## FACULTY OF LIFE SCIENCES

# SCHEME FOR

# M.Sc. Zoology PART-I and II

# (Semester: I, II, III and IV)

# Session: 2021–22, 2022-23



**Sri Guru Teg Bahadar Khalsa College**

**Sri Anandpur Sahib-140118, Punjab**

\*An Autonomous College

\*NAAC Accredited 'A' Grade

\*College with Potential for Excellence Status by UGC

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**SCHEME**

**M.SC. ZOOLOGY (Ist Year)**

**Session: 2021–22, 2022-23**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **YEAR** | **SEMESTER** | **COURSE** | **COURSE CODE** | **COURSE NAME** | **CREDITS** | **MARKS** | **TOTAL MARKS** |
| **EXTERNAL** | **INTERNAL** |
| I | I | CC-I | MZO111 | Biosystematics and Taxonomy | 4 | 70 | 30 | 100 |
| CC-II | MZO 112 | Evolutionary Biology | 4 | 70 | 30 | 100 |
| CC-III | MZO 113 | Molecular Biology | 4 | 70 | 30 | 100 |
| CC-IV | MZO 114 | Developmental Biology | 4 | 70 | 30 | 100 |
| CC-V | MZO115 | Concepts of Ecology | 4 | 70 | 30 | 100 |
| Practical I | MZO 116 | Theory Paper MZO 111 and 112 | 2 | 50 | - | 50 |
| Practical II | MZO 117 | Theory Paper MZO 113 and 114 | 2 | 50 | - | 50 |
| Practical III | MZO 118 | Theory Paper MZO 115 | 1 | 25 | - | 25 |
| **Total** | **25** |  |  | **625** |
| II | CC-VI | MZO 121 | Cytogenetics | 4 | 70 | 30 | 100 |
| CC-VII | MZO122 | General Physiology | 4 | 70 | 30 | 100 |
| CC-VIII | MZO 123 | Biochemistry | 4 | 70 | 30 | 100 |
| CC-IX | MZO 124 | General Immunology | 4 | 70 | 30 | 100 |
| EC-I | MZO 125 A | Bioinformatics and AppliedBiology | 4 | 70 | 30 | 100 |
| MZO 125 B | Industrial Zoology |
| Practical IV | MZO 126 | Theory Paper MZO 121 and 122 | 2 | 50 | - | 50 |
| Practical V | MZO 127 | Theory Paper MZO 123 and 124 | 2 | 50 | - | 50 |
| Practical VI | MZO 128 | Theory Paper MZO 125 A or125 B | 1 | 25 | - | 25 |
| **Total** | **25** |  |  | **625** |
| **TOTAL (Ist Year) SEMESTER I and II** | **50** |  |  | **1250** |
| **Pass percentage in Theory and Lab is 35%** |
| **CC= Core Course, EC= Elective Course** |

**SCHEME**

**M.SC. ZOOLOGY (IInd Year)**

**Session: 2021–22, 2022-23**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **YEAR** | **SEMESTER** | **COURSE** | **COURSE CODE** | **COURSE NAME** | **CREDITS** | **MARKS** | **TOTAL MARKS** |
| **EXTERNAL** | **INTERNAL** |
| II | III | CC-X | MZO211 | Animal Behaviour | 4 | 70 | 30 | 100 |
| CC-XI | MZO 212 | General Endocrinology | 4 | 70 | 30 | 100 |
| CC-XII | MZO 213 | Instrumentation and Biostatistics | 4 | 70 | 30 | 100 |
| CC-XIII | MZO 214 | Cell Signalling | 4 | 70 | 30 | 100 |
| CC-XIV | MZO215 | Microbiology | 4 | 70 | 30 | 100 |
| Practical VII | MZO 216 | Theory Paper MZO 211 and 212 | 2 | 50 | - | 50 |
| Practical VIII | MZO 217 | Theory Paper MZO 213 and 214 | 2 | 50 | - | 50 |
| Practical IX | MZO 218 | Theory Paper MZO 215 | 1 | 25 | - | 25 |
| **Total** | **25** |  |  | **650** |
| IV | CC-XV | MZO 221 | Zoogeography, Wildlife and itsmanagement | 4 | 70 | 30 | 100 |
| CC-XVI | MZO222 | Histology and Histochemistry  | 4 | 70 | 30 | 100 |
| CC-XVII | MZO 223 | Bio – Techniques | 4 | 70 | 30 | 100 |
| CC-XVIII | MZO 224 | Fish and fisheries | 4 | 70 | 30 | 100 |
| EC-II | MZO 225 A | Parasitology | 4 | 70 | 30 | 100 |
| MZO 225 B | Entomology |
| MZO 225 C | Research Project | Thesis 70 |
| Practical X | MZO 226 | Theory Paper MZO 221 and 222 | 2 | 50 | - | 50 |
| Practical XI | MZO 227 | Theory Paper MZO 223 and 224 | 2 | 50 | - | 50 |
| Practical XII | MZO 228 | Theory Paper MZO 225 A or 225 B or 225 C | 1 | 25 | - | 25 |
| **Total** | **25** |  |  | **650** |
| **TOTAL (IInd Year) SEMESTER III and IV** | **50** |  |  | **1250** |
| **Pass percentage in Theory and Lab is 35%** |
| **CC= Core Course, EC= Elective Course** |

**SEMESTER– I**

**CORE COURSE I**

**MZO 111**

**BIOSYSTEMATICS AND TAXONOMY**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE PAPER**

To give students a thorough understanding in the principles and practice of biosystematics. This course will help the students to acquire an in depth knowledge on the diversity and relationships existing in the animal world. Taxonomic concepts will help to develop a holistic appreciation of the phylogeny of animal world and of different taxonomic tools used in the classification

**LEARNING OUTCOMES**

On completion of the course, the student is expected to be able to: know the basic concept of biosystematics and procedure in taxonomy. Identified the taxonomic status of the entire animal world and discuss the evolutionary model of the group.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

**SECTION – A**

1. **Definition and basic concepts of biosystematics and taxonomy**
	* Historical perceptions of systematics.
	* Importance and applications of biosystematics in biology.
2. **Trends in biosystematics- concepts of different conventional and newer aspects.**
	* Chemotaxonomy
	* Cytotaxonomy
	* Molecular taxonomy.
	* Ecotaxonomy
	* Behavioural taxonomy.
3. **Species concepts – species category, different species concepts; sub-species and other intra-specific categories.**
	* Biological Species Concepts, its merits and demerits.
	* Typological species.
	* Nominalistic Species Concept.
	* Evolutionary Species Concept.

**SECTION-B**

1. **Taxonomic characters-details account of different kinds**
2. **Procedure in taxonomy**
	* Taxonomic procedures-taxonomic collections, preservation, curation, process of identification.
	* Taxonomic keys-different kinds of taxonomic keys, their merits and demerits.
	* Systematic publications-different kinds of publications.

6 **Sustainable utilization of Biodiversity**

* Equitable sharing and conservation of Biodiversity.
* Genetic Variations.
* Non-genetic Variations.

**SUGGESTED READINGS**

* M. Kato. The Biology of Biodiversity, Springer.
* G.G. Simpson, Principle of Animal taxonomy, Oxford IBM Publishing Company.
* E. Mayr. Elements of Taxonomy.
* E.O. Wilson. The diversity of Life (The College Edition), W.W. Northern and Co.
* Mayr, E. 1963. Animal species and Evolution. The Belknap press, Harward Univ. Press, Cambridge.
* Mayr, E. 1970. Populations, species and evolution, Cambridge Mass, Harvard Univ. Press.
* Ferguson, A., 1976. Biochemical systematics and evolution, john biley and Sons, N.Y., Toronlo.
* Gote, H.E. 1982. Animal Taxonomy.
* Mayr, E. and E. Aschhok. 1991. Principles of systematic, McGraw Hill Book Co. London.
* Quicke, D.L.J. 1996. Principles and Techniques of contemporary Taxonomy. Blacky Academic and Professional, London, New York.
* Sebuh, R.T. 2000. Biological systematics: Principles and Application, Cornell University Press.
* V.C. Kapoor. Theory and Practices of Animal Taxonomy. 7th edition, Oxford and IBH Publishing Co Pvt.Ltd

**SEMESTER– I**

**CORE COURSE II**

**MZO 112**

**EVOLUTIONARY BIOLOGY**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE COURSE**

This course is aimed at providing an understanding of evolutionary patterns and relationships. The students will be able to get insight into the process and patterns of biological evolution and the role of evolution as the central unifying concept of biology

**LEARNING OUTCOMES**

After completion of the course, student will gain knowledge about, Theories of Evolution, eras and evolution of species, evolutionary process such as variation, speciation, natural selection, origin of primates and man.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

**SECTION – A**

1. **Evolutionary Biology**
	* Lamarckism
	* Darwin–concepts of variation, adaptation, struggle, fitness and natural selection
	* Mendelism
	* Spontaneity of mutations
	* The evolutionary synthesis.
2. **Origin of cells and unicellular evolution**:
	* Origin of basic biological molecules
	* Abiotic synthesis of organic monomers and polymers
	* Concept of Oparin and Haldane
	* Miller’s Experiment (1953)
	* The first cell
	* Evolution of prokaryotes
	* Origin of eukaryotic cells
	* Evolution of unicellular eukaryotes
	* Anaerobic metabolism, photosynthesis and aerobic metabolism.
3. **Paleontology and Evolutionary History:**
	* The evolutionary time scale
	* Eras, periods and epoch
	* Major events in the evolutionary time scale
	* Origins of unicellular and multi cellular organisms
	* Ancestory of Man, Horse, Camel and Elephant.

**SECTION B**

1. **Phylogeny:**
	* Concepts of neutral evolution, molecular divergence and molecular clocks
	* Molecular tools in phylogeny, classification and identification
	* Protein and nucleotide sequence analysis
	* Mutations and molecular evolution
	* Gene duplication and divergence.
2. **Evolutionary processes in population and species:**
	* Population genetics – Populations, Gene pool, Gene frequency
	* Hardy-Weinberg Law
	* Concepts and rate of change in gene frequency through natural selection, migration and random genetic drift
	* Adaptive radiation
	* Isolating mechanisms
3. **The Mechanism**
	* Speciation
	* Allopatric and Sympatric speciation
	* Convergent evolution
	* Sexual selection
	* Co-evolution.

