

Baba Mastnath University (BMU)

Private university in Haryana



**Structure and Syllabus of
M.Sc. ZOOLOGY (Ist to IVth Semesters) Course
Under CBCS-LOCF**

(Effective from the Academic Session 2022-23)

In phased manner

**Department of Zoology
Baba Mastnath University,
Asthal Bohar, Sector-29, Rohtak-124021,
Haryana (INDIA)**

DEPARTMENT OF ZOOLOGY
M.Sc. Zoology Programme
(As per Choice based Credit System w.e.f. the academic year 2022–2024)

Programme Outcomes (POs) for M.Sc. Zoology

- PO1** To accustom students with recent knowledge and techniques in basic and applied zoological sciences.
- PO2** To develop an understanding of the organismal, cellular, biochemical and environmental basis of life.
- PO3** To provide insight into ethical implications of biological research for environmental protection and good laboratory practices and biosafety.
- PO4** To develop problem-solving innovative thinking with robust communication and writing skills in youth with reference to Zoological Sciences
- PO5** To impart practical and project-based vocational training for preparing youth for a career in research and entrepreneurship in fields of life sciences for self-reliance.

Program Specific Outcomes

PSO1: Students will have knowledge and skills and in-depth acquaintance of animal species, their life biology, evolution, and interaction with the environment at organismal, cellular and molecular level

PSO2: Students would sufficiently be skilled and empowered to solve the problems in the realms of Zoology and its allied areas.

PSO3: Students would gain proficiency in research methodology and assessment techniques in animal science.

PSO4: Students would gain competencies and professional skills for working and conducting research in the field of Zoology and related areas of life science research.

PSO5: They would have abundance of job opportunities in the education, Research agriculture-based, and health related sectors.

Credits FOR M.SC ZOOLOGY (TWO YEAR COURSE):

CORE COURSE = 92

DISCIPLINE SPECIFIC ELECTIVE = 12

DISSERTATION = 20

TOTAL Credits = 124

INSTRUCTION FOR THE STUDENTS

Course Types: Core Course (C):- There are Core Courses in every semester. These courses are to be compulsorily studied by a student as a core requirement to complete the requirement of a programme in a said discipline of study.

Discipline specific elective (D):- Discipline specific course is a course which can be chosen from a pool of papers. It will be supportive to the discipline of study & mandatory as per course curriculum.

Scheme of Examination for M.Sc. Zoology (Semester system) as per Choice Based Credit System (CBCS) to be implemented w.e.f. session 2022-2024 in Phased Manner

Semester-wise distribution of course and credits in M.Sc. Zoology Programme of BMU Rohtak

			Semester I				
Course No	Nomenclature of the Paper	Credits	Hours	MM (Maximum Marks)	IA (Internal Assessment)	Total Marks	Exam duration (Hrs)
	Core courses						
22-MSZOO-101C	Biomolecules	4	4	80	20	100	3
22-MSZOO-102C	Fundamentals of Molecular Biology	4	4	80	20	100	3
22-MSZOO-103C	Diversity of Life forms -I	4	4	80	20	100	3
22-MSZOO-104C	Advanced Physiology	4	4	80	20	100	3
22-MSZOO-105C	Seminar I	2		50	-	50	
	Elective Courses						
22-MSZOO-106DSE	Basic Principles of Aquaculture	4	4	80	20	100	3
22-MSZOO-107OE	Biostatistics and Biological Calculations	4	4	80	20	100	3
	Lab Courses						
22-MSZOO-108CL	Practical based on 101C and 102C	4	8	100	-	100	6
22-MSZOO-109CL	Practical based on 103C,104C and 106C/107C	4	8	100	-	100	6
	Total Credits	30					
			Semester II				
course No	Nomenclature of the Paper	Credits	Hours	MM (Maximum Marks)	IA (Internal Assessment)	Total Marks	Exam duration (Hrs)
	Core courses						
22-MSZOO-201C	Cell Biology	4	4	80	20	100	3
22-MSZOO-202C	Cell Metabolism	4	4	80	20	100	3
22-MSZOO-203C	Diversity of Life forms -II	4	4	80	20	100	3
22-MSZOO-204C	Tools and Techniques in Zoology	4	4	80	20	100	3
22-MSZOO-205C	Seminar II	2		50		50	
	Elective Courses						
22-MSZOO-206DSE	Wild Life Conservation	4	4	80	20	100	3
22-MSZOO-207OE	Parasitology	4	4	80	20	100	3
	Lab Courses						
22-MSZOO-208CL	Practical based on 201C and 202C	4	8	100		100	3
22-MSZOO-209CL	Practical based on 203C,204C and 206C/207C	4	8	100		100	3
	Total Credits	30					
			Semester III				
	Core Courses						
	Nomenclature of paper	Credits	hours	MM (Maximum Marks)	IA (Internal Assessment)	Total Marks	Exam duration (Hrs)
22-MSZOO-301C	Molecular Endocrinology	4	4	80	20	100	3
22-MSZOO-302C	Biology of Immune System	4	4	80	20	100	3
22-MSZOO-303C	Concept of Genetics	4	4	80	20	100	3
22-MSZOO-304C	Developmental Biology	4	4	80	20	100	3
	Elective Courses						
22-MSZOO-305OE	Environmental Biology	4	4	80	20	100	3
22-MSZOO-305SEC	Scientific Writing skills	4	4	80	20	100	3
	Lab Courses						
22-MSZOO-307CL	Practical based on 301C and 302C	4	8	100		100	6
22-MSZOO-308CL	Practical based on 303C, 304C and	4	8	100		100	6

	305C/306C						
	Total Credits	28					
			Semester IV				
	Core Courses						
	Nomenclature of the paper	Credits	Hours	MM (Maximum Marks)	IA (Internal Assessment)	Total Marks	Exam duration (Hrs)
22-MSZOO-401C	Animal Behavior	4	4	80	20	100	3
22-MSZOO-402C	Animal Biotechnology	4	4	80	20	100	3
22-MSZOO-403C	Ecology and Evolution	4	4	80	20	100	3
Lab Course							
22-MSZOO-404CL	Practical based on 401C, 402C and 403C	4	4	100	-	100	6
22-MSZOO-405CL	Dissertation/Field Work/Project Report/Review Paper	20	40	300	-	300	
	Total Credits	36					

Course Title: Biomolecules Code: 22-MSZOO-101C**Credits: 4; Total Marks: 100; Final Theory Examination: 80; Internal Assessment – 20**

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objectives:

1. To develop understanding of biological processes at chemical, biochemical and molecular level to perform wide range of analytical techniques to explore biological activities.
2. To provide general overview of different biochemical experimental approaches to understand the structure and functions of cell and its components.

Course Outcomes:

- CO1:** It will provide the students a basic appreciation of the underlying principles and practical strategy of the analytical and preparative techniques that are fundamental to study and understanding of life processes.
- CO2:** It will make the students to understand the general reactions of various metabolic pathways.
- CO3:** Students will be able to explain the principle, working, materials used and applications of various biological techniques that are used to study the basic biological processes.

Unit I

Biomolecular foundations of biology: pH, pK, acids, bases, buffers, bonds- Van der Waal's, electrostatic, hydrogen bonding and hydrophobic interaction, free energy, resonance, isomerisation. Structure of soluble biomolecular pool of cells – aminoacids and peptides, glycoproteins, vitamins.

Unit II

Nucleic acids: Types, structural organization and helix-coil transition energetics. Physicochemical techniques and macromolecular analysis, Biomolecular interaction: Protein-ligand, protein-protein, nucleic acid-protein and nucleic acid-ligand interactions.

Unit-III

Proteins: Amino acid and their properties, Protein structure- Primary, Secondary, Tertiary and Quaternary. Conjugated proteins- Lipoproteins, glycoprotein's, Nucleoproteins, Structure and functions, Proteins and nucleic acid interaction and Ramachandran plot, Proteins in plasma membrane.

Unit- IV

Enzymes: Classification and Nomenclature of enzymes, enzymes kinetics: Derivation of Michaelis-Menten equation, mode of action of enzymes and biochemical role of coenzymes and isoenzymes, Ribozyme and Abzyme, Concept of enzymes regulation, Applications of immobilised enzymes.

List of Recommended Books:

1. Donald Voet and J.G. Voet, Biochemistry, 3rd edition. John Wiley and Sons (2004).
2. Eric E. Conn, Paul K. Stumpf and others. Outlines of Biochemistry 5/E. John Wiley and Sons. (1995).
3. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer. Biochemistry. 5th edition W.H. Freeman and Company, New York (2006).
4. Lehninger – Principles of Biochemistry & Bartle. Nelson & Cox. 4th edition. W. H Freeman and Company, New York.

Laboratory Course- Biomolecules Code: 22-MSZOO-108CL

Objectives:

1. Introduction of various bio-analytical techniques for analysis.
2. Evaluate the utility of various analytical techniques as a qualitative and quantitative tool.

