaining fish health.

CO3: Students will gain an understanding of the characteristics and identification of freshwater ornamental fishes, as well as their feeding and breeding behaviors. The unit also introduces marine ornamental fishes, exploring their unique traits and identification techniques. Feeding habits and spawning behavior for both freshwater and marine species are studied in detail. This knowledge equips students with a comprehensive understanding of ornamental fish biology for care and breeding purposes.

UNIT-1: Aquarium Construction and Maintenance (10hrs)

1.1 Aquarium Fabrication: Frame, glass type, size, thickness

1.2 Site Selection and Setting Up: Placement and environmental factors

1.3 Stocking Capacity: Determining number and type of fish

1.4 Aquarium Accessories and Maintenance: Heaters, filters, aerators, decoratives, cleaning schedule

UNIT-2: Water Quality and Fish Health (10hrs)

2.1 Abiotic Components: Dissolved Oxygen, Carbondioxide, pH, ammonia levels

2.2 Biotic Components: Aquarium plants (rooted, branched, floating)

2.3 Fish Diseases and Symptoms: White spot, Fin rot, Gill flukes, Mouth Fungus

2.4 Disease Management: Treatment methods and preventive care

UNIT-3: Biology of Ornamental Fishes (10hrs)

3.1 Freshwater Ornamental Fishes: Characteristics and identification

3.2 Feeding & Breeding (Freshwater): Feeding habits and spawning behavior

3.3 Marine Ornamental Fishes: Characteristics and identification

3.4 Feeding & Breeding (Marine): Feeding habits and spawning behavior

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – IV
(Syllabus for the examination to be held in May 2027, 2028 and 2029)

Course No. P2ZOTE411 Course Title: Aquarium Fish Management

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:

- 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, New Delhi.
- 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.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – IV
(Syllabus for the examination to be held in May 2027, 2028 and 2029)

Course No. P2ZOTE412 **Course Title: Basics of Neuroscience**

Credits: 2 **Maximum Marks: 50**

Course Outcomes:

CO1: Students will gain an understanding of neuroscience as an interdisciplinary field and its wide-ranging applications. The unit covers the historical development of neuroscience and its key milestones in research. Students will explore the various branches within neuroscience and their contributions to the field. Recent advances and cutting-edge research in neuroscience will also be discussed to highlight its evolving nature.

CO2: This unit introduces students to the structure and function of neurons, emphasizing their role in the nervous system. Students will learn about the different types of neurons and their distribution, starting from the process of neurulation. The role of neurotransmitters, both stimulatory and inhibitory, in communication between neurons is explored. The structure and function of synapses will also be studied to understand neuronal communication.

CO3: Students will examine case studies related to brain tumors and epilepsy to understand the clinical manifestations of nervous system illnesses. The unit also covers structural and functional neurological disorders, with a focus on neurodegenerative diseases. Students will explore the pathophysiology of these conditions and the therapeutic strategies available for treatment. The importance of early diagnosis and intervention in neurological health will be emphasized.

UNIT-1: Scope of Neuroscience **(10hrs)**

1.1 Neuroscience and its multidisciplinary

1.2 Scope and various fields of neuroscience

1.3 Historical evidence in the field of neuroscience

1.4 Recent advances in neuroscience

UNIT-2: Neuronal structure, types, distribution, and functioning **(10hrs)**

2.1 Neurons: structure and function

2.2 Types of Neurons and distribution since neurulation

2.3 Neurotransmitters: types and function (stimulatory and inhibitory)

2.4 Synapse

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

3.1 Case studies (Brain tumors and Epilepsy)

3.2 Structural and functional Illnesses

3.3 Neurodegenerative diseases

3.4 Therapeutics

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – IV
(Syllabus for the examination to be held in May 2027, 2028 and 2029)

Course No. P2ZOTE412

Course Title: Basics 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

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – IV
(Syllabus for the examination to be held in May 2027, 2028 and 2029)

Course No. P2ZOTE413 **Course Title: Bioinformatics and Biostatistics Essentials**

Credits: 2 **Maximum Marks:50**

Course Outcomes:

CO1: Students will gain an understanding of the fundamentals of bioinformatics, including its scope, definitions, and real-world applications. They will explore major biological databases for storing and accessing biological data. The basics of sequence alignment, particularly DNA and protein sequence comparisons using tools will be covered. Additionally, students will be introduced to the fields of genomics and proteomics, understanding their role in modern biological research.