**SUGGESTED READINGS**

* Futuyma, Douglas J. 2005. Evolutionary Biology (3rd edition) Sinauer Associates, Inc., Sunderland, Massachusetts
* Coyne, Jerry A. and Orr, Allen H. 2004. Speciation Sinauer Associates, Inc., Sunderland, Massachusetts
* Gould, Stephen Jay. 2002. The Structure of Evolutionary Theory. Harvard University Press, Cambridge, Massachusetts
* Gould, Stephen Jay. 1997. Ever Since Darwin, Reflections in Natural History. W.W. Norton and company Net work
* Mayr, E. 1963. Animal Species and Evolution. Harvard University Press, Cambridge, Massachusetts
* Freeman, S. and Harron, C. Jon.2006 Evolutionary Analysis (4th Edition) Prentice Hall, Inc. Pearson, NJ
* Veer Bala Rastogi, Organic Evolution, Medtec publishers.
* Stickberger`s Evolution by Brian K Hall Benedikt Hallgrimsson (4th Edition)

**SEMESTER– I**

**CORE COURSE III**

**MZO113**

**MOLECULAR BIOLOGY**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE COURSE**

To acquaint students the knowledge of concepts of molecular biology, current biotechnology and its applications.

**LEARNING OUTCOMES**

After completion of this course students will be able to:

* Explain the process of inheritance.
* Describe how RNA, DNA and proteins are synthesized, mechanisms of life including replication, transcription and translation.
* Describe process of gene regulation of every vital body activity.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

**SECTION-A**

* 1. **DNA replication in Prokaryotes:**
		+ Enzymes and accessory proteins involved in DNA replication.
		+ Mechanism of DNA replication.
		+ Co-ordination of leading and lagging strands.
	2. **DNA replication Eukaryotes**:
		+ Enzymes and accessory proteins involved in DNA replication.
		+ Mechanism of DNA replication.
		+ DNA Repair.
	3. **Prokaryotic transcription:**
		+ RNA polymerase
		+ Promoter
		+ Initiation, elongation and termination.
	4. **Eukaryotic transcription:**
		+ RNA polymerases
		+ Promoters for RNA Pol. I, II and III
		+ Initiation, elongation and termination
		+ Post-transcriptional modification of mRNA.

**SECTION –B**

* 1. **Translational Machinery :**
		+ Genetic code.
		+ RNAs: tRNA, mRNA, rRNA.
		+ Ribosomes and synthetase.
	2. **Mechanism of Translation:**
		+ Initiation, elongation and termination in Prokaryotes.
		+ Initiation, elongation and termination in Eukaryotes.
	3. **Regulation of gene expression in Prokaryotes and Eukaryotes:**
		+ Prokaryotic transcriptional regulation: Cis and Trans control in Lactose Paradigm, Attenuation and Catabolite repression.
		+ Translational control: Stringent control, autogenous control.
		+ Transcriptional and post transcriptional regulation in Eukaryotes.
	4. **Antisense and Ribozyme Technology.**
		+ Synthesis and molecular mechanism of antisense RNA molecules.
		+ Hammer head, hairpin and other ribozymes
		+ Steps in recombinant DNA technology
		+ Applications of antisense, ribozyme and r-DNA technology

**SUGGESTED READING**

* Brown, T.A. (1998). Molecular Biology Labfax II: Gene Cloning and DNA Analysis. II Edition, Academic Press, California, USA.
* Glick, B.R. and Pasternak, J.J. (2009). Molecular Biotechnology - Principles and Applications of Recombinant DNA. IV Edition, ASM press, Washington, USA.
* Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNA- Genes and Genomes- A Short Course. III Edition, Freeman and Co., N.Y.,USA.
* Primrose, S. B. and Twyman, R. M., (7th Ed. 2006), 2. Principles of Gene Manipulation and Genomics Blackwell Publishing, West Sussex, UK
* Bernard R. and Jack Molecular Biotechnology: Principles and application of recombinant DNA, , ASM Press, Herndon, USA.

**SEMESTER– I**

**CORE COURSE IV**

**MZO114**

**DEVELOPMENTAL BIOLOGY**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE PAPER**

To make students understand the concept of cell growth, Axis and pattern formation in development.

**LEARNING OUTCOMES**

Students who successfully complete this course will be able to:

* Outline and compare the developmental stages which occur in a variety of animal phyla.
* Explain the mechanisms which lead to cell determination.
* Describe the evolutionary conservation of developmental mechanisms.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

**SECTION –A**

1. **Basic concepts of development:**
* Potency, commitment, specification, induction, competence, determination and differentiation
* Morphogenetic gradients
* Cell fate and cell lineages; stem cells
* Genomic equivalence and the cytoplasmic determinants.
1. **Gametogenesis:**
* Spermatogenesis,
* Oogenesis,
* Structure of Gametes
1. **Fertilization:**
* Cell surface molecules in sperm-egg recognition in animals,
* In Mammals,
* In Sea Urchin,
* Blocks to Polyspermy
1. **Early Embryonic Development:**
* Development in Invertebrates: Sea Urchin,
* Development in vertebrates: Drosophila and Amphibia.

**SECTION – B**

1. **Morphogenesis and organogenesis in animals**:
* Cell aggregation and differentiation in D*ictyostelium*
* Organogenesis – vulva formation in *Caenorhabditis elegans*
* Eye lens induction
1. **Axis and pattern formation in:**
* Drosophila
* Frog
* Chick
1. **Development of the Tetrapod Limb regeneration in vertebrates**
2. **Post embryonic development-**
* Larval formation
* Metamorphosis
* Teratogenesis
* Sex determination
1. **Environmental Regulation of Animal Development**

**SUGGESTED READINGS**

* Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA
* Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press
* Carlson R. F. (1988) Pattern's Foundations of Embryology, Mcgraw-Hill Publishers.
* Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers
* Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University
* Urspaung, H.: Major Problems in Developmental Biology, Academic Press, New York, 1966.
* Verma, P.S. and Aggarwal, V.K. Chordate Embryology (1997), S. Chand and Company Ltd.

**SEMESTER– I**

**CORE COURSE V**

**MZO 115**

**CONCEPTS OF ECOLOGY**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE PAPER**

To define the basic rules and concepts of the ecology science. To define the ecology of individual, population, community and ecosystem. To define the concepts that is the ambient, environment, biome, biosphere, ecosphere, ecological relationship and factors, and homeostasis.

**LEARNING OUTCOMES**

Students who successfully complete this course will be able to:

* + Describe animal distribution patterns in relation to abiotic and biotic factors.
	+ Define the essential characteristics underlying natural ecosystems.
	+ Explain model population and community-level dynamics.
	+ Interpret and present ecological results.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

**SECTION –A**

1. **Population Ecology:**
	* Population attributes.
	* Population interactions.
	* Survivorship Curves.
2. **Communities:**
	* Community characteristics.
	* Ecological Succession
3. **Industrialization and Ecological Consequences.**

**SECTION –B**

1. **Biogeography and Biodiversity:**
	* Grassland to Tundra, Forest, Marine and Freshwater Ecosystems.
	* Wetlands.
	* Global Environmental change.
2. **Biological Invasions:**
	* Establishment of Invasive species.
	* Ecological impacts of Invasive species
	* Ecology of exotic species.
3. **Ecology of space travel**
	* Life support systems (Mechanical, Chemoregeneration).
	* Exobiology.

**SUGGESTED READINGS**

* Smith, R and Smith, T. 2005. Elements of Ecology (5th Edition). Pearson Publishers, USA
* Odum, E and Barrett, Gary W. 2005. Fundamentals of Ecology Thompson Publishers, USA
* Nentwig, W. 2006. Biological Invasions. Springer Publishers
* Cockwood, J. Hoopes, Martha and Marchetti, Michael 2006Invasion Ecology. Blackwell Publishers, UK

**SEMESTER– I**

**PRACTICAL I**

**MZO116**

**Pertaining to theory papers MZO111 andMZO112**

|  |  |  |
| --- | --- | --- |
| Credits: 2 |  | Pass Percentage: 35% |
| Maximum Marks: 50 |  | Pass Marks: 18 |

**MZO111**

1. Techniques of collection and preservation with respect to insects and fishes,
2. To prepare identification keys of various animal groups
3. To study external morphological features of various animal groups (beaks and claws, scales of fishes, wing venation and external genitalia of insects).
4. Identification methods for insects, fishes, birds etc.

**MZO112**

1. Study of organisms with reference to their evolutionary significance (adaptations, connecting links and modifications, missing links, and living fossils, continuous and discontinuous distribution).
2. Phylogenetic analysis in context with phenetics and cladistics.

**SEMESTER– I**

**PRACTICAL II**

**MZO117**

**Pertaining to theory papers MZO113andMZO114**

|  |  |  |
| --- | --- | --- |
| Credits: 2 |  | Pass Percentage: 35% |
| Maximum Marks: 50 |  | Pass Marks: 18 |

**MZO113**

1. Study of course of meiosis in grasshopper and bug.
2. Study of chiasmata position and chiasma frequency during Prophase I
3. Study of polytene chromosomes of *Chironomus* larva.
4. Chromosome preparation by air drying technique to study morphological details of monocentric chromosomes.
5. Chromosome preparation by air drying technique to study morphological details of holocentric chromosomes

**MZO114**

1. To study life cycle of acellular slime mould.
2. To study life cycle of cellular slime mould.
3. To study the internal structure of Chick egg.
4. To study the external morphology of blow fly.
5. To study the development of chick embryo from permanent slides.
6. To study the development of frog embryo from permanent slides.

**SEMESTER– I**

**PRACTICAL III**

 **MZO118**

**Pertaining to theory paper MZO 115**

|  |  |  |
| --- | --- | --- |
| Credits: 1 |  | Pass Percentage: 35% |
| Maximum Marks: 25 |  | Pass Marks: 09 |

**MZO115**

1. Analysis of soil for the following parameters: soil texture, pH, temperature, humidity, water holding capacity.
2. To study the external morphology and ecological adaptations of: *Pristis-*the sawfish, *Draco volans*, *Hyla arborea*, Axolotl larva of *Ambystoma, Varanus*, *Trygon*the Sting ray, *Syngnathus*the pipe fish, Stick Insect.
3. Estimation of population:
	1. Insect population using sweep net method.
	2. Population estimation using Mark and Release method (using beads/pulses etc).
4. To take up marbles of 56 different colours, mix these in different ratio by selecting one colour for one species and find out:
	1. Species composition/Diversity
	2. Dominant Species
	3. Population ratio

**SEMESTER II**

**CORE COURSE VI**

**MZO121**

**CYTOGENETICS**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE COURSE**

The course will enable the students to understand Mendelian and post Mendelian modes of inheritance, Mutation and Genetic analysis.