Outcomes:

CO1: Explain the principles of various techniques and apply the knowledge of the techniques for designing various experiments in research and development.

List of Practical:

1. Estimation of alkaline and acid phosphatases in the liver procured from local market.
2. Qualitative estimation of carbohydrates, lipids and protein in tissue procured from local market.
3. Quantitative estimation of glycogen, cholesterol protein in tissue procured from local market.

Paper: Fundamentals of Molecular Biology Code: 22-MSZOO-102C**Credits: 4; Total Marks: 100; Final Theory Examination: 80; Internal Assessment– 20**

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objectives:

1. The aim of this paper is to impart advanced knowledge about the principles of molecular biology
2. To enable the students to know about all the molecular process within the cell
3. This core course will make students understand DNA replication, transcription and translation.

Outcomes:

CO1: Students will learn fundamentals of molecular biology

CO2: Students would gain expertise in understanding of DNA replication, transcription and translation processes.

UNIT- I

The history behind DNA, DNA as genetic material, A, B, Z form of DNA, DNA supercoiling (linking number, twist, writh), Organization of DNA into chromosomes, Nucleosome Model, Central dogma of biology, Structure of RNA.

UNIT –II

Chemistry of synthesis of DNA, Mechanism of DNA replication in prokaryotes (Initiation, activation and finishing DNA replication). Salient feature of DNA replication in eukaryotes, Telomere, DNA repair mechanism.

UNIT-III

Mechanism of transcription in prokaryotes, Mechanism of transcription in eukaryotes, RNA splicing and Alternative in eukaryotes, Model of gene regulation in prokaryotes (Lac operon, Trp operon). Salient feature of Gene regulation in eukaryotes.

UNIT-IV

Role of mRNA and tRNA during protein synthesis. Structure of Ribosome, mRNA transport, Initiation, Elongation & termination phases of translation.

List of Recommended Books

1. Bruce Alberts, Molecular biology of the Cell, 2014
2. Harvey Lodish, Molecular cell biology, 2007
3. James D. Watson, Molecular Biology of Gene, 2022
4. James Watson, Molecular Biology of Gene, 2004
5. P.K. Gupta, Cell and Molecular of the Cell, 2005

Laboratory Course - Fundamentals of Molecular Biology Code: 22-MSZOO-108CL

Objective: To make students aware of various experiments in field of molecular biology

Outcomes: Students will learn key experiments of molecular biology

List of Practical:

1. Agarose gel electrophoresis of DNA.
2. Amplification of DNA by PCR.
3. Demonstration of Northern blotting
4. Demonstration of Southern blotting
5. DNA Extraction from Agarose gel.
6. Estimation of DNA by chemical method.
7. Estimation of RNA by chemical method.

Course Title: Diversity of Life Forms-1 Code: 22-MSZOO-103C

Credits: 4; Total Marks: 100; Final Theory Examination: 80; Internal Assessment – 20

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objectives

1. Make students to understand how life evolved from simple to complex organization by division of labour & enhancing efficiency in Invertebrates.
2. In depth knowledge of minor phyla and their organization and relationship with other invertebrates phyla

Course Outcomes

CO1: Make students to understand how life evolved from simple to complex organization by division of labour & enhancing efficiency in Invertebrates.

CO2: The study of invertebrates reveals progressive evolutionary history of organisms

CO3: Students would be able to understand adaptations of huge complex and diverse life forms.

Unit-I

Salient Features and classification up to classes with reference to diversity in animal form: Protozoa, Porifera, Coelenterata and Helminthes, General account in Porifera to Helminthes, Common parasites and pathogens of Humans caused and prevention, Porifera: Canal system and skeleton system, Coelenterata: Polymorphism

Unit-II

Salient Features and classification up to classes with reference to diversity in animal form: Annelida, Arthropoda, Mollusca and Echinodermata.

General account in Annelida to Mollusca, Coelom; Torsion and detorsion, Ambulacral system

Unit-III

Natural history of Indian subcontinent: Biological diversity Migrations of animals (fishes, birds and mammals) according to change in season: Major habitat types of the subcontinent, Geographic origins, Common Indian mammals, birds, Seasonality of the subcontinent.

Unit-IV

Organisms of conservation concern: Rare, endangered, threatened species etc. Conservation strategies. Wildlife conservation projects: Project Tiger, Project Rhino, Project Elephant, Project crocodiles

List of Recommended Books

1. B.K. Tikadar. Threatened Animals of India, ZSI Publication, Calcutta.
2. E.O. Wilson. The Diversity of Life (The College Edition), W.W. Northern & Co.
3. Parasitic diseases of wildlife and domestic animals by A. Alonso Aguirr
4. The diversity of living organisms, author: Richard Stephen Kent Barnes

Laboratory Course-Diversity of Life forms – 1 Code: 22-MSZOO-109CL

Objective

1. To acquire practical knowledge of histological studies and water analysis which will help further in research studies.

Laboratory Course outcomes

CO1: The study will help the students to understand the new discoveries about the structure and internal functioning of the cell due to technological improvements.

List of practical

1. Slides and Museum specimens: Protozoa to Echinodermata.
2. Study of mouth parts of different insects with the help of charts and CD.
3. To identify parasites of domestic animals
4. To identify parasites of human
5. To prepare report on Rare/endangered/threatened species of Haryana
6. To show the dissection of the representative animals like Cockroach & Earthworm for their anatomical studies of various systems with the help of charts.
7. To study and classify representative animal specimen belonging to Protozoans to Echinodermata with charts and available material.
8. To study diversity of nest in birds

Course Title: Advanced Physiology Code: 22-MSZOO-104C**Credits: 4; Total Marks: 100; Final Theory Examination: 80; Internal Assessment – 20**

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objectives:

1. The aim of this paper is to impart advanced knowledge about the principles of human physiology
2. To enable the students to know about all the physiological processes going on in animal/human body.
3. This core course will make students understand how animal/human body works at all levels.

Course Outcomes:

CO1: The aim of this paper is to impart advanced knowledge about the principles of physiology of both cells and organisms.

CO2: Students would gain expertise in physiology of different Phyla and Classes of animals

CO3: An appropriate understanding of functioning of each system of different groups of animals with their comparison will be acquainted.

UNIT- I

Digestive system: Feeding mechanisms and regulation; Physiology of mammalian ingestion, digestion, absorption, assimilation and egestion; GI tract physiology; Energy balance and BMR; Comparative anatomy of digestive system in Fish, Amphibia, Reptiles, Birds, and Mammals.

Dentition in mammals

Physiological adaptations acclimatization and acclimation in response to high altitude, deep sea environment, high and low ambient temperature

UNIT –II

Respiratory system: Organs and transport of gases; respiratory pigments; exchange of gases; neural and chemical regulation of respiration; Respiratory acidosis, alkalosis and regulation of pH; Comparative anatomy of respiratory organs in Fish, Amphibia, Reptiles, Birds, and Mammals; Respiratory pigments through different phylogenetic groups; Physiological response to oxygen deficient stress.

Circulatory System: Comparative anatomy of aortic arches and heart in Fish, Amphibia, Reptiles, Birds, and Mammals; Structure of heart and blood vessel: Composition and functions of body fluids and their regulation; blood volume; blood volume regulation; Heart sounds, ECG – its principle and significance, Cardiac cycle, cardiac output and its regulation, blood pressure. Lymphatic system and blood coagulation

UNIT-III

Patterns of nitrogen excretion among different animal groups.

Comparative anatomy of digestive system in Fish, Amphibia, Reptiles, Birds, and Mammals

Functional anatomy of renal unit; mechanisms of ultrafiltration, tubular reabsorption and urine formation, micturation; Counter current mechanism; Physiology of excretion- renal regulation of acid balance; Dialysis; Influence of hormone in kidney functions.

Definition and basic classification of organisms on the basis of osmoregulation; Osmotic challenges of different environments; Mechanism of osmoregulation in fresh water, Estuarine and Marine animals; Osmoregulation in migratory organisms, Control and regulation of osmoregulation

UNIT-IV

Muscle and Receptor physiology: Structure and function of Muscle; neural control of muscle tone and posture; neuromuscular transmission and nerve conduction; Physiology and molecular mechanism of cardiac muscle regulation.

Gross neuro-anatomy of the brain and spinal cord, central and peripheral nervous system.

Structure and classification of neurons and glial cells; Synaptic action, dendritic properties and functional operation of spinal cord, Brain stem; Ca²⁺ and transmitter release; post synaptic transmission mechanism; diversity of neurotransmitters: acetylcholine, catecholamine, serotonin, GABA, glycine, histamine, peptides, NO, and opioids.

