

SYLLABUS FOR M.Sc. COURSE IN ZOOLOGY

PG I SEMESTER

SESSION – 2021-22 Onwards



**DEPARTMENT OF ZOOLOGY
SCHOOL OF BIOLOGICAL SCIENCES (SBS)
DR. HARI SINGH GOUR VISHWAVIDYALAYA
SAGAR (M.P.) 470 003**

DR. HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A CENTRAL UNIVERSITY)

M.Sc. Zoology: 04 Semester Course

Curriculum: 2021 - 2022 Onwards

1. Name of the Program: **M. Sc. Zoology**
2. Duration of the Program:
 - a) Minimum duration: 2 years
 - b) Maximum duration: 4 years
3. Structure of the Program:
 - a) Number of core courses: 16 (80 credits)
 - b) Minimum number of Elective courses to be opted by the student: 02 (6+2 = 8 credits)
 - c) Minimum number of Open elective courses to be opted by the student: 02 (2 credits each)
4. Scheme of Examination:
 - a) Mid Semester-I Examination : 20 Marks
 - b) Mid Semester-II or Internal Assessment : 20 Marks
[15 marks: Assignment; 05 marks: Attendance]
 - i) 75% and below : 00 marks
 - ii) >75% and upto 80% : 01 marks
 - iii) >80% and upto 85% : 02 marks
 - iv) >85% and upto 90% : 03 marks
 - v) >90% and upto 95% : 04 marks
 - vi) >95% : 05 marks
 - c) End Semester Examination* : 60 marks

* Student can appear in the End Semester Examination only if he/she appears I Mid Semester Examination and Internal Assessment.

End semester Examination for Practical course: 60 Marks

- a) Assessment of practical exercise : 40 marks
- b) Viva-voce : 10 marks
- c) Sessional + Practical record : 10 marks

M.Sc. I Semester

Paper Course Code	Paper Title	Credits
P-I ZOO-CC-121	Principles of Systematic Zoology – Theory	04
ZOO-CC-122	Principles of Systematic Zoology – Practical	01
P-II ZOO-CC-123	Invertebrates: Structure and Function – Theory	04
ZOO-CC-124	Invertebrates: Structure and Function– Practical	01
P-III ZOO-CC-125	Endocrinology – Theory	04
ZOO-CC-126	Endocrinology – Practical	01
P-IV ZOO-CC-127	Vertebrate Physiology – Theory	04
ZOO-CC-128	Vertebrate Physiology – Practical	01
Total Credits		20

M.Sc. COURSE, SESSION – 2021-2022
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO CC 121
PRINCIPLES OF SYSTEMATIC ZOOLOGY

L	T	P	C
4	0	0	4

12hrs/unit (Total: 60 Hrs)

Objective:

1. To be familiar with the basis of classification of different animal phyla, collection and classification of species, and their genetic variation.

Unit I

Principles of Systematics

- Definition and basic concepts of biosystematics
Alfa, beta, Gamma Taxonomy
Newer trends in Taxonomy (Molecular taxonomy details)
- Theories of Systematics

Unit II

Species Concept

- Species categories
- Typological, Nominalistic, Biological, Evolutionary, Phylogenetic & Recognition species concept
- Polytypic species
- Intraspecific categories
- Hierarchy of categories

Unit III

Taxonomic collections

- Systematic collections: value and scope of collection
- Curation of collections, housing, cataloguing
- Loans and expendable collection materials
- Taxonomic characters, different types:-(Morphological, behavioural, cytological and biochemical) and process of identification

Unit IV

Procedure of classifications

- Qualitative and quantitative analysis of Variations and procedure of classifying
- Non genetic and Genetic Variations
- Individual, social, ecological and traumatic Variation
- Sex associated and non-sex associated variations

Unit V

Principles and application of Zoological nomenclature

- Taxonomic publications
- Rules of Zoological Nomenclature
- Interpretation of Rules of nomenclature
- Type specimens and their importance

Suggested Reading (All latest editions)

1. M.Kato. The Biology of Biodiversity, Springer.
2. J.C. Avise, Molecular Markers, Natural History and Evolution, Chapman & Hall, New York.
3. E.O. Wilson, Biodiversity, Academic Press, Washington.
4. G.G. Simpson, Principle of Animal taxonomy, Oxford IBH Publishing Company.
5. E. Mayer, Principles of Systematic Zoology. McGraw-Hill Book Co.
6. E.O. Wilson, The Diversity of Life (The College Edition), W.W. Northerm & Co.
7. B.K. Tikadar, Threatened Animals of India, ZSI Publication, Calcutta.
8. Go to: Animal Taxonomy

Learning Outcome:

After successful completion of this course, the students will be able to:

1. Understand the historical development of systematics.
2. Discuss the basic concept and theories of systematics.
3. Develop an understanding about the nature of “species”. Appreciate the complexities and difficulties of various species concepts.
4. List levels of the Linnaean hierarchical classification system and discuss the evolution of the three domains from the universal ancestor.
5. Learn about taxonomic collection and how taxonomic characters help in the process of identification.
6. Develop an understanding about the procedure of classification.
7. Develop an appreciation about various rules of zoological nomenclature and its interpretation
8. Learn about various taxonomic publications.

M.Sc. COURSE, SESSION – 2021-2022
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO CC 122
PRINCIPLES OF SYSTEMATIC ZOOLOGY
Practical

L	T	P	C
0	0	2	1

1. Recent classification of animals exemplified by museum specimens.
2. Identification of animal species with the help of taxonomic keys.
 1. Insect fauna up to order
 2. Fish fauna up to families
 3. Identification of earthworm
3. Methods of taxonomic collection and preservations.
4. Collection of local fauna.
5. Morphological variations in animal phyla.
6. Methods of measuring biodiversity.
7. Methods of key preparation
8. Mitochondrial gene diversity

M.Sc. COURSE, SESSION – 2021-2022
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
M. Sc. I Semester
INVERTEBRATES: STRUCTURE AND FUNCTION
Course code ZOO - CC- 123

Theory

L	T	P	C
4	0	0	4

12hrs/unit (Total : 60 hrs)

Objective:

To introduce students about evolution of higher organisms from lower organisms and their life processes

Unit – I

Organization

- Symmetry in animal organization – Asymmetry, radial, biradial and bilateral symmetry – Significance.
- Coelom – Evolution of coelom. Acoelomate, pseudocoelomate, coelomate groups: Protostomia and Deuterostomia, their significance.
- Metamerism – Evolution of metamerism – Pseudometamerism, cyclo metamerism. Corm theory. Embryological theory – Significance, Organization of coelom- Enterocoelic, Schizocoelic and Gonocoelic.

Unit – II

Locomotion, Nutrition and Digestion

- Flagellar and ciliary movements in Protozoa
- Hydrostatic movement in Coelenterate, Annelid and Echinoderm
- Patterns of feeding and digestion in lower metazoan
- Filter feeding in Polychaeta, Mollusca and Echinodermata

Unit – III

Respiration, Circulation and Excretion

- Different types of respiratory organs – Gills, lungs and trachea
- Respiratory pigments
- Mechanism of respiration
- Different types of excretory organs- coelom ducts, Nephridia and Malpighian tubules.
- Mechanisms of excretion and osmoregulation.

Unit – IV

Nervous System and Chemical Co-ordination

- Primitive nervous system: Coelenterata and Echinodermata
- Advanced nervous system: Annelida, (Polychaeta and Oligochaets), Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda).
- Endocrine glands in Crustaceans and Insects – Pheromones and Allelochemicals.

Unit – V

Reproduction and Minor Phyla

- Pattern of sexual and asexual reproduction.
- Larval forms of free living invertebrates, larval forms of parasites and their phylogenetic significance.
- General Characters and affinities of Minor phyla: Rotifera, Chaetognatha, Phoronida and Sipunculida.

Suggested readings:

1. Animal Physiology: Adaptation and Environmental, Nelson, KS. (ed.) Cambridge University Press, UK
2. Comparative Animal Physiology, Prosser, CL. & Brown, Jr. FA; Saunders. USA
3. Invertebrate: Structure and Function, Barrington, E. J. W.; Oxford, Clarendon Press.
4. Invertebrate Zoology, Barnes, Robert. D; Saunders. USA
5. Invertebrate Zoology, Jordan EL, Verma, PS; S. Chand Publishing, New Delhi
6. Modern Text Book of Zoology: Invertebrates, 12th Edition Kotpal, R. L.; Rastogi Publication, Meerut

Learning Outcome:

Students will be able to identify the comparison among various life processes in invertebrates and their evolution.