CO2: This unit introduces students to the importance and applications of biostatistics in biological research and data analysis. Students will learn the different types of and various sampling methods used in biological studies. They will gain a solid understanding of measures of central tendency and dispersion. The unit also covers basic probability concepts and probability distributions, focusing on their application in biological contexts.

CO3: Students will learn how to perform hypothesis testing to evaluate biological data. They will understand the concepts of correlation and regression to analyze relationships between biological variables. The unit provides an introduction to statistical software which are essential tools for data analysis in biology. Ethical considerations in data analysis and scientific research will also be addressed, emphasizing integrity in scientific studies.

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

1.1 Basics of Bioinformatics: Definition, Scope, and Applications

1.2 Biological Databases: NCBI, EMBL, UniProt, and PDB

1.3 Basics of Sequence Alignment: DNA and Protein Sequence Comparisons (BLAST, FASTA)

1.4 Introduction to Genomics and Proteomics

UNIT-2: Basics of Biostatistics **(10hrs)**

2.1 Introduction to Biostatistics: Importance and Applications in Biology

2.2 Types of Data: Qualitative vs. Quantitative, Sampling Methods

2.3 Measures of Central Tendency and Dispersion: Mean, Median, Mode, Standard Deviation

2.4 Basics of Probability: Probability Distributions and Their Applications in Biology

UNIT-3: Statistical Analysis and Computational Tools **(10hrs)**

3.1 Hypothesis Testing: Concept, t-test, and Chi-Square Test

3.2 Correlation and Regression: Relationship Between Biological Variables

3.3 Introduction to Statistical Software: MS Excel, GraphPad Prism, and R Basics

3.4 Ethics in Data Analysis and Scientific Research

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – IV
(Syllabus for the examination to be held in May 2027, 2028 and 2029)

Course No. P2ZOTE413 Course Title: Bioinformatics and Biostatistics Essentials

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.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – IV
(Syllabus for the examination to be held in May 2027, 2028 and 2029)

Course No. P2ZORE425 **Course Title: Field Visit/Industrial Training**
Credits: 2 **Maximum Marks:50**

Course Outcomes: This course is designed to provide students of Zoology with practical exposure to real-world biological and ecological environments, as well as industry practices related to animal sciences. Through field visits to biodiversity-rich habitats, research institutions, zoological parks, aquaculture farms, wildlife sanctuaries, and museums, students gain firsthand knowledge of animal diversity, ecological interactions, and conservation strategies. Industrial training components may include visits to laboratories, fish hatcheries, or other zoology-related industries, helping students understand the application of zoological knowledge in various professional settings.

The course aims to bridge the gap between theoretical learning and practical application, enhance observational and recording skills, and encourage students to critically analyze biological systems in natural or applied settings.

UNIVERSITY OF JAMMU
DEPARTMENT OF ZOOLOGY
SYLLABUS FOR POSTGRADUATE PROGRAMME IN ZOOLOGY
(2-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP) – 2020
PG SEMESTER – IV
(Syllabus for the examination to be held in May 2027, 2028 and 2029)

Course No. P2ZORC426 **Course Title: Research Project/Dissertation**
Credits: 16 **Maximum Marks:400**

Course Outcomes: The Research Project/Dissertation is designed to provide students with hands-on exposure to scientific research methodologies. It aims to develop their ability to independently design and conduct experiments, analyze data critically, interpret results, and present findings in a systematic and scholarly manner. Through this course, students gain practical experience in experimental techniques, literature review, hypothesis formulation, data collection, statistical analysis, and scientific writing.

Each student will be assigned a mentor under whose guidance they will complete a research-based project. At the end of the semester, students must submit their project report in the form of a dissertation.

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

	Time allotted for Examination	% Weightage		
Mid Term Appraisal	4 hours	25%		
External Examination	4 hours	75%	50%	Project report
			25%	Viva voce
Total				100

Distribution of Marks in Research (Dissertation/Project) in 4th Semester

Total Credits=16, Total Marks=400

Internal Evaluation = 100 Marks, External Evaluation = 300 Marks

Internal Research (Dissertation/Project) Evaluation

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.