ہائیر ایجوکیشن کمیشن
HIGHER EDUCATION COMMISSION
Government of Pakistan, Islamabad

Sector H-9
Islamabad, Pakistan
Phone : +92-51-90402114
+92-51-90402121
www.hec.gov.pk
mabaig@hec.gov.pk

*Office of the*
**Deputy Director** (Curriculum)
Academics Division

No. HEC/CD/NCRC/ZOOLOGY/2025/7136
February 12, 2025

**SUBJECT: REVISED CURRICULA FOR DEGREE PROGRAMS IN ZOOLOGY**

The Higher Education Commission (HEC) of Pakistan, as mandated by its law, provides guidance to Higher Education Institutions (HEIs) on curricula for tertiary education levels in alignment with the National Qualifications Framework (NQF). To address evolving academic trends and market demands, HEC, in collaboration with the Pakistan Academy of Sciences (PAS), has revised the curricular standards for Zoology degree programs at NQF levels 5, 6 and 7. These updated standards are intricately aligned with HEC's Undergraduate Education Policy V 1.1 (2023) and Graduate Education Policy (2023), ensuring coherence with national priorities and adherence to international benchmarks.

**2.** The revised curricula for Zoology degree programs, incorporating an option for advanced electives, are hereby notified. Universities offering these programs are advised to align their Zoology curricula with these updated standards as a minimum requirement. Additionally, the respective departments must develop course contents in accordance with the prescribed framework, ensuring that the programs address both national and local industry needs. The finalized course contents should be submitted electronically to this office at the earliest. An electronic copy of the revised curricula is available on HEC's official website.

**3.** Through effective implementation of these standards, HEC envisions a future where Pakistani graduates in Zoology excel in scientific discovery and technological innovation, making substantial contributions to socio-economic progress both nationally and globally.

**MUHAMMAD ALI BAIG**

**Vice Chancellors/Rectors/Heads**
All Public/Private Sector Universities/DAIs

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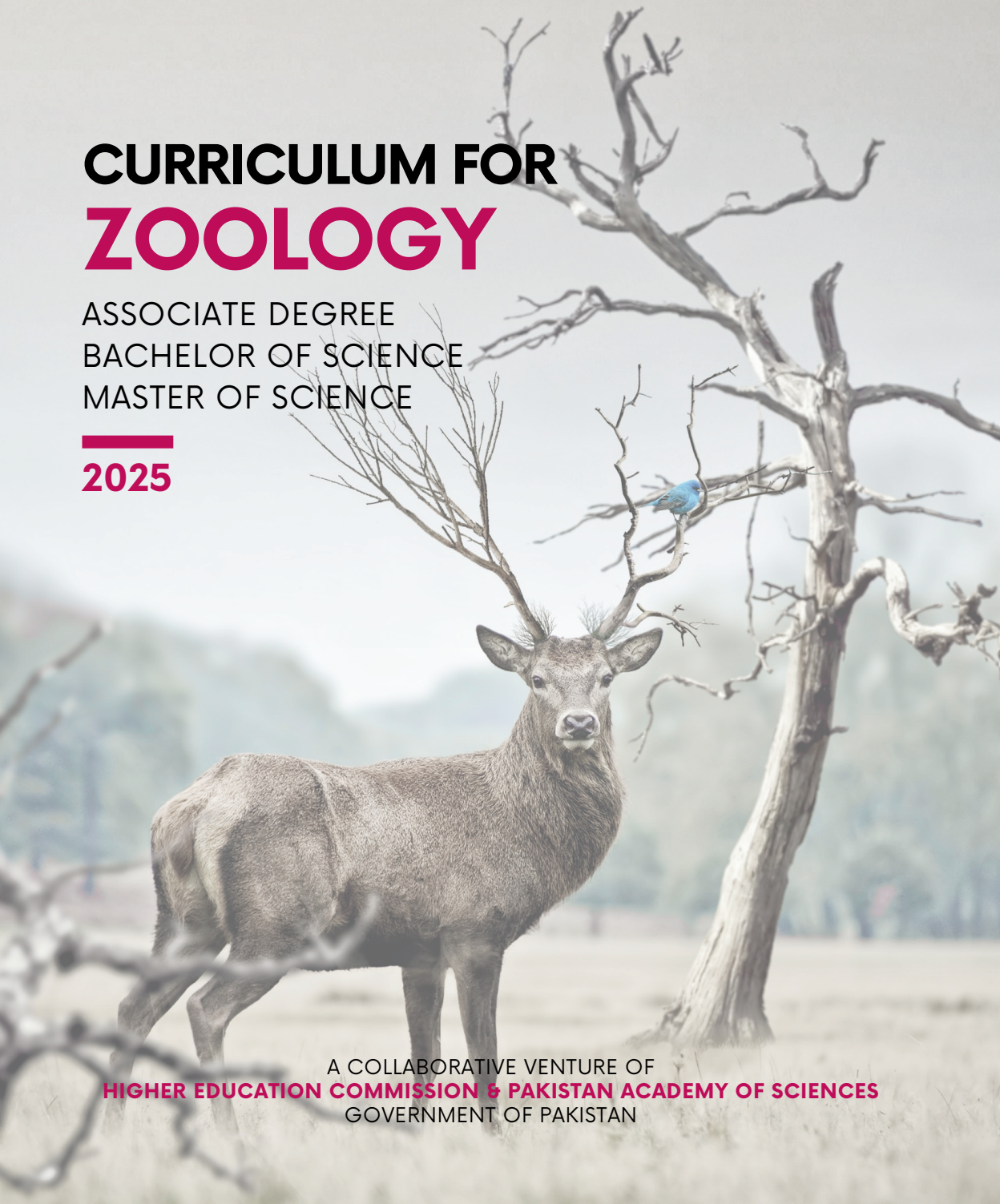
# CURRICULUM FOR
# ZOOLOGY

ASSOCIATE DEGREE
BACHELOR OF SCIENCE
MASTER OF SCIENCE

**2025**



A COLLABORATIVE VENTURE OF
**HIGHER EDUCATION COMMISSION & PAKISTAN ACADEMY OF SCIENCES**
GOVERNMENT OF PAKISTAN



CURRICULUM FOR

# ZOOLOGY

DEGREE PROGRAMS

2025

Prepared by:
**SUBJECT EXPERTS**
Different Universities

Designed and Edited by:
**MUHAMMAD ALI BAIG**
Deputy Director (Curriculum) | Academics Division
Higher Education Commission, Islamabad

Coordinated by:
**AMAD UD DIN**
Assistant Director (Curriculum) | Academics Division
Higher Education Commission, Islamabad

# Table of Contents

# Contributions

**DR. AMINA ZUBERI** Convener
Professor
Department of Zoology
Quaid-i-Azam University, Islamabad
Phone: +92-331-5597169

**DR. MUHAMMAD NAEEM KHAN**
Professor (Emeritus)
Institute of Zoology
University of the Punjab, Lahore
Phone: +92-300-1881961

**DR. NUZHAT SHAFI**
Professor & Chairperson
Department of Zoology, University of Azad Jammu & Kashmir, Muzaffarabad
Phone: +92-333-5240171

**DR. SAJID MALIK**
Professor
Department of Zoology
Quaid-i-Azam University, Islamabad
Phone: +92-332-7684963

**DR. IRAM LIAQAT**
Associate Professor
Department of Zoology
Government College University, Lahore
Phone: +92-341-7824964

**DR. MUHAMMAD ALI**
Associate Professor & Head
Department of Zoology, University of Baltistan, Skardu
Phone: +92-342-2399931; +92-355-5192671