Comparative study of Mechanoreception, Photoreception, Chemoreception and Equilibrium reception

List of Recommended Books:

1. C.L. Prosser. Comparative Animal Physiology. W.B. Saunders & Company.
2. Chatterjee C C, Human Physiology. 1992.
3. Guyton, Text book of Medical Physiology, 10th Ed. W B Saunders 23
4. Sastry K V and Shukla V. Text Book of Physiology and Biochemistry, Rastogi Publication, Meerut
5. Wood, D.W. Principles and Animal physiology, 1968.

Laboratory Course: Advanced Physiology Code: 22-MSZOO-109CL

Objectives:

1. The aim of this practical paper is to impart advanced human physiology related knowledge.

Outcome:

CO1: The aim of this paper is to impart practical understanding on different physiological aspect.

List of Practical:

1. Demonstration of estimation of Haemoglobin.
2. Demonstration of determination of TLC, DLC, RBC &Count.
3. Demonstration of determination of bleeding and clotting time.
4. Demonstration of determination of blood groups.
5. Demonstration of measurement of blood pressure.
6. Demonstration of estimation of ESR.
7. To study the effect of exercise on cardiovascular and respiratory systems.
8. Demonstration of estimation of the glucose level in blood of mammal.

Course Title: Basic Principles of Aquaculture Code: 22-MSZOO-106DSE
Credits: 4; Total Marks: 100; Final Theory Examination: 80; Internal Assessment – 20

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objectives:

1. The aim of this paper is to understand the nature, status and scope of aquaculture at national and international levels and to acquire knowledge on the importance of aquaculture.
2. To gain knowledge on integrating aquaculture with agriculture and animal husbandry
3. To critically evaluate the problems faced in aquaculture and its possible solutions and to inculcate thorough knowledge on the prospects and importance of aquaculture

Course Outcomes:

CO1: After completion of this course, the student would be able to illustrate the prospects and importance of aquaculture.

CO2: The students will be able to classify different types of aquaculture.

CO3: The aim of this paper is to impart advanced knowledge about the principles of physiology of both cells and organisms.

UNIT-I

Introduction: Concept of Blue Revolution, History and definition of Aquaculture, Scope of Aquaculture in India and at global Level.

Types of aquaculture: Traditional, Extensive, Semi-Intensive, Intensive, Super Intensive. Classification based on water type: Freshwater, brackish water, open sea farming, wastewater aquaculture. Types of Aquaculture systems: pond, tanks, cage, pen, raft, raceways, aquaponics, RAS, Biofloc. Running water, periodic water exchange and zero water exchange systems.

UNIT-II

Major steps involved in Aquaculture: criteria for site selection, Pond preparation. Biosecurity measures. Stocking. Water quality management, feed management, disease management, Growth Assessment. Harvesting. Post harvesting.

Integrated aquaculture systems: Rice cum fish culture, polyculture, Poultry cum fish, Livestock cum fish farming. Problems and prospects.

UNIT-III

Candidate species for aquaculture from finfishes, prawns/ shrimps, crabs, oysters, mussels, bivalves and seaweeds. Diversification of species for aquaculture. Criteria required for the selection of candidate species in aquaculture.

UNIT-IV

Problems faced in aquaculture and its possible solutions. Prospects and importance of aquaculture for food security, Employment generation and Entrepreneurship, Sustainable aquaculture practices.

List of Recommended Books:

1. Ackefors, H., Huner, J. V., & Konikoff, M. (2017). *Introduction to the general principles of aquaculture*. CRC Press.
2. Christenson, K. 2019. *Aquaculture- Introduction to Aquaculture for small farmers* (3rd Ed). Create Space Independent Publishing Platform, USA, 104pp.
3. ICAR, 2011. *Handbook of Fisheries and Aquaculture*. ICAR, New Delhi, 1116 pp.
4. McLarney, W. 2013. *Freshwater Aquaculture*. Echo Point Books & Media, USA, 594 pp.

Laboratory Course-Basic Principles of Aquaculture Code: 22-MSZOO-109CL

Objective: The objective of this course is to give practical knowledge about the techniques used to check quality of water for aquaculture.

Outcomes: After completion of this course the students will be able to identify various aquatic lives. They will also check suitability of water for culturing fishes.

List of Practical:

1. Estimation of Carbonates, Bicarbonates in water samples
2. Estimation of Chlorides in water samples
3. Estimation of dissolved oxygen
4. Estimation of ammonia in water
5. Study of algal blooms and their control
6. Collection & identification of zooplankton and phytoplankton

Course Title: Biostatics and Biological Calculations Code: 22-MSZOO-107OE**Credits: 4; Total Marks: 100; Final Theory Examination: 80; Internal Assessment – 20**

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objectives:

The aim of this paper is to learn basic concepts of biostatistics and calculations in biological field

Course Outcomes:

CO1: After completion of this course, the student would be able to solve biological biostats problems

CO2: The students will be able to solve biological numerical problems which will help them in various competitive exams and research

Unit I

Collection, classification and tabulation of data. Frequency distribution, Diagrammatic and Graphical presentation of statistical data, sampling techniques. Central tendency, Dispersion, coefficient of variation, Skewness and Kurtosis, Correlation, Regression, Non-parametric tests and Parametric Test, Testing of Hypothesis, Chi-square tests, t and 'f' test

UNIT II

Probability: Approaches to measurement of Probability, Random experiments, sample space, events. Mathematical definition of probability of an event. Probability distributions: - Distribution of Binomial, Poisson and Normal Distributions and their properties, Analysis of variance for one-way classified data, and two-way classified data (Introduction only).

UNIT III

Introduction to significant digits, Concept of Mole and Molarity, Numerical Problems based on pH, Buffer, Dilution and preparations of Solutions

UNIT IV

Calculations based on spectrophotometry, Nucleic acid calculation – DNA, RNA- Calculations, Calculations based on Proteins. Calculations based on PCR

List of Recommended Books:

1. Basic Biostatistics: Statistics for Public Health Practice Textbook by B. Burt Gerstman
2. Biostatistics: A Foundation for Analysis in the Health Sciences Book by Wayne W.
3. Calculations for Molecular Biology and Biotechnology: A Guide to Mathematics in the Laboratory
4. How to Solve Mathematical Problems in General Biochemistry

Laboratory Course- Biostatics and Biological Calculations Code: 22-MSZOO-109CL

Objective: To introduce the students to research methods applicable in biological studies.

Outcomes: To acquaint the students to different types of scientific writing.

List of Practical:

1. Calculation of dispersion & measure of central tendency
2. Tests of statistical significance
3. Using online resources for literature review
4. Using plagiarism checker

Course Title: Cell Biology Code: 22-MSZOO-201C**Credits: 4; Total Marks: 100; Final Theory Examination: 80 Internal Assessment – 20**

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objectives:

1. To make students learn the deeper aspects of cell structure and function at molecular level.
2. To apprise students about likeness between the physiological processes at the cellular and organismic levels.

Course Outcomes:

- CO1:** This core course will make students able to understand how the cell functions as a unit of life.
- CO2:** Through this course, students will be able to appreciate the importance of various cell function and structures in the evolution of multicellular organisms.
- CO3:** The studies will make the students reveal elegance, dynamics and economy in the living cell and a gratifying unity in the principles by which a cell functions.
- CO4:** The students will know about the basic cellular and molecular approaches for cancer development and treatment

UNIT- I

Biomembranes: Molecular composition and arrangement, functional consequences; Cellular Transport – Recapitulation of the plasma membrane; diffusion, active transport and pumps, uniports, symports and antiports, receptor mediated endocytosis.

Structure of nucleus and function, Cytoskeleton and cell movement: Introduction to cytoskeleton and its role; Molecular structure of actin, myosin and their organization; Structure and dynamic organizations of microtubules and microfilaments; Microtubule motors and movement; Kinesin and Dynein- role in intracellular transport; Intermediate filaments; Role of centrioles and basal bodies; Structure and functions of cilia and flagella

UNIT –II

The Extra Cellular Matrix and Cell interactions: Cell walls; The ECM and cell-matrix interactions; Cell-cell interactions: adhesion junctions, tight junctions, gap junctions, plasmodesmata; cell-cell adhesion

Cell matrix adhesion: Integrins; Collagen; Non-collagen components Protein sorting and transport: Protein uptake into the ER; Membrane proteins and Golgi sorting; Mechanism of vesicular transport; Lysosomes; Molecular mechanism of secretory pathway

UNIT-III

Cell cycle: Eukaryotic cell cycle; Cell cycle and its regulation; Commitment to cell division; Entry into and exit from the cell cycle; Checkpoints in the mammalian cell cycle; Turnover of cellular components; Degradation of cytosolic proteins; Cell Division; Role of Meiosis in Genetic Variation

Cell – Cell signaling: Key concepts in cellular signaling mechanisms; Second messenger systems; G-protein coupled receptors; Receptor tyrosine kinases; MAP kinase cascade; Desensitization of receptors; Survival and death pathways.