M.Sc. COURSE, SESSION – 2021-2022
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
IN INVERTEBRATES: STRUCTURE AND FUNCTION
Course code ZOO CC 124
Practical

L	T	P	C
0	0	2	1

List of practical

1. Nervous System: Prawn/Squilla and Pila/Sepia/Mytilus

2. Mounting: Gill, Statocyst, Nephridia and Spermatheca in Earthworm

3. Specimens and slides:

PROTOZOA – *Monocystis*, *Noctiluca*, *Opalina*, *Euglena*, *Paramecium*

PORIFERA – *Sycon* (T.S., L.S.), *Grantia* (T.S)

Museum Specimens of *Leucosolenia*, *Hyalonema*, *Spongilla euspongia*,

CNIDARIA : Slides of *Obelia* polyp and Medusa, *Pennaria*, *Aurelia* – Tentaculocysts Museum Specimens of *Hydra*, *Physalia*, *Porpita*, *Gorgonia*, *Metridium*, *Aurelia*, *Corallium*, *Pennatula*, *Metridium*, *Virgularia*, *Zoanthus*, *Favia*.

HELMINTHES – Slides of mature segment, Gravid segment of *Tenia*, Museum Specimens of *Ascaris*, *Taenia*, *Planaria*, *Faciola*

ANNELIDA – Slide of Setae, ovary, septal nephridia of earthworm, parapodia of *Nereis* and *Heteronereis*, Museum Specimens of *Hirudinaria*, *Patella*, *Eunice*, *Chloea*, *Polynoe*, *Terebella* *Eurythoe*.

***ARTHROPODA:** Male and Female *Culex*, Male and Female *Anopheles*, Slides of *Cyclops*, *Daphnia*, *Chelifer*, *Section of Peripatus*, Museum specimen of *Balanus*, *Lepas*, *Hippa*, *Gongylus*, *Limulus*, *Squilla*, *Eupagurus*

MOLLUSCA - Museum Specimens of *Chiton*, *Patella*, *Aplysia*, *Helix*, *Limax*, *Nautilus*, *Octopus*.

ECHINODERMATA – Museum Specimens of *Echinodiscus*, *Holothuria*, *Antedon*

SPECIMEN OF MINOR PHyla

Larval Form: Parasitic and free swimming larval forms.

M.Sc. COURSE, SESSION – 2021–22
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO CC 125
ENDOCRINOLOGY

Theory

L	T	P	C
4	0	0	4

12hrs/unit (Total: 60 Hrs)

Objective

To introduce students about endocrine glands and their role in regulation of physiology.

Unit-I

General Endocrinology, Reproductive hormones and behavior

- Introduction to endocrinology and endocrine system
- Phylogeny and ontogeny of endocrine glands
- Discovery and Classification of hormones
- Overview of reproductive hormones secretion in males and females
- Regulatory mechanism of reproductive hormones in spermatogenesis and oogenesis
- Hormones effects on behaviour and immunity
- Biological activities of prostaglandins

Unit II

Biosynthesis of Hormones and Regulation

- Biosynthesis of steroid hormones de novo
- Biosynthesis and amino-acid derived small size hormones
- Biosynthesis and simple peptide hormones – Pre – and Pro- hormones
- Hormones and Homeostasis
- Termination mechanism of hormone action.

Unit-III

Pituitary and Pineal glands

- Pituitary gland: histological structure and function
- Hormones secretion from pituitary gland and mechanism of action
- Autoimmune disorder of pituitary gland
- Pineal gland: histological structure and function
- Hormones secretion from pineal gland and mechanism of action
- Role of pineal gland in stress related diseases

Unit-IV

Thyroid, Parathyroid and Thymus glands

- Thyroid gland: histological structure and function

- Hormones secretion from thyroid gland and mechanism of action
- Imbalance of thyroid hormone and related diseases
- Parathyroid gland: histological structure and function
- Hormones secretion from parathyroid gland and mechanism of action
- Parathyroid gland disease (hyperparathyroidism)
- Structure and function of Thymus

Unit-V

Adrenal gland and hormones of GIT

- Physiology of adrenal gland: structure and function of excretory hormones
- Mechanism of action of adrenal gland secreted hormones
- Endocrine diseases involve dysfunctions of the adrenal gland
- Hormonal control of digestion – from oesophagus to intestine (feeding to absorption)
- Hormonal regulation of carbohydrate, protein and lipid metabolism

Suggested Reading

1. E.J.W. Barrington, General and Comparative Endocrinology, Oxford, Clarendon Press.
2. P.J. Bentley, Comparative Vertebrate Endocrinology, Cambridge University Press.
3. R.H. Williams, Text Book of Endocrinology, W.B. Saunders.
4. C.R. Martin, Endocrine Physiology, Oxford University Press.
5. A. Gorbman et. al. Comparative Endocrinology, John Wiley & Sons.
6. W.S. Hoar General and comparative Animal Physiology.
7. Harpers Biochemistry by David A. Bender et al.

Learning Outcome:

Students will be able to understand the role of hormones in physiology, pathological conditions and importance of hormones for maintenance of good health.

M.Sc. COURSE, SESSION – 2021–22
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO CC 126
ENDOCRINOLOGY
Practical

L	T	P	C
0	0	2	1

1. Histological study of different endocrine glands (Pituitary, Thyroid, Parathyroid, Adrenal, Thymus, Gonads and Pancreas).
2. Microtomy to prepare stained, permanent mounts of different endocrine glands
3. Study of oestrous cycle of rat
4. Sperm count and mobility assay
5. Eosin-Nigrosin staining of live and dead spermatozoa
6. To detect the presence of human chorionic gonadotropin hormone
7. Preparation of melanophore index of rasbora fish scale due to the effect of adrenalin hormone.

M.Sc. COURSE, SESSION – 2021–22
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO CC 127
VERTEBRATE PHYSIOLOGY

L	T	P	C
4	0	0	4

12hrs/unit (Total: 60 Hrs)

Objective: To introduce students about the physiological processes, their mechanism and regulation.

Unit-I: Food, Feeding and Digestion

- Types of food and nutrition: proteins, carbohydrates, fats, water and fat soluble vitamins, and minerals
- Feeding Mechanisms in general
- Physiology of digestion: secretions of GIT, Neural and hormonal regulation of secretion of digestive enzymes
- Role of Liver and Pancreas in digestion
- Absorption of protein, carbohydrate and lipid, food assimilation; defecation
- Adaptation of Gut to metabolic rate and diet

Unit-II: Respiration and Circulation

- Types of respiration: External, Internal and tissue respiration
- Physiology of Respiration
- Transport of O₂ & CO₂ in blood; Bohr's effect; Rhythmicity and control of breathing
- Lymphatic system: lymph circulation
- Heart, heart valves, pace maker, ECG, conduction and nervous regulation of heart
- Blood: hemopoiesis, composition, coagulation mechanism, blood pressure
- Blood groups, Rh factor, and blood related diseases, types of Anemia, blood transfusion

Unit-III: Nervous and Muscular System

- Nervous system: General organization, structure of neuron
- Resting and action potential, all or none law, ionic basis of nerve potential, origin and propagation of action potential
- Conduction of nerve impulse, local circuit theory, saltatory conduction
- Synapse: synaptic transmission, neurotransmitters, neuropeptide, FMRF-amide family, hypothalamic pituitary factors, mechanism of excitation, reflexes

- Muscles: types, structure & function
- Muscle biomechanics: mechanism of muscle contraction and relaxation, mechanical properties of muscles, all and none law, electrical properties of muscles, energy of muscle contraction, Cori cycle

Unit-IV: Excretion and Reproduction

- Physiology of excretion: products of metabolism
- Types of excretory products in animals, urine formation
- Physiology of reproduction: structure and function of male and female reproductive system
- Fertilization and post-fertilization developments, structure of sperm, female reproductive cycle, hormones of reproduction, parturition, lactation

Unit-V: Physiological Regulations and Ocular Physiology

- Thermoregulation: mechanism and regulation, homeothermy
- Osmoregulation: mechanism and regulation, fluid control in the body
- Overview of sensory system: smell and taste, mechanism of hearing, cutaneous sensation
- Ocular Physiology: structure and function, chemistry of vision, light and dark adaptation of eye, colour vision, optical defects

Suggested Readings:

1. W.S. Hoar General and comparative Animal Physiology.
2. Schiemdt-Nielsen Animal Physiology: Adaptation and Environment. Cambridge
3. C.L. Prosser Comparative Animal Physiology WB. Saunders & Company
4. R. Eckert Animal physiology: Mechanism and Adaptation W.H.Freeman& Company.
5. C.R. Martin, Endocrine Physiology, Oxford University Press.
6. Harpers Biochemistry by David A. Bender et al.