**DR. SAMRAH MASUD**
Associate Professor
Institute of Zoology
Bahauddin Zakariya University, Multan
Phone: +92-300-6338836

**DR. SHAHZAD ALI**
Associate Professor, Department of Wildlife & Ecology, University of Veterinary & Animal Sciences, Lahore
Phone: +92-334-5170679

**DR. AKHTAR RASOOL**
Assistant Professor
Centre for Animal Sciences & Fisheries
University of Swat, Swat
Phone: +92-331-4183262

**DR. TASLEEM AKHTAR**
Junior Lecturer
Department of Zoology, University of Azad Jammu & Kashmir, Muzaffarabad
Phone: +92-308-8870673

**DR. ABDUL RAUF SHAKOORI**
Professor (Emeritus)
School of Biological Sciences
University of the Punjab, Lahore
Phone: +92-333-4673255

**DR. NOOR KHAN**
Professor
Institute of Zoology
University of the Punjab, Lahore
Phone: +92-300-4929621

**DR. RUBINA MUSHTAQ**
Professor & Chairperson, Department of Zoology, Federal Urdu University of Arts, Science & Technology, Karachi
Phone: +92-331-8101381

**DR. FARRAH ZAIDI**
Associate Professor
Institute of Zoological Sciences
University of Peshawar, Peshawar
Phone: +92-324-5161524

**DR. KHALID ABBAS**
Associate Professor
Department of Zoology, Wildlife and Fisheries
University of Agriculture, Faisalabad
Phone: +92-333-6734766

**DR. NASREEN KHAN**
Associate Professor & Chairperson
Department of Zoology
Jinnah University for Women, Karachi
Phone: +92-306-2176289

**DR. SHABANA NAZ**
Associate Professor
Department of Zoology
Government College University, Faisalabad
Phone: +92-335-6444995

**DR. WAHEED ALI PANHWAR**
Associate Professor
Department of Zoology, University of Sindh Jamshoro
Phone: +92-336-3682670

**MR. ROOH ULLAH**
Lecturer
Department of Zoology, Shaheed Benazir Bhutto University, Sheringal, Upper Dir
Phone: +92-300-3711837

**MR. MUHAMMAD ALI BAIG** Secretary
Deputy Director (Curriculum)
Academics Division
Higher Education Commission, Islamabad
Phone: +92-51-90402114

# Preface

The curriculum serves as a comprehensive blueprint for the teaching-learning process that students must navigate to achieve specific academic objectives. This encompasses clearly defined prior learning requirements, program objectives, scheme of studies, and course learning outcomes. As knowledge rapidly evolves and new fields emerge, it is crucial to continually develop and revise curricula to ensure they remain current, relevant, and impactful.

As mandated by its law through Clause 10-1 (a), (l), (s), and (v), the Higher Education Commission (HEC) of Pakistan has been developing and periodically updating curricula through its National Curriculum Revision Committees (NCRCs). These committees are generally composed of subject matter experts, researchers, and representatives from accreditation bodies, professional councils, and industry stakeholders. In response to the evolving needs, HEC, in collaboration with the Pakistan Academy of Sciences (PAS), has undertaken the task to develop robust standards for the curricula of degree programs in Zoology at levels 5, 6 and 7 of the National Qualifications Framework. These standards are meticulously structured in accordance with the HEC's Undergraduate Education Policy V 1.1 (2023) and Graduate Education Policy (2023), ensuring alignment with both national priorities and international educational standards.

The degree programs in Zoology are designed to equip students with cutting-edge knowledge and practical skills, fostering innovation and research to address the emerging and unique challenges in the field of Zoology. It is hoped that these curricular standards, prescribed by subject experts from across the country, will not only contribute towards meeting the national educational and economic requirements but will also elevate the competency levels of our graduates in the field of Zoology.

With the support of universities in implementing these standards, HEC envisions a future where Pakistani graduates in Zoology are at the forefront of scientific discovery and technological innovation, driving progress and contributing to the betterment of society both nationally and internationally.

**Dr. Amjad Hussain**
Director General
Academics Division

# Guiding Principles

### MINIMUM STANDARDS

The curricular standards and guidelines prescribed in this document are mandatory at minimum level. Universities or the concerned departments may however set higher standards provided that the standards prescribed herein are not reduced or compromised.

### COURSE SEQUENCE, TITLES & CREDITS

For Bachelor of Science and Master of Science in Zoology, the sequence of courses prescribed in this document is logically arranged and is suggestive only. The concerned department may rearrange the sequence and alter the course titles and credit hours provided that the essence of the courses prescribed herein remains intact. The concerned department may also add more courses as and when required subject to approval of university's relevant statutory body.

### COURSE LEARNING OUTCOMES

The course learning outcomes (CLOs) prescribed in this document represent the minimum level of competency and understanding expected from students. While these standards must not be compromised, departments are encouraged to enhance the rigor of the CLOs by incorporating additional learning outcomes, provided these do not alter the essence of the prescribed standards. In this document, CLOs are exclusively developed for major and interdisciplinary courses, whereas for electives, CLOs are not prescribed as these are advanced or specialized courses. The development of CLOs for electives is the responsibility of the concerned department, taking into account the course's advanced nature and relevance to the program. For General Education courses as prescribed in the HEC Undergraduate Education Policy V 1.1. including the course of Pakistan Studies, departments may adopt the CLOs prescribed in the HEC-developed model courses, as available on its website.

### COURSE SYLLABUS

This document serves as a comprehensive guideline delineating the CLOs for each course as prescribed for the Bachelor of Science and Master of Science in Zoology as minimum standards. The concerned department is required to meticulously prepare, modify, and tailor the syllabus of each course, ensuring alignment with the stipulated learning outcomes. It is in this regard imperative that the concerned department utilizes instructional, reference, and reading materials that it deems appropriate to effectively meet the CLOs.

### GENERAL EDUCATION

For Bachelor of Science in Zoology, the courses prescribed for General Education including the course of "Pakistan Studies" must mandatorily be offered with the same titles and credit hours as prescribed in the HEC Undergraduate Education Policy V 1.1. The concerned department may adopt and follow the learning outcomes and study contents developed by HEC for these courses as available on its website. The requirement of General Education is not applicable to Master of Science in Zoology.

### REQUIREMENT OF INTERNSHIP

Internship of 3 credit hours is a mandatory degree award requirement for Bachelor of Science

in Zoology. Internship of 6 to 8 weeks (preferably undertaken during semester or summer break) must be graded by a faculty member in collaboration with the supervisor in the field. This requirement cannot be substituted with additional course work, capstone or project work.

## REQUIREMENT OF CAPSTONE

It is a mandatory degree award requirement of 3 credit hours for Bachelor of Science in Zoology. The capstone is a multifaceted body of work that serves as a culminating academic and intellectual experience for students. It must be supervised and graded by a faculty member as per the protocols prescribed by the concerned department. This requirement cannot be substituted with additional course work or internship.

## ASSOCIATE DEGREE IN ZOOLOGY

The eligibility criteria and the first-four semesters of the Bachelor of Science in Zoology as prescribed in this document guide the admission requirement and the structure of Associate Degree in Zoology, respectively. Field experience / internship is not a mandatory requirement for the Associate Degree in Zoology.

## LABORATORY REQUIREMENTS

The departments offering degree programs in Zoology are required to adhere to the laboratory requirements as specified in this document, as minimum standards. The concerned department is expected to enhance the laboratory standards as and when required and maintain / upgrade the same from time to time in order to ensure quality education and research in the field of Zoology.