UNIT-IV

Biology of Cancer: The development and causes of cancer; Oncogenes; Tumor suppressor genes; Molecular approaches to cancer treatment

Cell Death: Necrosis and Programmed cell death; Molecular Mechanism; Applications and Significance

Biology of Ageing: Morphological, Physiological and Functional changes during Ageing; Telomeres and Ageing; Theories of Ageing

List of Recommended Books:

1. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Garland Publishing Inc., New York.
2. Molecular Cell Biology, Lodish et al., W.H. Freeman and Company (8th Ed. 2016)
3. Molecular Biology, Weaver R. F., McGraw-Hill Education (5th Ed. 2011)

Laboratory Course - Cell Biology Course Code- 22-MSZOO-208CL

Objectives:

1. To apprise students about likeness between the physiological processes at the cellular and organismic levels.

Outcomes:

CO1: This course will make students able to understand the location and structural arrangement of different tissue and with special attention will be made on the cellular division process.

List of Practical:

1. Demonstration of water movement by haemolysis and crenation in blood cells.
2. Observation of Barr body in the Buccal Epithelial cells of human females.
3. Preparation of a temporary mount of Buccal epithelial cells.
4. Preparation of polytene chromosomes from salivary glands of *Drosophila* larva.
5. Study on squash technique for the study of Mitosis/Meiosis.

Course Title: Cell Metabolism Code: 22-MSZOO-202C**Credits: 4; Total Marks: 100; Final Theory Examination: 80; Internal Assessment – 20**

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objectives:

1. The aim of this paper is to impart advanced knowledge about the principles of biochemistry
2. To enable the students to know about all the key metabolic pathways within cell

Course Outcomes:

CO1: The aim of this paper is to impart advanced knowledge about the principles of Biochemistry

CO2: Students would gain expertise in metabolic pathways and their regulation within cell.

UNIT- I

Introduction to metabolism: Biochemical reaction, Bioenergetics, Law of thermodynamics, Concept of Gibbs free energy, Standard free energy charge, biological oxidation-reduction reaction, Cell as an open system, Introduction to enzymes and working of enzymes and Isoenzymes.

UNIT –II

Carbohydrate Metabolism: Glycolysis, Feeder pathways of Glycolysis, Diabetes and Lactose intolerance, Fates of pyruvate and pyruvate metabolism, Krebs cycle, Pentose phosphate pathway, Gluconeogenesis, Coordinated Regulation of Glycolysis and Gluconeogenesis and Electron transport chain

UNIT-III

Fatty acid Metabolism: Oxidation of fatty acid- Beta Oxidation pathways, Oxidation of monounsaturated fatty acid and Oxidation of polyunsaturated fatty acid, Ketone bodies and Fatty acid synthesis.

UNIT-IV

Nucleotides and amino acid Metabolism: Urea cycle, Glucose-alanine cycle, Fates of amino acid – Glycogenic and Ketogenic amino acid, Catabolic pathway of Phenylalanine, tyrosine, Overview of amino acid biosynthesis and Overview of biosynthesis and degradation of Nucleotides.

List of Recommended Books:

1. Donald Voet and J.G. Voet, Biochemistry, 3rd edition. John Wiley and Sons (2004).
2. Eric E. Conn, Paul K. Stumpf and others. Outlines of Biochemistry 5/E. John Wiley and Sons. (1995).
3. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer. Biochemistry. 5th edition W.H. Freeman and Company, New York (2006).
4. Lehninger – Principles of Biochemistry & Bartle. Nelson & Cox. 4th edition. W. H Freeman and Company, New York.

Laboratory Course -Cell Metabolism Code: 22-MSZOO-208CL

Objective: To enable students to carry out key experiments in area of cell metabolism

Outcomes: Students will learn about key experiments related to carbohydrates, lipids biochemistry.

List of Practical:

1. Qualitative test for glucose and starch
2. Quantitative analysis of reducing sugars
3. Determination of blood sugar
4. Determination of serum cholesterol
5. Determination of hemoglobin level
6. Study of enzymatic hydrolysis of starch
7. Determination of salivary amylase activity

Course Title: Diversity of life forms –II Code: 22-MSZOO-203C**Credits: 4; Total Marks: 100; Final Theory Examination: 80; Internal Assessment – 20**

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objectives

1. This paper deals with the comparative and evolutionary trends in structure and function of the organ systems of the vertebrate series.
2. To understand what are the general characters and different categories of chordates animal.
3. To understand the level of organization in chordate subphylum.
4. To understand the origin and evolutionary relationship in different subphylum of chordates.

Course Outcomes:

CO1: Students would gain expertise in explaining how a variety of interacting processes generate an organism's heterogeneous shapes, size and structural features that arise on the trajectory from embryo to adult or more generally throughout a life cycle.

CO2: Students would have a systematic and organized learning about the knowledge and concepts of growth and development of organisms.

Unit I

General Characters and development of Urochordata and Cephalochordata. Affinities of Hemichordata, Urochordata and Cephalochordata.

Unit II

Characters and affinities of Cyclostomata, Salient features of different groups of fishes; comparison between Chondrichthyes and osteichthyes; Dipnoi. Origin and evolution of Amphibia. Parental care in Amphibia

Unit III

Origin of Reptilia and adaptive radiation in Reptilia. Characters and affinities of Chelonia and Rhynchocephalia Origin and ancestry of birds, Characters and affinities of Ratitae. Origin and mechanism of flight in birds. Palate in birds. Migration in birds.

Unit IV

Origin of mammals. Characters and affinities of Prototheria and Metatheria. Dentition in mammals, Aquatic and flying adaptations in mammals, Adaptive radiation in mammals.

List of Recommended Books:

1. Boolotian and Stiles: College Zoology (Macmillan)
2. E. Mayer. Elements of Taxonomy.
3. E. Mayer. Elements of Taxonomy.
4. E.O. Wilson. The Diversity of Life (The College Edition), W.W. Northern & Co.
5. G.G. Simpson. Principle of animal taxonomy, Oxford IBH Publishing Company
6. G.G. Simpson. Principle of animal taxonomy, Oxford IBH Publishing Company.
7. Marshall and Williams: Text Book of Zoology
8. Parker & Haswell: Text Book of Zoology Vol.II (Macmillan)

Laboratory Course Diversity of life forms –II Code- 22-MSZOO-209CL

Objectives

Providing the students with the ability to recognize the major groups of invertebrates and to identify the specimens of invertebrate phyla.

Course Outcomes:

CO1: Students will be able to identify biodiversity around them and spread awareness about biodiversity conservation

CO2: This course will help the students to understand research based knowledge methods for the welfare of human.

List of Practical:

1. Economic note on specific animal
2. Study and classify specimen up to order of various phyla of vertebrates with the help of charts
3. Study of accessories bladders in fishes with the help of CD/chart
4. To show the dissection of the representative animals like herdmania, scoliodon, rat and lizard, for their anatomical studies of various systems with the help of CD/chart.

Course Title: Tools and Techniques in Zoology Code: 22-MSZOO-204C**Credits: 4; Total Marks: 100; Final Theory Examination: 80; Internal Assessment – 20**

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objectives:

1. To acquaint the students with various instruments and methodological techniques enable them to pursue scientific research in future.

Course Outcomes:

CO1: Students would gain proficiency in research methodology and assessment techniques in animal science.

CO2: Students would gain basic knowledge of the underlying principles and practical strategy of the analytical and preparative techniques that are fundamental to study and understanding of life processes.

UNIT- I

Microscopy: Principle, structural parts and applications of simple & compound microscope, phase-contrast microscope, fluorescence microscope, transmission electron microscope and scanning electron microscope.

Cell fractionation method: Principle of centrifugation and ultracentrifugation

UNIT –II

Spectrophotometry: Principle and structural parts of a spectrophotometer and their applications.

Chromatography: Principles of chromatography, paper chromatography, thin layer chromatography, gas chromatography, gel permeation chromatography, ion exchange chromatography, high pressure liquid chromatography, affinity chromatography.

UNIT-III

Electrophoresis: Principles of electrophoresis, (Brief introduction to paper electrophoresis, polyacrylamide gel electrophoresis (SDS-PAGE), agarose gel electrophoresis, isoelectric focussing, Northern, Southern and Western Blotting techniques.

Principle and Applications of Polymerase chain reaction (PCR), Real Time-PCR & their application, Principal uses of Crisper Technology.

UNIT-IV

Properties of Radiation, Mechanism of Radioactive Decay, Beta & Gamma emission, Interactions of beta and gamma radiation with matter, electron capture, Decay schemes and energy level diagrams. The laws of Radioactive Decay. Physical, biological and effective half lives, Radionuclide hazards.

Liquid scintillation counter, principles and applications of autoradiography.