Learning Outcome:

Students will be able to understand how the physiological systems work solely and in connection with each other, which are carried out by body, such as digestion, respiration, reproduction, nervous system etc.

M.Sc. COURSE, SESSION – 2021–22
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO CC 128
VERTEBRATE PHYSIOLOGY (PRACTICAL)

L	T	P	C
0	0	4	1

List of practical:

1. Histological study of all organs systems
2. Enzymatic activity of human salivary amylase
3. Effect of pH & temperature on amylase activity
4. Measurement of blood pressure.
5. Determination of Blood groups and Rh Factor
6. Counting of blood cells by haemocytometer
7. Determination of bleeding time
8. Test of Ammonia, urea, uric acid and creatinine in urine sample
9. Study of osmotic hemolysis and chemical hemolysis

SYLLABUS FOR M.Sc. II SEMESTER COURSE IN ZOOLOGY

PG II SEMESTER

SESSION – 2021-22 Onwards



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M.Sc. II Semester

Paper Course Code	Paper Title	Credits
P-I ZOO-CC-221	Population Genetics and Evolution – Theory	04
ZOO-CC-222	Population Genetics and Evolution – Practical	01
P-II ZOO- CC -223	Vertebrates: Structure & Function – Theory	04
ZOO- CC -224	Vertebrates: Structure & Function – Practical	01
P-III ZOO- CC -225	Toxicology, Environmental Biology and Ethology– Theory	04
ZOO- CC -226	Toxicology, Environmental Biology and Ethology– Practical	01
P-IV ZOO- CC -227	Biochemistry – Theory	04
ZOO- CC -228	Biochemistry – Practical	01
P-V ZOO-E-229T*	1. Genetic Engineering 2. Molecular Taxonomy and DNA Barcoding 3. Free radicals, Oxidative Stress and Antioxidants 4. Medical Biochemistry Theory	03
ZOO-E-229P*	1. Genetic Engineering 2. Molecular Taxonomy and DNA Barcoding 3. Free radicals, Oxidative Stress and Antioxidants 4. Medical Biochemistry Practical	01
	Total Credits	24
ZOO- OE- 229	OPEN ELECTIVE-Genetic Engineering	02

*Elective Courses for M.Sc. II Semester

Elective course in M.Sc. II Sem. will be taught in rotation each year from the syllabus provided from serial no. 1 to 4

P.G. COURSE, SESSION 2021-2022
M.Sc. SECOND SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO CC 221
POPULATION GENETICS AND EVOLUTION
Theory

L	T	P	C
4	0	0	4

12 Hrs/Unit (Total: 60 Hrs)

Objective: To make students aware about concepts of evolution and theories of organic evolution; also conservation of the biological diversity.

Unit-I

- Concepts of evolution and theories of organic evolution with an emphasis on Darwinism
- Neo-Darwinism.
- Hardy-Weinberg law of genetic equilibrium
- Natural selection (ii) Mutation (iii) Genetic drift (iv) Migration
- Meiotic drive
- Genetic structure of natural populations
- Factors affecting human disease frequency

Unit-II

- Molecular population genetics
- Patterns of change in nucleotide and amino acid sequences
- Ecological significance of molecular variations
- Analysis of quantitative traits
- Quantitative traits and natural selection
- Estimation of heritability
- Genotype-environment interactions

Unit-III

- Genetics of speciation
- Phylogenetic and biological concept of species
- Patterns and mechanisms of reproductive isolation
- Models of speciation (Allopatric, sympatric, parapatric)
- Evolution of gene families, Molecular drive

Unit-IV

- Origin of higher categories
- Micro-and Macro-evolution
- Molecular phylogenetics
- Phylogenetic inference-Distance methods, parsimony methods,

- maximum likelihood method
- Amino acid sequences and phylogeny
- Molecular clocks

Unit-V

- Origin and evolution of economically important microbes and animals
- Population genetics and ecology
- Metapopulations
- Monitoring natural populations
- Loss of genetic variations
- Conservation of genetic resources in diverse taxa

Suggested- Reading Material

1. Dobzhansky, Th. Genetics and Origin of Species. Columbia University Press.
2. Dobzhansky, Th., FJ. Ayala, G.L. Stebbins and J.M. Valentine. Evolution. Surjeet Publication, Delhi.
3. Futuyama, DJ. Evolutionary Biology, Sinauer Associates, INC Publishers, Dunderland.
4. Hartl, D.L. A Primer of Population Genetics. Sinauer Associates, Inc, Massachusetts.
5. Jha, AP, Genes and Evolution. John Publication, New Delhi.
6. King, M. Species Evolution-The role of chromosomal change. The Cambridge University Press, Cambridge.
7. Merrel, DJ. Evolution and Genetics. Holt, Rinehart and Winston, Inc.
8. Smith, JM. Evolutionary Genetics. Oxford University Press, New York.
9. Strikberger, MW. Evolution. Jones and Bartlett Publishers, Boston London.

Learning Outcome:

After studying formal models of gene frequency change, students will get a deep interest on the evolutionary processes, and to permit the consequences of different evolutionary hypotheses to be explored in a quantitatively precise way.

P.G. COURSE, SESSION 2021-2022
M.Sc. SECOND SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO CC 222
POPULATION GENETICS AND EVOLUTION
Practical

L	T	P	C
0	0	2	1

List of Practical

1. Distribution of gene frequency in a particular population (Brahmins, Saxenas etc.) with reference to:
 - a. Size of index and ring finger.
 - b. Freeness ear lobes.
 - c. Blood groups, A,B, AB, O, Rh, MNS etc.
2. Phenotypic plasticity in
 - a. Butterfly
 - b. *Rasbora*
 - c. *Ophiocephalus* or *Notopterus*
3. Electrophoretic pattern of DNA fragments belonging to Horse, Man, Monkey, Cow etc after treatment with particular restriction endonuclease.
4. Distribution of frequency of serum isozymes like, LDH & DH, Glutamate dehydrogenase, glucose-6-phosphate dehydrogenase etc in a population.
5. Some numerical problems on Hardy Weinberg's law.
6. Determination of average Heterozygosity and gene polymorphism

M.Sc. COURSE, SESSION - 2021-2022
M. Sc. II Semester
General Paper – I
VERTEBRATES: STRUCTURE AND FUNCTION
Course code ZOO CC 223
Theory

L	T	P	C
4	0	0	4

12hrs/unit (Total : 60 hrs)

Objective

To introduce the students about the morphology and classification of higher vertebrates.

Unit – I

- Origin of Vertebrates
- General Organization of Pisces with reference to *Scoliodon*
- Classification of Pisces
- Comparative account of Petromyzon and Myxin

Unit – II

- General organization of Amphibia with reference to *Rana*
- Classification of Amphibia
- Limbless amphibians
- General Organization of Reptelia with reference to *Varanus*
- Classification of Reptelia
- Brief account of Dinosaurs, Crocodile, and Snakes
-

Unit – III

- General organization of Aves with reference to *Columba*
- Classification of Aves
- Flight adaptation in Birds, Palate in Birds

Unit – IV

- General Organization of Mammalia with reference to *Oryctolagus*
- Classification of Mammalia
- Brief account: Archaeopteryx and Flightless Birds

Unit – V

- Brief account: Primate, Chiropterans, Cetacean
- Brief account: Carnivores, Proboscidea, Rudentia
- Aquatic Mammals, Stomach in Ruminants
- Brief account: Dentation in Mammals

Recommended Readings:

1. Marvalee H. Wake, Hyman's comparative vertebrate anatomy. University of Chicago press.
2. Noriyuki Satoh, Chordate-origin and evolution. Elsevier
3. Parkel Haswell, A textbook of Zoology vol. 2 Franklin classics trade press.