**LEARNING OUTCOMES**

Students will learn to

* Demonstrate an advanced knowledge of human Cytogenetics and disease;
* Demonstrate human cell culture, chromosome preparations, karyotyping and analysis of chromosomes;
* Diagnose and interpret pathology of chromosomes (chromosome aberrations, trisomy, rearrangements etc.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

**SECTION –A**

1. **Biology of Chromosome**
	* Metaphase chromosomes, Centromere, Kinetochore, Telomere and its maintenance.
	* Heterochromatin and Euchromatin.
	* Giant Chromosomes: Polytene and Lampbrush chromosomes
2. **Sex determination.**
	* Sex chromosomes and Sex determining mechanisms.
	* Dosage compensation in *Drosophila, Caenorhabditis elegans* and Human.
3. **Alterations of chromosomes**
* Structural Alterations of chromosomes
* Numerical Alterations of chromosomes
1. **Mutation**
	* Types, causes and detection
	* Mutant types – lethal, conditional, biochemical
	* Loss of function, gain of function
	* Germinal verses somatic mutants
	* Insertional mutagenesis.

**SECTION B**

1. **Recombination:**
	* Homologous and non-homologous recombination including transposition.
2. **Extensions of Mendelian principles**
	* Codominance
	* Incomplete dominance
	* Gene interactions
	* Pleiotropy
	* Genomic imprinting
	* Penetrance and expressivity
	* Phenocopy
	* Linkage and crossing over
	* Sex linkage
	* Sex limited and sex influenced characters.
3. **Gene mapping methods**
	* **Extra chromosomal inheritance**
	* Inheritance of Mitochondrial and chloroplast genes
	* Maternal inheritance.
4. **Human genetics**
	* Pedigree analysis
	* Karyotypes
	* Genetic disorders.

**SUGGESTED READINGS**

* Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India
* Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc
* Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cummings
* Russell, P. J. (2009). *Genetics- A Molecular Approach.*III Edition. Benjamin Cummings
* Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W.
* H. Freeman and Co
* Fletcher H. and Hickey I. (2015). *Genetics.* IV Edition. GS, Taylor and Francis Group, New York and London.

**SEMESTER II**

**CORE COURSE VII**

**MZO 122**

**GENERAL PHYSIOLOGY**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE COURSE**

This course will provide students with the understanding of basic physical and chemical principles underlying the physiological processes and how animals adapt physiologically to the environment changes.

**LEARNING OUTCOMES**

Students will learn to explain the basic knowledge of *animal physiology*. Students can define various systems, metabolism, working and abnormalities of the animal body.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

**SECTION A**

1. **Digestive system**
	* Digestion
	* Absorption
	* Energy balance
	* Assimilation.
2. **Blood Circulation**
	* Blood corpuscles, Blood cells and Haematopoiesis
	* Blood volume and its regulation
	* Blood groups, Haemoglobin, Haemostasis.
	* Comparative anatomy of heart structure, Myogenic heart
	* ECG – its principle and significance
	* Cardiac cycle, Heart as a pump
	* Blood pressure
	* Neural and chemical regulation of circulation
3. **Excretory system**
* Comparative physiology of excretion
* Kidney, Urine formation, Micturition, Urine concentration
* Waste elimination, Regulation of water balance
* Electrolyte balance, Acid-base balance.
* **Thermoregulation:** Comfort zone, Body temperature – physical, chemical, neural regulation, acclimatization and BMR.

**SECTION B**

1. **Respiratory system**
	* Comparison of respiration in different species
	* Anatomical considerations
	* Transport of gases
	* Exchange of gases
	* Neural and chemical regulation of respiration.
	* High altitude and deep water respiratory stress.
2. **Nervous system**
	* Neurons
	* Action potential
	* Gross neuro-anatomy of the brain and spinal cord
	* Central and peripheral nervous system
	* Neural control of muscle tone and posture.
	* **Sense organs:** Vision, hearing and tactile response.
3. **Muscles**
	* Ultra structure of skeletal muscle.
	* Contractile proteins.
	* Mechanism of Muscle contraction.
	* Isotonic and Isometric contraction.
	* Tetanic contractions.
	* Fatigue

**SUGGESTED READINGS**

* Dantzler, W.H. (ed.) Comparative Physiology (Handbook of Physiology): Vol. 1, 2Oxford University Press, New York, USA
* Davson, H. 1964. A Text Book of General Physiology, Little Brown and Co., Boston
* Ganong, W.F. 2003. Review of Medical Physiology, 21st Edition. Applenton and Lange (A Publishing Division of Prentice Hall).
* Guyton, A., G. 1986, Text Book of Medical Physiology 7th edition Sanders Publication.
* Hoar, W.S. 1983. Comparative Animal Physiology, 3rd Edition. Prentise Hall Inc. Indian Print by Jay Print Pack Pvt. Ltd., New Delhi.
* Prosser, C.L. 1973. Comparative Animal Physiology W.B. Saunders Co. (Indian Print by Asia Playing Cards Co., Agre in 1984.

**SEMESTER II**

**CORE COURSE VIII**

 **MZO 123**

**BIOCHEMISTRY**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE PAPER**

The course aims at the understanding of metabolic pathways and their linkage, metabolism of primary metabolites – monosaccharaides, lipids, amino acids and the mechanism of enzyme action.

**LEARNING OUTCOMES**

The paper imparts trough knowledge in the fundamentals of biochemistry of all the biomolecules like the carbohydrates, proteins, lipids, nucleic acids, their classification structure and metabolism.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

**SECTION – A**

1. **Structure, Chemical properties and classification of**
	* Carbohydrates
	* Lipid
	* Proteins.
2. **Overview of Metabolism**
	* Catabolism Vs Anabolism
	* Stages of catabolism
3. **Carbohydrate Metabolism** Sequence of reactions and regulation of
	* Glycolysis
	* Citric acid cycle
	* Phosphate pentose pathway
	* Gluconeogenesis
	* Glycogenesis
	* Glycogenolysis
4. **Lipid Catabolism**
	* β-oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms
	* Lipid Anabolism: Biosynthesis of palmitic acid
	* Ketogenesis and its physiological significance in Diabetes mellitus and Alcoholism

**SECTION – B**

1. **Protein Metabolism**
	* Catabolism of amino acids:
	* Transamination
	* Deamination
	* Urea cycle
	* Fate of C-skeleton of Glucogenic and Ketogenic amino acids
2. **Bioenergetics**
	* Mitochondrial Electron transport chain
	* Mechanism of Mitochondrial oxidative phosphorylation
	* Chemiosmotic theory.
3. **Structure and Functions of Enzymes**
* Nomenclature and classification
* Cofactors
* Specificity of enzyme action
* Isozymes
1. **Mechanism of enzyme action**
* Enzyme kinetics
* Factors affecting rate of enzyme-catalyzed reactions
* Derivation of Michaelis-Menten equation, Concept of Km and Vmax, Lineweaver- Burk plot
* Multi-substrate reactions
* Enzyme inhibition
* Allosteric enzymes and their kinetics
* Regulation of enzyme action.

**SUGGESTED READINGS**

* Cox, M.M and Nelson, D.L. (2008). *Lehninger Principles of Biochemistry*, V Edition, W.H. Freeman and Co., New York
* Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). *Biochemistry*, VI Edition, W.H. Freeman and Co., New York.
* Murray, R.K., Bende*r, D.A.,* Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). *Harper’s Illustrated Biochemistry*, XXVIII Edition, International Edition, The McGraw- Hill Companies Inc.
* S.chand.publication Fundamentals of Biochemistry J.l jain ,Sunjay Jain,Nitin jain

**SEMESTER II**

**CORE COURSE IX**

 **MZO 124**

**GENERAL IMMUNOLOGY**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE COURSE**

This course is aimed at providing an understanding of evolutionary patterns and relationships. The students will be able to get insight into the process and patterns of biological evolution and the role of evolution as the central unifying concept of biology

**LEARNING OUTCOMES**

Imparts in depth knowledge of tissues, cells and molecules involved in host defense mechanisms. Understanding of types of immunity CO3 Interactions of antigens, antibodies, complements and other immune components. Understanding of immune mechanisms in disease control, vaccination, process of immune interactions.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

**SECTION–A**

1. **Introduction:**
	* Innate immunity, Adaptive (specific) immunity, comparative immunity,
	* Immune dysfunction and its consequences.
2. **Cells and organs of the Immune system:**
	* Hematopoiesis,
	* Cells of the immune system,
	* Organs of immune system.
3. **Antigens :**
	* Factors responsible for the generation of Antigenicity,
	* Epitopes and Haptens.
4. **Immunoglobulin:**
	* Basic structure sequencing studies, Fine structure,
	* Classes and Biological activities,
	* Antigenic determinants, B cell receptors.

**SECTION – B**

1. **Antigen Processing and Presentation:**
	* Role of Antigen Presenting cells,
	* Evidence of Two Processing and Presentations pathways,
	* Endogenous Antigens Presentation of Nonpeptide Bacterial Agents.
2. **T-cell:** Generation, Activation and differentiation
3. **B-cell:** Generation, Activation and differentiation.
4. **Cancer**
	* Genetic rearrangements in progenitor cells, Interaction of cancer cells with normal cells
	* Cancer and the cell cycle
	* Oncogenes, Tumor suppressor genes
	* Virus-induced cancer
	* Metastasis, Apoptosis
	* Therapeutic interventions of uncontrolled cell growth.

**SUGGESTED READINGS**

* Ovan M. Roitt, 1988: Essential Immunology ELBS.
* Robert M. Coleman, Mary F. Lanbard and Raymond E.S. Card, 1992: Fundamental Immunology Wm. C. Brown Publishers.
* Roitt, I.M., Brostoff. J. and Male, D.K., 1985: Immunology Churchil Livingstone.
* Tragger, W., 1986: Living Together- The Biology of Animal Parasitism, Plenum Press.
* Ruben, L.N. and Gershwin, M.E., 1982: Immune Regulation.
* Cooper, E.L., 1976: Comparative Immunology, Prentice Hall.
* Burnet, F.M. Immunology W.H. Freeman and Company.
* Cheng, T.C., The Biology of Animal Parasities, W.B. Saunders Co.
* Hayward, A.R. Immunodeficiency.
* Godsby, R.A. et al, 2000: Kuby Immunology W.H. Freeman and Co.
* Benjamini, et al. 2000: Immunology – A short course, Wiley Liss.

**SEMESTER II**

**ELECTIVE COURSE I**

 **MZO 125A**

**BIOINFORMATICS AND APPLIED BIOLOGY**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE COURSE**

To make the student familiar with the fundamentals of Bioinformatics. To become familiar with sequencing of genetic material. To impart the knowledge of biotechnology, different applications of biotechnology to mankind.

