Dr. Bhimrao Ambedkar University, Agra

A State University of Uttar Pradesh (Paliwal Park, Agra -282004)

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A Documentary Support

for

Matric No. – 1.1.1

Programme Outcomes & Course Outcomes

under the

Criteria – I

(Curriculum Design and Development)

Key Indicator - 1.1

in

Matric No. – 1.1.1

MASTER OF SCIENCE (ZOOLOGY)

1988

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Dr. B.R.A. University, Agra

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DR. BHIM RAO AMBEDKAR UNIVERSITY, AGRA

SCHOOL OF LIFE SCIENCES

Master in Faculty

Semester Wise Syllabus for M.Sc. Zoology

DEPARTMENT OF ZOOLOGY

SUBJECT: ZOOLOGY

FACULTY OF LIFE SCIENCE

SYLLABUS FOR CORE/ELECTIVE COURSES

(Based on Choice Based Credit System)

REVISED COURSES AND SYLLABUS
M.SC. ZOOLOGY
Faculty of Life Science
BASED ON CHOICE BASED CREDIT SYSTEM (CBCS)
Department Of Zoology
School of Life Science, Dr. Bhimrao Ambedkar University, Agra
UNDER NEP -2020

Courses	M Sc Zoology I Semester	Max Marks		Total Marks	Credits	Type of Courses
	Course Titles	CIE	End Semester Examination			
MZ-C101	Biosystematics and Invertebrates	25	75	100	4	GC
MZ-C102	Molecular and Cell Biology	25	75	100	4	GC, EC
MZ-C103	Biological Techniques and Instrumentation	25	75	100	4	GC,EC, EPC
MZ-C104	Microbiology and Immunology	25	75	100	4	GC,EC. SDC
	Minor	25	75	100	4	GC,EC
MZ-C105	Practical		100	100	4	GC, SDC
	Research Project /Survey/Industrial Training					
	Total Marks End Semester Examination			**600**	**24**	
	M Sc Zoology II Semester					
MZ-C201	Chordates and Evolutionary Biology	25	75	100	4	GC
MZ-C202	Genetics and Biotechnology	25	75	100	4	GC,EC
MZ-C203	Animal Physiology	25	75	100	4	GC
MZ-C204	Biostatistics and Computer Application	25	75	100	4	GC EC, EPC
MZ-C205	Practical		100	100	4	GC SDC
MZ-C206	Research Project/Survey/Industrial Training		200	200	8	GC SDC
	Total Marks End Semester Examination			**700**	**28**	
	M Sc Zoology III Semester					
MZ-C301	Developmental Biology	25	75	100	4	GC
MZ-C302	Animal Behaviour	25	75	100	4	GC
MZ-C303	Environmental Pollution, Health and Education	25	75	100	4	GC, EC
MZ-E304	Systematics and Morphology of Fishes	25	75	100	4	GC
MZ-E305	Wild Life Ecology					GC,EC
MZ-C306	Practical		100	100	4	GC, SDC
	Research Project /Survey/Industrial Training					
	Total Marks End Semester Examination			**600**	**20**	
	M Sc Zoology IV Semester					
MZ-C401	Biological Chemistry	25	75	100	4	GC,EC
MZ-C402	Cell and Molecular Toxicology	25	75	100	4	GC,EC
MZ-E403	Physiology and Embryology of Fishes	25	75	100	4	GC
MZ-E404	Wildlife Biodiversity and Conservation					GC,EC
MZ-E405	Aquaculture and Fisheries	25	75	100	4	GC,EPC
MZ-E406	Environmental Physiology					
MZ-C407	Practical		100	100	4	GC, SDC
MZ-C408	Research Project/Survey/Industrial Training		200	200	8	GC, SDC
	Total Marks End Semester Examination			**700**	**28**	
	Grand Total Marks and Credits (I, II, III & IV Semesters)			**2500**	**100**	

Note: **The I and II semesters of the first year of the M. Sc. Zoology in Faculty of Life Science Programme will be Known as VII and VIII semester of The B. Sc. Research in Faculty of Life Science.* Courses Code having 'C' abbreviation is Core course and having 'E' abbreviation is Elective course.* No. Of Total Courses - 27, *EC: Employability Courses, *EPC: Entrepreneurship Courses, *SDC: Skill Development Courses,* GC: Global Course**

POST-GRADUATE PROGRAM OUTCOMES

At the end of Post Graduate Program, a student would have:

PO1: Attained profound Expertise in Discipline.

PO2: Acquired ability to function in multidisciplinary Domains.

PO3: Attained ability to exercise Research Intelligence in investigations and Innovations.

PO4: Learnt Ethical Principles and be committed to Professional Ethics.

PO5: Obtained Ability to maneuver in diverse contexts with Global Perspective.

PROGRAMME SPECIFIC OUTCOMES

PSO1: Understand the Basics of Biosystematics and Invertebrates, Chordates, Developmental Biology, Animal Behaviour, Health and Hygiene.

PSO2: Apply the advanced principles and techniques of Molecular and Cell Biology, Biological Techniques and Instrumentation, Microbiology and Immunology, Genetics and Biotechnology, Animal Physiology, Biostatistics and Computer application, Biological Chemistry, Cell and Molecular Toxicology, Clinical Haematology.

PSO3: Evaluate the mechanisms of Evolutionary Biology, Environmental Pollution, Health, and Education, Environmental Physiology, Wild Life Ecology, Wildlife Biodiversity and Conservation, Systematics and Morphology of Fishes, Physiology and Embryology of Fishes for the betterment of the natural and human world.

PSO4: Analyze biological and non-biological samples using experimental techniques

PSO5: Create new knowledge using ethical biological research for the betterment of the natural and human world

M. Sc. Zoology I Semester
Course-MZ-C101: Biosystematics and Invertebrates
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives:

- To help students to know the importance of the invention of living animals.
- To make students acquainted with basic principles and procedures of describing taxa.
- To make students understand different levels of biological diversity through the systematic classification of invertebrate.

UNIT – I **15 Hrs**

1. **Definition of basic concept of biosystematics and taxonomy:** Historical resume of systematic, importance and application of biosystematics and material basis of biosystematics.
2. **Trends in biosystematics:** Concepts of different conventional and newer aspects of chemotaxonomy, cytotaxonomy and molecular taxonomy**.**
3. **Procedure keys in taxonomy:** Taxonomy collections, preservations and curetting process of identification, different kinds of taxonomy keys their merit and demerits and International code for Zoological Nomenclature.

UNIT – II **15 Hrs**

1. **Feeding Mechanism:** Filter feeding, Parasitic mode of feeding.
2. **Excretion:** Structural and functional organization of excretory systems in various invertebrates and survey of various excretory products met within them.
3. **Receptors:** Structural and functional organization of the mechano receptors, chemoreceptor's and photoreceptors.

UNIT – III **15 Hrs**

1. **Organization of Coelom:** Acoelmates, Pseudocoelomates and Coelomates.
2. **Respiration:** Structural and Functional organization of Respiratory organs and mechanism in Invertebrates.
3. **Minor Phyla:** Concept, Characteristics and Affinities of Rotifera and Hemichordata.

UNIT – IV **15Hrs**

1. **Reproduction:** Reproduction in Invertebrates.
2. Larval forms of Crustacea Echinodermata and Helminthes.
3. Ploymorphism in Coelentrate, Torsion in Gastropoda.

Suggested Reading:

1. Structure and Function of Invertebrates by Barrington
2. Invertebrates by Barns
3. Invertebrate Series by Hyman

Course Outcomes:

On the successful completion of the course, students would be able to-

CO1: Understand different levels of biological diversity through systematic classification and familiarize taxa-level identification of animals.

CO2: Describe the process of feeding and excretion in invertebrates. Impart knowledge of parasitic forms of lower invertebrates.

CO3: Discuss the mechanism of respiration in invertebrates and the concepts, characters, and affinities of Hemichordates.