Suggested Readings:

1. Dan L. Brown, Chordate Zoology. Intelliz press. New York, USA.
2. R. L. Kotpal, Modern textbook of Zoology vertebrate. Rastogi Publishers, Meerut.
3. E. L. Jordan, P.S. Verma, Chordate Zoology. S. Chand Publications. New Delhi
4. Dev Bhattacharya, Textbook of Chordate Zoology. Arjun publication, New Delhi
5. R. K. Saxena and Sumitra Saxena, Comparative Anatomy of Vertebrates. Viva Book Publishers. New Delhi.
6. P. H. Clevelan Jr, Larry. S. Roberts, A. Larson, Biology of Animals, McGraw-Hill

Learning Outcome:

Students will be able to differentiate the higher vertebrates on the basis of their morphology into different classes.

M.Sc. COURSE, SESSION - 2021-22
M. Sc. II Semester
General Paper – I, PRACTICAL
VERTEBRATES: STRUCTURE AND FUNCTION
Course code ZOO CC 224

L	T	P	C
0	0	2	1

List of Practical

1. Major Dissections: Bony Fish- Afferent arteries, Efferent arteries, Cranial Nerves

2. Minor Dissection: Frog

- Cranial Nerves
- Spinal nerves
- Digestive system
- Urinogenital system

3. Museum Specimens: Protochordates to mammals

4. Histological Slides: Protochordates to Mammals

5. General anatomy of any Vertebrates: Rats/ Mice/Fish

6. Microtomy to prepare stained, permanent mounts of different organs e.g. skin, liver, lung, kidney and gonads etc.

7. Skeletal system: fish, amphibian, reptilian, aves and mammal.

- Skull
- Vertebral Column
- Limb Bones
- Girdles

8. Accessory respiratory organs in fishes.

M.Sc. COURSE, SESSION - 2021-2022
M. Sc. IV Semester General Paper – II
TOXICOLOGY, ENVIRONMENTAL BIOLOGY AND ETHOLOGY
Course code ZOO CC 225
Theory

L	T	P	C
4	0	0	4

12Hrs/unit (Total: 60 Hrs)

Objectives:

This paper is aimed to develop awareness about Toxicants, heavy metal toxicity, environmental pollution and ecological impact assessment

Unit I:

Toxicology

- Introduction to Toxicology
- Kinds of Toxic Substances
- Toxicity-Influencing Factors
- Exposure to Toxic Substances
- Dose–Response Relationships
- Xenobiotic and Endogenous Substances
- Toxicification and Detoxification
- Synergism, Potentiation, and Antagonism
- Behavioural and Physiological Responses
- Reproductive and Developmental Effects

Unit II :

Conservation and management of natural resources

- Concepts of Classification of Natural Resources
- Soil and Water Conservation measures
- Forest Fire mitigation and management
- Deforestation and Biodiversity including role of NBA
- Major wild life projects: Project Tiger, Lion, Crocodile and Elephant
- Natural Hazards: Food, Landslides, Coastal, earthquake
- Biodiversity: Need for conservation of biodiversity
- Benefits and threats to biodiversity
- Endangered species management and biodiversity protection
- Alternative sources of Energy

Unit III :

Global Environmental Issues

- Overview of major Environmental Issues
- Climate change, Global Warming, Global cooling

- Oceans and plastic pollution
- Acid rains
- Green House effect
- Sea level rise

Unit IV

Ethology

- Definition, Branches and Concept of Ethology
- Fixed action patterns (FAP)
- Innate Realizing Mechanism (IRM)
- Action specific energy
- Learning and Imprinting
- Methods of studying behaviour

Unit V

- Mammalian Nervous system and Behavior
- Hormones and Behavior
- Pheromones
- Biological clocks
- Social Organization and Orientation
- Habitat Selection and Foraging Behavior

Suggested Readings:

1. Ecology and Environment, Sharma, PD.;Rastogi Publication, Meerut.
2. A Text Book of Modern Toxicology, Hodgson, Earnest; John wiley & Sons, Inc., Publication
3. Animal Behaviour (Ethology), Agarwal VK.; S. Chand Publications, New Delhi
4. Behaviour Ecology: Krebs & Davis, (3rd 1993, Blackwell)
5. Animal Behavior: Reena Mathur (3rd edition) (2010-2011). Publisher Rastogi publication.
6. An Introduction to animal behaviour , By Aubrey Manning ELBS publication.
7. Animal Societies and Evolution, A scientific American publication . W. H. Freeman and Co. USA.
8. Animal Behaviour, BY Niko Tinbergen, Time Life International , Netherland.

Learning Outcome

Students will be able to understand and identify the behaviour in variety of taxa. Designing and implementing experiments to test hypothesis relating animal behaviour.

M.Sc. COURSE, SESSION - 2021-2022
M. Sc. II Semester
TOXICOLOGY ENVIRONMENTAL BIOLOGY AND ETHOLOGY
Course Code ZOO CC 226
Practical

L	T	P	C
0	0	2	1

List of Practicals:

1. Field visit to river/lake and water and wastewater treatment plants.
2. Water analysis of municipal and industrial wastes for the detection of DO, BOD, COD, Alkalinity, pH, turbidity, and temperature.
3. Soil analysis for the detection of N, P, & K.
4. Waste water treatment methods.
5. Measurement of sounds by DB meter in silent, industrial, residential and commercial zones.
6. Biodegradation of pesticides.
7. Models of non-conventional energy resources
8. Wild life: endangered and frightened species
9. Experiment to demonstrate greenhouse effect.
10. Recourses & their conservation.
11. Biosphere reserves, National parks and wildlife sanctuaries in India.
12. Demonstration of reflexes in man
13. Study of learning behaviour.
14. Display of electric organ of an electric ray.
15. Demonstration of parental care / nest building / sexual dimorphism.
16. Study of learning behaviour in mice by using a zigzag or T-shaped maze
17. Study of wall-seeking behaviour in mice
18. A field study of play behaviour or parent-young interactions in a troop of rhesus monkeys
19. A field study of foraging or trail making behaviour in a seed harvester or predatory ant species

Suggested Reading Material

1. Alcock : Animal Behaviour: An Evolutionary Approach (7th ed 2005, Sinaur).
2. Bolhuis & Giraldeau: The Behavior of Animals: mechanisms, function, and evolution (2005, Blackwell)
3. Drickamer, Vessey & Jakob: Animal Behavior: Mechanisms, Ecology, Evolution (2007, McGraw-Hill)
4. Krebs & Davis: Behavioural Ecology. (3rd ed 1993, Blackwell)
5. Lehner: Hand Book of Ethological Methods.(2nd ed 1996, Garland)
6. Manning & Dawkins: An introduction to Animal Behaviour (5th ed 1998, Cambridge Univ. Press)

P.G. COURSE, SESSION 2021-2022
M.Sc. II SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO CC 227
BIOCHEMISTRY

Theory

L	T	P	C
4	0	0	4

12hrs/unit (Total : 60 hrs)

Objectives: The course will help in understanding mechanism by which biomolecules give shape to cells and how pathways are regulated.

Unit I

Amino acids and proteins

- Amino acids
- Acids and bases
- Protein structure
- Myoglobin and haemoglobin
- Collagen
- Protein purification
- Electrophoresis of proteins
- Protein sequencing and peptide synthesis
- Amino acid metabolism

Unit II

Enzymes

- Introduction to enzymes
- Thermodynamics
- Enzyme kinetics
- Enzyme inhibition
- Regulation of enzyme activity

Unit III

Nucleic Acids

- DNA structure
- DNA replication in prokaryotes & eukaryotes
- RNA structure
- Transcription in prokaryotes & eukaryotes
- Regulation of transcription by RNA Pol II
- Processing of eukaryotic pre-mRNA
- Ribosomal RNA
- Transfer RNA

Unit IV

Protein Synthesis

- The genetic code
- Translation in prokaryotes
- Translation in eukaryotes
- Protein targeting
- Protein glycosylation

Unit V

Carbohydrate & Lipid metabolism

- Monosaccharides, disaccharides, Polysaccharides and oligosaccharides
- Glycolysis & Gluconeogenesis
- Pentose phosphate pathway
- Glycogen metabolism & its regulation
- Structures and roles of fatty acids
- Fatty acid breakdown & synthesis
- Triacylglycerols
- Cholesterol
- Lipoproteins

Suggested readings:

1. B. D. Hames. Instant Notes in Biochemistry. Bios Pub. UK.
2. Voet D. and Voet J.G., Biochemistry, John Willey and Sons.
3. Nelson D.L., Cox M.M. Lehninger, Principles of Biochemistry, MacMilan , USA.
4. Metzler D.E. and Metzler C.M. , Biochemistry, Wiley – Liss.
5. Devlin T.M., Text book of Biochemistry, Willey-Liss.