## ELECTIVES

**a)** In accordance with the **National Qualifications Framework**, the department is required to offer 6-7 electives comprised of 18-21 credit hours i.e., minimum of 25% of the major i.e., Zoology comprised of 72 credit hours, to meet the criteria of nomenclature with specialization. Where the department increases the range of major beyond 72, the number of electives will accordingly be adjusted.

**b)** Where the electives are opted from general pool of electives, the degree will be awarded as Bachelor of Science in Zoology in its generic form and without any specialization. **Example: Bachelor of Science in Zoology.**

**c)** Where the electives are opted from within a single specialization domain, the degree will be offered as Bachelor of Science in Zoology (with name of specialization) in accordance with the National Qualifications Framework (2015). **Example: Bachelor of Science in Zoology (Entomology).**

**d)** Subject to approval of the relevant statutory body, the department may develop additional specializations other than those prescribed in this document.

**e)** It should however be noted that offering of the degree program with specialization is prescribed here as an option only and not as a mandatory requirement or a binding on the concerned department. In view of this, the concerned department may consider to offer the degree program with specialization or otherwise, as per available academic, human and infrastructural resources.

## EQUIVALENCE OF QUALIFICATIONS

All the graduates having degrees of Bachelor of Science in Zoology with or without specialization will be considered at par in terms of their knowledge, skills and abilities acquired through the course of the degree program, for the purpose of employment and further education. Therefore, all graduates having Bachelor of Science in Zoology with any specialization are considered equivalent to Bachelor of Science in Zoology. However, where specific specialization of Zoology is required by the employing agency such as Mammalogy, the same cannot be considered at par with any other specialization of Zoology such as Parasitology. The titles given here are only examples for clarification.

## ENTRY & EXIT PROVISIONS

### Pathway for Graduates with Associate Degree

**a)** Students having completed Associate Degree in Zoology or any discipline related to the field of Zoology shall be required to complete deficiency courses up-to a maximum of 18 credit hours (if required) as determined by the admitting university / department. In case where the deficiency courses are of more than 18 credit hours, the concerned university may decide not to offer admission in accordance with its screening, admission and merit calculation criteria approved by its statutory bodies.

**b)** The minimum eligibility for admission in the fifth semester in this case is 2.00/4.00 CGPA obtained in the prior qualification i.e., Associate Degree. The admitting university may, however, set higher eligibility criteria for admission in the fifth semester of Bachelor of Science in Zoology.

### Pathway for Graduates with Conventional BSc / Equivalent Degree Programs

**a)** Students having completed two-year conventional BSc / equivalent degree programs are allowed admission in the fifth semester of Bachelor of Science in Zoology in which case, such students shall be required to complete deficiency courses up-to a maximum of 21 credit hours as determined by the admitting university / department. In case where the deficiency courses are of more than 21 credit hours, the concerned university may decide not to offer admission in accordance with its screening, admission and merit calculation criteria approved by its statutory bodies.

**b)** The minimum eligibility for admission in the fifth semester in this case is 45% cumulative score obtained in the prior qualification i.e., two-year conventional BSc / equivalent degree programs. The admitting university may however set higher eligibility criteria for admission in the fifth semester of Bachelor of Science in Zoology.

### Exiting from Bachelor of Science in Zoology with the Associate Degree

Exit from Bachelor of Science in Zoology with Associate Degree in the same discipline is allowed in accordance with the provisions of HEC Undergraduate Education Policy V 1.1. and only in such circumstances where no other remedy is available to safeguard the academic career of the student.

CURRICULUM FOR

# **BACHELOR OF SCIENCE (BS)**

ZOOLOGY

# BS Zoology

## PROGRAM DESCRIPTION

The Bachelor of Science in Zoology program is designed in accordance with the provisions of the HEC Undergraduate Education Policy V 1.1. to provide students with a comprehensive and in-depth understanding of the diverse animal kingdom. This program integrates knowledge across various domains, including animal diversity, physiology, behavior, ecology, genetics, and evolutionary biology, equipping students with essential analytical, observational, and research skills. It prepares graduates for careers in zoology, biodiversity conservation, and environmental sciences, as well as for further academic pursuits in related fields. The curriculum is structured to offer a balanced, progressive, and engaging learning experience through theoretical instruction, practical training, and research-oriented activities. Throughout the course of this degree program, students will gain hands-on experience with modern laboratory techniques, advanced fieldwork methodologies, and computational tools essential for zoological research and professional practice. The program also emphasizes the ability to effectively communicate scientific knowledge ensuring that graduates are well-prepared for careers in academia, research institutions, environmental management, wildlife conservation, and zoological parks.

## STANDARD NOMENCLATURE

The scheme of study prescribed for the four-year undergraduate degree in Zoology is based on a total of seven advanced generic and specialization electives. Where the seven courses are adopted from within a single specialization domain, the degree will be offered as **Bachelor of Science in Zoology (with name of specialization)** in accordance with the National Qualifications Framework (2015), and where the seven courses are adopted from more than one specialization domains, the degree will be awarded as **Bachelor of Science in Zoology** in its generic form and without any specialization.

## PROGRAM LEARNING OUTCOMES

By the completion of Bachelor of Science in Zoology, the graduates will be able to:

**a)** Demonstrate a comprehensive understanding of fundamental and applied concepts in Zoology.

**b)** Effectively use methods and techniques applied in Zoology, including fieldwork, research, laboratory experiments, data analysis, and modern computational tools.

**c)** Communicate scientific knowledge and research findings in Zoology with a commitment to advancement in the field with special emphasis on biodiversity conservation and socioeconomic development of the country.

## ELIGIBILITY & ADMISSION CRITERIA

Higher Secondary School Certificate (involving 12 years of schooling) or an IBCC equivalent qualification in any science group with a subject of Biology or General Biology is the basic eligibility requirement for admission in the Bachelor of Science in Zoology. The admitting university may set minimum eligibility scores and may conduct entry / admission test through its own testing body or an external testing services provider of repute as per the screening, admission and merit calculation criteria approved by its statutory bodies.

## PROGRAM STRUCTURE

The Bachelor of Science in Zoology is structured in accordance with the provisions of the HEC Undergraduate Education Policy V 1.1. and comprises of minimum 137 credit hours (including supervised internship and capstone) spread over 8 regular semesters. Universities may offer courses up-to maximum of 144 credit hours provided that the total number of credit hours are reasonably set to achieve the Program Learning Objectives (PLOs) without putting undue burden on students. Summary of the program including the model scheme of study is given below.