CO4: Explain the reproduction mechanism in invertebrates and describe various larval forms in crustacea.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	-	1	2	3	-	-	1	1
CO2	3	-	1	1	2	3	-	-	1	1
CO3	3	-	1	1	2	3	-	-	1	1
CO4	3	-	1	1	2	3	-	-	1	

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability Course

M. Sc. Zoology I Semester
Course-MZ-C102: Molecular and Cell Biology
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives:

Part-A Molecular Biology:

- To understand genome organization in lower and higher organisms.
- To understand replication, mutation, and repair events in both Prokaryotic and eukaryotic organisms.
- To understand the central dogma of life and gene flow.
- To know gene regulation.

Part-B Cell Biology:

- This course will provide knowledge about the complex organization in the eukaryotic cell and the molecular mechanisms of the cellular processes that exist in all cell types.
- The course will also focus on cellular-origin diseases.

UNIT: I **15Hrs**

1. Structure of DNA and Types of DNA
2. **Replication of DNA**: Semi-conservative replication of DNA; DNA replication in Prokaryotes and Eukaryotes, DNA damage, DNA repair
3. Nucleosome and structure of chromatin.

UNIT – II **15Hrs**

1. Three-dimensional structure of t-RNA, Clover Leaf model, L type model.
2. Transcription Mechanism Prokaryotes and Eukaryotes
3. Regulation of gene expression: Prokaryotie organism: Lac operon, Trp operon

UNIT – III **15Hrs**

1. Modern concepts of the structure and functions of biomembranes
2. Structural and functional Organization of Cell Organelles (Mitochondrial, lysosomes, Golgi apparatus, and Endoplasmic reticulum)
3. Nuclear membrane, interphase nucleus, different types of chromosomes,

UNIT – IV **15Hrs**

1. Cellular differentiation and cell cycle
2. Role of Ribosomes in protein synthesis, Operon model.
3. Cellular origin of diseases: Cancer, Glycogen storage diseases, Lipid storage diseases, inborn error of metabolism Phenylketonuria, galactosaemia,
4. Thalassemia, and sickle cell anaemia.

Suggested Reading:

1. Molecular Cell Biology, Lodish et al. Scientific American Books (1995)
2. Principles of cell and Molecular Biology, Kleinsmith LJ & Kish VM, Harper Collins College Publishers (1995).
3. Cell and Molecular Biology, Karp G, John Wiley and Sons. (1999).
4. Molecular Biology, Friedfelder D, Jones and Bartlett Publication, (1998).
5. Molecular Biology of Cell, Alberts B *et al.* Garland Publishers, (2001)

Course Outcomes:

On the successful completion of the course, students would be able to-

CO1: Understand the synthesis, structure, and function of nucleic acid and replication in prokaryotes and eukaryotes also Describe the process of DNA repair and chemistry of nucleosome and its arrangement in the chromosome.

CO2: Explain the transcription mechanism and gene regulation.

CO3: Be able to understand how the cell functions as a unit of life with the help of bio membrane and endomembrane system study. Also describe the chromosome types structure and nomenclature.

CO4: Explain cell cycle, protein synthesis mechanism and different cellular origin diseases.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3	-	3	-	2	2
CO2	3	3	2	1	3	-	3	-	2	2
CO3	3	3	2	2	3	-	3	-	1	1
CO4	3	3	2	2	3	-	3	-	2	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability, Entrepreneurship and Skill Development course

M. Sc. Zoology I Semester
Course-MZ-C103: Biological Techniques and Instrumentation
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives:

- To understand the biological techniques.
- Develop scientific-technical expertise, culture, and work habits.
- Familiarize with the basic tools and techniques of scientific study, emphasizing biological sciences.
- Develop a basic understanding of the equipment's usage.
- To understand analytical techniques and equipment used in biological sciences.
- To understand the basic principle and applications of microscopy and centrifugation.
- To acquire knowledge of the Chromatographic and electrophoretic method for the separation of biological molecules.

UNIT-I **15Hrs**

1. **Fixation:** principle and chemical bases of fixation by formaldehyde, gluteraldehyde, chromium salts, mercury salts tetra oxide, alcohol and acetones, freeze drying and freeze substitution techniques.
2. Embedding, block making and sectioning.
3. **Chemical basis of staining**: Pas, metachromasis, Feulgen, lipid and protein staining.

UNIT-II **15Hrs**

1. Measurement of cell size
2. **Biochemical Methods:** Carbohydrates, Lipids and Proteins
3. **Haematological methods:** Total Leucocyte Count, Taotal erythrocytes Count, Differential Leucocyte count, Hb Concentration, PCV, ESR and Res cell indices

UNIT- III **15Hrs**

1. Various types of microscopes, phase contrast, interference, fluorescence, polarized microscope, transmission and scanning microscope.
2. Centrifugation types and their applications
3. Electrophoresis types and their applications

UNIT – IV **15Hrs**

1. Chromatography types and their applications
2. Autoradiography types and their applications
3. X-ray diffraction types and their applications

Suggested Reading:

1. Principles and Techniques in biochemistry and molecular biology - Wilson & Walkes
2. Techniques in microscopy and cell Viology, Tata-Mc Craw Hil.
3. Robert Braun Introduction to instrumental analysis - Mc.Crew.Hil
4. Bisen & Mathw. Tools and Techniques in Life Sciences,- CBS Publishers & distributors.

Course Outcomes:

On the successful completion of the course, students would be able to-

CO1: Demonstrate a general understanding of the Fixation, embedding and staining techniques in biological research.

CO2: Describe different biochemical and haematological methods in the field of biological sciences.

CO3: Acquaint knowledge of microscopy, centrifugation and electrophoresis techniques.

CO4: Get proficiency in chromatography, autoradiography and X-ray diffraction techniques

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3	-	3	-	2	2
CO2	3	3	2	1	3	-	3	-	2	2
CO3	3	3	2	2	3	-	3	-	1	1
CO4	3	3	2	2	3	-	3	-	2	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability Course

M. Sc. Zoology I Semester
Course-MZ-C104: Microbiology and Immunology
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives:

Part-A Microbiology:

- To study the basics of Microbiology.
- To understand the Microbial Taxonomy.
- To study the different types of Microbial diseases.
- To understand the concept of Microorganism as a component of the environment.
- To acquaint students with basic concepts of microbial diversity and how the microbe concept emerged.

Part-2 Immunology:

- To understand cells and organs of Immunology.
- To study the basics of antigen, antibody and MHC molecules.
- To study clinical immunology with respect to various diseases.

UNIT- I **15Hrs**

1. **History and scope of Microbiology:** Recognition of the microbial role of diseases, Microbial effects on organic & inorganic matter, the composition of microbial world and the scope and relevance of microbiology.
2. **Virus:** Concepts, general properties, cultivation, purification Assay, structure and structural properties.
3. **Microbial Taxonomy:** Morphological, Physiological, Metabolic ecological and molecular characteristics. Aerobic and Anaerobic motile and non-motile gram negative and gram positive bacteria.

UNIT – II **15Hrs**

1. **Nature of symbiotic microbial association:** Types of symbiosis, functions commensalism, mutualism, distribution microbiota of human body, Host parasite relationship.
2. **Microbial Diseases:** Viral air born, Direct contact, Food born and Water born diseases, Bacterial air born direct contact, Food born and Water born disease, Fungi and Protozoan diseases.
3. **Microorganism as components of environment:** Microorganism and the structure of natural environment, physiological state of microorganisms in environment, Soil microorganism, Aquatic microorganism community. symbio

UNIT – III **15Hrs**

1. Basic concepts of immunity, Types of immunity, Phagocytosis, Inflammation.
2. Cells and molecules of the immune system, functions of immune response, antibody production and their function.
3. The adaptive immune response- T cell immunity, properties, cytotoxicity, Antibody production by B lymphocyte.

UNIT-IV **15Hrs**

1. Deficiency of immune system, autoimmune diseases, allergy and hypersensitivity.
2. Structure of antibody molecule and immunoglobulin genes.
3. Interaction of antibody molecules with specific antigens, antigen recognition by T lymphocyte.