Learning Outcome:

After successfully completing this course, the students will be able to:

1. Understand about the importance and scope of biochemistry.
2. Understand the structure and biological significance of carbohydrates, amino acids, proteins, lipids and nucleic acids.
3. Understand the concept of enzyme, its mechanism of action and regulation.
4. Understand the process of DNA replication, transcription and translation.
5. Understand the process of carbohydrate and lipid metabolism and its regulation.

P.G. COURSE, SESSION 2021-2022
M.Sc. II SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO CC 228
BIOCHEMISTRY
Practical

L	T	P	C
0	0	2	1

Practical:

1. Preparation of standard graph of protein for quantitative estimation of protein
2. Preparation of standard graph of DNA for quantitative estimation of DNA
3. Preparation of standard graph of RNA for quantitative estimation of RNA
4. Preparation of standard graph of Pi for determining V-max of mitochondrial ATPase Enzyme
5. Effect of substrate concentration, temperature and pH on mitochondrial ATPase enzyme
6. Chromatography; TLC and Paper chromatography
7. DNA isolation
8. RNA isolation

Suggested readings:

1. Plummer, D.T. Practical Biochemistry, Tata McGraw-Hills.
2. Wilson, K. and Walker, K. Principles & Techniques of Practical Biochemistry. Cambrigde Uni.Press.

SYLLABUS FOR M.Sc. III SEMESTER COURSE IN ZOOLOGY

PG III SEMESTER

SESSION – 2021-2022



**DEPARTMENT OF ZOOLOGY
SCHOOL OF BIOLOGICAL SCIENCES (SBS)
DR. HARI SINGH GOUR VISHWAVIDYALAYA
SAGAR (M.P.) 470 003**

M. Sc. III Semester			
Core Course Code		Paper Title	Credits
P- I ZOO CC 321	Theory	Biostatistics and Computational Biology	04
ZOO CC 322	Practical	Biostatistics and Computational Biology	01
P –II ZOO CC 323	Theory	Immunology	04
ZOO CC 324	Practical	Immunology	01
P- III Special Paper			
ZOO CC 325-A	Theory	Cell Architecture	04
ZOO CC 326-A	Practical	Cell Architecture	01
ZOO CC 325-B	Theory	Structure and Function of Insects	04
ZOO CC 326-B	Practical	Structure and Function of Insects	01
ZOO CC 325-C	Theory	Fish Structure and Function	04
ZOO CC 326-C	Practical	Fish Structure and Function	01
ZOO CC 325-D	Theory	Principles of Environmental Biology	04
ZOO CC 326-D	Practical	Principles of Environmental Biology	01
P-IV Special Paper			
ZOO CC 327-A	Theory	Cell Physiology	04
ZOO CC 328-A	Practical	Cell Physiology	01
ZOO CC 327-B	Theory	Insect Taxonomy & Ecology	04
ZOO CC 328-B	Practical	Insect Taxonomy & Ecology	01
ZOO CC 327-C	Theory	Fish Physiology & Ecology	04
ZOO CC 328-C	Practical	Fish Physiology & Ecology	01
ZOO CC 327-D	Theory	Composition of Biosphere	04
ZOO CC 328-D	Practical	Composition of Biosphere	01
ZOO SE 329-A	Theory	Free Radicals, Oxidative Stress and Antioxidants	03
ZOO SE 329- B	Practical	Free Radicals, Oxidative Stress and Antioxidants	01
Total Credits			24
ZOO-OE-329	Theory	Free Radicals, Oxidative Stress and Antioxidants	02

Elective Courses for M.Sc. III Semester (any one)

1. Methods in Molecular Biology 2. Biological methods to study the tissue 3. Neurobiology 4. Vermibiotechnology
 Elective course in M. Sc. III Sem. will be taught in rotation each year from the syllabus provided from serial no. 1 to 4

M.Sc. COURSE, SESSION – 2021–22
PG THIRD SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO CC 321
BIostatISTICS AND COMPUTATIONAL BIOLOGY
Theory

L	T	P	C
4	0	0	4

12hrs/unit (Total: 60 Hrs)

Objective:

To understand the mathematical and statistical theories and their applications in biostatistical methods; use and interpret result to analyse research data.

Unit I

- Matrices and Vectors
- Exponential functions
- Periodic functions and differential equations
- Mathematical modelling

Unit II

- Sampling, Data collection and recording.
- Central tendency – concept; arithmetic mean, mode, median for ungrouped and grouped data.
- Measures of dispersion: absolute and relative measures; range, standard deviation (grouped and ungrouped data), variance, quartile deviation, coefficient of variability.

Unit III

- Skewness, Kurtosis
- Probability - normal, poisson and binomial
- parametric and non - parametric test.

Unit IV

- Statistical Methods: Hypothesis testing, significance and correlation. Correlation.
- Linear models and regressions. Pearson and other correlation coefficients. Multiple regressions.
- Distribution- Normal, t-test and chi square test
- Analysis of variance

Unit V

- Basic concepts of computer, hardware and operating systems: Windows, Android, iOS
- Use of common application software in biology: word processing, spreadsheets, graphics and data base.
- Introduction to web browsing software and search engines with special reference to online resources.

- Definition, history, scope and applications of bioinformatics, Biological Databases primary & Secondary Databases e.g. GenBank, EMBL, DDBJ, Entrez, OMIM, SWISS-Prot etc. Use of PubMed, BLAST etc.

Suggested Reading Material

1. Batschelet, E., Introduction to mathematics for life scientists. Springer-Verlag, Berlin.
2. Jorgensen, S.E., Fundamentals of ecological modeling, Elsevier, New York.
3. Swartzman, G.L., and S.P.O. Kaluzny, Ecological simulation primer, Mac millan, New York.
4. Lendren, D., Modelling in behavioral ecology, Chapman & Hal, London, U.K.
5. Sokal, R.R. and F.J. Rohlf, Biometry, Freeman, San Francisco.
6. Snedecor, G.W. and W.G. Cochran, Statistical methods, Affiliated East-West Press, New Delhi (Indian ed.).
7. Green, R.H., Sampling design and statistical methods for environmental biologists, John Wiley & Sons, New York.
8. Murray, J.D., Mathematical biology, Springer-Verlag, Berlin.
9. Pielou, E.C., The interpretation of ecological data: A primer on classification and ordination.

Learning Outcome:

Skilled research personnels may be developed who will be able to analyze, interpret and predict the data in scientific research and biomedical practices.

M.Sc. COURSE, SESSION – 2021–22
PG THIRD SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO CC 322
BIOSTATISTICS AND COMPUTATIONAL BIOLOGY
PRACTICAL

L	T	P	C
0	0	2	1

LIST OF PRACTICALS

1. Numerical Based on:
Matrices.
Mean, median and mode.
Mean deviation, variance, standard deviation and standard error.
2. Representation of data: Bar diagrams, π -diagrams, Histograms, Frequency polygons and ogives.
3. t-test
4. F-test
5. Chi square test
6. ANOVA
7. Demonstration of PubMed in searching scientific literature using authors name, fields, limits etc.
8. Demonstration of BLAST in comparing Protein Sequences.
9. Use of Sigma Stat/Prism Software for Statistical analysis.
10. Use of Search engines and online resources.

M.Sc. COURSE, SESSION – 2021–22

M. Sc. III Semester

General Paper – II, Theory

IMMUNOLOGY

Course code ZOO CC 323

Theory

L	T	P	C
4	0	0	4

12hrs/unit (Total: 60 Hrs)

Objective:

Students will be taught the basics of immunology so as to develop understanding of the subject, such as how the immune system does work, molecular and cellular components and pathways that protect an organism from infectious agents or cancer.

Unit - I:

Overview and elements of the immune system

- Overview of the Immune System
- Cells, Tissues, and Organs of the Immune System
- Antigens: Basic properties, B and T cell epitopes, haptens and adjuvants.
- Antibodies: Structure and functions.
- Basic properties and functions of cytokines.

Unit - II:

Modes of Immune Response

- T Cell receptors, B cell receptor, VDJ recombination
- Structure and Function of MHC, antigen presenting cells, exogenous and endogenous pathway of antigen presentation and processing
- Innate and adaptive immune response, effector mechanism of cellular and humoral immunity
- Antigen Presentation
- Complement system: Types and function.