| | |
|---|---|
| **Minimum Credit Hours** | 137 |
| **General Education** | 32 credit hours (13 courses) |
| **Discipline Related Courses / Major** | 72 credit hours (24 courses) |
| **Interdisciplinary / Allied Courses** | 27 credit hours (9 courses) |
| **Internship** | 3 credit hours |
| **Capstone** | 3 credit hours |
| **Program Duration** | Minimum: 4 years (8 regular semesters)<br>Maximum: 6 years (12 regular semesters)<br>The maximum limit is further extendable in accordance with HEC semester rules |
| **Semester Duration** | 16-18 weeks for regular semesters<br>(1-2 weeks for examination)<br>8-9 weeks for summer semesters<br>(1 week for examination) |
| **Course Load (per semester)** | 15-18 credit hours for regular semesters<br>Up-to 8 credit hours for summer semesters<br>(for remedial/deficiency/failure/repetition courses only) |
| **3 Credit Hours (Theory)** | 3 classes (1 hour each) **OR**<br>2 classes (1.5 hour each) **OR**<br>1 class (3 hours) per week throughout the semester |
| **1 Credit Hours (Lab / Field Work)** | 1 credit hour in laboratory or practical work / project requires lab contact of 3 hours per week throughout the semester |

| SEMESTER 1 | | | |
|---|---|---|---|
| **S.N.** | **Course** | **Credit Hours** | **Category** |
| 1 | Diversity of Invertebrates | 3 (2-1) | Major |
| 2 | Diversity of Plants | 3 (2-1) | Interdisciplinary |
| 3 | Quantitative Reasoning – I * | 3 (3-0) | General Education |
| 4 | Natural Science ** | 3 (2-1) | General Education |
| 5 | Functional English * | 3 (3-0) | General Education |
| 6 | Applications of Information & Communication Technologies (ICT) * | 3 (2-1) | General Education |
| **TOTAL CREDIT HOURS: 18** | | | |

| SEMESTER 2 | | | |
|---|---|---|---|
| **S.N.** | **Course** | **Credit Hours** | **Category** |
| 1 | Cell Biology | 3 (2-1) | Major |
| 2 | Diversity of Chordates | 3 (2-1) | Major |
| 3 | Plant Physiology & Ecology | 3 (2-1) | Interdisciplinary |
| 4 | Quantitative Reasoning – II * | 3 (3-0) | General Education |
| 5 | Expository Writing * | 3 (3-0) | General Education |
| 6 | Social Sciences *** | 2 (2-0) | General Education |
| **TOTAL CREDIT HOURS: 17** | | | |

| SEMESTER 3 | | | |
|---|---|---|---|
| **S.N.** | **Course** | **Credit Hours** | **Category** |
| 1 | Animal Ecology | 3 (2-1) | Major |

| | | | |
|---|---|---|---|
| 2 | Animal Form & Function – I (Comparative Anatomy) | 3 (2-1) | Major |
| 3 | Animal Behavior | 3 (3-0) | Major |
| 4 | Basic Chemistry | 3 (2-1) | Interdisciplinary |
| 5 | Islamic Studies * (Ethics for non-Muslim students) | 2 (2-0) | General Education |
| 6 | Pakistan Studies * | 2 (2-0) | General Education |
| 7 | Arts & Humanities **** | 2 (2-0) | General Education |
| **TOTAL CREDIT HOURS: 18** | | | |

| **SEMESTER 4** | | | |
|---|---|---|---|
| **S.N.** | **Course** | **Credit Hours** | **Category** |
| 1 | Evolution | 3 (3-0) | Major |
| 2 | Animal Form & Function – II (Comparative Physiology) | 3 (2-1) | Major |
| 3 | Entomology | 3 (2-1) | Major |
| 4 | Developmental Biology | 3 (2-1) | Major |
| 5 | Civics & Community Engagement * | 2 (2-0) | General Education |
| 6 | Entrepreneurship * | 2 (2-0) | General Education |
| 7 | Ideology & Constitution of Pakistan * | 2 (2-0) | General Education |
| **TOTAL CREDIT HOURS: 18** | | | |

| **SEMESTER 5** | | | |
|---|---|---|---|
| **S.N.** | **Course** | **Credit Hours** | **Category** |
| 1 | Zoogeography & Paleontology | 3 (2-1) | Major |

| | | | |
|---|---|---|---|
| 2 | Marine Biology | 3 (3-0) | Major |
| 3 | Principles of Systematic Zoology | 3 (2-1) | Major |
| 4 | Principles of Biochemistry | 3 (2-1) | Interdisciplinary |
| 5 | Principles of Genetics | 3 (2-1) | Interdisciplinary |
| 6 | Biostatistics | 3 (2-1) | Interdisciplinary |
| **TOTAL CREDIT HOURS: 18** | | | |

| **SEMESTER 6** | | | |
|---|---|---|---|
| **S.N.** | **Course** | **Credit Hours** | **Category** |
| 1 | Fisheries & Aquaculture | 3 (2-1) | Major |
| 2 | Research Methodologies & Bioethics | 3 (2-1) | Major |
| 3 | Elective – I ***** | 3 | Major |
| 4 | Elective – II ***** | 3 | Major |
| 5 | Molecular Biology | 3 (2-1) | Interdisciplinary |
| **TOTAL CREDIT HOURS: 15** | | | |

| **SEMESTER 7** | | | |
|---|---|---|---|
| **S.N.** | **Course** | **Credit Hours** | **Category** |
| 1 | Wildlife Conservation & Management | 3 (2-1) | Major |
| 2 | Economic Zoology | 3 (3-0) | Major |
| 3 | Elective – III ***** | 3 | Major |
| 4 | Elective – IV ***** | 3 | Major |

| | | | |
|---|---|---|---|
| 5 | Microbiology & Immunology | 3 (2-1) | Interdisciplinary |
| **TOTAL CREDIT HOURS: 15** | | | |

| **SEMESTER 8** | | | |
|---|---|---|---|
| **S.N.** | **Course** | **Credit Hours** | **Category** |
| 1 | Elective – V ***** | 3 | Major |
| 2 | Elective – VI ***** | 3 | Major |
| 3 | Elective – VII ***** | 3 | Major |
| 4 | Computational Biology | 3 (2-1) | Interdisciplinary |
| 5 | Capstone | 3 | Capstone |
| **TOTAL CREDIT HOURS: 15** | | | |

* HEC designed model courses may be adopted and used by the university.

** The university / concerned department may offer any course in the broader category of **"Natural Sciences"** which should have relevance to the purpose of the degree program.

*** The university / concerned department may offer any course in the broader category of **"Social Sciences"** including but not limited to a course of Psychology, Sociology, Anthropology etc.

**** The university / concerned department may offer any course in the broader category of **"Arts & Humanities"** including but not limited to a course of regional or international language such as Chinese, Arabic, French, Spanish etc.

***** Read in conjunction with guidance given on **"Standard Nomenclature"** in this document, the university / concerned department may offer any 7 courses from either the general pool of electives or from within one of the specializations of Zoology keeping in view the available academic, human and infrastructural resources. **Credit combination** may be arranged in accordance with the nature of the course.

## DEGREE AWARD REQUIREMENTS

The following minimum requirements are prescribed for award of Bachelor of Science in Zoology:

**a)** All courses in the General Education category with titles and credit hours as prescribed in the HEC Undergraduate Education Policy V 1.1. including the course of "Pakistan Studies" must be completed.

**b)** Minimum of 137 credit hours as prescribed in this document must be completed.

**c)** Capstone of 3 credit hours must be completed in accordance with HEC Undergraduate Education Policy V 1.1. This requirement cannot be substituted with additional coursework or internship.

**d)** Internship of 3 credit hours must be completed in accordance with HEC Undergraduate Education Policy V 1.1. This requirement cannot be substituted with additional coursework, capstone, research or project work.

**e)** CGPA must not be below 2.00/4.00 at the time of completion of the degree program. The university may however set higher standard in this regard.

**f)** The minimum duration to complete the degree program is 8 regular semesters and the maximum duration is 12 regular semesters. The maximum duration may further be extended in accordance with HEC semester guidelines. Summer semester is not considered as a regular semester.

MAJOR SPECIALIZATIONS

**BACHELOR OF SCIENCE (BS)**

ZOOLOGY

# Specializations (BS)

## MAJOR SPECIALIZATIONS FOR BS ZOOLOGY

Following are a few **example specialization streams** in case where the Bachelor of Science in Zoology is offered with specialization. Subject to approval of the relevant statutory body, the department may develop additional specializations other than those prescribed below. The concerned department may consider to offer the degree program with specialization or otherwise, keeping in view the available academic, human and infrastructural resources.