Suggested Reading:

1. Microbiology by Presscott
2. Immunology by Kuby

Course Learning Outcomes:

On the successful completion of the course, students would be able to-

CO1: Explain the history and scope of Microbiology. Also, able to describe concept, properties and assay of viruses. Understand the taxonomy (identification, binomial nomenclature, and Classification schemes/keys) and comprehend the various approaches of microbial taxonomy.

CO2: Describe the nature of symbiotic microbial association and microbial diseases. Explain the relative concept of Micro-organism and Environment.

CO3: The students will be able to identify the cellular and molecular basis of immune responsiveness and understand how the innate and adaptive immune responses coordinate to fight invading pathogens.

CO4: Explain the structure of immunoglobulins. Understand the immunomodulatory strategies essential for generating or suppressing immune responses as required in hypersensitivity reactions, autoimmune diseases, and cancer.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	1	1	2	-	3	-	-	1
CO2	3	2	2	2	3	-	3	-	2	2
CO3	3	3	3	2	3	-	3	-	3	3
CO4	3	3	3	2	3	-	3	-	3	3

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Skill Development Course

M. Sc. Zoology I Semester
Course-MZ-C105: Practical
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives:

- To identify the museum specimen.
- To perform different cell and molecular exercises.
- To better understand the mitosis and different stages of mitotic processes.
- To better understand the relative length of each stage of mitosis.
- To understand the methods involved in different biochemical and hematological experiments.

1. Identification and Comments of Museum Specimens and Slides
2. Identification of Zooplanktons
3. Preparation of permanent slides of Invertebrates
4. Cell and molecular exercises
5. Identification and comments on microbiological slides
6. Measurement of Cell size
7. Identification and comments of different chromosomes
8. Preparation of temporary slides of chromosomes
9. Preparation temporary Slides of different stages of cell division
10. Identification and principle of different instruments
11. Write down the methods of different biochemical and haematological methods

Course Outcomes:

On the successful completion of the course, students would be able to-

CO1: Understand the knowledge of invertebrates and be able to gain knowledge about microbiological slides.

CO2: Gain knowledge about the techniques and experiments that contributed to understanding molecular mechanisms of cellular processes.

CO3: Identify and understand the principle of bioinstrumentation.

CO4: Explain different methods of biochemical and hematological experiments.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	1	1	1	-	3	3
CO2	3	3	3	2	2	-	1	-	3	3
CO3	3	3	3	2	2	-	1	-	3	3
CO4	3	3	3	2	2	-	1	-	3	3

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3 % =3

Employability Course

M. Sc. Zoology I Semester
Course- Minor/ Elective- Health and Hygiene
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives:

- To provide an interdisciplinary understanding of public health issues with a more detailed understanding of the areas pertaining to biological science.
- To make the student aware of the essentials of public health and sanitation thereby warding off diseases and uplifting the living standards of the community.
- To learn the principles of nutrition.
- To understand the ill effects of modern lifestyle.
- To study the advantages of being hygienic.
- The specific objectives of the course are to provide a basic understanding of the scope of public health issues, particularly related to policies on public health, public health nutrition, infectious biology and sanitation, social and preventive medicine, and the environmental issues that affect public health.

Unit-I **15Hrs**

1. Public and community health- Introductory idea, definition, and Objectives of public and Community health.
2. Daily nutritional requirements and Nutritional deficiencies.

Unit-II **15Hrs**

1. Environmental and personal hygiene- Introduction, Importance, and components
2. Health laws for food safety and hygiene

Unit-III **15Hrs**

1. Food poisoning and toxins- Types and symptoms
2. Treatment of food poisoning and food toxins

Unit-IV **15Hrs**

1. Health effects of pan masala, supari, ganja, alcohol, smoking, tea and coffee
2. Side effects of junk food and soft drinks

Suggested readings:

1. Elements of hygiene and public health by Rai Bahadur Jaising, P. Modi , Elsevier
2. Introduction to public health by Mary - Jane Schneider , Jones and Barlette learning
3. Fundamental food microbiology by A. Ray and A. Bhunia , CR

Course Outcomes:

On the successful completion of the course, students would be able to-

CO1: Students will get a holistic overview of the interdisciplinary nature of Public health and Understand the concepts of public health nutrition. Also, Explain the importance of food and nutrition in public health by Assessing nutritional status of community and developing necessary intervention.

CO2: Explain the importance and components of environmental and personal hygiene. Also, describe the law for food safety and hygiene.

CO3: Describe the different types, symptoms and treatment of food poisoning and toxins.

CO4: Explain the effects of pan masala, smoking drinking, etc, and the side effects of junk food and soft drinks on health.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	1	3	-	-	1	2
CO2	3	3	2	2	2	3	-	-	2	2
CO3	3	3	2	2	2	3	-	-	2	2
CO4	3	3	2	2	2	3	-	-	2	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability Course

M. Sc. Zoology I Semester
Course- Minor/ Elective- Clinical Haematology
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives:

- The lectures of this course are describing the basic concepts of hematology with principles of blood testing.
- The course includes a definition of the science of haematology, hematopoiesis, blood components and function etc. In addition, the manual automation in hematology and common pathological blood disorders will also be covered.
- Let the students understand human blood and its disorders based on a piece of up-to-date knowledge and in a simple way.
- Familiarize students with the pathophysiological background of main blood disorders.

UNIT-I **15Hrs**

1. Introduction to haematology
2. Origin and development of blood
3. Components of blood and their functions

UNIT-II **15Hrs**

1. Basic needs of clinical laboratory
2. Specimen collection 3.
3. Formation of blood smear
4. Morphologic examination of blood cells

UNIT-III **15Hrs**

1. Clotting time , Bleeding time
2. Haemoglobin concentration , PCV , ESR
3. Total RBC count , Total leucocyte count , Differential leucocyte count
4. Red cell indices- MCV , MCH , MCHC

UNIT – IV **15Hrs**

1. Clinical significance of routine haematological tests
2. Blood related diseases
3. Blood groups

Suggested reading :

1. Penington *et al*., Clinical Haematology in Medical Practice. Eng. Language Book Society & Cell Scientific Publication, London.
2. Wintrobe, M.M. *et al*. Clinical Haematology, K.M. Varchese Co., Bombay.

3. Mukherjee, K.L., Medical Laboratory Techniques (A procedure Manual for Routine Diagnostic Tests) Vol. 1-111 Tata McGraw Hill publishing company Ltd. , New Delhi teghe Carlour UNIT - III Routine haematologic tests.

Course Outcomes:

On the successful completion of the course, students would be able to-

CO1: Understand the principles of hematology and explain the origin, components, development, and functions of blood.
CO2: Explain the basic need of clinical laboratory for formation of blood smear and morphologic information of blood cells.

CO3: Describe different methods of haematological techniques.

CO4: Explain the clinical significance of haematological tests and able to describe different Blood related diseases and Blood groups.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	2	-	2	-	3	3
CO2	3	3	3	2	2	-	2	-	3	3
CO3	3	3	3	2	2	-	2	-	3	3
CO4	3	3	3	2	2	-	2	-	3	3

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M. Sc. Zoology II Semester
Course-MZ-C201: Chordates and Evolutionary Biology
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives:

Part-A Chordates

- To understand what the chordates are.
- To understand different categories of chordates.
- To understand the general characters of chordates.
- To understand the level of organization in chordate subphylum.
- To understand the origin and evolutionary relationship in different subphylum of chordates.

Part-B Evolutionary Biology

- To know who Charles Darwin was, and how two of his simple observations led to the development of the theory of evolution by natural selection.
- To be able to clearly define evolution.
- To understand how the link between environment and evolution.
- To understand how we can determine whether or not a population is evolving for a specific character.
- To be familiar with the different agents of evolution.
- To understand how one species may diverge into two species.
- To comprehend why genetic isolation is an essential part of speciation.