List of Recommended Books:

1. Bacq, Z.M. and Alexander, P, Fundamentals of Radiography, Pergamon Press, London (1989).
2. Bennett, A.H. and Usterbere, H, Phase Microscopy: Principle and applications, John Wiley and Sons, London (1951).
3. Dawes, C.J., Techniques for Transmission and Scanning Electron Microscopy, Ladd Rew. Ind., Inc., Publishers (1981).
4. Freshrey, R.I. and Allen, R, Culture of Animal Cell: A manual of basic techniques, Lis Inc., New York. (1983).
5. In-vitro Cultivation of Animal Cells. BIOTOL, Elsevier (2004).
6. Michael G, Flow Cytometry: A Practical Approach, 3rd Edition Edited Michael G. Ormerod Oxford University Press (2000).
7. Watt, J.M., The Principles and Practice of Electron Microscopy, Watt (1985).

Laboratory Course - Tools and Techniques in Zoology Code – 22-MSZOO-209CL

Objectives:

1. To acquaint the students with various instruments and methodological techniques enable them to pursue scientific research in future.

Outcomes:

CO1: Students would gain proficiency in research methodology and assessment techniques in animal science.

CO2: Students would gain basic knowledge of the underlying principles and practical strategy of the analytical and preparative techniques that are fundamental to study and understanding of life processes.

List of Practical:

1. To study the parts of the compound microscope and phase-contrast microscope and their maintenance.
2. To study the living material under the phase contrast microscope.
3. Finding out the diameter, area and circumference with the help of stage micrometer and oculometer.

Course Title: Wildlife Conservation Code: 22-MSZOO-206DSE**Credits: 4; Total Marks: 100; Final Theory Examination: 80; Internal Assessment – 20**

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objective:

To educate the students about the importance of wild life conservation and about different hot spots in India.

Course Outcomes:

CO1: Students will understand importance of wild life in their life and understand importance of wild life in human life.

CO2: Students will understand how they conserve the wild life.

Unit –I

Wildlife: Definition, Nature, Damage and significance. Basic electric fence design, live trapping, Mist netting, Wildlife zones of India, Methods for conservation of wildlife, Red Data Book.

Unit-II

Wildlife tourism: Definition and scope, Major wildlife spots of India (National park, Sanctuaries and Biosphere Reserve), Importance of wild life in nature.

Unit-III

Extinctions: Definition, Reasons for extinction of wildlife, Poaching- Definition and implications, evidence in Poaching cases, anti poaching operations.

Unit-IV

Law for conservation of Wildlife in India, National projects: Tiger project, Elephant project, Project Rhinoceros, Project crocodile.

List of Recommended Books:

1. Techniques for wildlife Census in India by W.A. Rogers (A field Manual); Wildlife Institute of India, Dehradun.
2. Wildlife Biology by Raymond F Dasmann, Wiley Eastern Ltd., New Delhi, 198
3. Wildlife in India by Saharia, V.B. Natraj Publ. Deharadun (U.P.).
4. Wildlife wealth of India by T.C Majupuria, Tecpress Services, L.P., 487/42-SOL- Wattenslip, PratumamBnagkok, 10400, Thailand

Laboratory Course: Wildlife Conservation Code: 22-MSZOO-209CL

Objectives:

The aim of this practical paper is to impart basics knowledge about wildlife conservation in natural habitat.

Outcomes:

The aim of this paper to impart the knowledge about conservation methods for the wild life.

List of Practical:

1. Analysis of standard pug marks of large sized wild mammals.
2. Animal behavior patterns using Photostat sheets/ repertoire sheets.
3. Field visit to a zoo or wildlife part/sanctuary and preparation of field report.
4. Preparation of field diary on the basis of observations regarding habitat, habits of common available avian and rodent fauna of the region.
5. Study of beaks and claws of different bird species.
6. Study of Diversity indices: use of software in calculating diversity indices.
7. Study of Migratory Birds

Course Title: Parasitology Code: 22-MSZOO-207OE**Credits: 4; Total Marks: 100; Final Theory Examination: 80; Internal Assessment – 20**

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objectives:

1. To enable the students to understand the basic concepts in parasitology and acquaint them with the different types of host parasite interactions, immune response generated during parasitic infections, ecological adaptations and transmission of the parasites.
2. It will enable the students to understand the different vectors involved in transmission of parasitic diseases and various aspects involved in their diagnosis.

Course Outcomes:

CO1: The aim of this paper is to impart advanced knowledge about the principles of physiology of both cells and organisms.

CO2: Students would gain expertise in physiology of different Phyla and Classes of animals

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.

UNIT I

Introduction to Parasitology: Parasitism- Definition & concept, Origin and evolution of parasites, Types of Parasites and Hosts, Interrelationship between Host and Parasites, responses of hosts to parasitic infection.

Mode of transmission of parasite, Host specificity and parasitic adaptation, Bioinvasion, Factors influencing Parasitism; Influence of season, host age and other phonological factor on parasitic population (prevalence, intensity etc).

UNIT II

Protozoa: Classification, general morphology, biology, mode of transmission, pathogenicity, laboratory diagnosis and prophylaxis of protozoan parasites, *Giardia lamblia*, *Trypanosoma spp*, *Plasmodium spp*, *Cyclospora cayetanensis*.

Trematodes: Classification, general account, primary and secondary host of trematodes, egg hatching, variation of life cycle in Monogenea and Digenea with examples. Morphology, biology, mode of transmission, pathogenicity, laboratory diagnosis and prophylaxis of *Fasciolopsisbuski*, *Clonorchis sinensis*, *Paragonimuswestermani*.

UNIT III

Cestodes: Classification, general account, larval form of cestodes, comparative study of scolices in cestodes. Life cycle pattern of cestodes. Morphology, biology, mode of transmission, pathogenicity, laboratory diagnosis and prophylaxis of *Hymenolepis nana*, *Taenia saginata*.

Nematodes: Classification, general account, biology, mode of transmission, pathogenicity, laboratory diagnosis and prophylaxis of *Trichuris trichura*, *Strongyloidesstercoralis*, *Dracunculus medinensis*, *Brugiamalayi*.

Unit IV

Parasites of veterinary importance: Parasitic insects, mites and ticks; parasites of insects and their significance; nematode parasites of plants, morphology, biology, lifecycle and infection of crop plants by major plant parasitic nematodes, host parasite interactions.

Parasitic Zoonosis: Introduction, types, geographical distribution, nature, epidemiology, global burden and challenges, pathogenesis, diagnosis, treatment and prophylaxis of zoonotic viral (Rabies, Japanese encephalitis), bacterial (brucellosis, plague), protozoan (toxoplasmosis, trypanosomiasis, leishmaniasis and babesiosis) and helminthes (Clonorchis, Fasciolopsiasis, Echinococcosis, Taeniasis and Trichinellosis) diseases.

List of Recommended Books:

1. Foundations of Parasitology, Roberts L.S. and Janovy J., McGraw-Hill Publishers, New York, USA.
1. Modern Parasitology: A Textbook of Parasitology, FEG Cox., Wiley-Blackwell, U. K.
2. Parasitology: A Conceptual Approach, Eric S. Loker, Bruce V. Hofkin

Laboratory Course- Parasitology Code: 22-MSZOO-209CL

Objectives

To provide practical knowledge of various techniques used in examination of living hosts, collection, preservation, permanent slides preparation and identification of arthropod vectors.

Outcome:

To contribute on prevention of parasitic diseases of public health importance through field work.

List of Practical:

1. Culturing insect parasitic nematode, and chasing the lifecycle of the nematode on the insect host.
2. Demonstration of *in vitro* culture of *Plasmodium*, infection of mice with *Plasmodium*, chasing the process of infection by histopathology and immune reactions.
3. Study of larva and molluscan stages of helminthes through permanent slides/photomicrographs.
4. Study of prepared slides and museum specimens of selected parasites of representative groups of protozoans, helminths and arthropods.

Course Title: Molecular Endocrinology Code: 22-MSZOO-301C**Credits: 4; Total Marks: 100; Final Theory Examination: 80; Internal Assessment – 20**

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objectives: To explore the molecular approaches to study the mechanism of action of hormones and related molecules involved in various physiological processes

Course Outcomes:

- CO1:** It helps in explaining hormonal synergism and antagonism at the molecular level
- CO2:** Students will be able to identify the organs involved in the endocrine function and an understanding of appropriate key human endocrine disorder will also be developed
- CO3:** Develop an in-depth comprehensive knowledge of endocrinology from a physiological, cellular, and molecular perspective.
- CO4:** This course will make students understand the basic structure and chemical organization of hormones and various signalling molecules.

UNIT-I

Basic concept of endocrinology, its scope and role in molecular biology. Autocrine, paracrine and telocrine regulation of hormones.

Chemical nature of hormones (Amino-acid derived hormones; Peptide hormones; Glyco-protein hormones; Steroid hormones and Prostaglandin)

Sequence-specific DNA binding receptor proteins; Nuclear receptor proteins; Cytosolic receptor proteins; Cell surface receptor proteins; Their role in gene transcription, cell differentiation and cell proliferation.