### Specialization 1: Animal Microbiology

Below is the recommended list of courses within the given specialization. The concerned department may offer any 7 courses from the following list or any other course relevant to the given specialization.

**a)** Antimicrobial Resistance Mechanisms
**b)** Aquatic Microbiology
**c)** Bacterial Genetics
**d)** Bacterial Physiology and Metabolism
**e)** Environmental Microbiology
**f)** Epidemiology
**g)** Food and Dairy Microbiology
**h)** Food Microbiology
**i)** Fundamentals of Microbiology
**j)** Glacial Microbiome
**k)** Immunology and Host Pathogens Interactions
**l)** Industrial Microbiology
**m)** Medical Microbiology
**n)** Microbial Anatomy and Physiology
**o)** Microbial Diversity
**p)** Microbial Enzymology
**q)** Microbial Food Safety
**r)** Microbial Genetics and Biotechnology
**s)** Microbial Genomics and Bioinformatics
**t)** Microbiome of Extreme Environments
**u)** Mycology
**v)** Parasitology and Parasitic Diseases
**w)** Soil Microbiology
**x)** Vaccinology
**y)** Virology and Viral Diseases

### Specialization 2: Animal Physiology

Below is the recommended list of courses within the given specialization. The concerned department may offer any seven (07) courses from the following list or any other course

relevant to the given specialization.

**a)** Behavioral Physiology
**b)** Cardiovascular Physiology
**c)** Clinical Endocrinology
**d)** Clinical Physiology
**e)** Comparative Physiology
**f)** Defense Physiology
**g)** Developmental Physiology
**h)** Digestive Physiology
**i)** Ecological Physiology
**j)** Endocrinology
**k)** Evolutionary Physiology
**l)** Exercise Physiology
**m)** Homeostasis and Osmoregulation
**n)** Hormonal and Muscular Coordination
**o)** Muscle Physiology
**p)** Neurophysiology
**q)** Nutrigenomics
**r)** Pathophysiology
**s)** Physiological Techniques
**t)** Physiology of Aging
**u)** Renal Physiology
**v)** Reproductive Physiology
**w)** Respiratory Physiology and Gaseous Exchange
**x)** Stress Physiology
**y)** Thermoregulation in Animals

### Specialization 3: Biotechnology

Below is the recommended list of courses within the given specialization. The concerned department may offer any 7 courses from the following list or any other course relevant to the given specialization.

**a)** Animal Biotechnology and Transgenics
**b)** Bio-entrepreneurship and Biotechnology Business
**c)** Biomedical Technology and Applications
**d)** Bioremediation and Bioprocessing
**e)** Biotechnology and Animal Health
**f)** Biotechnology in Agriculture
**g)** Biotechnology in Environmental Conservation
**h)** Cell Culture and Tissues Engineering
**i)** Computational Biotechnology
**j)** Ethical Issues in Biotechnology
**k)** Gene Therapy
**l)** Genetic Engineering and Gene Editing

**m)** Genetical Modified Organisms (GMOs)
**n)** Genomics and Proteomics
**o)** Industrial Biotechnology
**p)** Introduction to Animal Biotechnology
**q)** Marine Biotechnology
**r)** Metabolomics and Transcriptomics
**s)** Molecular Biology and Genetics
**t)** Molecular Diagnosis and Forensic Science
**u)** Nanobiotechnology
**v)** Pharmaceutical biotechnology
**w)** Recombinant DNA Technology
**x)** Stem cell Biology and Regenerative Medicine
**y)** Synthetic Biology and Bioengineering

### Specialization 4: Entomology

Below is the recommended list of courses within the given specialization. The concerned department may offer any 7 courses from the following list or any other course relevant to the given specialization.

**a)** Agricultural Entomology
**b)** Apiculture and Bee Biology
**c)** Chemical Ecology of Insects
**d)** Economic Entomology
**e)** Forensic Entomology
**f)** Host-Parasite Interactions in Insects
**g)** Insect Behavior and Communication
**h)** Insect Biochemistry
**i)** Insect Conservation and Biodiversity
**j)** Insect Ecology
**k)** Insect Evolution and Genetics
**l)** Insect Molecular Biology
**m)** Insect Neurobiology
**n)** Insect Physiology
**o)** Insect Population Dynamics
**p)** Insect Systematics and Taxonomy
**q)** Insect Toxicology
**r)** Insecticide Resistance and Management
**s)** Insect-Microbe Interaction
**t)** Insects as Model Organisms
**u)** Insects in Climate Change and Environmental Monitoring
**v)** Integrated Pest Management
**w)** Medical and Veterinary Entomology
**x)** Pollination Biology
**y)** Vector Biology and Public Health

### Specialization 5: Fisheries & Aquaculture

Below is the recommended list of courses within the given specialization. The concerned department may offer any 7 courses from the following list or any other course relevant to the given specialization.

**a)** Applied Fisheries
**b)** Aquaculture Engineering
**c)** Aquaculture Genetics and Selective Breeding
**d)** Aquaculture Policy and Governance
**e)** Aquaponics and Recirculating Systems
**f)** Aquatic Ecology and Limnology
**g)** Aquatic Toxicology
**h)** Climate Change and Fisheries
**i)** Fish Behavior
**j)** Fish Breeding and Physiology
**k)** Fish Diseases and Health Management
**l)** Fish Farm and Hatchery Management
**m)** Fish Genetics and Biotechnology
**n)** Fish Habitat Restoration and Enhancement
**o)** Fish Immunology
**p)** Fish Nutrition and Feeding
**q)** Fisheries Conventions, Regulations and Protocols
**r)** Fisheries Economics and Business Management
**s)** Fisheries Extension and Feasibility
**t)** Ichthyology
**u)** Inland Water Fisheries Management
**v)** Marine and Coastal Aquaculture
**w)** Post Harvest Processing and Value Addition
**x)** Principles and Practices of Aquaculture
**y)** Sustainable Fisheries Resource Management

### Specialization 6: Mammalogy

Below is the recommended list of courses within the given specialization. The concerned department may offer any 7 courses from the following list or any other course relevant to the given specialization.

**a)** Conservation of Mammals
**b)** Disease Ecology in Mammals
**c)** Ecology of Mammals
**d)** Economic Mammalogy
**e)** Evolution of Mammals
**f)** Field Mammalogy
**g)** Livestock Mammals
**h)** Mammalian Adaptations
**i)** Mammalian Anatomy

j) Mammalian Behavior Ecology
k) Mammalian Conservation Biology
l) Mammalian Diseases and Health Management
m) Mammalian Foraging and Feeding Ecology
n) Mammalian Genetics and Biotechnology
o) Mammalian Pest Management
p) Mammalian Physiology
q) Mammalian Reproduction and Development
r) Mammalian Sensory Systems
s) Mammalian Taxonomy and Systematics
t) Mammals Taxidermy
u) Marine Mammalogy
v) Population Cycles and Behavior
w) Primatology
x) Small Mammal Ecology
y) Zoonotic Diseases in Mammals

### Specialization 7: Marine Biology

Below is the recommended list of courses within the given specialization. The concerned department may offer any 7 courses from the following list or any other course relevant to the given specialization.