UNIT-I **15Hrs**

1. Outline classification of various classes of chordates
2. General organization and affinities of Cephalochordata and Cyclostomata
3. General organization and affinities of Holocephali and Dipnoi

UNIT- II **15Hrs**

1. Adaptation and parental care in Ambhibia.
2. Characters and affinities of Ratitiae, palate in birds and Mirgration in birds
3. Characters and affinities of Prototheria and Matatheria

Unit- III **15Hrs**

1. Modern concept of Natural Selection; characteristics of evolution; extinction, replacement irreversibility of specialization.
2. Genetic and quantitative aspects of evolution; population as unit of evolution gene frequency, gene pool, evolution result of gene frequency, genetic equilibrium and Hardy- Weinberg law.
3. Genetic drift (Sewal Wright effect).

UNIT-IV **15Hrs**

1. Speciation- Definition of species, sub-species and races, speciation a gradual or a sudden process.

2. Isolation mechanism- Geographical, ecological, physiological, biochemical, anatomical, developmental, behavioural, psychological and social.
3. Effects of isolation- Restrictions of random disperse and random mating, character displacement, reduction of fertility.

Suggested Reading:

1. Biology of Animals-Cleveland P. Hickman JR Larryds. Roberts.
2. Evolution by Monroe W Strickberger
3. Evolution by Dobzhansky, Ayala, Stebbins, Valentine

Course Outcomes:

On the successful completion of the course, students would be able to-

CO1: Student should be able to describe the classification of chordates and general organization and affinities of Cephalochordata, Cyclostomata Holocephali and Dipnoi.

CO2: Explain the adaptation and parental care in Amphibia also able to describe the characters and affinities of Ratitiae, Prototheria, and Matatheria. Describe palate and migration in birds.

CO3: Explain important processes, principles, and concepts and critically evaluate theories and empirical research within evolutionary biology. Also, able to describe Hardy-Weinberg Law.

CO4: Describe different evolutionary processes.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	1	2	2	3	-	-	1	1
CO2	3	1	1	2	2	3	-	-	1	1
CO3	3	2	2	2	2	-	-	3	2	2
CO4	3	2	2	2	2	-	-	3	2	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability Course

M. Sc. Zoology II Semester
Course-MZ-C202: Genetics and Biotechnology
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives

Part-1 Genetics

- To understand how inheritance patterns are affected by position on chromosomes.
- To understand gene interactions and multiple alleles.
- Be able to distinguish between maternal effect, sex-linked, and cytoplasmic modes of inheritance.
- To study mutation.
- To understand Bacterial Genetics

Part-2 Biotechnology

- To develop an understanding of current techniques used in biotechnology and their applications.
- To understand Recombinant DNA techniques and DNA Fingerprinting.
- To understand basic cell culture and preservation techniques
- To understand the applications of Animal cell culture.

UNIT-I **15Hrs**

1. Interaction of genes Complementary, supplementary, epitasis, duplicate and inhibitory actions, polygenes, pleiotropy and penetrance.
2. Allelism: Pseudoulleles, (ABO, Rh and Mn types of blood groups and their genetics).
3. Cytoplasmic inheritance and maternal effects.

UNIT-II **15Hrs**

1. Mutation and mutagenic agents: Classification of mutations, translocation, inversion, deletion, duplication and gene mutation.
2. Genetic mapping, three point test- Interference. Coincidence.
3. Bacterial genetics: Bacterial mutation, conjugation and transduction. Sex linked inheritance.

UNIT-III **15Hrs**

1. Hybridization Technology
2. Primary & Established cell line culture and Culture Media
3. Applications of Animal Cell Cultures

UNIT-IV **15Hrs**

1. DNA recombination and expression in bacterial cell
2. DNA finger printing
3. Application of Biotechnology in industry.

Suggested Reading:

1. Principles of Genetics, Gardner EJ and Sunstad DP, John Wiley and Sons, (2000).
2. Genetics, Strickburger MW, Macmillan Pub. Co., (1994).
3. Human Molecular Genetics, Strachan T and Read AP, Garland Science, (2004).

Course Outcomes:

On the successful completion of the course, students would be able to-

CO1: Students can correlate phenotype with genotype, understand genetic interaction Multiple allelism, cytoplasmic interaction and maternal effects. Students will be able to set hands on genetic crosses to understand recessive and dominant, segregation, pattern of inheritance and finally evaluating statistical significance by counting the progeny as statistical analysis provides crucial. insight into many biological processes.

CO2: Describe mutation and Genetic mapping also able to explain the concept of bacterial genetics.

CO3: Acquaint fundamentals of Animal cell culture. Utilize skills of cell culture for the development of biomolecules of clinical importance

CO4: Students will understand the importance of Recombinant DNA techniques and DNA fingerprinting and be able to explain the application of Biotechnology in industry.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3	-	3	-	2	2
CO2	3	3	2	1	3	-	3	-	2	2
CO3	3	3	3	2	3	-	3	-	3	3
CO4	3	3	2	2	3	-	3	-	2	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M. Sc. Zoology II Semester
Course-MZ-C203: Animal Physiology
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives:

- The major aims of this course are to provide students with a basic understanding of the fundamental processes and mechanisms that serve and control the various functions of the body.
- It should be noted that, although introductory, this course in Human Physiology is comprehensive in scope. Areas treated in detail include both relatively simple cellular mechanisms as well as more complex interactions between whole organ systems.
- The major areas of study include digestion, absorption, muscle, blood, the cardiovascular system, excretion, reproduction, and neurophysiology. primary literature to develop the ability to think critically about issues in animal physiology and write about those in an effective manner.

UNIT-I **15Hrs**

1. Role of digestive glands and regulation of their activities, Digestion and absorption of carbohydrates, Lipids, Proteins,
2. Water and electrolyte absorption, Symbiotic digestion, Vitamins.
3. Body fluids and compartments of intracellular and extracellular fluids.

UNIT-II **15Hrs**

1. Physiology of RBCS and WBCS and their functions, Blood group, Blood clotting, Blood vascular system, Cardiac cycle and its regulation.
2. Mechanism of urine formation in a mammal, Acid base balance and regulation of kidney function, Osmoregulation.
3. Physiology of respiration and transport of gases and respiratory pigments

UNIT-III **15Hrs**

1. Physiology of Pituitary, Thyroid, Parathyroid, Adrenal glands, Pancras and their functions.
2. Types of muscles, Ultra structure of skeletal muscle mechanism, Skeletal muscle contraction tetanus, and fatigue and summation
3. Effect of sympathetic and parasympathetic activity on autonomic effectors, Central nervous system regulation, spinal reflex arc

UNIT-IV **15Hrs**

1. Integrated functions of hypothalamus, limbic system
2. Hypothalamic control of pituitary activity and phenomenon of neurosecretion
3. Physiology of reproductive hormones and their functions

Suggested Reading:

1. G. Giese: "Cell Physiology" (3rd Ed) Saunders, Toppan
2. C. A. Keil, E. Neil & E.N. Joeb (1982): "Samson Wright, Applied Physiology" Oxford Univ. Press.
3. R. Eckert & D. Randall (1982): "Animal Physiology: 2nd Ed." W. H. Freeman & Co.
4. W. A. Hoar (1982): "General& Comparative Animal Physiology 3rd Ed." Prentice Hall Inc.
5. C. L. Prosser (1973): "Comparative Animal Physiology" W. B. Saunders.

Course Outcomes:

On the successful completion of the course, students would be able to

CO1: Explain the molecular and cellular basis of physiological functions in animals e.g. Digestion and absorption.

CO2: Describe the physiology of Blood, Osmoregulation, respiration, and excretion.

CO3: Describe the physiology and functions of different glands also be able to explain the physiology of muscles and nervous system.

CO4: Explain the physiology of the hypothalamus and the physiology of reproductive hormones and their functions.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3	-	3	-	2	2
CO2	3	3	3	3	3	-	3	-	3	3
CO3	3	3	3	2	3	-	3	-	3	3
CO4	3	3	2	2	3	-	3	-	2	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability and Entrepreneurship Course

M. Sc. Zoology II Semester
Course-MZ-C204: Biostatistics and Computer application
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives:

- Understand and apply statistical methods for the design of biomedical research and analysis of biomedical research data
- Understand and use mathematical and statistical theory underlying the application of biostatistical methods
- use and interpret results from specialized computer software for the management and statistical analysis of research data
- Learn to participate in a research team setting in study design, data coordination and management, and statistical analysis and reporting of study results
- Participate in a research team in the development and evaluation of new and existing statistical methodology.