Unit - III:

Immune system and infectious disease

- Mechanism of transmission, sites of pathogen entry, steps needed to establish infection, role of innate and non specific immunity during infection.
- Viral and bacterial immunopathology: Role of cytokines, NK Cells, T cells and antigen presenting cells in early defense; interferons and their mechanism of action and antibody mediated immunity against viruses and bacteria.
- Evading the immune response in case of bacterial and viral infection, antigenic shift and drift using suitable example of influenza virus.
- Immunity to Worms

Unit - IV

Immunomodulation

- Immunodeficiencies: Characteristics, types of primary and secondary immunodeficiency disorders, diagnosis and treatment.
- Immunosuppression and immunosuppressive drugs.
- Hypersensitivity: Types and functions
- Immunizations: History (smallpox), principles of immunization and booster Immunization, types of vaccines, routes and scheme of immunization.

Unit - V:

Immune Responses against Tissues

- Immunological Tolerance: Definition, types of tolerance (central & peripheral), consequences of tolerance, key elements involved in tolerance mechanism.
- Autoimmunity (loss of self-tolerance to self-antigens & loss of central and peripheral tolerance) and Autoimmune disease (systemic Lupus Erythematosus, Rheumatoid Arthritis, Scleroderma, Multiple sclerosis, Myasthenia Gravis, Graves Disease. Autoimmune hemolytic anemia & Type I diabetes).
- Transplantation (autograft, isograft, allograft & xenograft) and Rejection (hyperacute, acute and chronic), immunological basis, graft versus host reaction & prevention of graft rejection. An
- Immunobiology of cancer: tumor antigen, immunosurveillance & immunoediting, mechanism by tumor cells avoid the immunosurveillance, tumor immunotherapy.

Suggested Reading:

1. Kuby Immunology, International Edition (2018) by Judy Owen, Jenni Punt, Sharon Stanford and Patricia Jones.
2. Fundamentals of Immunology, VII Edition (2012) by William E. Paul.
3. Immunology, VIII Edition (2013) by David Male, Jonathan Brostoff, David Roth and Ivan Roitt.
4. Cellular and Molecular Immunology, First- South Asia edition (2017) by Abdul K Abbas, Andrew H. Litchman and Shiv Pillai.

Learning Outcome:

1. Develop an appreciation about the various components of the immune system that work together to protect the host.
2. Identify cells, tissues and organs of the immune system.
3. Develop an understanding of the structural and molecular features of different classes of antibody molecules and their functions.
4. Discuss the various mode of immune response like innate immunity, antigen presentation and cell mediated cytotoxicity.
5. Develop an understanding about immunological defense against various infectious agents like viruses, bacteria, protozoans and worms.
6. Develop an understanding of the immunological disorders as either a deficiency or defect of component or excess activity as hypersensitivity.
7. Gain a grasp of the principle of vaccination.
8. Appreciate mechanisms of tolerance, autoimmune disorder, transplantation and rejection.
9. Learn the immunobiology of transplantation, rejection and immunity to cancer.

M.Sc. COURSE, SESSION – 2021–22

M. Sc. III Semester

General Paper - II, Practical

IMMUNOLOGY

Course code ZOO CC 324

L	T	P	C
0	0	2	1

List of Practical

1. Handling of laboratory animals
2. Immune system and organs in a mammalian animal model
3. Routes of inoculation in mammalian model
4. Blood film preparation and identification of cells.
5. Isolation of mouse spleenocytes by density gradient centrifugation
6. ELISA
7. Radial immune-diffusion
8. Immunological diagnosis (Blood group)
9. Extraction and purification of lymphocyte and its genomic DNA.
10. Immunocytochemistry/Immunohistochemistry
11. Western Blot: diagnosis of viral disease/cancer/pregnancy
12. RT-PCR and its applications in immunology
13. Flow cytometry (acquisition and analysis of immune cells)

Suggested Reading:

1. Kuby Immunology, International Edition (2013) by Judy Owen, Jenni Punt and haron Stranford.
2. Fundamentals of Immunology, VII Edition (2012) by William E. Paul.
3. Immunology, VIII Edition (2013) by David Male, Jonathan Brostoff, David Roth and Ivan Roitt.

M.Sc. COURSE, SESSION – 2021-2022

M. Sc. III Semester

(SPECIAL PAPER) III

CELL ARCHITECTURE

Course code: ZOO CC 325-A

Theory

L	T	P	C
4	0	0	4

12 Hrs./unit (Total: 60 Hrs.)

Objective: To introduce students the dynamics of cell and cellular components

Unit – I

- Prokaryotic and eukaryotic cell organization
- Various types of microscopy to study cell architecture
- Sorting cells and their parts: flow cytometry, fractionation, centrifugation

Unit – II

- Cytoskeleton: microtubules, microfilaments and related proteins
- Microtubule polymerization, dynamic instability and treadmilling
- Actin polymerization dynamics, cell crawling

Unit – III

- Cell wall architecture: lipid and protein in cellular membrane, protein lipid interaction
- Specialized regions of the plasma membrane: pancreatic acinus, plasma membrane of intestinal epithelial cell, microvilli
- Cell junction: tight junction, gap junction

Unit – IV

- Integrins, Collagen and non – collagen components
- Nucleus
- Interphase nucleus
- Biogenesis of nucleus

Unit – V

- Endoplasmic reticulum,
- Golgi complex,
- Mitochondria,
- Lysosomes, Vacuoles, peroxisomes

Suggested Readings:

1. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc., USA
2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing Inc., New York.
3. Lehninger, Principles of Biochemistry, Fifth Edition.
4. Genetics : Principles and Analysis : Daniel L. Hartl, Elizabeth W. Jones.

5. Molecular Cell Biology, Lodish et al., W.H. Freeman and Company (8th Ed. 2016)

Learning Outcome:

1. Students will understand the structure and purpose of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles
2. Students may apply their knowledge of cell biology to selected examples of changes or losses in cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.
3. Students will understand the structure and function of various cell organelles.

M.Sc. COURSE, SESSION – 2021-2022

M. Sc. III Semester

(SPECIAL PAPER) III

CELL ARCHITECHTURE

PRACTICAL

Course code: ZOO CC 326-A

L	T	P	C
0	0	2	1

List of Practicals

1. Visualization methods for cells and sub-cellular components: light microscopy, phase contrast microscopy, scanning and transmission microscopes. Laser scanning confocal microscope and atomic force microscope.
2. Demonstration of cell sorting by flow cytometry
3. Use of different types of centrifuge.

M.Sc. COURSE, SESSION – 2021-2022
M. Sc. III Semester
(SPECIAL PAPER) III
STRUCTURE & FUNCTION OF INSECTS
Course Code ZOO CC 325-B
Theory

L	T	P	C
4	0	0	4

12Hrs./unit (Total: 60 Hrs.)

Objectives: To study general anatomy and physiology of insects.

Unit – I

- Head: Segmentation, structure, endoskeleton, antenna
- Mouth: Structure and mechanism of feeding, Types of mouth parts
- Thorax: Structure, endoskeleton, structure and modification of legs
- Wings: Origin, structure, modification and function of wings

Unit – II

- Integument: Structure and chemistry
- Abdomen: Structure, pregenital appendages, cerci and external genitalia
- Digestive system: Structure and anatomy of the alimentary canal

Unit – III

- Respiratory system: Structure in aquatic and terrestrial insects
- Circulatory system: Circulatory organs, types and functions of hemocytes
- Excretory system: Structure of excretory organs.

Unit – IV

- Nervous system
- Neuron endocrine system: Structure of neuroendocrine glands, structure and role of hormones, Endocrine control of metamorphosis and reproduction
- Sense organs: photoreception, mechanoreceptor and chemoreception, sound production in insects

Unit – V

- Reproductive System: structure of male and female reproductive system
- Embryology: Pre and post embryonic development. Types of larvae and pupae, type of metamorphosis, diapauses

Suggested readings:

1. Chapman: The Insects: structure and function (4th ed, 1998, ELBS)
2. Imms: A general text book of entomology, 2 vols (1997, Asia Publishing House)
3. McGavin: Essential Entomology (2001, Oxford Univ Press)
4. Srivastava: A text book of applied entomology, Vol I & II (1993, Kalyani Publishers)

5. Wigglesworth: Principles of Insect Physiology (1972, ELBS)

6. Gullan and Cranston: The Insects: An outline of entomology(5th ed, 2014, Wiley Blackwell)

Learning Outcome:

Students will be able to:

- Learn the external morphology of insects (i.e., to learn about the features of insects which help to distinguish one kind of insect from another).
- Study specializations and adaptability of structures such as the mouthparts, antennae, legs, wings and pronotum.
- To understand how an insect lives, functions, and reproduces.
- To be able to explain how many of the morphological differences that are observed among the major groups of insects can be viewed as adaptations of those insect groups to different biological conditions.