**LEARNING OUTCOMES**

Students gain skills in basics of internet based bio informational tools for study and research. Use in recombinant DNA technology, genetic manipulations and in a variety of industrial processes.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

**SECTION – A**

* 1. **Bioinformatics:**
		+ - Introduction, objectives and advantages.
* Elementary Knowledge about Biological Molecules ( Proteins, Nucleic Acid) and their Structural Profiles
* Understanding and Using Biological databases
	+ - * Sequence databases: Primary and secondary databases.
			* Introduction to Protein sequence databases: GENPEPT, UNIPROT, SWISSPROT, PIR. Sequence formats: GENBANK, FASTA, and ASN. The NCBI resource, ENTREZ, PUBMED, MEDLINE. ENTREZ Boolean search terms and statements, NCBI bookshelf.
* Local and Global sequence alignment, pairwise and multiple sequence alignment.
	+ - * Scoring an alignment, scoring matrices.

**SECTION –B**

* 1. **Applied Biology:**
		+ Molecular markers and their role in modern biology
		+ Transgenic animals, Molecular approaches to diagnosis and strain identification
		+ Stem cell technology
		+ Genomics and its applications.
		+ Biosensors, features and types
		+ Bioremediations
		+ Microbial Fermentation
		+ Cell and Tissue culture methods for Animals

**SUGGESTED READINGS**

* Xiong, Jin.2006. Essential Bioinformatics. Sinauer Associates, Inc., Sunderland, Massachusetts
* Rastogi, S.C., Mendiratta, Namita and Rastogi, Parag. 2003. Bioinformatics: Concepts , Skills and Applications . CBS Publishers and Distributors
* Walker, J.M. and Rapley, R.2000. Molecular Biology and Biotechnology (4th edition) . The Royal Society of Chemistry, Cambridge, U.K
* Avise, John C. 2004. Molecular Markers, Natural History and Evolution (2nd Edition) Sinauer Associates, Inc. , Sunderland , Massachusetts
* Old R.W., Primrose S.B., Principles of Gene Manipulation, An introduction to Genetic Engineering Third edition, Blackwell Scientific Publications, 2002.
* Bioinformatics: A Lab guide to the analysis of genes and proteins. Ed. By Baxevanis, 1998.
* Bioinformatics: Sequences, structure and databanks by Des Higgins and Willie Taylor, Oxford University Press, 2000.
* Bioinformatics: A Lab guide to the analysis of genes and proteins. Ed. By Baxevanis, 1998.
* Bioinformatics: Sequences, structure and databanks by Des Higgins and Willie Taylor, Oxford University Press, 2000.

**SEMESTERII**

**ELECTIVE PAPER I**

**MZO 125 B**

**INDUSTRIAL ZOOLOGY**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE COURSE**

To teach the students both in the classroom and on the field for self-employment in applied branches of Zoology including aquaculture, cattle farming, poultry and meat industry.

**LEARNING OUTCOMES**

On completion of the course, students are able to: 1. Understand the concepts of Aquaculture, poultry and cattle industry. 2. Understand the various Indian breeds and their distribution and characteristics. 3. To aware the students about economic importance of these animals.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

**SECTION – A**

1. Aquaculture : definition and impending food crisis
2. Prawn culture
3. Pearl culture
4. Poultry farming
5. Breeds of chicken birds and scientific methods of breeding

**SECTION –B**

1. Common diseases such as:
	1. Ranikhet disease
	2. Fowl pox
	3. Coccidiosis
	4. Salmonellosis
2. Development and maintenance of meat animals and meat industry
3. Exotic and indigenous breeds of sheep, goat, pig
4. Status of dairy industry in India, development and maintenance of dairy animals
5. Introduction to value added milk products (flavored milk, cream, cheese, butter, yoghurt)

**SUGGESTED READINGS**

* Pillay, T.V.R. and Kutty, M.N. 2005. Aquaculture: Principles and Practices (2nd Edition) . Blackwell Publishing Ltd. Oxford U.K
* Jhingran, V.G. 1977. Fish and fisheries of India. Hindustan Pub. Co. India
* Kurian, C.V and Sabastian, V.O. 1976. Prawns and Prawn Fisheries of India. Hindustan Publ. Corp (India)
* Rice, E.J and Botosford, H.E. 1949. Lab Poultry Management John Wiley, Hansen Inc. New York
* Sahai, R. and Vijh, R. K. 2000. Domestic Animal Diversity (Conservation and sustainable development). SI Publication, 231 MIG Housing Board, Karnal
* Winter A.R. and Funk E.M. 1956 Poultry Science and Practice, J.E Lippinoctt and Co. Chicago, Philadelphia, New York
* Legates, J.E. and Wariwick J.E. 2000. Breeding and Improvement of Farm Animals MC-Grawl –Hill Publishers, London

**SEMESTER II**

**PRACTICAL IV**

**MZO126**

**Pertaining to theory papers MZO121 andMZO122**

|  |  |  |
| --- | --- | --- |
| Credits: 2 |  | Maximum Marks:50 |
| Pass Percentage: 35% |  | Pass Marks: 18 |

**MZO121**

1. To study the sex chromatin body in the human neutrophil cells.
2. To study the sex chromatin body in the human buccal mucosal cells.
3. To prepare the Polytene chromosomes from salivary glands of *Chironomous* larva.
4. To calculate the allelic frequencies of given population.
5. To calculate the genotypic frequencies of given population.
6. To study the human karyotype.

**MZO122**

1. Preparation and staining of thin blood film to study polymorphonuclear leukocytes
2. Determination of A, B, O blood group typing and Rh factor.
3. Determination of haemoglobin content of given sample of blood.
4. Determination of Cooke Arneth count.
5. Determination of Peroxidase reaction
6. Enumeration of column chromatography.

**SEMESTER II**

**PRACTICAL V**

**MZO127**

**Pertaining to theory papers MZO123 and MZO124**

|  |  |  |
| --- | --- | --- |
| Credits: 2 |  | Maximum Marks:50 |
| Pass Percentage: 35% |  | Pass Marks: 18 |

**MZO123**

1. To estimate the content of milk protein casein in a given sample of milk.
2. To study the effect of concentration on the rate of reaction between sodium thiosulphate and HCl.
3. To study the action of enzyme amylase from the saliva of human beings.
4. To study the effects of change in temperature on the rate of reaction between sodium thiosulphate and HCl.
5. To study the permeability of plasma membrane.
6. To perform tests to identify: Carbohydrates, Proteins, and Lipids

**MZO 124**

1. Perform differential leukocyte count (DLC) of the given blood sample.
2. Perform total leukocyte count (TLC) of the given blood sample.
3. Perform antigen-antibody reactions by Ouchterlony method (precipitation reaction).
4. Study of histological section of primary and secondary lymphoid organs.
	1. Thymus
	2. Spleen
	3. Payer’s patches
5. Study of histological sections to demonstrate cellular infiltration as pathological sign caused by parasitic infections.

**SEMESTER II**

**PRACTICAL VI**

**MZ128**

**Pertaining to theory papers MZO125 A or MZO125B**

|  |  |  |
| --- | --- | --- |
| Credits: 1 |  | Maximum Marks:25 |
| Pass Percentage: 35% |  | Pass Marks: 09 |

**MZO 125 A**

1. Retrieval of DNA sequences from ENTREZ databases
2. Retrieval of protein sequences
3. Retrieval of sequences in different sequence formats
4. Searching for publications in PUBMED by different criteria

**MZO 125 B**

1. Test for detection of formalin in given milk samples.
2. Test for detection of water in given milk samples.
3. Test for detection of pulverized soap in given milk samples.
4. Test for detection of urea in given milk samples.
5. Test for detection of starch in given milk samples.
6. Test for detection of cane sugar in given milk samples.
7. Test for detection of salt in given milk samples.
8. Test for detection of ammonium sulphate in given milk samples.
9. Test for detection of benzoic acid and salicylic acid in given milk samples.
10. Egg structure and evaluation of egg quality.

### SEMESTER III

### CORE COURSE X

### MZO 211

**ANIMAL BEHAVIOUR**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE COURSE**

To understand Animal behaviour and response of animals to different instincts. Various kinds of Animal adaptations

### LEARNING OUTCOMES

Students who successfully complete this course will be able to:

* Explain the influence of natural selection on behavior.
* Describe and give examples of reproductive behaviors and mating strategies employed by animals.
* Explain corporative and competitive behavioural interactions.
* Define eusociality and explain the costs and benefits of this strategy.

### INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

### INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

### SECTION-A

1. **Animal Psychology-** Classification of behavioural patterns
	* Analysis of Behaviour (ethogram)
	* Innate Behaviour
2. **Behavioural Genetics**:
	* Genes and behaviour
	* Evolution of behaviour
	* Co-evolution
3. **Control of behaviour:**
	* Neural
	* Hormonal
4. **Communication :**
	* Chemical
	* Visual
	* Audio
	* Evolution of language (primates)

### SECTION-B

1. **Social Behaviour**:
	* Aggregation
	* Schooling in fishes
	* Flocking in birds
	* Group selection, kin selection, altruism
	* Social organization in insects and primates.
2. **Reproductive Behaviour:**
	* Mating systems
	* Use of space and territoriality
	* Courtship
	* Sperm competition
	* Parental investment and Reproductive success
	* Parental Care
3. **Biological Rhythms:**
	* Circadian and circannual rhythms
	* Orientation and navigation
	* Migration of fishes and birds
4. **Learning and memory**
	* Insight learning
	* Association learning
	* Reasoning
	* Cognitive skills

### SUGGESTED READINGS

* Alocock, J. Animal behaviour: An evolutionary approach, Sinauer Assoc., Sunderland, Mass. USA.
* Bradbury, J.W., and S.L. Verhrencamp. Principles of Animal Communication, Sinauer Assoc., Sunderland, Mass. USA.
* Clutton-Brock, T.H. The evolution of Parental care, Princeton Univ. Press, Princeton, NJ, USA.
* Eibl-Eibesfeldt, I. Ethology. The biology of behaviour, Holt, Rinechart and Winston, New York.
* Gould, J.L. The mechanisms and evolution of behaviour.
* Hauser, M. The evolution of communication, MIT Press, Cambridge, Mass. USA.
* Hinde, R.A. Animal behaviour: A synthesis of Ethology and comparative psychology. McGraw-Hill, New York.
* Krebs, J.R. and N.B. Davies, Behavioural ecology, Blackwell, Oxford, U.K.
* Wilson, E.O. Sociobiology: The new synthesis, Harvard Univ. Press, Cambridge, Mass. USA.
* Mathur Reena, Animal Behaviour (2005) Rastogi Publications.