UNIT- I **15Hrs**

1. Introduction to Biostatistics – Definition, Terms, Applications and Role of biostatistics in modern research.
2. Sampling techniques and data representation
3. Measures of central tendency and Distribution
4. Measures of dispersion

UNIT- II **15Hrs**

1. Probability and chi square test
2. Correlation and liner regression
3. Test of significance
4. Experimental design and analysis of variance

UNIT-III **15Hrs**

1. Basic components of computers – Hardware (CPU, input, output storage devices), Software (operating systems).
2. Introduction to MS EXCEL – use of worksheet to enter data, edit data, copy data, move data and Graphical tools in EXCEL for presentation of data.
3. MS – WORD – editing, copying, moving, formatting, table insertion, drawing flow charts etc.,
4. Introduction to Power Point, image, data handling and Graphical tools in PPT for Presentation.

UNIT-IV **15Hrs**

1. Introduction to Internet – Basics and Applications of Internet, Internet working Internet access.
2. Understanding the World Wide Web (WWW).
3. Searching Tools – World Search Engines, Search Directories and Encyclopedias.
4. Online safety – spywares and viruses

Suggested Reading:

1. Statistical methods, Snedecor, G.W. and W.G. Cochran, Iowa State Univ. Press Biometry by W. H. Freeman and Francisco

2. Computer Fundamentals 1St Edition 2017 by RS Salaria

Course Outcomes:

On the successful completion of the course, students would be able to

CO1: Explain the basics of biostatistics and measures of central tendency and its application in research.

CO2: Learn how to design an experiment analyze the data with the help of ANOVA, test of significance, chi-square test, etc.

CO3: Explain the basics of computer, and Microsoft tools and will be able to learn how to handle the data.

CO4: Understand the basics of the INTERNET.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3	-	3	-	2	2
CO2	3	3	3	3	3	-	3	-	3	3
CO3	3	3	3	2	3	-	3	-	3	3
CO4	3	3	2	2	3	-	3	-	2	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Skill Development Course

M. Sc. Zoology II Semester
Course-MZ-C205: Practical
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives:

- To study the slides related to vertebrates.
- To have a knowledge of museum specimens.
- To understand the principles of Mendelian inheritance.
- To understand the various types of non-Mendelian inheritance.
- To solve the problems based on Population Genetics.
- To study the mapping techniques.
- To perform Hematological Experiments.

1. Cranial Nerves of *Scoliodon*
2. Museum specimens (from each Class not less than 15 specimens).
3. Slides related to vertebrate parts.
4. Problems based on multiple alleles – Blood groups
5. Problems based on Mendel's Laws – monohybrid and dihybrid ratios
6. Problems based on gene frequency – Hardy Weinberg Law
7. Karyotype studies
8. Haematological estimations of Blood

Course Outcomes:

On the successful completion of the course, students would be able to

CO1: Identify Museum specimens and slides of vertebrates.

CO2: Bring awareness to human society on various genetic disorders, and its inheritance patterns and to develop the methods, and techniques of fighting against the diseases.

CO3: Students shall be able to understand the definition and scope of population genetics with their history the mathematical models.

CO4: Distinguish normal and abnormal haematological laboratory findings to predict the diagnosis of haematological disorders and diseases.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	1	1	-	-	1	2
CO2	3	3	3	2	2	-	1	-	3	3
CO3	3	3	3	2	2	-	-	1	2	2
CO4	3	3	3	2	2	-	1	-	3	3

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M. Sc. Zoology III Semester
Course-MZ-C301: Developmental Biology
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives: The main objective of Developmental Biology course is to provide four-dimensional thinking of students to truly understand the patterns and process of embryonic development, body plan, fate map, induction, competence, regulative and mosaic development, molecular and genetic approach for the study of developing embryo which is not necessarily shared with any other disciplines in the biological sciences. The relevance of Developmental Biology to the study of human disease will be exemplified throughout using different model organisms

UNIT: I **15Hrs**

1. **Theories of Development:** Preformation of epigenesis
2. **Biochemistry of semen**: semen composition and formation, assessment of sperm function and Y – specific probes
3. **Fertilization**: significance of fertilization for development, the essence of activation of egg, pre and post fertilization events and biochemistry of fertilization

UNIT: II **15Hrs**

1. Different types of eggs in chordates
2. **Early embryonic development:** patterns of cleavage, Blastulation and Gastrulation in chordates (Tunicates to Mammals), fate maps, morphogenic movements, mechanics and significance of gastrulation
3. **Casual basis of development**: primitive embryonic induction, concepts of potencies, prospective fates, progressive determination, induction of the primitive nervous system (Speman's primary organization), nature and regionally specific properties of the inductor

UNIT: III **15Hrs**

1. **Organogenesis:** morphogenesis of brain and heart
2. **Embryonic development:** development and physiology of extra- embryonic membranes in amniotes
3. Development, types and physiology of mammalian placenta

UNIT: IV **15Hrs**

1. **Metamorphosis in Amphibia:** structural and physiological changes during metamorphosis, endocrine control of metamorphosis
2. **Regeneration**: types of regeneration (physiological, reparative and compensatory, hypertrophy), regenerative ability in chordates, morphological and histological process in amphibian limb regeneration, origin of cells for regeneration, differentiation.
3. Environmental regulation of animal development.

Suggested Reading:

1. Gilbert, S.F. Developmental Biology. 10th Edition, Sinauer Associated Inc., Massachusetts
2. Balinsky, B.I. Introduction to Embryology. Saunders, Philedelphia
3. Berril, N.J. and Karp, G. Development Biology. McGraw Hill, New York
4. Hamburger V and Hamilton HL. Handbook of chick developmental stages. Saunders Publications. 1965.

Course Outcomes:

On the successful completion of the course, students would be able to

CO1: Developmental Biology enquires about the fundamental processes that underpin the fertilization of an egg cell and its step-by-step transformation into the fascinating complexity of a whole organism. Students will be able to understand theories of development, biochemistry of semen and fertilization process.

CO2: Explain the early embryonic development in chordates and casual basis of development.

CO3: Describe the process of organogenesis, development and physiology of extra embryonic membrane and mammalian placenta.

CO4: Explain the metamorphosis in Amphibia and regeneration process.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	1	2	2	3	-	-	1	1
CO2	3	3	3	3	3	3	-	-	3	3
CO3	3	3	3	3	3	3	-	-	3	3
CO4	3	3	3	3	3	3	-	-	3	3

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M. Sc. Zoology III Semester
Course-MZ-C302: Animal Behaviour
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives:

Behavior is one of the most important and interesting aspects of animal biology. Behaviors permit flexibility that allows animals to respond rapidly to environmental changes. This course exposes students to the broad field of animal behavior. Students will come to understand the historical foundations of the field, as well as current theories and evidence for a broad range of behavioral topics. We will also focus on how the science underlying our theoretical understanding of behavior is conducted, and how behavioral hypotheses at all levels of analysis can be tested experimentally. Students also participate in practical exercises to learn some fundamental techniques used to study behavior, and will practice reading and analyzing current scientific literature. Behavioral ecology and the evolution of behaviors as adaptations will be recurring themes interwoven through all topics discussed.