M.Sc. COURSE, SESSION – 2021–22
M. Sc. III Semester
(SPECIAL PAPER) III
STRUCTURE & FUNCTION OF INSECTS
PRACTICAL
Course Code ZOO CC 326-B

L	T	P	C
0	0	2	1

List of Practicals:

1. Types of antenna and mouth parts
2. Different types of wings, tegmina, hemielytra, different types of wings venation.
Male genitalia: Grasshopper and 43oleopteran
Female genitalia: Grasshopper, Gryllus, Coleoptera
3. Sting of honey bee and wasp
4. Preparation of pericardial cells, oenocytes and nophrocytes
5. Different types of spiracles, opening and closing mechanism respiratory organs in aquatic insects
6. Auditory and sound producing organs
7. Neuroendocrine system of cockroach, grasshopper and bugs
8. Sympathetic and central nervous system of the above mentioned insects
9. Reproductive system of male and female insects.

M.Sc. COURSE, SESSION – 2021–22
M. Sc. III Semester
(SPECIAL PAPER) III
FISH STRUCTURE AND FUNCTION
Course Code ZOO CC 325-C

Theory

L	T	P	C
4	0	0	4

12hrs/unit (Total : 60 hrs)

Objective

A multidisciplinary field that deal with the fisheries of commercial importance its physiology and ecology provide an integrated view on fisheries

Unit I:

Integumentary system

- Structure: modification of fins
- Types of scales and development
- Colour change mechanism
- Squamation, barbells and flaps

Unit II :

Skeletal structure

- Axial skeletal-skull, vertebral column, Ribs
- Appendicular Skeleton-girdles
- Jaws and jaws suspension
- Fins and origin of paired fins

Unit III:

Circulatory system

- Types of heart in fishes
- Composition of blood
- Arterial system
- Venous system
- Physiology of circulation in fishes

Unit IV

Respiratory system

- Structure of the gill in fishes
- Physiology of respiration
- Accessory respiratory organs
- Blood circulation in air bladder

Unit V

Excretion and osmoregulation

- Structure of kidney in fish.
- Physiology of excretion
- Osmoregulation and ionic balance in fresh water and marine fishes
- Endocrine control of excretion and osmoregulation

Suggested readings:

1. Bond E. Carl. 1979. Biology of Fishes, Saunders.
2. Halver JE. 1972. Fish Nutrition. Academic Press.
3. Hoar WS and Randall DJ. 1970. Fish Physiology, Vol. I-IX, Academic Press, New York
4. Lagler KF, Bardach, JE, Miller, RR, Passino DRM. 1977. Ichthyology, 2nd Ed. John Wiley & Sons, New York.
5. Lovell J. 1989. Nutrition and Feeding of Fish. Van Nostrand Reinhold, New York.
6. Moyle PB and Joseph J. Cech Jr. 2004. Fishes: An Introduction to Ichthyology. 5 th Ed. Prentice Hall.
7. Nikolsky GV. 1963. Ecology of Fishes, Academic Press.
8. Norman JR and Greenwood PH. 1975. A History of Fishes, Halsted Press. 9. Potts GW and Wootten RJ. 1984. Fish Reproduction: Strategies and Tactics, Academic Press.

Learning Outcome:

Because of the great importance of fish as a protein rich diet, the course exert a great significance for managing fish as a natural resource and also offer fisheries research in governmental and other organizations.

M.Sc. COURSE, SESSION – 2021–22
M. Sc. III Semester
FISH STRUCTURE AND FUNCTION
Course Code ZOO CC 326-C
PRACTICAL

L	T	P	C
0	0	2	1

List of Practical

1. Demonstration of sense organs
 - a. Webberian ossicles of *Clarias*
 - b. Accessory respiratory organ and pituitary gland
2. Demonstration of major system
 - a. Efferent Branchial System in Wallago
 - b. Afferent Branchial System in Wallago
 - c. Dissection of internal ear
3. Mounting (permanent) of scales
4. Study of museum specimen, slides and bones
5. Articulation of skeletal system

M.Sc. COURSE, SESSION – 2021–22
M. Sc. III Semester
SPECIAL PAPER - III
PRINCIPLES OF ENVIRONMENTAL BIOLOGY
Course code ZOO CC 325-D

Theory

L	T	P	C
4	0	0	4

12hrs/unit (Total : 60 hrs)

Objective:

To introduce students about the multidisciplinary nature of environmental biology and role of environment to sustain life on earth.

Unit – I

- Definition, principles and scope of Environmental Science.
- Earth, Man and Environment. Ecosystems, Pathways in Ecosystems.
- Physico-chemical and Biological factors in the Environment.

Unit – II

- Geographical classification and zones.
- Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere.
- Natural resources, conservation and sustainable development.

Unit – III

- **Chemical composition of Air** : Classification of elements, chemical speciation. Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Thermochemical and photochemical reactions in the atmosphere. Oxygen and ozone chemistry, Chemistry of air pollutants, Photochemical smog.
- **Water Chemistry** : Chemistry of water, concept of DO, BOD, COD, sedimentation, coagulation, filtration, Redox potential.
- **Soil Chemistry** : Inorganic and organic components of soil, Nitrogen pathways and NPK in soils.

Unit – IV

- **Toxic Chemicals in the environment – Air, Water** : Pesticides in water.
- Biochemical aspects of Arsenic, Cadmium, Lead, Mercury, Carbon Monoxide, Os and PAN Pesticides, Insecticides, MIC
- Carcinogens in the air, water and soil.

Unit – V

- **Principles of Analytical Methods--** Titrimetry, Gravimetry, Colourimetry, Spectrophotometry
- Chromatography, Gas Chromatography, Atomic Absorption Spectrophotometer, GLC, HPLC.
- Electrophoresis X – ray fluorescence, X-ray diffraction. Flame photometry.

Suggested Readings:

1. Ecology and Environment, P.D. Sharma Rastogi Publication.
2. Fundamental of Ecology. E.P.Odum, G.W. Barrett.
3. Environmental Science by Willam .P.Cunninsham, Barbora. woodworth saigo.
4. Essential of Ecology by Colin R. Townsend, Michael. Begon, John..L.Harper.
5. Environmental Science by G.Tyler Miller.

Learning outcome:

Students will be able to understand the role of environment in sustaining life and importance of environmental knowledge.

M.Sc. COURSE, SESSION – 2021–22
M. Sc. III Semester
(SPECIAL PAPER) IV
PRINCIPLES OF ENVIRONMENTAL BIOLOGY
PRACTICAL
Course code ZOO CC 326-D

L	T	P	C
0	0	2	1

List of Practical

1. Social organization.
2. Methods for calculation of population density.
3. Different types of ecological pyramids.
4. Experiment of demonstrate greenhouse effect.
5. Resources & their conservation.
6. Estimation of alkali metals in various samples by flame-photometry.
7. Water analysis for physico-chemical characteristics.

M.Sc. COURSE, SESSION – 2021–22
M. Sc. III Semester
(SPECIAL PAPER) IV
CELL PHYSIOLOGY
Course Code ZOO CC 327-A
Theory

L	T	P	C
4	0	0	4

12hrs/unit (Total : 60 hrs)

Objectives: To introduce students about the physiology of cell, cellular receptors, cellular signalling and various complex mechanisms in the cell.

Unit – I

- Transport across prokaryotic cells
- Osmosis: movement of water and regulation of cell volume in animal cells
- Internalization of macromolecules and particles: endocytosis, exocytosis, pinocytosis, phagocytosis

Unit – II

- Concept of receptors, receptor ligand binding, endocrine, paracrine and autocrine signaling
Receptor mediated endocytosis
- Extracellular receptors and their coupling to different signals transducing machinery: ion channels, active transport and ion pumps

Unit – III

- Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G protein coupled receptors, signal transduction pathways
- Second messengers and regulation of signaling pathways: phosphatidylinositol, inositol trisphosphate, DAG, cAMP, cGMP, prostaglandins
- Receptor regulation

Unit – IV

- Oxygen consumption of cells: aerobic oxidation
- Glycolysis and fermentation: anaerobic oxidation
- Cell oxidation with emission of light: luminescence
- Bioenergetics and Oxidative phosphorylation.