### SEMESTER III

### CORE COURSE XI

### MZO 212

**GENERAL ENDOCRINOLOGY**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE COURSE**

To learn basic and advanced endocrine biochemistry, physiology and pathophysiology, which provide the basis for understanding endocrine diseases? To accumulate a critical mass of fundamental information and Lab approaches for the diagnosis, management and prevention of endocrine disorders

### LEARNING OUTCOMES

The student will develop an understanding of the role of the endocrine system in maintaining homeostasis and health. The student will be better able to understand the integrative workings of the human body by studying this signaling system.

### INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

### INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

### SECTION-A

1. **Hormones and hormone Action:**
	* Classification of hormones
	* Storage and secretions of hormones
	* Mechanism of hormone action: Membrane bound receptors, Intracellular receptors, and Concepts of Second messengers in hormone action: cAMP, cGMP, calcium ions, phosphoinositides and protein kinase cascade, Control of hormone secretion, Measurement of hormones in blood by radioimmunoassay (RIA).
2. **Hypothalamus and pituitary gland:**
	* The pituitary gland and its relation to the hypothalamus
	* Control of pituitary secretion by hypothalamus
	* Physiological functions and regulation of growth hormone
	* Abnormalities of growth hormone secretion
	* Neurohypophyseal hormones: Chemical nature and physiological functions of antidiuretic hormone (Vasopressin) and oxytocin.
3. **Thyroid hormones:**
	* Biosynthesis and secretion of thyroid hormones.
	* Physiological functions of thyroid hormones
	* Regulation of thyroid hormones
	* Antithyroid substances
	* Abnormalities of thyroid hormones

### SECTION- B

1. **Parathyroid hormones:**
	* Physiological anatomy of parathyroid glands
	* Effect of parathyroid hormone on calcium and phosphate metabolism
	* Regulation of parathyroid secretions
	* Calcitonin and its control on calcium ion concentration.
2. **Adrenocortical hormones:**
	* Functions of the glucocorticoids on metabolism
	* Regulation of cortisol secretion
	* Catecholamine’s: Biosynthesis and metabolism of epinephrine and norepinephrine.
	* Physiological effects of catecholamine’s
3. **Pancreas and its hormones:**
	* Insulin and its metabolic effects
	* Glucagon and its effect on glucose metabolism.

### SUGGESTED READINGS

* E.J.W. Barrington: General and comparative Endocrinology, oxford, clarendox press.
* Guyton, AG and Hall J.E: Text book of Medical Physiology 11th Ed, Saunders publications. 2006.
* William F. Ganong: Review of medical physiology, international 21st edition M C Graw Hill companies. 2003.
* P.J. Bentley: Comparative vertebrate Endocrinology, Cambridge University Press, 1976.
* R.H. Williams: Text Book of Endocrinology, W, B. Saunders.
* Gobermanetal: Comparative Endocrinology, John Wiley and sons.
* Francis. S. Greenspan and David G. Gardner: Basic and clinical endocrinology, 7th edition MC graw Hill Co. 2003.
* Norman Lavin: Manual of Endocrinology and Metabolism, Linncott Williams and Williams.

### SEMESTER III

### CORE COURSE XII

### MZO 213

**INSTRUMENTATION AND BIOSTATISTICS**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE COURSE**

Students gain knowledge about various tools and techniques used in biological systems and give them insight about their use in research. Biostatistics teaches them to use the best data analysis methods. Students gain knowledge about statistical methods like measures of central tendencies, Probability. Learns about hypothesis testing and inferential statistics and the problem-solving methods.

### LEARNING OUTCOMES

Students who successfully complete this course will be able to:

* Choose an appropriate sampling scheme and/or experimental design for a given biological question.
* Select and apply the appropriate analytical methods to biological data.
* Demonstrate the necessary skills for biological data management, analysis and graphical presentation.
* Evaluate critically the primary instrumental requirements observation and experimental biology.

### INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

### INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

### SECTION A

1. **Methods in field biology:**
	* Methods of estimating population density of animals,
	* Ranging patterns through direct, indirect and remote observations,
	* Sampling methods in the study of behaviour, habitat characterization: ground and remote sensing methods.

### Radiolabeling techniques:

* + Detection and measurement of different types of radioisotopes normally used in biology,
	+ Incorporation of radioisotopes in biological tissues and cells,
	+ Molecular imaging of radioactive material,
	+ Safety guidelines.

### Microscopic techniques:

* + Visualization of cells and subcellular components by light microscopy,
	+ Resolving powers of different microscopes,
	+ Microscopy of living cells,
	+ Scanning and transmission microscopes,
	+ Different fixation and staining techniques for EM, freeze-etch and freeze- fracture methods for EM, Image processing methods in microscopy.

### SECTION B

1. **Electrophysiological methods:**
	* Single neuron recording,
	* Patch-clamp recording,
	* ECG, Brain activity recording, Lesion and stimulation of brain,
	* Pharmacological testing,
	* Positron emission tomography (PET), Magnetic resonance imaging (MRI), Functional MRI (fMRI), computerized axial tomography (CAT).

### Biophysical Method:

* + Molecular analysis using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy
	+ Molecular structure determination using X-ray diffraction and NMR,
	+ Molecular analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.

### Statistical Methods:

* + Measures of central tendency and dispersal;
	+ Probability distributions (Binomial, Poisson and normal);
	+ Sampling distribution;
	+ Difference between parametric and non-parametric statistics;
	+ Confidence Interval; Errors; Levels of significance; Regression and Correlation; t test; Analysis of variance; χ2 test;
	+ Basic introduction to Multivariate statistics, etc.

### SUGGESTED READINGS

* Lehninger, A. Nelson, Dand Cox 2003. Principles of Biochemistry. CBS Publishers, New Delhi.
* Wilson, K and walker John 2005. Principles and Techniques of Biochemistry. Cambridge University Press.
* Stefen 2005. Basic Techniques in Molecular Biology. Springer Publishers.
* Ranjit Kumar 2002. Research Methodology; A step by step Guide for beginner’s sage publishers.
* Karp, Gerald 2002. Cell and Molecular Biology, Concepts and Experiments John Willey and Sons. U.K.
* Gupta, PK 2005. Cell and Molecular Biology. Rastogi Publications. Meerut.
* Singh, BD 2003. Biotechnology. Kalyani Publishers. New Delhi.
* Pavia, D.L., Lampmann, N.G.M and Kris, G.S. 2001 introduction to spectroscopy, 3rdedn. Harcourt, New York.
* Gupta, S.C., and Kapoor, V.K, 2001 fundamentals of Applied Statistics. Sultan Chand K Sons, 3rdedn, Jan 2001.
* PSS Sundar Rao and J Richard, Introduction to Biostatistics and Research Methods. PHI Learning Publishers.

### SEMESTER III

### CORE COURSE XIII

### MZO214

**CELL SIGNALLING**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE COURSE**

To understand how membrane-bound and nuclear receptors signal. To get deeper knowledge about the functioning and regulation of kinases, GPCRs, nuclear hormone receptors and cytokine receptors. To gain knowledge on the role of cell signaling in development and progression of animals.

### LEARNING OUTCOMES

After studying this course, students should be able to:

* Define and understand the terms like Cell signalling, G Protein coupled receptors, Enzyme linked receptors, ERK and TKA receptors.
* Understand the basic principles of signal transduction mechanisms, in particular the concepts of response specificity, signal amplitude and duration, signal integration and intracellular location
* Give examples of different types of extracellular signals and receptors, and explain their functional significance
* Describe the mechanisms by which different receptors may be activated by their respective ligands
* Describe and give examples of the structure and properties of the major components of signal transduction pathways.

### INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

### INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

### SECTION A

1. **Cell Signalling introduction**
* Types of Signalling
* Types of receptors
* Ion channel linked receptors
* Acetylcholine Cation channel
1. **G Protein coupled receptors**
* G protein, Stimulatory G Protein
* GPCR and G Protein mechanism
* Receptors of GPCR, Ligands of GPCR,
* Regulation of GPCR
1. **Signalling through G Protein coupled receptors**
* C AMP Pathway
* IP3 DAG Pathway
* Calcium calmodulin complex
* GPCR in vision

 **SECTION B**

1. **Enzyme linked Receptors**
* Receptor tyrosine Kinase
* Ligands of RTK
* Mode of action of RTK
1. **ERK Extra cellular signal regulated kinase**
* Ras-MAP Kinase pathway
* IP3/DAG pathway
* PI-3 Pathway/AKT
* mTOR and insulin signaling
1. **Tyrosine Kinase Associated Receptors**
* JAK-STAT Pathways
* Receptor serine/threonine kinases
* TGF-β Pathways
* Product of pathway
* Histidine Kinase associated receptor