UNIT: I **15Hrs**

1. Different patterns of behaviour
2. A general picture of the mammalian nervous system with system special reference to the involvement of hypothalamus in the regulation of behaviour patterns.
3. Hormones and behaviour
4. Methods of studying behaviour: brain lesions, electrical stimulation and drug administration

UNIT: II **15Hrs**

1. Behavioural genetics
2. Components of feeding behaviour; hunger and drive, directional movement, avoidance, eating, carrying and hoarding, Factors influencing choice if food,
3. Nervous regulation of food and energy intake
4. Learning: Habituation, conditioned reflex, trial and error, latent learning, learning and discrimination, imprinting neural mechanism of learning

UNIT: III **15Hrs**

1. Concept of Instinctive behaviour, phyletic decent and physiology
2. Motivated behaviour: Drive, satiation and its neurophysiological control
3. Orientation- classification of various types of taxes and kinases
4. Social behavior in primates: Social signals; olfactory, tactile, visible, audible

UNIT: IV **15Hrs**

1. Status, dominance, hierarchy, territorial behaviour, courtship and mating, aggression, primate societies
2. Reproductive behaviour in fish (stcikle back or any other fish)
3. Social behaviour in insects: communications, concealment behaviour
4. The role of pheromones (a general account)

Suggested Reading:

1. Animal Behaviour: an Evolutionary Approach – John Alcock.
2. Measuring behaviour: an Introductory Guide – Martin Bateson.
3. Animal Behaviour by Reena Mathur

Course Outcomes:

At the completion of their Animal Behaviour course, students would be able to:

CO1: Explain different patterns of behaviour and methods for studying animal behaviour.

CO2: Learn behavioural genetics, components of feeding behaviour and learning.

CO3: Describe the most important aspects of animal behaviour i.e. social behaviour.

CO4: Explain social behaviour in primates and insects also be able to reproductive behaviour in fish and role of pheromones.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	2	2	3	-	-	1	2
CO2	3	1	2	2	2	3	-	-	2	2
CO3	3	1	2	2	2	3	-	-	2	2
CO4	3	1	2	2	2	3	-	-	1	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability Course

M. Sc. Zoology III Semester
Course-MZ-C303: Environmental Pollution, Health and Education
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives:

- Basic knowledge and concept of causes, effects, and control of different types of environmental pollution.
- To study population growth and its impact on health and the environment.
- To study the measures taken for its improvement.

UNIT- I **15Hrs**

1. Natural resources, their conservation and development
2. Mineral resources
3. Energy resources
4. Waste management

UNIT-II **15Hrs**

Pollution (Monitoring sources, effects and control)

1. Water
2. Air
3. Land
4. Sound

UNIT-III **15Hrs**

1. Urban health problem, Impact of urbanization stress, Behaviour pattern of health, Health status and Health management
2. Rural health problem
3. Socioeconomic environment, impact of weather, natural disaster, Pollution water availability, food resources, safely in relation to human health

UNIT -IV **15Hrs**

1. Education and improvement of social environment.
2. Indian society in transition-status of socio-culture values-ecological ethics.
3. People's science movements.
4. UNESCO's Man and Biosphere programme.

Suggested Reading:

1. Pollution (Vol.1-6) by C. S. Stern
2. Environmental ecology by T.N. Khoshoo

Course Outcomes:

On the successful completion of the course, students would be able to

CO1: Gain knowledge about the environment and will learn about the natural resource, its importance, and environmental impacts of human activities on natural resource.

CO2: Aware students about problems of environmental pollution, its impact on human and ecosystem and control measures.

CO3: Describe the urban and rural health problems due to environmental pollution.

CO4: Aware and educate society for improvement of social environment.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	2	-	-	3	2	2
CO2	3	3	2	2	2	-	-	3	2	2
CO3	3	3	2	2	3	-	-	3	2	2
CO4	3	3	2	2	3	-	-	3	2	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M. Sc. Zoology III Semester
Course-MZ-E304: Systematics and Morphology of Fishes
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives: This course has been designed to understand identification and classification of commercially important fishes.

UNIT-I **15Hrs**

1. Evolutionary Classification, merits and demerits of Berg's classification, Ostracoderms, Placoderms
2. Origin and evolution of Fishes
3. Adaptive radiation of fishes

UNIT-II **15Hrs**

1. Hill stream and Deep sea fishes adaptations
2. Scale and Coloration of fishes
3. Origin of fins, locomotion and electric organs

UNIT-III **15Hrs**

1. Fish nutrition, food and feeding habits
2. Elementary canal in fishes and physiology of digestion
3. Respiration in fishes

UNIT-IV **15Hrs**

1. Morphology of air breathing fishes
2. Morphology of Swim bladder webrion ossicless
3. Fish Skeleton

Suggested Reading:

1. Fish and Fisheries by S S Khanna
2. Fish and Fisheries of India by V.G. Jhingran

Course Learning Outcomes:

On the successful completion of the course, students would be able to

CO1: Explain the evolution and classification of fishes.

CO2: Describe the mechanism of adaptations of fishes and will be able learn scale, coloration and origin of fins in fishes.

CO3: Explain nutrition and physiological mechanism of digestion and respiration in fishes.

CO4: Explain the morphology of fishes.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	2	2	-	-	3	1	2
CO2	3	2	1	2	2	-	-	3	1	2
CO3	3	2	1	2	2	-	-	3	1	2
CO4	3	2	1	2	2	-	-	3	1	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability Course

M. Sc. Zoology III Semester
Course-MZ-E305: Wild Life Ecology
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives:

- To know the meaning of "habitat" and be able to name the habitat requirements for wildlife and the factors that affect wildlife suitability.
- To know and understand basic ecological concepts and terminology.
- To understand the difference between an ecosystem, community, and population.
- To be able to explain how communities interact with their non-living surroundings to form ecosystems.
- To understand wildlife population dynamics such as birth, mortality, age-structure, sex ratio, and mating systems.
- To recognize that all living things must be well-adapted to their native environment to survive.
- To be able to identify, describe and explain the advantages of specific anatomical, physiological and/or behavioral adaptations of wildlife to their environment.
- To know the meaning of the term "Biodiversity" and understand why biodiversity is important to people and wildlife.
- To understand the importance of the 3 levels of biodiversity: genetics, species and ecosystem or community, and understand the implications of biodiversity loss at each level

Unit I **15Hrs**

1. Population growth of wild life, growth of organism with non - overlapping generation, and exponential growth
2. Predation models of prey - predatory dynamics optional forging theory - Patch choice, diet choic, prey , selection , forging time
3. Population regulation - extrinsic and intrinsic mechanism
4. Mutalism animal- animal relationship

Unit II **15Hrs**

1. Types of Ecosystem - nutrient cycle , food chain , food web
2. Habitat Ecology - Aquatic fresh water ecology, estuarine ecology and oceanography
3. Terrestrial Ecology - Forest and Grassland ecology, desert life , Himalayan ecology , Floristic regions and Islands of India
4. Environmental hazards, destruction of habitat and extrication of specise causes and preventive measures.

Unit III **15Hrs**

1. Morphological variations and adaptations in species of Reptiles, birds and mammals in different Ecosystem, Forest, deserts hills, rivers , sanctuaries and oceans .
2. Behaviour and breeding patterns of Wild species
3. General anatomical organisation and sense organs in wild species
4. Oil field pollution, drilling operations, monitoring, Environmental impact assessment.

Unit IV **15Hrs**

1. Origin and evolution of Reptiles, birds and mammals
2. Special features in the development Biology of Reptiles, birds and mammals.
3. Management of Soil resources.
4. Zoogeographical regions and world biota

Suggested Reading:

1. Wildlife Ecology, Conservation, and Management by John M fryxell
2. Ecology by Peter Sterling
3. Fundamentals of Ecology by E.O. Odum

Course Outcomes:

On the successful completion of the course, students would be able to

CO1: Explain wildlife population growth and population regulation mechanisms also be able to describe predation and mutualism process.

CO2: Describe basics of ecosystem (aquatic and terrestrial) and will be able to explain preventive measures for wildlife ecology.

CO3: Describe morphological variations, adaptation, behaviour, breeding pattern of wild species.

CO4: Explain the origin, evolution and developmental biology of Reptilies, Birds and mammals. Also, be able to explain management of soil resources and Zoogeographical regions.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	2	2	-	-	3	1	2
CO2	3	2	1	2	2	-	-	3	1	2
CO3	3	2	1	2	2	-	-	3	1	2
CO4	3	2	1	2	2	-	-	3	1	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Skill Development Course

M. Sc. Zoology III Semester
Course-MZ-C306: Practical
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives:

- This course includes the experimental study of Developmental Biology and Animal Behaviour.
- To be able to list the types of characteristics that make an organism ideal for the study of developmental biology.
- To learn social behaviour by performing different experimental approach in animal behaviour.
- To measure responses to stimuli or to trained behavioral responses in a laboratory context, without a particular emphasis on evolutionary adaptivity.