a) Climate Change and Marine Ecosystems
b) Coastal Ecosystems
c) Coastal Tourism Management
d) Coastal Zone Management
e) Coral Reef Biology
f) Deep Sea Chemosynthetic Ecosystems
g) Mangroves Ecology
h) Mariculture Technologies
i) Marine Animal Behavior
j) Marine Biodiversity and Conservation
k) Marine Biogeography
l) Marine Biotechnology
m) Marine Blue Economy
n) Marine Ecology and Ecosystem
o) Marine Fisheries Management
p) Marine Genetics and Evolution
q) Marine Invertebrate Biology
r) Marine Microbiology
s) Marine Planktology
t) Marine Pollution and Its Impact
u) Marine Resource Economics

v) Marine Vertebrate Biology
w) Oceanography
x) Polar Marine Biology
y) Sea Food Handling, Processing, and Safety

### Specialization 8: Parasitology

Below is the recommended list of courses within the given specialization. The concerned department may offer any 7 courses from the following list or any other course relevant to the given specialization.

a) Applied Parasitology and Control Measures
b) Entomology and Insect borne Diseases
c) Fundamentals of Parasitology
d) Helminthology
e) Host Parasite Interaction
f) Immunology
g) Immunoparasitology
h) Medical Parasitology
i) Molecular Epidemiology of Parasitic Diseases
j) Molecular Parasitology and Genomics
k) Parasite Diversity and Evolution
l) Parasite Drug Resistance
m) Parasite Ecology and Epidemiology
n) Parasite Physiology and Biochemistry
o) Parasite Sytematics and Taxonomy
p) Parasite Vectors Interaction and Disease Transmission
q) Parasitic Diseases in Animals and Human
r) Parasitology and Public Health
s) Parasitology Ecology and Evolutionary Biology
t) Parasitology of Aquatic Organisms
u) Protozoology and Protozoic Diseases
v) Research Methods in Parasitology
w) Tropical Parasitology
x) Veterinary Parasitology
y) Wildlife Parasitology

### Specialization 9: Wildlife Biology

Below is the recommended list of courses within the given specialization. The concerned department may offer any 7 courses from the following list or any other course relevant to the given specialization.

a) Captive Breeding of Wildlife
b) Conservation Biology
c) Conservation Genetics
d) Ecodevelopment Planning and Participatory Management

e) HEndangered Species Management
f) Global Biodiversity and Conservation Policies
g) Habitat Management for Wildlife
h) Human-Wildlife Conflict Management
i) Geographic Information System
j) National Parks, Sanctuaries, and Wildlife Protected Areas
k) Population Management, Capture, and Rehabilitation
l) Sustainable Wildlife Tourism
m) Taxidermy
n) Urban Wildlife Management
o) Wildlife Conservation Techniques
p) Wildlife Diseases and Community Health
q) Wildlife Ecology and Landscaping
r) Wildlife Ethology
s) Wildlife Forensics
t) Wildlife Health Management
u) Wildlife Hunting and Trade
v) Wildlife Law and Policy
w) Wildlife Monitoring and Assessment
x) Wildlife Nutrition
y) Wildlife Population Dynamics

CURRICULUM FOR

# **MASTER OF SCIENCE (MS)**

ZOOLOGY

# MS Zoology

## PROGRAM DESCRIPTION

The Master of Science in Zoology is designed in alignment with the HEC Graduate Education Policy 2023, aiming to provide students with a comprehensive and advanced understanding of animal sciences. The program focuses on deepening students' knowledge of zoological disciplines, including animal physiology, behavior, ecology, and molecular biology, while emphasizing the latest research methodologies and technological advancements in zoological sciences. Through this program, students will be equipped to conduct independent research, addressing complex zoological challenges such as wildlife conservation, evolutionary biology, and environmental sustainability. Advanced elective courses in Zoology are incorporated into the curriculum, allowing students to specialize in emerging areas and tailor their studies to align with career goals. Upon completion, graduates will be well-prepared to contribute to the advancement of zoological sciences and develop innovative solutions to critical challenges related to biodiversity, animal health, and ecological preservation.

## STANDARD NOMENCLATURE

To ensure uniformity, the standard nomenclature of all graduate degree programs (NQF-7) in Zoology must be **"Master of Science in Zoology"**.

## PROGRAM LEARNING OUTCOMES

By the completion of Master of Science in Zoology, the graduates will be able to:

**a)** Critically analyze and synthesize advanced concepts and current research in various fields of Zoology.

**b)** Apply advanced experimental techniques and methodologies to conduct independent research and solve complex problems in Zoological sciences.

**c)** Demonstrate the ability to effectively communicate scientific findings and theoretical concepts in Zoology to both specialized and general audiences.

## ELIGIBILITY & ADMISSION CRITERIA

**a)** An undergraduate degree (involving 16 years of education) in Zoology is the basic eligibility requirement for admission in the Master of Science in Zoology.

**b)** Candidates having undergraduate degrees (involving 16 years of education) in any discipline other than but relevant to the discipline of Zoology are also eligible for admission to the program subject to completion of deficiency courses up-to a maximum of 9 credit hours to be determined by the concerned department in accordance with the provisions of the HEC Graduate Education Policy (2023).

**c)** In addition to the basic eligibility, the admitting university is further required to conduct a rigorous admission test as an eligibility condition for admission to the program, with a passing score of 50% **(OR)** accept the GRE / HAT General / equivalent tests, with a passing score of 50%. The admitting university may also set minimum eligibility scores (above 50%) as per the screening, admission and merit calculation criteria approved by its statutory bodies.

## PROGRAM STRUCTURE

The program of Master of Science in Zoology is designed in accordance with the HEC Graduate Education Policy (2023). Summary of the program including the model scheme of study is given below.

| | |
|---|---|
| **Minimum Credit Hours** | 30 |
| **Minimum Coursework Requirement** | 24 credit hours (8 courses) |
| **Thesis Requirement (mandatory)** | 6 credit hours |
| **Program Duration** | Minimum: 1.5 Years (3 regular semesters)<br>Maximum: 4 Years (8 regular semesters)<br>**Note:**<br>In case a student is unable to secure an MS within the prescribed timeframe and claims for extension in duration, the university may constitute appropriate authority and determine the causes of delay. In the event of force majeure (i.e., delay on account of circumstance beyond the control of student), the university may grant an extension in the period of award of MS degree in accordance with the duration limiting factor(s) and shall also take corrective measures in case the delay is caused by process or administrative reasons. |
| **Semester Duration** | 16-18 weeks for regular semesters<br>(1-2 weeks for examination)<br>8-9 weeks for summer semesters<br>(1 week for examination) |
| **Course Load (per semester)** | 9-12 credit hours for regular semesters<br>Up-to 8 credit hours for summer semesters<br>(for remedial / deficiency / failure / repetition courses only) |
| **3 Credit Hours (Theory)** | 3 classes (1 hour each) **OR**<br>2 classes (1.5 hour each) **OR**<br>1 class (3 hours) per week throughout the semester |
| **1 Credit Hours (Lab / Field Work)** | 1 credit hour in laboratory or practical work requires lab / field contact of 3 hours per week throughout the semester. |

| SEMESTER 1 | | | |
|---|---|---|---|
| **S.N.** | **Course** | **Credit Hours** | **Category** |
| 1 | Advanced Techniques in Zoological Sciences * | 3 (1-2) | Core |
| 2 | Elective – I ** | 3 | Elective |
| 3 | Elective – II ** | 3 | Elective |
| 4 | Elective – III ** | 3 | Elective |
| **TOTAL CREDIT HOURS: 12** | | | |

| SEMESTER 2 | | | |
|---|---|---|---|
| **S.N.** | **Course** | **Credit Hours** | **Category** |
| 1 | Research Design and Biostatistics * | 3 (2-1) | Core |
| 2 | Elective – IV ** | 3 | Elective |
| 3 | Elective – V ** | 3 | Elective |
| 4 | Elective – VI ** | 3 | Elective |
| **TOTAL CREDIT HOURS: 12** | | | |

| SEMESTER 3 | | | |
|---|---|---|---|
| **S.N.** | **Course** | **Credit Hours** | **Category** |
| | Thesis *** | 6 | Research |
| **TOTAL CREDIT HOURS: 6** | | | |

* These are the **mandatory courses** for the program.