**SUGESTED READINGS**

* [Bruce Alberts](https://www.google.com/search?q=Bruce+Alberts&stick=H4sIAAAAAAAAAOPgE-LSz9U3sEw3L7LMU-IEsc2yyo0rtGSyk630k_Lzs_XLizJLSlLz4svzi7KtEktLMvKLFrHyOhWVJqcqOOYkpRaVFO9gZQQA16fjj0oAAAA&sa=X&ved=2ahUKEwim9d-zrMPwAhVBzTgGHWepDJMQmxMoATAjegQIFxAD), [Alexander Johnson](https://www.google.com/search?q=Alexander+Johnson&stick=H4sIAAAAAAAAAOPgE-LSz9U3sEw3L7LMU-LRT9c3NDQuMaooz8rTkslOttJPys_P1i8vyiwpSc2LL88vyrZKLC3JyC9axCromJNakZiXklqk4JWfkVecn7eDlREA4T5CQ1EAAAA&sa=X&ved=2ahUKEwim9d-zrMPwAhVBzTgGHWepDJMQmxMoAjAjegQIFxAE), [Martin Raff](https://www.google.com/search?q=Martin+Raff&stick=H4sIAAAAAAAAAOPgE-LSz9U3sEw3L7LMUwKzTSuNK4wMtGSyk630k_Lzs_XLizJLSlLz4svzi7KtEktLMvKLFrFy-yYWlWTmKQQlpqXtYGUEAJbplMtJAAAA&sa=X&ved=2ahUKEwim9d-zrMPwAhVBzTgGHWepDJMQmxMoAzAjegQIFxAF), [Julian Lewis](https://www.google.com/search?q=Julian+Lewis&stick=H4sIAAAAAAAAAOPgE-LSz9U3sEw3L7LMU-IGsQ0NMvIKjU21ZLKTrfST8vOz9cuLMktKUvPiy_OLsq0SS0sy8osWsfJ4leZkJuYp-KSWZxbvYGUEAHITkTxLAAAA&sa=X&ved=2ahUKEwim9d-zrMPwAhVBzTgGHWepDJMQmxMoBDAjegQIFxAG), [Keith Roberts](https://www.google.com/search?q=Keith+Roberts&stick=H4sIAAAAAAAAAOPgE-LSz9U3sEw3L7LMUwKzMwrS0swstWSyk630k_Lzs_XLizJLSlLz4svzi7KtEktLMvKLFrHyeqdmlmQoBOUnpRaVFO9gZQQAHUdpvUsAAAA&sa=X&ved=2ahUKEwim9d-zrMPwAhVBzTgGHWepDJMQmxMoBTAjegQIFxAH), [Peter Walter](https://www.google.com/search?q=Peter+Walter&stick=H4sIAAAAAAAAAOPgE-LSz9U3sEw3L7LMU-IEsZPLisrKtWSyk630k_Lzs_XLizJLSlLz4svzi7KtEktLMvKLFrHyBKSWpBYphCfmAKkdrIwAzNATL0kAAAA&sa=X&ved=2ahUKEwim9d-zrMPwAhVBzTgGHWepDJMQmxMoBjAjegQIFxAI), [Dennis Bray](https://www.google.com/search?q=Dennis+Bray&stick=H4sIAAAAAAAAAOPgE-LSz9U3sEw3L7LMUwKzjcxSyvMstWSyk630k_Lzs_XLizJLSlLz4svzi7KtEktLMvKLFrFyu6Tm5WUWKzgVJVbuYGUEAPxYJjVJAAAA&sa=X&ved=2ahUKEwim9d-zrMPwAhVBzTgGHWepDJMQmxMoBzAjegQIFxAJ), [James D. Watson](https://www.google.com/search?q=James+Watson&stick=H4sIAAAAAAAAAOPgE-LSz9U3sEw3L7LMU-IAsU1Mysu0ZLKTrfST8vOz9cuLMktKUvPiy_OLsq0SS0sy8osWsfJ4JeamFiuEJ5YU5-ftYGUEALarDG1IAAAA&sa=X&ved=2ahUKEwim9d-zrMPwAhVBzTgGHWepDJMQmxMoCDAjegQIFxAK) 1983 Molecular Biology of the Cell, W.W. Norton and Co.
* Godsby, R.A. et al, 2000: Kuby Immunology W.H. Freeman and Co.
* Karp, Gerald 2002. Cell and Molecular Biology, Concepts and Experiments John Willey and Sons. U.K.
* Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA
* Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc
* Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings
* I.J brand Kramer, III Edition, Cell Signaling

### SEMESTER III

**CORE COURSE XIV**

**MZO 215**

**MICROBIOLOGY**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE COURSE**

This course is designed to explain the importance of microbial diversity. It describes role of different microorganisms to human.

### LEARNING OUTCOMES

Students who successfully complete this course will be able to:

* Describe disease-causing microorganisms and microbial agents at organismal, cellular and/or molecular levels.
* Relate normal cellular and molecular structures to their functions.
* Explain cellular processes and mechanisms that lead to physiological functions and pathological state.

### INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

### INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

**SECTION A**

1. **General Microbiology**
	* Characterization, Classification and Identification of micro-organisms.
	* Morphology and fine structure of bacteria
	* Reproduction in bacteria
2. **The Viruses**
	* Viruses: Animal and Bacterial Viruses
	* The viroids
	* The prions
3. **General Characteristics of**
	* Protozoa
	* Algae
	* Fungi

4. **Microbial Genetics**

* + Bacterial recombination
	+ Transformation
	+ Conjugation
	+ Transduction

### SECTION –B

1. **Environmental Microbiology**
	* Microbial flora of soil and their role in Nitrogen and Carbon transformation.
	* Aquatic micro-organisms and their importance.
2. **Food and Industrial microbiology**
	* Microbial spoilage and Preservation of food
	* Fermented foods: Yoghurt, Bulgarian Milk, Acidophilus Milk, Kumiss, Kefir, Soy, Tempeh, Tofu
	* SCP, Probiotics, Prebiotics
3. **Micro-organisms and Human health**
	* Microbial agents of diseases
	* Bacteria,
	* Viruses
	* Protozoa.
4. **Control of microorganism by**
	* Physical agents
	* Chemical agents

### SUGGESTED READINGS

* General Microbiology by R.V. Stainer, J.L. Ingraham, M.L. Wheelis and P.R. Painter, Mac Millan, Hong Kong, 1992.
* General Microbiology by H.G. Schegel, Cambridge University, Press, U.K. 1995
* Microbiology by Pelczar, M.J., Chan, C.S. and Krieg, D.R. McGraw-Hill offices, New York, 2000
* Microbiology: Principles and Applications by Greager, J.G., Black, J.G. and Davision, V.E., Prentice Hall, New Jersey, 1990.
* Principles of Microbiology by R.M. Atlas, Mosby, St. Louis, 1995.
* Microbiology, A Human Perspective by E.W. Nester, C.E. Roberts, M.T. Nester, WCB Phis, London, 1995.

### SEMESTER III

### PRACTICAL VII

### MZO216

**Pertaining to theory papers MZO211 andMZO212**

|  |  |  |
| --- | --- | --- |
| Credits: 2 |  | Maximum Marks:50 |
| Pass Percentage: 35% |  | Pass Marks: 18 |

**MZO 211**

1. To study the behaviour of rat by using the "Skinners Boxes"
2. Habituation/Sensitization in mosquito larvae.
3. To study the Grooming behaviour of Cockroach.
4. To study the behaviour of Earthworm.
5. Simulating the dilution, confusion and odd prey effects.
6. To study the rolling behaviour of pill bugs.
7. To assess the importance of a visual stimulus (background colour/brightness) and olfactory stimulus (background food/odorant) on an individual's decision to position itself relative to it.

### MZO 212

1. To study the permanent slides of some endocrine glands by microtome: Thyroid, Pancreas, Thymus, Spleen, Adrenal gland, Testis and Ovary.
2. To study the Process of spermatogenesis, process of oogenesis, Corpus luteum, Structure of sperm, Parathyroid gland, Sickle cell anaemia, Mammary gland and Calcified and decalcified bone.
3. To demonstrate the abnormalities of growth hormone: Dwarfism, Gigantism and Acromegaly.
4. To demonstrate the abnormalities related to Thyroid Gland: Hyperthyroidism Exophalmos, Goitre and Grave's disease; Hypothyroidism Myxoedema, Cretinism.
5. To demonstrate the abnormalities of Adrenal Gland: Cushing Syndrome.

### SEMESTER III

### PRACTICAL VIII

### MZO217

**Pertaining to theory papers MZO213 andMZO214**

|  |  |  |
| --- | --- | --- |
| Credits: 2 |  | Maximum Marks:50 |
| Pass Percentage: 35% |  | Pass Marks: 18 |

**MZO213**

1. To study the principle, working and applications of Compound microscope.
2. To study the principle, working and applications of Stereo zoom microscope.
3. To study the principle, working and applications of Phase contrast microscope.
4. To study the principle, working and applications of Fluorescent microscope.
5. To study the principle, working and applications of Spectrophotometer.
6. To prepare the chromatograph for different inks/oils by paper chromatography.

### MZO214

1. Study of cell organelles from electron micrographs.
2. Preparation of temporary stained slides of mitosis .
3. Abnormalities of mitotic/meiotic divisions (through micrographs/karyotypes).
4. Demonstration of animal cell culture.
5. Study of DNA damage by micronucleation/Comet Assay.

### SEMESTER III

### PRACTICAL IX

###  MZO218

**Pertaining to theory paper MZO 215**

|  |  |  |
| --- | --- | --- |
| Credits: 1 |  | Maximum Marks:25 |
| Pass Percentage: 35% |  | Pass Marks: 09 |

**MZO 215**

1. Sterilization of glassware used in microbiology laboratory and preparation of nutrient broth and nutrient agar.
2. Preparation of nutrient agar plates and swabbing to obtain colonies
3. Study of morphology, texture, colour, margin of bacterial colonies.
4. Differential staining of given culture to identify gram positive and gram negative bacteria.
5. Perform hanging drop mount method to examine the motility of bacteria.
6. Determine the quality of given milk sample by using methylene blue test.
7. Perform stormy clot fermentation test to detect the presence of anaerobic bacteria in given milk sample.
8. Demonstration of Catalase activity for H2O2 production in the given bacterial colony.
9. Determine the growth curve of given bacterial colony.

### SEMESTER IV

### CORE COURSE XV

### MZO 221

**ZOOGEOGRAPHY, WILDLIFE AND ITS MANAGEMENT**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE COURSE**

To understand distribution of fauna in different realms interaction, Theories of Evolution, Knowledge of eras and evolution of species. The course is an introduction to wildlife management at the state, national and international level and some of the tools used by wildlife managers In addition to providing a sound scientific and theoretical background on wildlife sciences and management, tutorial activities and a field trip will provide the students with a hands-on experience and Lab skills and tools used by wildlife managers.

### LEARNING OUTCOMES

On completion of the course, students are able to:

* Understand the Origin and development of animals, process of evolution, concepts of Universe, Geological time scale, theories of life cycles, Zoogeographical realm.
* Students can Demonstrate knowledge of the main components of wildlife management and be able to give examples..

### INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

### INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

### SECTION-A

* 1. **Zoogeography:**
		+ Zoogeographical realms
		+ Origin of major group of animals
		+ Principles, types and theories of distribution of animals
	2. **Island theory and conservation:**
		+ Habitats as Islands
		+ Island biogeography theory
		+ Speciation and Island conditions
	3. **Population and Environment:**
		+ Complexity of interactions between population and environment
		+ Reaction of organism to environmental complexity
		+ Sub-specific and trans-specific aspects of evolution
1. **Introduction to wild life.**
2. **Wild life management Principles:**
	* Food
	* Cover
	* Predators
	* Diseases.

### SECTION-B

### Important wild animals of India (mammals and birds)

1. **Factors important in wild life management:**
	* Water
	* Soil
	* Exotic animals
2. **Wild life protection Act:**
	* Hunting of wild animals.
	* Sanctuaries and National parks
	* Central Zoo Authority
	* Trade in wild animals
3. **Conservation biology**
	* Conflict between man and wild life.
	* Wild life conservation projects of India (Project Tiger, Rhino, Snow Leopard, Lion etc.)
	* The success Stories of wildlife projects.
	* Modern practices in wild life conservation.
	* Wildlife foundations, Boards and Committees of India.