1. Observation of living Chick embryo.
2. Larval Developmental stages of Drosophila.
3. Chromosome squash preparation from Drosophila larval salivary glands.
4. Chemical communication in ants
5. Maze learning in small mammals
6. Selective predation of coloured prey items
7. The practical of Elective courses 13 and 14 based as per syllabus

Course Outcomes:

On the successful completion of the course, students would be able to

CO1: Experimental approach of the developmental biology that can be used to probe multi-scale interactions; particularly in terms of how alterations at higher levels of organisation impact those at lower levels via downward causation.

CO2: Demonstrate knowledge of key concepts in animal behavior.

CO3: Demonstrate the experiments related to the physiology and morphology of fishes.

CO4: Understand the experimental approach towards wildlife ecology.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	1	1	-	-	3	3
CO2	3	3	3	2	2	1	-	-	3	3
CO3	3	3	2	2	2	-	-	1	2	2
CO4	3	3	2	2	2	-	-	1	2	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability Course

M. Sc. Zoology IV Semester
Course-MZ-C401: Biological Chemistry
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives: To introduce molecular structure and interactions present in various biomolecules that help in functioning and organization of living cell

Unit – I **15Hrs**

1. **Bio-Catalysis:** Classification, nomenclature and mechanism of action of enzymes; nature of enzymes; enzyme specificity; factors affecting enzyme activity; enzymatic and co-enzymatic catalysis, coenzyme and their functions.
2. Organic constituents in living systems
3. Bee Lambert's law, Principles and applications of colorimetry and spectrophotometry.
4. Metabolism of Amino acids

Unit – II **15Hrs**

1. Structure and importance of monosaccharides, sugar derivatives, disaccharides, polysaccharides.
2. Catabolism of glycogen, glucose and fructose; details of Glycolysis, Kreb's cycle and Cori cycle.
3. Phosphogluconate pathway(pentose phosphate pathway)
4. Synthesis of glycogen; glycogensis and glyconeogenesis.

Unit – III **15Hrs**

1. Definition, general properties, classification and importance of amino acids and proteins, nucleo-proteins.
2. Structure formulae of the amino acids.
3. Structure of proteins; primary, secondary, tertiary and quaternary.
4. Basic knowledge of the determination of amino acid sequence exemplifies by a tripeptide.

Unit – IV **15Hrs**

1. Definition, general properties and classification.
2. Fatty acids, structure, properties, types and importance, with special reference to essential fatty acids.
3. Structure and importance of different types of Lipids.
4. Metabolism of fat and fatty acid

Suggested Reading:

1. Principles of biochemistry, by Lehninger
2. Biochemistry, by Donald Voet and Judith Voet.
3. Biochemistry, by Harper.
4. Biochemistry. Jeremy M.Berg, JohnL.Tymovzko, Lubert Strye

Course Outcomes:

After completion of the course, students would be able to

CO1: Explain the role of enzyme in reactions and its mechanism of action.

CO2: Describe the importance of carbohydrates and its metabolism.

CO3: Interpret molecular structure and importance of amino acids and proteins.

CO4: Explain the importance of lipids and its metabolism.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3	-	3	-	2	2
CO2	3	3	2	1	3	-	3	-	2	2
CO3	3	3	3	2	3	-	3	-	3	3
CO4	3	3	2	2	3	-	3	-	2	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability Course

M. Sc. Zoology IV Semester
Course-MZ-C402: Cell and Molecular Toxicology
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives:

- Give the competence to understand advanced toxicological and give skills to generalise about the fate of chemicals from their chemical structure
- Give knowledge and understanding of molecular mechanisms of toxicity and defence systems against toxicity

UNIT – I **15Hrs**

1. History and scope of Toxicological
2. Effects of toxins on plasma membrane, passive transport, active transport, diffusion, membrane fluidity
3. Toxicity of Mixtures
4. Cytotoxicity

UNIT – II **15Hrs**

1. Genetic Toxicology
2. Introduction of carcinogenesis
3. Effects of toxins on endoplasmic reticulum- ER enzymes, effects of toxins on ER
4. Effects of toxins on mitochondria- mitochondrial membrane permeability, electron transport disturbances, oxidative injury to mitochondria, apoptosis

UNIT – III **15Hrs**

1. Apoptosis and toxicants
2. Effects of toxins on microsomes and peroxisomes- microsomal induction by chemicals, peroxisomal proliferation by toxins, microsomal enzymes, peroxisomal enzymes ad their role in cell injury
3. Cytopathology
4. Occupational toxicology

UNIT – IV **15Hrs**

1. Effects of toxins on cytoskeleton- effects of toxins on actin filaments (microfilaments), intermediate filaments, cilia and flagella
2. Dose time effect relationship
3. Absorption, distribution and elimination of xenobiotics
4. Biotransformation

Suggested reading:

1. Cell and molecular biology: Concepts and experiments by G. Karp , Wiley
2. Molecular biology of the cell by B. Alberts , A. Johnson et al . , Garland Science , T & F Group

3. General and applied toxicology by Ballantyne , T. Marrs , T. Syversen (Volume – II) , McMillan , UK
4. Handbook of Toxicoogical pathology by W.M. Haschek , C.G. Rousseaux , M.A. Walling , (Volume – I) , Academic Press

Course Outcomes:

On the successful completion of the course, students would be able to

CO1: Understand the basics of Toxicology and molecular mechanisms behind the deleterious effects of selected chemicals on membranes.

CO2: Learn the impact and timing of toxic manifestations in the cell organelles also be able to describe the genetics of toxicity.

CO3: Describe the relationship between apoptosis and toxicants also be able to describe cytopathology and Occupational toxicology.

CO4: Understand the toxic effects on cytoskeleton and be able to explain absorption, distribution and elimination of xenobiotics.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3	-	3	-	2	2
CO2	3	3	2	1	3	-	3	-	2	2
CO3	3	3	3	2	3	-	3	-	3	3
CO4	3	3	2	2	3	-	3	-	2	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M. Sc. Zoology IV Semester
Course-MZ-E403: Physiology and Embryology of Fishes
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives: Various physiological aspects of fish viz. respiration, excretion, reproduction, etc. are included in this course. To study the embryology of fishes also included in this course.

UNIT-I **15Hrs**

1. Stato - acoustic Lateral line system
2. chemoreceptors; organ of sight & organ of smell
3. Osmoregulation and mechanism of water salt balance in fresh water & marine fishes

UNIT-II **15Hrs**

1. Circulatory system
2. Excretory system
3. Nervous system

UNIT-III **15Hrs**

1. Fish migration
2. Parental care in fishes
3. Reproductive system in fishes
4. Structure and kind of eggs and their maturation

UNIT-IV **15Hrs**

1. Cleavage and early embryonic development in fishes
2. Hatching and post embryonic development including fundamentals of morphogenesis in fishes
3. Endocrine glands in fishes

Suggested Reading:

1. Fish and Fisheries by S S Khanna
2. Fish and Fisheries of India by V.G. Jhingran

Course Outcome:
On the successful completion of the course, students would be able to

CO1: Describe different sense organs and osmoregulation mechanism in fishes.

CO2: Explain different aspect of physiological mechanism fish e.g. Circulatory, Excretory, and nervous system.

CO3: Explain the migration and parental care mechanisms in fishes also be able to describe reproductive system and structure, kinds and maturation of eggs.

CO4: Describe embryonic development and fundamental of morphogenesis in fishes also be able to describe the different endocrine glands in fishes.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	-	-	3	2	2
CO2	3	2	2	2	2	-	-	3	2	2
CO3	3	2	1	2	2	-	-	3	1	2
CO4	3	2	2	2	2	-	-	3	2	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability Course

M. Sc. Zoology IV Semester
Course-MZ-E404: Wild life Biodiversity and Conservation
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives: This course teaches the essential elements, concepts and skills related to wildlife conservation and management. This includes implementing habitat management practices; identifying wildlife conflicts; and participation in personal and community leadership development activities and planning. The perspectives of science and management will be elucidated in the context of historical, current and future strategies designed to conserve the diversity of life.