** The university / concerned department may offer any advanced course in the field of Zoology as an **elective**, where required as per the available academic, human and infrastructural resources. **Credit combination** (reflecting balance of theory and lab / field work) must be arranged in accordance with the nature of the course.

*** Research work for **thesis** must be conducted by students individually in accordance with the university's policy as approved through its statutory bodies provided that the same is in accordance with the HEC Graduate Education Policy (2023).

## DEGREE AWARD REQUIREMENTS

The following minimum requirements are prescribed for award of Master of Science in Zoology:

**a)** Minimum of 24 credit hours including 6 credit hours for core courses and 18 credit hours for elective courses as prescribed in this document must be completed.

**b)** In addition to coursework of 24 credit hours, research thesis of minimum 6 credit hours must also be completed individually as mandatory requirement of the degree program. Requirement of research work / thesis cannot be substituted with additional course work.

**c)** CGPA must not be below 2.50/4.00 at the time of completion of the degree program. The university may however set higher standard in this regard.

**d)** The minimum duration required to complete the degree is 3 regular semesters which may be extended up to maximum of eight 8 semesters. Summer / winter semester is not considered as a regular semester.

# COURSE LEARNING OUTCOMES

## FOR BS & MS ZOOLOGY

Arranged in Alphabetical Order

# Course Learning Outcomes

**(Arranged in Alphabetical Order)**

## ADVANCED TECHNIQUES IN ZOOLOGICAL SCIENCES

By the end of this course, students will be able to:

- Demonstrate proficiency in using advanced laboratory and field techniques relevant to Zoological research.
- Apply advanced analytical tools and technologies to study animal systems, biodiversity, and ecological interactions.
- Critically evaluate the limitations and applicability of various techniques for addressing complex research questions in Zoology.

## ANIMAL BEHAVIOR

By the end of this course, students will be able to:

- Explain the fundamental principles and mechanisms of animal behavior.
- Analyze the influence of genetics, environment, and learning on animal behavior.
- Evaluate the ecological and evolutionary significance of different behavioral patterns.

## ANIMAL ECOLOGY

By the end of this course, students will be able to:

- Understand the interactions between animals and their environments.
- Analyze population dynamics and community structure within ecosystems.
- Evaluate the impact of environmental changes on animal populations and biodiversity.

## ANIMAL FORM AND FUNCTION – I: COMPARATIVE ANATOMY

By the end of this course, the students will be able to:

- Describe the anatomical structures of various animal groups.
- Compare the functional adaptations of organ systems across different taxa.
- Evaluate the evolutionary significance of anatomical variations for adaptations.

## ANIMAL FORM AND FUNCTION – II: COMPARATIVE PHYSIOLOGY

By the end of this course, the students will be able to:

- Explain the comparative physiological processes in animals.
- Compare physiological adaptations of animals in response to environment.
- Analyze the role of homeostasis in maintaining functional stability in animals.

## BASIC CHEMISTRY

By the end of this course, the students will be able to:

- Understand the fundamental concepts of inorganic and organic chemistry.
- Apply principles of stoichiometry, chemical reactions, and thermodynamics to solve basic chemistry problems.
- Explain the properties of gases, liquids, and solids, and their behavior in various chemical systems.

## BIOSTATISTICS

By the end of this course, the students will be able to:

- Apply statistical methods to analyze biological data.
- Interpret results of statistical analyses in the context of biological research.

- Design experiments and surveys using appropriate statistical techniques.

### CELL BIOLOGY

By the end of this course, the students will be able to:

- Understand the structure, function, and molecular organization of animal cells.
- Explain the mechanisms of cell division and cellular signaling.
- Analyze cellular transport and communication processes.

### COMPUTATIONAL BIOLOGY

By the end of this course, the students will be able to:

- Identify computational tools to solve biological problems and analyze large datasets.
- Use bioinformatics techniques to model and interpret biological processes.
- Evaluate computational approaches for studying molecular and evolutionary biology.

### DEVELOPMENTAL BIOLOGY

By the end of this course, the students will be able to:

- Understand the cellular and molecular mechanisms underlying animal development.
- Describe the stages of embryonic development and differentiation in major animal groups.
- Evaluate the genetic regulation of developmental processes and teratology.

### DIVERSITY OF CHORDATES

By the end of this course, the students will be able to:

- Identify and classify major groups within the phylum Chordata.
- Explain the evolutionary relationships and adaptations of chordates.
- Analyze the ecological roles and physiological characteristics of different chordates.

### DIVERSITY OF INVERTEBRATES

By the end of this course, the students will be able to:

- Identify and describe the diversity of invertebrate phyla.
- Analyze the structural and functional adaptations of invertebrates.
- Evaluate the ecological significance and evolutionary history of invertebrates.

### DIVERSITY OF PLANTS

By the end of this course, the students will be able to:

- Identify and classify major plant groups based on their characteristics.
- Analyze the structural and functional adaptations of plants to different environments.
- Evaluate the ecological roles and evolutionary significance of plant diversity.

### ECONOMIC ZOOLOGY

- By the end of this course, the students will be able to:
- Understand the economic importance of animals in agriculture, industry, and medicine etc.
- Explain the contributions of animal resources to human welfare and the economy.
- Discuss effective utility of animal resources for commercialization and sustainable economic development.

### ENTOMOLOGY

By the end of this course, the students will be able to:

- Identify and classify major insect orders and families.
- Analyze the ecological roles of insects and their interactions with other species.
- Evaluate the ecological, economic, medicinal, and agricultural significance of insects.

### EVOLUTION

By the end of this course, the students will be able to:

- Understand the concept, philosophy and mechanisms of evolution, including natural selection and genetic drift.
- Analyze evolutionary relationships between different animal groups.
- Evaluate the role of evolution in shaping biodiversity, speciation, and adaptation.

### FISHERIES & AQUACULTURE

By the end of this course, the students will be able to:

- Explain the principles of fisheries management and aquaculture practices.
- Analyze the ecological and economic importance of various aquatic species.
- Evaluate sustainable practices in the fisheries and development of aquaculture industry.

### MARINE BIOLOGY

By the end of this course, the students will be able to:

- Understand the ecological processes and physical factors that influence marine ecosystems and organisms.
- Analyze the biodiversity and adaptations of marine life across different habitats, such as coral reefs, open oceans, and deep-sea environments.
- Evaluate the impact of human activities, climate change, and pollution on marine ecosystems and propose conservation strategies.

### MICROBIOLOGY & IMMUNOLOGY

By the end of this course, the students will be able to:

- Explain the structure and function of microorganisms and their interactions with hosts.
- Analyze immune system mechanisms in animals and their role in defense.
- Evaluate the impact of microorganisms on animal health and disease.

### MOLECULAR BIOLOGY

By the end of this course, the students will be able to:

- Understand the molecular basis of gene structure, expression and regulation in animal cells.
- Analyze the structure and function of nucleic acids and proteins.
- Identify molecular techniques used to study biological processes.