Biosynthesis of peptide hormones, transcriptional and post-transcriptional modifications

UNIT-II

Prostaglandin structure, type, synthesis and biological activities.

Biosynthesis and secretion of thyroid, insulin, vasopressin, and oxytocin hormones.

Mechanism of action of peptide hormones; concept of second messengers, cAMP, cGMP, Ca⁺⁺, IP₃, DAG, NO, signal transduction mechanisms.

Mechanism of action of steroid hormones. Endocrine control of spermatogenesis, oogenesis and folliculogenesis in mammals.

UNIT-III

Hormonal regulation of Metabolism: (Role of Insulin & Glucagon in regulation of Carbohydrate metabolism; Metabolic regulatory hormones in Lipid & Protein metabolism); Endocrine regulation of calcium and phosphate homeostasis in mammals. Gastrointestinal hormones (Source, composition) and their role in regulation of metabolic activity.

Types of hormones and their release sites in Insects, Prothoracicotropic hormone, Ecdysteroids, Juvenile hormone, Neuropeptides.

UNIT-IV

Thymic hormones and cell immunity. Pineal gland structure, biosynthesis of melatonin, diurnal variations of pineal gland functions

Pheromones: Classification, chemical nature, structure, functions, relevance in applied fields, clinical applications.

Hormones and human health: Stress, metabolic and reproductive disorders (Pituitary, Pancreas, Thyroid, Testis, Ovary) - molecular basis and therapeutics.

List of Recommended Books:

1. E.J.W. Barrington. General and Comparative Endocrinology, Oxford, Clarendon Press.
2. F Bolander. Molecular Endocrinology, 3rd Edition, 2004, Academic Press, Elsevier
3. G. Litwack. Biochemical Actions of Hormones, Academic Press.
4. H. Maurice Goodman. Basic Medical Endocrinology, Fourth Edition, 2008, Academic Press, Elsevier
5. L.P. Freedman. Molecular Biology of Steroid and Nuclear Hormone Receptors, Birkhauser.
6. Mac E. Hadley, Jon E. Levine. Endocrinology, Pearson Prentice Hall, 2007
7. P.J. Bentley. Comparative Vertebrate Endocrinology. Cambridge University Press.

Laboratory Course-Molecular Endocrinology Code-22-MSZOO-307CL

Objectives: To explore the practical approaches to study the mechanism of action of hormones and related molecules involved in various physiological processes

Outcomes:

CO1 It helps to develop an in-depth comprehensive knowledge of endocrinology from a physiological, cellular, and molecular perspective in different group of animals.

List of Practical:

1. Study of histological slides and endocrine glands of vertebrates.
2. Demonstration of retro-cerebral complex (endocrine system) in insects (e.g., cockroach/any other insect).

Course Title: Biology of Immune System Code: 22-MSZOO-302C**Credits: 4; Total Marks: 100; Final Theory Examination: 80; Internal Assessment – 20**

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objectives:

1. To acquaint the students with the basic concepts of immunology and immune effector mechanisms.
2. The primary objective of this course is to help students develop skills necessary for critical analysis of contemporary literature on topics related to health and disease and role of immune system.

Course Outcomes:

CO1: The students will be able to identify the cellular and molecular basis of immune responsiveness.

CO2: The students will be able to describe immunological response and how it is triggered and regulated.

CO3: The students will be able to understand the immunomodulatory strategies essential for generating or suppressing immune responses as required in hypersensitivity reactions, transplantation, autoimmune diseases and cancer.

UNIT- I

Antigens: Immunogens, hapten and adjuvants, major classes of antigens, physical and chemical properties of antigens, Antigenicity and Immunogenicity, Basis of antigen specificity. MHC – types and importance- distribution and function. Antigen processing and presentation to T- lymphocytes. Immunoglobulins: Structure and functions of different classes of human immunoglobulins, generation of antibody diversity, monoclonal antibodies

Primary and secondary immune response, Innate and adaptive immunity; humoral and cell mediated immunity, Cells of the immune system and their differentiation, Lymphocyte traffic; organization and structure of primary and secondary lymphoid organs.

UNIT II

Major Histocompatibility Complex in mouse and HLA system in human: MHC haplotypes, Class I and class II molecules, Cellular distribution, Peptide binding, Expression and diversity and Disease susceptibility and MHC/HLA, Mechanism of immune response and generation of immunological diversity; Genetic control of immune response, Effector mechanisms; Applications of immunological techniques.

UNIT III

Complement system: Components of the complement activation, classical, alternative and lectin pathways of Complement activation, Toll-like receptors, Cytokines: Structures and functions, Cytokine receptors and Cytokines and Immune response and Immunological tolerance;

UNIT IV

Types and mechanism of hypersensitive reactions, Disorders of immune system, self tolerance and autoimmunity, Immunosuppression, immunodeficiency involving only B cells, only T cells, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiency, vaccines.

List of Recommended Books:

1. Essentials of Immunology, David, Brostoff and Roitt, Mosby & Elsevier Publishing [Latest edition].
2. Fundamentals of Immunology by William E. Paul, Lippincott Williams & Wilkins Publishing [Latest edition].
3. Immuno Biology- The immune system in health and disease, Janeway, Travers, Walport and Shlomchik, Garland Science Publishing [Latest edition].
4. Kuby Immunology, Richard, Thomas, Barbara, Janis, W. H. Freeman and Company [Latest edition].

Laboratory course: Biology of Immune System Code: 22-MSZOO-307CL

Objective: The candidate will gain hands-on knowledge and acquire adequate skill required to identify and enumerate immune cells and also perform agglutination reactions.

Course Outcome:

CO1: At the end of the course, students will be able to identify various immune cells and enumerate them

CO2: The students will be able to identify blood groups and types

List of Practical:

1. To find the blood group of own blood
2. To find the Rh factor of own blood group
3. To estimate the amount of Hb present in human blood
4. To estimate the TLC present in 1mm³ volume
5. Quantitative assay of precipitation
6. Rocket immunoelectrophoresis
7. Separation of lymphocytes
8. Sandwich enzyme linked immunosorbant assay
9. Haemagglutination test

Course Title: Concepts of Genetics Code: 22-MSZOO-303C**Credits: 4; Total Marks: 100; Final Theory Examination: 80; Internal Assessment – 20**

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objectives:

1. The aim of this paper is to impart advanced knowledge about the principles of Genetics
2. To enable the students to know about Mendelian and Non-Mendelian Work

Course Outcomes:

CO1: The students will understand contribution of Mendel in field of genetics

CO2: Students would gain expertise in gene mapping

CO3: Students will understand principles of population genetics

UNIT- I

Introduction to Genetics (basic concepts and terms), Mendelian Genetics- Monohybrid cross, Dihybrid cross, Test cross and Back cross, Mendelian laws, Trihybrid cross-fork-lime method, Phenotype vs. Genotype, Inheritance of human traits- Pedigree analysis, Extranuclear inheritance.

UNIT –II

Concepts of allele, Incomplete dominance, Codominance. Genetics of ABO Blood groups (multiple allele), Lethal allele, Epistasis- dominant epistasis and recessive epistasis, Penetrance and expressively, Chromosomal mutation- variations in number and structure.

UNIT-III

Chromosomal theory of inheritance, Genetics of Drosophila eye color. Chromosome mapping- 2 point cross and 3 point cross. Microbial genetics-Conjugation, transduction and transformation and Gene mapping in bacteria.

UNIT-IV

Sex determination and Sex chromosome, Dosage comparative- Bar bodies and Population genetics- Hardey-Weinberg law. Allele frequencies and Genotype frequencies, Genetic drift.

List of Recommended Books

1. Harry Nickla, Concepts of Genetics, 1983
2. Robert J. Brooker, Concepts of Genetics, 2011
3. William S. Klug, Concepts of Genetics, 2018
4. William S. Klug, Concepts of Genetics, 2019

Laboratory Course: Concepts of Genetics Code-22-MSZOO-308CL

Objectives: To train students for experimental skills in the area of genetics

Course Outcome: Students will learn about key experiments of genetics

List of Practical:

1. Barr Body visualization within human Cheek cell
2. Karyotyping of human chromosomes
3. To study Mendelian inheritance
4. To study human phenotypic characters
5. To study Pedigree analysis
6. To study Mitosis
7. To study Meiosis

Course Title: Developmental Biology Code: 22-MSZOO-304C**Credits: 4; Total Marks: 100; Final Theory Examination: 80; Internal Assessment – 20**

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objectives

To explain how a variety of interacting processes generate an organism's heterogeneous shapes, size and structural features that arise on the trajectory from embryo to adult, or more generally throughout a life cycle.

Course Outcomes

CO1: Students would gain expertise in explaining how a variety of interacting processes generate an organism's heterogeneous shapes, size and structural features that arise on the trajectory from embryo to adult or more generally throughout a life cycle.