### SUGGESTED READINGS

* Whittaker, R.J.1998. Island Biogeography: Ecology, Evolution and conservation Oxford University Press, New York.
* Seevers, Charles Systematics, Evolution and Zoogeography Chicago Natural History Museum, Chicago.
* MacArthur, Robert H. and Wilson, Edward O.1967 The theory of Island Biogeography Princeton University Press, Princeton and Oxford.
* Futuyma, D.J. 2005. Evolution. Sinauer Associates Inc., USA .
* Dobzhansky, T, Ayala, F.J., Stebbins, G. Ledyard and Valentine, James W. 1975. Evolution. Surjeet Publications, Delhi, India.
* Teage R.D., 1967: A manual of wild life conservation. Natraj Publishers, Dehradun
* Giles R.H., 1980: Wild life management techniques. Wildlife Society, Washington.
* Dasmann, R.F., 1982: wildlife Biology, Wiley Easton Publishers.
* Sharia, V.B., 1985: Wildlife in India NatrajPublihsers, Dehradun.
* Teage R.D., 1989: A manual of Wildlife conservation.

### SEMESTER IV

**CORE COURSE XVI**

**MZO 222**

**HISTOLOGY AND HISTOCHEMISTRY**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE COURSE**

To describe the methods of studying cells and tissues, the specific characteristic of cell components in relation to the functions of each component, the scientific basis of tissue preparation. Histochemistry combines the techniques of biochemistry and histology in the study of the chemical constitution of cells and tissues.

### LEARNING OUTCOMES

On completion of the course, students are able to:

* Understand the terms Histology and Histochemistry.
* Correlate between histological structure and function of any cell or tissue.
* Handle the histological glass slides and examine them using the maximum microscopic facilities.
* Identify various types of stains and micro techniques.

### INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

### INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

### SECTION –A

1. Scope and importance of Histology and Histochemistry
2. General principles for the preparation of Tissue for Histological studies.
3. Principle for the preparation of tissues for Histochemical localization of various Substrates and Enzymes
4. Fixation – Principle, Aims and Objectives of fixatives. Chemical action of fixatives on cells and tissue components
5. The Theory of Staining and its importance
6. Histochemical classification of Carbohydrates and Principle for the Identification of Carbohydrates (Periodic acid/Shift method (PAS)
7. Histochemical localization of Muco polysaccharides by KMNO4/AB and PAS method.
8. Histochemical classification of Lipids. Principle for the demonstration of Lipids in various animal tissues (Copper pthyalocyanin method and Sudan Blank- B method)

### SECTION B

1. Histochemical classification of Proteins
2. Principles and mechanism for the Identification of Total Proteins and Glycoproteins (Bromophenol Blue and Congo red method)
3. Principle and mechanism for the identification of Amyloids.
4. Histochemical localization of Nucleic Acids, DNA and RNA (Fulgen reaction and Pyrorin –y method).
5. Cryostat and Importance of Enzyme histochemistry.
6. Localization of enzymes in tissues, Alkaline and Acid phosphates.
7. Application of Histochemical methods for the detection of various types of Carcinoma and Immunofloroscent techniques.

### SUGGESTED READINGS

* Histochemistry Theoretical and Applied, A. G. E. Pearse, (1999), Churchil Livingstone, London and New York.
* Progress in Medical Laboratory Techniques, J.D. Bancroft, (1990) Butterworth Press, London.
* Histochemistry Theory and Practice, Barka, T and Anderson, P.J (1989) Hoeber New York.
* Histochemistry in Focus,A source book of Technics and Research needs (2007), K.Shyamasundari and K.Hanmantha Rao,MJP Puplishers,Chennai.
* Cytochemistry, Danielli,J.F. (1999), Wiley and Sons, New York, Chapman and Hall, London.
* Histochemical Techniqes, Cassilmann,W.G.B (1988), Methuen, London
* Enjyme Histochemistry and its Applications in the study of Neoplasms, Burstone, M.S. (1978), Academic Press, New York.
* An introduction to Functional Histology, Bourne, G.H. (1988), Churchil, London.

### SEMESTER IV

**CORE COURSE XVII**

**MZO 223**

**BIO-TECHNIQUES**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE COURSE**

Understanding of basic concepts of instrumentation, to gain skills in techniques of chromatography, electrophoresis, spectroscopy and radioisotopes, to gain skills in histological, immunological and electrophysiological techniques.

### LEARNING OUTCOMES

Students can learn the basic principles of analyses and detection systems involved in molecular biology techniques, chromatographic, principles of electrophoresis and immunochemical techniques and discuss how these techniques can be used in molecular medicine.

### INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

### INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

### SECTION A

1. **Molecular Biology and Recombinant DNA methods:**
* Different separation methods, Isolation and purification of RNA, DNA (genomic and plasmid) and proteins.
* Analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis,
* Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems.
1. **Expression of recombinant proteins using bacterial, animal and plant vectors:**
* Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors.
* In vitro mutagenesis and deletion techniques,
* Genes knock out in bacterial and eukaryotic organisms.

### SECTION B

1. **Protein sequencing methods, detection of post translation modification of proteins:**
* DNA sequencing methods, strategies for genome sequencing.
* Methods for analysis of gene expression at RNA and protein level,
* Large scale expression, such as micro array based techniques,
* Isolation, separation and analysis of carbohydrate and lipid molecules,
* RFLP, RAPD and AFLP techniques
1. **Histochemical and Immunotechniques:**
* Antibody generation,
* Detection of molecules using ELISA, RIA, western blot, immuno- precipitation, flowcytometry and immuno-fluorescence microscopy,
* Detection of molecules in living cells, in situ localization by techniques such as FISH and GISH.

### SUGGESTED READINGS

* Wilson, K and walker John 2005. Principles and Techniques of Biochemistry. Cambridge University Press.
* Stefen 2005. Basic Techniques in Molecular Biology. Springer Publishers.
* Karp, Gerald 2002. Cell and Molecular Biology, Concepts and Experiments John Willey and Sons. U.K.
* Gupta, PK 2005. Cell and Molecular Biology. Rastogi Publications. Meerut.
* Singh, BD 2003. Biotechnology. Kalyani Publishers. New Delhi.
* An Introduction to Molecular Biotechnology(2nd) TX Wiley-Blackwell Michael Wink 1/23/2012. ISBN: 9783527326372
* Seidman and Moore, Basic Laboratory Methods for Biotechnology: Textbook and Laboratory Reference, 2nd edition. 2009. Prentice Hall. ISBN: 0321570146

### SEMESTER IV

**CORE COURSE XVIII**

**MZO 224**

**FISH AND FISHERIES**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE COURSE**

Course provides the students comprehensive understanding about aquatic ecosystem and various economical important fishes. It helps in Understanding of embryogenesis - Early development and post embryonic development. Understanding of fish habits and habitats and their functional anatomy.

### LEARNING OUTCOMES

Students gain knowledge in the areas of responses characterization and classification of fishes. Students gain knowledge of integumentary system - basic structure of skin, dermal and epidermal pigments, fins, and scales. The students will be well equipped to become very competent in research or teaching fields

### INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

### INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

### SECTION A

1. **Classification of Pisces**
* Brief introduction to Teleostei and Elasmobranchs
1. **Scales**
* Types, structure and functions
1. **Coloration**
* Chromatophores, pigments and biological significance of coloration in fish
1. Bioluminescence in fish and its significance.Electric organs, their structure and use in fish
2. **Respiratory organs**
* Structure, modification and function of gills, Air breathing accessory organs, Swim bladder
1. Lateral line organs, Ultimobranchial glands, Corpuscles of stannius

### SECTION B

1. Fisheries of India; Brief study of Marine, fresh water, estuarine and cold water fishery
2. Physico- Chemical and Biological Factors in Fish Culture
3. Construction and maintenance of Fish Farms
4. **Fishing methods**
* Marine fishing crafts and Gears
* Inland fishing crafts and Gears
* Unconventional fishing methods
* Fertilization and management of fishery pond (spawning, hatcheries, reusing, stocking)
* Transport, mortality of fish fry
* Composite culture and cage culture
1. **Biochemical composition of fish**
* Nutritional value of fish
* Poisoning toxicity and allergies from fish as food
1. **Principle and importance of fish preservation**
* Traditional and advanced methods of fish preservation: sun–drying, salting, pickling, smoking, chilling, frying and canning etc.
* Fish products like oil, fish sauce, fish glue etc.

### SUGGESTED READINGS

* Jhingran, V.G. 1978, Fish and Fisheries of India, Hindustan Publishing House (India), New Delhi, India.
* Talwar, P.K., Jhingran, A.G. 1991, Inland Fishes of India, Vols I and II,. Oxford and IBH, New Delhi, India.
* Karl, F. L., Win, C. 1969, Freshwater Fishery Biology, Brown Company Publication, Iowa.
* Moyel, P.B; J.J. Jr., Cech. 1988, Fishes: An introduction to ichthyology, Prentice Hall, Englewood, Ciffs, N.J.
* Nelson, J.S., 1976, Fish of the World, John Wiley and Sons, New York.
* Biswas, S.P. 2002, Fundamentals of Ichtyology, Narendra Publishing House, Delhi, India.
* Hoar, W.S; Randall, D.J. 1970, Fish Physiology, Vol. IV, Academic Press, New York.
* Jayaram, K.C., 1999, The fresh water fishes of the Indian origian region, Narendra Publishing House, Delhi, India.
* Tyagi, R; Shukla, A. 2002. Encyclopedia of Fish Series, Adaptations in Fishes, 1st Edition. Anmol Publication Pvt. Ltd., New Delhi, India.
* Miller, S.A., Harley, J.P. 2005, Zoology. 6th Edition, McGraw Hill Publications, New York.
* Weichert, C.K., 1965. Anatomy of the Chordates, 3rd Edition. McGraw Hill Publications, New York.

### SEMESTER IV

### ELECTIVE COURSE II

### MZO 225 A

**PARASITOLOGY**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE COURSE**

To learn and understand the scope of parasitology. To aware the students for various parasites and diseases which spreads in human with the help of study of host-parasite relationship. To aware the students about health. To understand the various disease causing vectors like Mosquitoes. Too aware about the typhoid, disease likes cholera.