### PLANT PHYSIOLOGY & ECOLOGY

By the end of this course, the students will be able to:

- Understand the physiological processes in plants, such as photosynthesis and respiration etc.
- Analyze the interactions of plants with their environment.
- Evaluate the role of plants in ecosystem functioning and ecological stability.

### PRINCIPLES OF BIOCHEMISTRY

By the end of this course, the students will be able to:

- Explain the structure and function of biomolecules in animals.
- Analyze metabolic pathways and their regulation in biological systems.
- Evaluate the role of biochemistry in animal physiology and cellular function.

### PRINCIPLES OF GENETICS

By the end of this course, the students will be able to:

- Understand the principles of heredity and genetic variation in animals.
- Analyze molecular mechanisms of mutations.
- Evaluate the role of genetics in evolution, breeding, and diseases.

### PRINCIPLES OF SYSTEMATIC ZOOLOGY

By the end of this course, the students will be able to:

- Explain the principles and methods of animal classification.
- Analyze the evolutionary relationships among animals using phylogenetic methods.
- Apply systematic approaches to classify and identify animal taxa.

### RESEARCH DESIGN & BIOSTATISTICS

By the end of this course, the students will be able to:

- Understand and apply advanced research methodologies, including experimental design, statistical analysis, and data interpretation in Zoological studies.
- Develop and execute independent research projects, formulating hypotheses, conducting literature reviews, and employing appropriate methodologies.
- Critically evaluate research papers and methodologies, and effectively communicate research findings through scientific writing and presentations.

### RESEARCH METHODOLOGIES & BIOETHICS

By the end of this course, the students will be able to:

- Understand the ethical principles and guidelines governing biological research and experimentation.
- Analyze bioethical issues related to genetics, biotechnology, and animal welfare.
- Apply ethical decision-making frameworks to address ethical dilemmas in scientific research and practice.

### WILDLIFE CONSERVATION & MANAGEMENT

By the end of this course, the students will be able to:

- Explain the principles of wildlife, its conservation and management strategies.
- Analyze the impact of human activities on wildlife populations and ecosystems.
- Evaluate conservation programs and practices for biodiversity protection.

### ZOOGEOGRAPHY & PALEONTOLOGY

By the end of this course, the students will be able to:

- Understand the geographical distribution of animals and its evolutionary significance.
- Analyze the fossil record to understand the history (geological timescale) and evolution of animal life.
- Evaluate the role of geological and climatic changes in shaping animal diversity.

# LABORATORY REQUIREMENTS

## FOR BS & MS ZOOLOGY

List of Essential and Desirable Equipment and Apparatus

# Laboratory Requirements

The following laboratory requirements are required for offering of degree programs in the discipline of Zoology.

## GENERAL LAB

- Microscope (Compound, Sterio & Binocular) (essential)
- Compound Microscope equipped with camera (essential)
- Water Bath (essential)
- Incubators (essential)
- Hygrometer (desirable)
- pH Meter (essential)
- DO meter (essential)
- Weight balance and analytical balance (essential)
- Scale for Body Weight and Height (essential)
- Distillation water plant (essential)
- Spectrophotometer (essential)
- Chemistry analyzer (desirable)
- Autoclave (essential)
- Microtomes (essential)
- Microwave oven (desirable)
- Magnetic Stirrer (essential)
- Hot Plate (essential)
- Refrigerator (essential)
- Dissection Board (essential)
- Hemocytometer (essential)
- Glucometer (essential)
- Hemoglobin meter (desirable)
- Muffle furnace (desirable)
- Kjeldahl apparatus (desirable)
- Microcentrifuge (desirable)
- Thermometer (essential)
- Laminar flow cabinet (desirable)
- Fume hood (essential)
- Nitrogen incubator (desirable)
- Cryopreservation box (desirable)
- Liquid nitrogen cylinder (desirable)
- Micro pipets (essential)
- Freezer (-80) (desirable)
- Deep freezer (essential)
- Quadrates grids (desirable)
- BOD meter (essential)
- Multiparameter (desirable)

- Plankton net (essential)
- Insect Mesh (essential)
- Measuring tapes and calipers (desirable)
- Video camera and maze boxes (desirable)
- Glassware (Conical flasks and Burets etc.) (desirable)
- Water testing kit (desirable)
- Baermann funnel (desirable)
- BP Apparatus (essential)
- Multimedia (essential)
- Temperature probes (essential)
- Viscometer (desirable)
- Analgesia meters (essential)
- Kymogram (essential)
- Shaker (essential)
- Biosafety kits (essential)
- First aid box (essential)
- Insect growth chamber (desirable)
- Aspirator (desirable)
- Respirometer (essential)
- Relevant glassware, plasticware, chemicals, and disposables (essential)

## ANALYTICAL LAB

- PCR machine (essential)
- Gel electrophoresis (horizontal and Vertical), power supply (essential)
- Gel documentation system / UV transilluminator (essential)
- Viscometer (desirable)
- Condenser (desirable)
- Extraction device (desirable)
- Polarimeter (desirable)
- Desiccator (desirable)
- Rotary evaporator (desirable)
- Tissue homogenizer (desirable)
- Chemical analyzer (desirable)
- Coloney counter (desirable)
- Ice box (essential)
- Distillation water plant (essential)
- Spectrophotometer (essential)
- Chemistry analyzer (desirable)
- Elisa (desirable)
- Autoclave (essential)
- Refrigerator (essential)
- Water Baths (essential)
- Shaker (essential)

- Incubator (essential)
- Dry Bath (essential)
- Vortex (essential)
- Microcentrifuge (essential)
- Centrifuge (essential)
- Shaking Incubator (essential)
- Calorimeter (desirable)
- Relevant glassware, plasticware, chemicals, and disposables (essential)

## FIELD LAB

- Drones and recording devices (desirable)
- GPS tracking devices (essential)
- Tags, tagging devices, and collars (essential)
- Tranquilizer devices (desirable)
- Insect boxes (essential)
- Collecting nets (essential)
- Apiculture box (essential)
- Fishing nets (essential)
- Water quality parameters kit (essential)
- Video cameras (essential)
- Binocular (essential)
- Multiparameter / portable meters (desirable)
- Ice chests (desirable)
- Handling packs (desirable)
- Mist nets (desirable)
- Chest waders (desirable)
- Insects collecting kits
- Plankton nets (desirable)
- Sacchi disc (essential)
- Malaise traps / light traps (desirable)
- Field safety kits (essential)
- First aid box (essential)
- Capture camera (essential)
- Insect stretching boards (desirable)
- Snap traps (desirable)

## MUSEUM / ANIMAL HOUSE / FARMS

- Preserved animals (essential)
- Prepared slides (essential)
- Preserved local fauna (essential)
- Taxonomic keys (essential)
- Insect cabinets (desirable)
- Wildlife cages (desirable)

- Fossils (desirable)
- Growth chambers (desirable)
- Fishponds / bio-floc tank (desirable)
- Aquaria (desirable)
- Animal models (essential)
- Animal Skeletons (essential)
- Aviary and birdhouses (desirable)
- Rodents boxes (desirable)
- Traps (essential)
- Taxidermy Kits (essential)
- Animal Houses / mini zoo (desirable)
- Relevant glassware, plasticware, chemicals, and disposables (essential)

A COLLABORATIVE VENTURE OF
**HIGHER EDUCATION COMMISSION & PAKISTAN ACADEMY OF SCIENCES**
GOVERNMENT OF PAKISTAN