CO2: Students would have a systematic and organized learning about the knowledge and concepts of growth and development of organisms.

CO3: Developmental biology displays a rich array of material and conceptual practices that could be analysed to better understand the scientific reasoning exhibited in experimental life sciences

Unit I

Developmental patterns in metazoans; Development in unicellular eukaryotes; Molecular basis of spermatogenesis, Oogenesis and fertilization

Unit II

Cell fate and Cell lineages; Stem cells; Cleavage types; Mechanism and regulation of cleavage; Blastula; Fate maps; Gastrulation, Neurulation and ectoderm; Mesoderm and endoderm

Unit III

Cytoplasmic determinants and cell specification: Cell commitment, specification, induction, competence, determination and differentiation, Germ cell determinants, Germ cell migration

Unit IV

Vulva formation Genetics of axis specification in *Drosophila*, Eye lens induction, Limb development and regeneration in vertebrates, Differentiation of neurons, HOX genes Metamorphosis, Environmental regulation of normal development, Sex determination

List of Recommended Books:

1. Ethan Bier. 'The Cold Spring'. Cold Spring Harbor Laboratory Press, New York.
2. Jonathan M. W. Slack. Essential Developmental Biology, 3rd Edition. 2012, Wiley-Blackwell
3. L. W. Browder *et. al.* Developmental Biology, 3rd Edition; Saunders College Publishing, Philadelphia.
4. L. Wolpert *et. al.* Principles of Development; Oxford University Press; 2002
5. S.F. Gilbert. Developmental Biology. 8th Edition Sinauer Associates Inc., Massachusetts.
6. T. Subramaniam. Molecular Developmental Biology, 2nd Edition, 2013. Narosa Publishing House

Laboratory Course: Developmental Biology Code – 22-MSZOO-308CL

Objective: To provide the students with the knowledge about the developmental stages, comparative structures of tissues, and analysis of genotoxicity and principles of sediment chemistry.

Course outcomes

CO1: Students would gain suitable understanding based on learning contents of embryology

CO2: Developmental biology displays a rich array of material and conceptual practices that could be analysed to better the scientific reasoning exhibited in experimental life sciences

List of Practical:

1. To study the various developmental stages of life cycle of *Caenorhabditis elegans* with the help of charts
2. To study the various developmental stages of embryogenesis and life cycle of *Drosophila*.
3. To study the various developmental stages of life cycle of Frog.
4. To study various developmental stages of chick embryo with the help of the permanent slides. 5. To study Development and Preservation of chick Embryo.

Course Title: Environmental Biology Code: 22-MSZOO-305OE**Credits: 4; Total Marks: 100; Final Theory Examination: 80; Internal Assessment – 20**

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objectives:

To educate the students about the basic environmental phenomena like pollution, ecosystem, biogeochemical cycles and gives the awareness of side effects of pollution to students.

Course Outcomes:

CO1: They will get idea about the impact of anthropogenic activities on the environment and importance of natural resources in life.

CO2: To provide general overview of different types of pollutants and functions of Environment and its components.

Unit-I

Environmental Pollution: definition of pollution, Types of pollutants, Causes and control of Air, soil, water and noise pollution, Environmental protection act 1986. Biotic and abiotic factors affecting Biodiversity

Unit-II

Energy Resources: Renewable and non renewable resources, Natural resources and their conservation, Bio fuel production and Application. Food chain and food web

Unit-III

Biodiversity: status, Monitoring and documentation. Types of biodiversity, Global warming, Ozone depletion, Biodiversity conservation strategies, photochemical smog, Biodiversity hot spot.

Unit-IV

Types of environmental health hazards, Pesticides-classification and effects, Bioaccumulation and biomagnifications, Concept of bioremediation, Waste management approaches.

List of Recommended Books:

1. Cunningham and Saigo: Environmental Science (5th Ed., McGraw Hill, 1999).
2. Odum and Baret: Fundamentals of Ecology (EWP, 2005).
3. Odum: Fundamentals of Ecology (Saunders, 1971).
4. Primark: A Primer of Conservation Biology (2nd Ed., Sinauer, 2004).
5. Raven, Berg, Johnson: Environment (Saunders. 1993).
6. Sharma: Ecology and Environment (7th Ed., Rastogi, 2000).
7. Turk and Turk: Environmental Science (4th Ed., Saunders, 1993).

Environmental Biology - Laboratory Course- Code: 22-MSZOO-308CL**Objectives:**

The Aim of this Practical Paper is to impart basics knowledge about effect of pollution on the crop biomass and ecosystem.

Outcomes:

The aim of this paper to get the knowledge about environmental effects on the living organism.

List of Practical:

1. Determination of standing crop energy status in a grassland area and construction of 'number' and 'biomass (wet weight) pyramids
2. Study of biotic components of a terrestrial ecosystem and description of the morphological adaptations of the collected organisms
3. Study of biotic components of a pond ecosystem and description of morphological adaptations of the collected organisms
4. Determination of texture, pH, carbonate, nitrate and base deficiency in different soil samples
5. Measurement of chlorophyll content per unit area of a grass field.
6. To determine the salinity of the soil.
7. To study desert adaptations in animals.
8. To study aquatic adaptation in animals.
9. To study aerial adaptation in animals.
10. To study inter specific relationships.
11. To study the biotic components of an ecosystem.

Course Title: Scientific Writing Skills Code: 22-MSZOO-305SEC**Credits: 4; Total Marks: 100; Final Theory Examination: 80; Internal Assessment – 20**

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objectives: This course aims to demystify the writing process and teach the fundamentals of effective scientific writing.

Course Outcomes:

CO1: Students will learn the writing process for effective scientific writing.

CO2: Students will learn the process of publishing scientific manuscripts

Unit I

Scientific and technical writing: Preparation of scientific report, Information, ideas, order of writing, Use of MS office, excels, PowerPoint for preparing a scientific report.

Scientific presentation: Preparation of presentation, Title, objective, methodology and results presentation,

Unit II

Meaning of Research in Biological Sciences, Methods of testing Hypotheses , Research plan and its components, Methods of Research (Survey, Observation, case study, experimental, historical and comparative methods) - Difficulties in Biological research.

Unit III

Oral presentations: Writing of Research Proposal, Report and Research Paper: Meaning and types - Stages in preparation - Characteristics - Structure - Documentation: Footnotes and Bibliography - Editing the final draft-Evaluating the final draft- Checklist for the of a good proposal/report/research paper. Basic knowledge of organizing conferences, symposia, workshop, exhibition etc

Unit IV

Use of web to collect specific information, Scientific paper and review writing, Correspondence with editors and reviewers, appropriate citations, copyright and Ethical issues in paper drafting, Acknowledgment, Keywords, Use of appropriate citations, usage of different softwares for manuscript preparation, usage of line-,bar-graphs, charts to describe the results.

List of Recommended Books:

1. Gupta S., Communication skills and Functional Grammer, University Science Press, New Delhi 110002.
2. John W. Davis, Communication skills: aguide for engineering and applied science students, Prantics Hall, 2001.
3. Llyod M., Bor R., Communication skills for medicine, Elsevier press, Churchill Liverstone Elsevier.
4. Rastogi, B.C., Bioinformatics, Concept, Skills & Applications, CBS Publications.
5. Richard Ellis, Communication Skills: Stepladders to success for professional, Gutenberg Press, Malta.

Scientific Writing Skills- Laboratory Course Code: 22-MSZOO-308CL

Objectives

To develop problem solving innovative thinking with robust communication and writing skills in youth with reference to biological sciences.

Course Outcomes:

CO1: Instruction will focus primarily on the process of learning of basics of computers.

CO2: Instruction will focus on the process of effective scientific writing *i.e.*, paper, review, paragraph or notes.

List of proposed experiments

1. Graphical representation of data
2. Application of MS office in interpretation of biological data
3. Biological Data Base assessment tools
4. Analysis of biological information by any bioinformatics tool
5. Preparation of presentation on suggested topic
6. Review writing on suggested topic

Course Title: Animal Behaviour Code: 22-MSZOO-401C**Credits: 4; Total Marks: 100; Final Theory Examination: 80; Internal Assessment – 20**

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objectives:

1. This course exposes students to the broad field of animal behaviour. Students will come to understand the historical foundations of the field, as well as current theories and evidence for a broad range of behavioural topics.
2. This course is focused on how the science underlying our theoretical understanding of behaviour is conducted, and how behavioural hypotheses at all levels of analysis can be tested experimentally.

Course Outcomes:

CO1: Students would gain insight into the important concept of animal behaviour and conservation.

CO2: It also helps the students in understanding the important factors which affect the animal behaviour

UNIT- I

An evolutionary approach to animal behaviour: History of the study of animal behaviour, objectives of behaviour, mechanism of behaviour: Neural control of behaviour, sensory processes and perception, ecology of senses.