UNIT- I **15Hrs**

1. Habit and habitat and zoogeographical distributions of Reptiles, bird and Mammalia.
2. Groups of allied importance - A fishes, amphibia and Insect
3. Forestry - forest resource, erosion, deforestation and afforestation.
4. Conservation movements in Himalayan Foot hills and Tribal belts of India and histories

UNIT-II **15Hrs**

1. National Parks and sanctuaries in India, concept in regards to Ecology
2. Important Nature reserves in the world
3. Interaction of man and Nature
4. Legislation, wild life protection Act and Regulations administration and economics

UNIT-III **15Hrs**

1. National Parks, Sancturies, planning management
2. National Parks and Sancturies - Case studies
3. Maintenance and rearing of wild species
4. Wild life value as tourism, acethetical game, ethical, commercial and scientific

UNIT-IV **15Hrs**

1. Environmental education, Public awareness and future programmes
2. Conservation movement in India historical perspectives
3. Biodiversity, its significance and conservation measures
4. Role of Biotechnology in species a development

Suggested Reading:

1. Wildlife Ecology, Conservation, and Management by John M fryxell
2. Ecology by Peter Sterling
3. Fundamentals of Ecology by E.O. Odum

Course Outcomes:

After completion of course students would be able to

CO1: Describe the basics of wild life biodiversity with groups of allied importance fauna and will be able to understand the knowledge of forestry.

CO2: Explain the role of national parks, sanctuaries, acts and regulations for the protection of wildlife.

CO3: Explain different measures taken for wild life conservation and value of wild life

CO4: Explain how to aware people about wildlife conservation movement also will be able to understand historical aspects of Wildlife conservation in India and India's conservation present day conservation priorities

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	2	2	-	-	3	1	2
CO2	3	2	1	2	2	-	-	3	1	2
CO3	3	2	1	2	2	-	-	3	1	2
CO4	3	2	1	2	2	-	-	3	1	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Entrepreneurship Course

M. Sc. Zoology IV Semester
Course-MZ-E405: Aquaculture and Fisheries
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives:
Culture techniques of aquatic organisms form different aquatic resources (freshwater, estuarine and marine) are included in this paper. The environmental and nutritional requirements, reproduction and diseases of fishes are the core parts of this paper.

UNIT-I **15Hrs**

1. Types of fisheries - Marine fisheries (deep water , off shore Riverine fisheries (Major river system of North India), Reservoir Estuaries fisheries
2. Prawns Fisheries - Fishing method, Culture methods, future of prawn fisheries in India and processing of Prawns.
3. Molluscan fisheries and Pearl industry, light fishing & ecosounders
4. Net & crafts of inland and marine water; Electric fishing

UNIT-II **15Hrs**

1. Effect of light temperature, turbidity, dissolved gases & solids in water
2. Types of planktons & their role in fish life
3. Maintenance of fresh water aquarium: Pond culture & its management
4. Principle cultivable fishes - Brief account of indigenous & transport of seed.

UNIT-III **15Hrs**

1. Induced breeding - stripping, hypophysation techniques
2. Special culture - Composite fish culture; fish culture in paddy fields sewage fish culture and integrated fish culture
3. Fish diseases and their control - Fungal diseases, bacterial diseases protozoan diseases, helminth diseases and diseases induced by pollutants; prophylectic measures .
4. Fish Preservation and processing - Cause of spoilage, methods of preservation, their merits and demerits

UNIT-IV **15Hrs**

1. Fish bye- products
2. Fish pollution and toxicity
3. Age and growth, length and weight relationship
4. Tagging of fishes

Suggested Reading:

1. Fish and Fisheries by S S Khanna
2. Fish and Fisheries of India by V.G. Jhingran

Course Outcomes:

On the successful completion of the course, students would be able to

CO1: Describe different types of fisheries and their culture methods.

CO2: Explain the effect of abiotic factors in water and types of planktons on fish life. Also, will be able to describe the principle of cultivable fishes.

CO3: Describe different types of fish disease and their control methods also will be able to explain the fish preservation methods and its processing.

CO4: Explain the Fish pollution and toxicity and by products of fish.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	2	2	-	-	3	1	2
CO2	3	2	2	2	2	-	-	3	2	2
CO3	3	2	2	2	2	-	-	3	2	2
CO4	3	2	2	2	2	-	-	3	2	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M. Sc. Zoology IV Semester
Course-MZ-E406: Environmental Physiology
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives:
Environmental Physiology focuses on physiological diversity in relation to the environments in which organisms live. This course is about how animals acclimate, adapt or evolve to the physiological challenges of their environment. Considering the current anthropogenic changes we are observing, it is perhaps crucial that student should understand and know how to measure the effects physical change places on organism's capacities to tolerate, or adapt to changes. This course will also emphasize on the study of ecosystem and its different communities.

UNIT-I **15Hrs**

1. Environmental physiology, Metabolism rate and body size, Basal metabolism
2. Climatic adaptations- Hibernation, Aestivation, Poikilotherms, Homeotherms, Acclimation and Acclimatization, Survival limits
3. Asphysic responses and their manifestations

UNIT-II **15Hrs**

1. Haematological changes in relation to environment
2. Impact of environment at cellular level
3. Principles and concept of ecosystem

UNIT-III **15Hrs**

1. Development and evolution of ecosystems.
2. Causes and kinds of succession, Diversity and productivity in relation to stages of succession and development.
3. Biotic and abiotic components and their interrelationship, and adaptations of animals to environment.

UNIT-IV **15Hrs**

1. Deserts: types and ecological attributes of desert species. Adaptations.
2. Freshwater: Lakes including salt lakes, ponds, streams, springs, rivers and marshes.
3. Estuarine: ecological peculiarities adaptations including imp of fauna.

Suggested Reading:

1. Ecology by Peter Sterling
2. Fundamentals of Ecology by E.O. Odum

Course Outcomes:

On the successful completion of the course, students would be able to

CO1: Student will be able to understand and know how to measure the effects physical change places on organism's capacities to tolerate, or adapt to changes.

CO2: Describe the impact of environment at cellular level and will also be able to emphasize on the basic principle and concepts of ecosystem.

CO3: Explain the development and evolution of ecosystem. Also, Describe the stages of succession and their development.

CO4: Describe the terrestrial and aquatic habitat with adaptation of species.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	2	-	-	3	2	2
CO2	3	3	2	2	2	-	-	3	2	2
CO3	3	3	2	2	3	-	-	3	2	2
CO4	3	3	2	2	3	-	-	3	2	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Skill Development Course

M. Sc. Zoology IV Semester
Course-MZ-C407: Practical
(Total Credits = 04; End Semester Marks = 75; CIE=25)

Course Objectives:

- To gain the experimental knowledge of Biological Chemistry and Molecular Toxicology.

1. Biochemical estimations of different parameters in Serum and Blood *viz*
   I. Blood Sugar
   II. Serum Cholesterol
   III. Serum Lipids
   IV. Low Density Lipoprotein
   V. High Density Lipoprotein
   VI. Triglyceride
   VII. Very Low Density Lipoprotein
   VIII. Total Protein, Albumin, Globulin and A/G ratio

2. Isolation of DNA from goat spleen
3. Estimation of DNA (diphenyl method)
4. Estimation of RNA (Orcinol method)
5. UV absorption spectra of native and denatured DNA
6. Agarose gel Electrophoresis of DNA
7. DNA amplification by PCR
8. Gel Documentation

Course Outcomes:

On the successful completion of the course, students would be able to

CO1: Students will demonstrate a core knowledge base in the theory and practice of modern biochemistry.

CO2: Students will critically evaluate data and design experiments to test hypotheses relevant to the practice of molecular biology.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	1	-	1	-	3	3
CO2	3	3	3	2	2	-	1	-	3	3

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3