### LEARNING OUTCOMES

Students who successfully complete this course will be able to:

* + Explain basics of the parasitic life-mode in context of ecological and evolutionary forces.
	+ Apply basic physiological, evolutionary and ecological concepts to parasitic relationships.
	+ Identify major parasitic groups, and describe their key characteristics.
	+ Describe the impact of parasitic infections on human health and history.
	+ Explain medical and public health aspects of human parasitic infections.

### INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

### INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

### SECTION-A

1. **Introduction to Parasitology**
* Types of parasites
* Types of host
* Ecological aspects of parasite
* Effects of parasites on hosts
* Adaptation of host
1. **Host parasite interaction**
* Host parasite relation
* Mode of transmission
* Source ofinfection**,**
* Recognition and entry processes of different pathogens like bacteria, viruses into animal, determinants of virulence in bacteria
* Spreading factors of bacterial infection
* Evading host defense
* Exotoxin and endotoxin
1. **Protozoa**
* General organization and outline classification of parasitic protozoa
* Epidemiology, morphology, life cycle, pathogenicity, and control of *Entamoeba histolytica, Balantidium coli, Giardia lamblia, Trichomonas, Leishmania, Trypanosoma, Plasmodium*

### SECTION –B

1. **Trematoda**
* General organization and outline classification of digenetic trematodes
* Variation in Life cycle in Digenea
* Ultrastructure of body wall of digenetic trematodes
* Epidemiology, morphology, life cycle, pathogenicity, and control of *Fasciola hepatica*, *Fasciola buski* and *Schistosomes*.
1. **Cestoda**
* General Organisation and outline classification of cestoda
* Various larval forms and ultrastructure of the body wall of cestodes
* Epidemiology, morphology, Life cycle, pathogenecity and control of *Diphyllobothrium latum, Taeniasolium, T. Saginata, Echinococcus granulosus, Hymenolepis diminuta, H. nana*
1. **Nematoda**
* General organization, classification and life cycle patterns
* Epidemiology, morphology, life cycle, pathogenicity and control of *Ascaris lumbricoides, Enterobius vermicularis, Ancylestooa duodenale, Necater americanus, Wuchereria bancriofti, Onchocerca volvulus* and *Dracunculus medinensis*.

### SUGGESTED READINGS

* Burton J. Bogitsh and Thomas C. Cheng: Human Parasitology Acadenac Press.
* Belding D.L., Text Book of Parasitology III edition, ApplenterCentrueyCnoff, New York.
* Richard R. Kudo: Protozoology, CheackThomes Publication.
* Levine N.D., Nematode Parasites of deomestic animals.
* Chatterjee, K.D. 1995 : Parasitology Chatterjee Medical Publisher
* Marquardt, W.C. Demaree, R.S. and Gruieve, B. 2000, Parasitology and Vector Biology, Harcort A.P.
* Apurba Sankar Sastry and Sandhya Bhat K: Essentials of medical parasitology

### SEMESTER IV

### ELECTIVE COURSE II

### MZO 225 B

**ENTOMOLOGY**

|  |  |  |
| --- | --- | --- |
| Credits: 4 | Time Allowed: 3 Hrs | Pass Percentage: 35% |
| Maximum Marks: 100 | Theory: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Theory : 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE COURSE**

To give knowledge of insect identification, morphology, anatomy and physiology through body segments, internal organs and metabolic processes study.

### LEARNING OUTCOMES

Students will learn a complete knowledge about basics of insect body, its morphology, its internal working and biochemical processes for further usage in any form in favour or against the insects.

### INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Section A and B will have four questions in each section from the respective sections of the syllabus and will carry 10 marks each. Section C will consist of 10 short-answer type questions will cover the entire syllabus uniformly and each will carry 3 marks.

### INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt two questions from each section A and B of the question paper and the entire section C.

### SECTION-A

* 1. **Brief evolutionary history of Insects**
* Introduction to phylogeny of insects
* Major Classification of Superclass Hexapoda.
* **Insect Orders**
* Distinguishing characters
* General biology
* Habits and habitats.
	1. **General Body segmentation**
* Morphology of facial sutures
* Facial region.
	1. **Structure and modifications of**
* Antennae
* mouth parts
* wings
* legs
	1. **Thorax and Abdomen**
* Topography of typical tergum, sternum and pleuron.
* Pre-genital, genital and post genital appendages
* Generalized structure of external genitalia.

### SECTION –B

* 1. **Anatomy and Physiology of insect**
* Digestive system
* Excretory system
* Circulatory system
* Respiratory system,
* Reproductive system
* Nervous System
	1. **Sense Organs**
* Visual
* Auditory
* Tactile
	1. **Glands**
* Exocrine glands
* Endocrine glands
	1. **Thermodynamics**
* Physiology of integument
* Moulting
* Growth
* Metamorphosis
* Diapause.

### SUGGESTED READINGS

* Snodgrass. R.E. Principles of Insect Morphology, A.D. Imm's General Text-Book of Entomology.
* Chapman, R.F. 1984: The Insect Structure and Function, English University Press.
* Ross, Herbert H. Ross, Charles A. and Ross, June R.P. 1982: Text Book of Entomology, edn.4, John Wiley and Sons, New York.
* Mani, M.S. 1982: General Entomology, Edn.3 Oxford and IBH Publishing Co., New Delhi.
* Imms, A.D. Richard, O.W. and Davies, R.G. (Eds.) 1977: General Textbook Entomology, 10th Edn., Champman and Hall, London.
* D.B. Tembhare: Modern entomology, Himalayan publishing house.

### SEMESTER IV

### ELECTIVE COURSE II

### MZO 225 C

**RESEARCH PROJECT**

|  |  |
| --- | --- |
| Credits: 4 | Pass Percentage: 35% |
| Maximum Marks: 100 | Thesis: 70 | Internal Assessment: 30 |
| Pass Marks: 35 | Thesis: 25 | Internal Assessment : 10 |

**OBJECTIVES OF THE COURSE**

To well versed the students for higher education and research in the field of life sciences.

To provide quality education offering skill based programs and motivate the students for self- employment in applied branches of Zoology.

To inculcate the value based education and entrepreneurial skills among the students.

### LEARNING OUTCOMES

Achieve excellence in education and scientific research in the field of Zoology.

* Develop and implement ways and means to ensure quality performance and outputs of the project.
* Optimal use of modern technology in education and scientific research.
* Implementation of advanced training to improve the skills of graduates in Zoology and related fields

### SEMESTER VI

### PRACTICAL X

###  MZO226

**Pertaining to theory papers MZO221 and MZO222**

|  |  |  |
| --- | --- | --- |
| Credits: 2  |  | Maximum Marks:50 |
| Pass Percentage: 35% |  | Pass Marks: 18 |

**MZO221**

1. To study the zoogeographic realms of the world.
2. Map studies:
	* India – Climatic Regions
	* India Rainfall and wind
	* India – Distributions of Animals
	* Distribution of endangered animal species in Himalayan region
	* Biodiversity Hotspots location in (a) World (b) India
	* Protected Areas of India such as National parks, Wildlife Sanctuaries, Biosphere Reserves.
3. To observe the behavior of one wild animal and to write a report on it.
4. To deliver a seminar on a topic related to wild life conservation.
5. To submit an assignment on a topic concerning wild life in India.
6. To prepare a report on the latest events concerning wild animals at the national and international level.
7. To visit a wild life National Park and to submit a report on it.

### MZO222

1. Preparation of Reagents and Isolation of Animal Tissues for Histological and Histopathological Studies.
2. Preparation of Histological, Histopathological and Histochemical slides by using various Fixatives.
3. Identification of Carbohydrates and allied chemical substances (Total Carbohydrates, Glycogen, Acid Mucopolysaccharides, Alkaline Mucopolysaccharides, Neutral Mucopolysaccharides) in Animal Tissues.
4. Identification of Proteins and allied chemical substances (Total Proteins, Glyco Proteins, Tyrosine, Tryptophan) in Animal Tissues.
5. Identification of Lipid profile ( Total Lipids and Phospho Lipids) in Animal Tissues
6. Identification of Nucleic Acids ( DNA and RNA ) in Animal Tissues
7. Screening of Cancer slides prepared by Immunoflorescent Study.
8. Demonstration of Enzyme Assay by Cryostat.

### SEMESTER IV

### PRACTICAL XI

### MZO227

**Pertaining to theory papers MZO223 and MZO224**

|  |  |  |
| --- | --- | --- |
| Credits: 2 |  | Maximum Marks:50 |
| Pass Percentage: 35% |  | Pass Marks: 18 |

**MZO223**

1. Demonstration of :

 ELISA, Affinity chromatography, Gel electrophoresis, Polymerase Chain Reaction, Gel documentation and photography

1. To separate proteins using PAGE.
2. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
3. Preparation of permanent slides (double staining)
4. DNA isolation - from Animal cell (goat liver), Human Blood (Fresh / Stored / Frozen), Plasmid and Microbes

**MZO224**

1. To identify, classify and study morphological characteristics of Chondrichthyes fishes.
2. To identify, classify and study morphological characteristics of Osteichthyes fishes
3. To prepare permanent slides of Placoid scales.
4. To prepare permanent slides of Ctenoid scales.
5. To prepare permanent slides of Cycloid scales.
6. To prepare permanent slides of Ganoid scales.
7. To prepare permanent slides of ampulla of lorenzini.
8. Visit to a fish farm and submission of report on it.

### SEMESTER IV

### PRACTICAL XII

### MZO228

**Pertaining to theory paper MZO 225 A or 225B OR 225 C**

|  |  |  |
| --- | --- | --- |
| Credits: 1 |  | Maximum Marks:25 |
| Pass Percentage: 35% |  | Pass Marks: 09 |

**MZO 225 A**

1. Preparation of permanent mounts of mouth parts of major vector species.
2. Study of permanent slides related to vectors (Whole mounts and various structures).
3. Preparation of permanent slides of antennae, wings, legs and other. Morphological structures of insects having medical importance.
4. Study of immature stages of various species of mosquitoes (eggs, larvae and pupae)
5. Collection and preservation of ticks and mites of medical and veterinary importance.

### MZO 225 B

1. Morphology of head region (Sutures, Structure, Tentorium etc.), thorax , abdomen and genital structures
2. Wing and its modifications
3. To study of following systems of *Ak* grasshopper
* Digestive system.
* Nervous system
* Internal reproductive system
1. To prepare assignments on
* Nerve conduction in insects.
* Muscle contraction
1. Collection and preservation of insects of various orders.
2. Laboratory culture of important stored grain insects.

### MZO 225 C

Viva of research project.