Approaches and methods in study of behaviour; Proximate and ultimate causation

Reciprocal altruism, group selection, kin selection and inclusive fitness. Cooperation and conflict in animals.

UNIT –II

Instinct and learning, Innate releasing mechanisms: key stimuli, stimulus filtering, supernormal stimuli, open and closed IRM. Fixed action pattern- characteristics and evolutionary features.

Memory; Cognition; Sleep and Arousal; instinctive and motivative behaviour; Biological Clock and Circadian rhythms.

Learning and cognition: habituation, classical conditioning, operant conditioning, latent learning, social learning,

Homeostasis and behaviour: motivational system and their physiological basis, motivational conflict and decision making, displacement activity, Hormonal regulation of behaviours.

UNIT-III

Development of Behavior, Social Dominance; Territoriality

Basic attributes of social life, social organization in honeybee, wasp, termite and ant. Kinds of societies among bees; social significance of the nest; caste determination in bees; Foraging and orientation; Defense mechanisms in bees; Dances and languages of honeybees Foraging behaviour of bees in relation to pollination

UNIT-IV

Parental care and mating systems: Parental manipulation, evolutionarily stable strategy, cost benefit analysis of parental care. Sexual selection: intra sexual selection (male rivalry), inter-sexual selection (female choice), infanticide, sperm competition, mate guarding, consequences of mate choice for female fitness, monogamous versus polygamous sexual conflict.

Intra and interspecific relationships, Aggressive Behaviour, Mimicry and Protective colouration – Definition, types of mimicry with examples; Migration, Orientation and Navigation; Domestication and Behavioral Changes

Human behaviour: An introduction to human behaviour, human nonverbal communication, mate selection and sexual strategy, family relationships and altruism, Linking behaviours to the brain, genes, hormones and environment.

List of Recommended Books:

1. Animal Behaviour (Ethology) by V.K. Ahggarwal, 2010.
2. Animal Behaviour, David McFarland, Pitman Publishing Limited, London, UK
3. Animal Behaviour, John Alcock, Sinauer Associate Inc., USA
4. Handbook of Ethological Methods by Lehner, Phillip N, 2nd ed. Cambridge University Press, Cambridge, 1996.
5. Mechanism of Animal Behaviour, Peter Marler and J. Hamilton; John Wiley & Sons, USA
6. Michener, C.D. 1981. The social behavior of the bees. The Belknap Press of Harvard Univ. Cambridge.
7. Principles of Animal Behaviour by Dugatkin, Lee A, W.W. Norton, New York, 2004.

Laboratory Course - Animal Behaviour Code: 22-MSZOO-404CL

Objectives:

1. This course exposes in practical exercises to learn some fundamental techniques used to study behaviour, and will practice reading and analyzing current scientific literature.

Outcomes:

CO1: Students would gain insight into the important concept of animal behaviour and conservation.

CO2: It also helps the students in understanding the important factors which affect the animal behaviour

List of Practical:

1. To study the phototactic behaviour of an insect.
2. To study the geotactic behaviour of an insect.
3. To study nesting behaviour in birds.
4. To study the geotaxis, phototaxis, chemotaxis and hydrotaxi of earthworm.
5. Fixed action pattern in spider.
6. Courtship and mating behaviour in *Drosophila*.
7. Foraging behaviour in a (Myna bird).
8. Territorial behaviour in stray dogs.

Course Title: Animal Biotechnology Code: 22-MSZOO-402C**Credits: 4; Total Marks: 100; Final Theory Examination: 80; Internal Assessment – 20**

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objectives: Identification and characterization of animals breed and study about different types of method to introduce foreign gene in to host and gets idea about basic study of tissue culture method and used in agriculture.

Course Outcomes:

CO1: Students will understand how genes are expressed and what regulatory mechanisms contribute to control of gene expression, basic principles and techniques in genetic manipulation

CO2: Students will understand about genetic engineering and gene transfer technologies for animals and animal cell lines.

Unit-I

Biotechnology: Scope and Application, Tissue culture in animals, Media Composition, Preparation and sterilisation, Cell harvesting methods, Micro propagation, Protoplast fusion and somatic hybridisation; Cybrides.

Unit-II

Application of genetic engineering in agriculture, health and industry, Antisense and Ribozyme technology, application, Inhibition of splicing, Polyadenylation and translation.

Unit-III

Transgenic animals: Methods for gene transfer in developing transgenic animals, Hybridoma technology, Application of transgenic animals, Genetic load and IVF technology for Humans.

Unit-IV

Stem cells: Scope, Properties and identification, Stem cell culture, techniques and their application in clinical science. Cell culture based vaccines.

List of Recommended Books:

1. Ballinic C. A., Philips J.P and Moo Young M. Animal Biotechnology. Pergamon press, New York. Latest addition.
2. Berger S. L. and A.R. Kimmel. Methods in enzymology guide to molecular cloning techniques (Vol 152). Academic Press Inc. San Diego.1996
3. Glick, B.R. and Pasternak J.J. Molecular Biotechnology. ASM Press, Washington DC.2003
4. Watson J.D.et al. Molecular Biology of Gene (Latest adition.) Publisher Benjamin Cummings. 2007.

Laboratory Course - Animal Biotechnology**Code: 22-MSZOO-404CL****Objectives:**

The aim of this practical paper is to impart basics knowledge about advanced biotechnology and cell culture.

Outcomes:

The aim of this paper to impart the knowledge about different methods for genetic engineering in animal biotechnology.

List of Practical:

1. To perform isolation of DNA
2. To perform isolation of DNA
3. To separate DNA sample by agarose gel electrophoresis
4. To perform western blotting to analyze the given protein sample DNA gel extraction
5. Quantitative estimation of protein ,glucose, DNA and RNA

Course Title: Ecology and Evolution Code: 22-MSZOO-403C**Credits: 4; Total Marks: 100; Final Theory Examination: 80; Internal Assessment – 20**

Note: There shall be nine questions in total. The first question will be compulsory (short answer type) covering the entire syllabus and the remaining eight questions will be from each unit (Two from each unit). Students are required to attempt five questions covering one question from each unit.

Objectives:

1. The primary objective of the course to aware the students about different life form on earth and drive home the relationship between different living forms both at the genetic and the ecological levels.
2. This course is focused on understanding to the students about interaction of living organism with environment.

Course Outcomes:

CO1: Students aware about of knowledge of evolution would facilitate in assessing the potential disease causing organisms and thus be able to design effective disease control strategies.

CO2: Students would be able to take up functional studies of many organisms. Students will be exposed to the fundamental aspects of ecology.

CO3: Students will get idea about the natural resources and their conservation.

Unit-I

Introduction and scope of Ecology, Biotic and Abiotic factors, Concept of habitat and niche- fundamental and realized niche, Character displacement.

Population Ecology: Characteristics, Population growth curve, r and k selection, types of species interaction. Keystone species

Unit-II

Ecology succession: Definition, types and mechanism. Concept of climax,

Ecosystem ecology: Ecosystem structure and function, Energy flow through ecosystem, Ecological pyramids, Primary production and decomposition.

Unit-III

Concept of Evolution and Theories of chemical evolution, evidence of evolution, Darwin and Lamarck theory, Natural selection, genetic drift, Sexual selection, Artificial selection, Mutation theory.

Unit-IV

Hardy Weinberg law of genetic equilibrium, Genetics and mode of speciation, Pattern and Mechanism of reproductive isolation, Concept of phylogenetic tree and construction of phylogenetic tree by Parsimony method, Phylogenetic gradualism and punctuated equilibrium.

List of Recommended Books:

1. Coyne and Orr: Speciation(2004, Sinauer)
2. Dobzhansky et al: 1976 Evolution (2004, Surjeet Publ)
3. Ecology by Krebs J. Charles, Harper & Row Publ. New York, 1982.
4. Fundamentals of Ecology by E.P. Odum, Saunders College Publishing, Philadelphia, 1971.
5. Futuyama: Evolutionary Biology(1998, Sinauer)
6. Natural Resources Conservation: An Ecological Approach by O.S. Qwen, MacMillan Publ. Co. N.T., 1994.

Laboratory Course: Ecology and Evolution Code: 22-MSZOO-404CL

Objectives:

The Aim of this practical paper gives the basic knowledge about environment living organism interaction and effect on their body structure.

Outcomes:

The Aim of this paper gives the idea about change in gene frequencies in a population and how the nature selects individuals in a population.

List of Practical:

1. Demonstration of natural selection under laboratory conditions by making competition between red-eyed and white-eyed *D. melanogaster*
2. Demonstration of Hardy-Weinberg equilibrium in human populations by taking examples of MN and ABO blood group systems
3. Study of inversion polymorphism in *Drosophila melanogaster*
4. Study of sexual isolation between two closely related and sympatric species of *Drosophila*: *D. bipectinata* and *D. malerkotliana*