Unit – V

- Action potential of cells and conduction of electrical impulse
- Coupled reaction, Group transfer, Biological energy transducers
- Development, propagation and transmission of action potential
- Synapses and impulse transmission, Neurotransmitter receptors

Suggested Readings:

1. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc., USA
2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson
Garland Publishing Inc., New York,
3. Lehninger, Principles of Biochemistry, Fifth Edition.
4. Genetics : Principles and Analysis : Daniel L. Hartl, Elizabeth W. Jones.

Learning Outcome:

Upon completion of the course, the students will be able to

1. Understand the biological activities that take place in a cell to keep it alive and explain the communications of cells with other cells and to the environment.
2. Figure out the concept of receptors and their coupling to different signals transducing machinery.
3. Explain the events of regulation of second messengers and signalling pathways.
4. Have knowledge how energy is used, generated in cells and about oxygen consumption of cells.
5. Understand the structure of synapses, purpose of neurotransmitters and impulse transmission through nerves.

M.Sc. COURSE, SESSION – 2021–22
M. Sc. III Semester
(SPECIAL PAPER) IV
CELL PHYSIOLOGY
PRACTICAL
Course Code : ZOO CC 328-A

L	T	P	C
0	0	2	1

List of Practicals

1. Staining of Golgi complex, mitochondria, peroxisomes etc.
2. Experiment on osmosis
3. Study of hemolysis
4. Introduction to nucleic acid and protein sequence databases: data mining methods for sequence analysis, web-based tools for sequence searches, motif analysis and presentation.

M.Sc. COURSE, SESSION – 2021–22
M. Sc. III Semester
(SPECIAL PAPER) IV
INSECT TAXONOMY AND ECOLOGY
Course Code ZOO CC 327-B

Theory

L	T	P	C
4	0	0	4

12hrs/unit (Total : 60 hrs)

Objective:

Insect taxonomy and Ecology attempts to introduce students to the various orders and some of the most important families of insects so that they can distinguish between harmful and beneficial insects, which form the basis of entomology. The course emphasizes on understanding the morphological fundamentals of insects in order to understand their diversity.

Unit – I

- Origin and evolution of insects
- Molecular markers in insects: Classes of molecular marker
- Classification of insects up to orders following Imms revised by Richards and Davis Vol. I & II

Unit – II

- Classification up to super families following Imms revised by Richards and Davis Vol. I & II
- Apterygota: *Thysanura*, *Diplura*, *Protura*, *Collembola*
- Pterygota: Palaeoptera, Odonata
- Orthopteroid: *Orthoptera*

Unit – III

- Classification up to superfamilies:
- Orthopteroid: Dictyptera, Isoptera
- Hemipteroid: Hemiptera (Homoptera, Heteroptera)
- Neuropteran: Coleoptera
- Panorgod insects: Diptera, Lepidoptera, Hymenoptera

Unit – IV

- Insects in medical, veterinary sciences: Common vector insects, their mode of transmission, life cycle, diseases & control
- Insect in forensic and forest sciences: Common insects & their life cycle

Unit – V

- Principles of insect ecology
- Effect of temperature, humidity and light on the biology of insects
- Social behaviour of insects: migration, adaptation and distribution

Suggested readings:

1. Imms: A General Text Book of Entomology (2 vols.), Asia Publishing House, 1997
2. Gullan & Cranston: The Insects: An Outline of Entomology (5th ed.) Wiley Blackwell, 2014

3. Srivastava: A text book of applied entomology, Vol I & II (1993, Kalyani Publishers)
4. Mullen and Durden: Medical and Veterinary Entomology, Academic Press, 2002
5. Byrd and Castner: Forensic Entomology, CRC Press, 2001
6. Service: Medical Entomology for Students (5th ed.), Cambridge University Press, 2012
7. Harborne: Introduction to Ecological Biochemistry (4th ed.), 1993

Learning Outcome:

After successful completion of this course, the students will be able to:

1. Develop an understanding about the origin and evolution of insects.
2. Learn about molecular markers in insects.
3. Will develop the ability to classify insects upto super families
4. Learn about the important insects of medical, veterinary and forest sciences
5. Gain an appreciation about the scope of insects in forensic entomology.
6. Develop an understanding of how insects interact with each other and their natural environment
7. Learn how environmental factors like temperature, humidity and light affects the biology of insects.

M.Sc. COURSE, SESSION – 2021–22
M. Sc. III Semester
(SPECIAL PAPER) IV
INSECT TAXONOMY AND ECOLOGY
PRACTICAL
Course Code ZOO CC 328-B

L	T	P	C
0	0	2	1

List of Practicals

1. Collection and Identification of Insect
2. Classification of insects belonging to the different orders as follows:
Apterygota: Thysanura, Diplura, Protura, Collembola
Pterygota: Palaeptera, Odonata
Orthopteroid: Orthoptera
Orthopteroid: Dictyoptera, Isoptera
Hemipteroid: Hemiptera, Isoptera
Neuropteran: Coleoptera
Panorgod insects: Diptera, Lepidoptera, Hymenoptera
3. Practical on molecular taxonomy
4. Effects of abiotic factors like temperature, humidity and light on insects.

M.Sc. COURSE, SESSION – 2021–22
M. Sc. III Semester
(SPECIAL PAPER) III
FISH PHYSIOLOGY AND ECOLOGY
Course Code ZOO CC 327-C
Theory

L	T	P	C
4	0	0	4

12hrs/unit (Total : 60 hrs)

Objective:

A multidisciplinary field that deals with the fisheries of commercial importance, its physiology and ecology provide an integrated view on fisheries

Unit - I

Digestive system

- Digestive physiology and nutrient digestibility in fish.
- Gastromatic index
- Digestive glands and their role in physiology of digestion
- Adaptive modification in digestive tract of fishes

Unit II

Nervous system and sense organs

- Central nervous system
- Autonomic and peripheral nervous system
- Cutaneous sense organs
- Structure of eye
- Acoustico-lateral line system in fish
- Weberian ossicle
- Light producing organs, poison gland and electric organs.
-

Unit III

Endocrine system, its regulation and hormonal action

- Pituitary gland
- Thyroid
- Ultimobranchial glands
- Adrenal gland
- Pancreatic Islets
- Pineal organs
- Urophypophysis

Unit IV

Excretory system

- Mode of reproduction in fish
- Male reproductive organs
- Female reproductive system
- Secondary Sexual Characters
- Hormonal regulation of fish reproduction
- Parental care
- Environmental and endocrine factors regulating reproductive cycles

Unit V

Ecology

- Ecological factors: pH, Dissolved oxygen, temperature, light etc.
- Ecological classification of fish: marine, estuarine and fresh water habitat.
- Deep sea adaptation
- Hill stream fish
- Migration in fish
- Adaptation to environmental extremes, temperature and stress.

Suggested readings:

1. Biology of Fishes. 2008. Bone, Q. and Moore, R., Talyor and Francis Group, CRC Press, U.K.
2. The Diversity of Fishes. 1994. G.S. Helfman, B.B. Collette & D.E. Facey (Eds) Blackwell Sceince, USA.
3. Readings in Ichthyology. 1979. M.S. Love and G.M. Cailliet (eds). Prentice-Hall of India.
4. The Senses of Fish Adaptations for the Reception of Natural Stimuli. 2004. von der Emde, R., Mogdans, J. and Kapoor, B. G., Narosa Publishing House, New Delhi, India.
5. Fish Physiology. (Series) W.S.Hoar and D.J. Randall (Series Eds). Academic Press, UK
6. The Physiology of Fishes. 2013. Evans, D. H. and Claiborne, J. D., Taylor and Francis Group, CRC Press, UK.

Learning Outcome:

Because of the great importance of fish as a protein rich diet, the course exert a great significance for managing fish as a natural resource and also offer fisheries research in governmental organizations.

M.Sc. COURSE, SESSION – 2021–21
M. Sc. III Semester
(SPECIAL PAPER) III
FISH PHYSIOLOGY AND ECOLOGY
Course Code ZOO CC 328-C
Practical

L	T	P	C
0	0	2	1

List of Practical

1. Demonstration of sense organs
 - a. Webberian ossicles of Clarias
 - b. Accessory respiratory organ and pituitary gland
2. Demonstration of major system
 - a. Efferent Branchial system in Wallago
 - b. Afferent Branchial System in Wallago
 - c. Dissection of internal ear
3. Mounting (permanent) of scales
4. Study of museum specimen, slides and bones
5. Articulation of skeletal system

M.Sc. COURSE, SESSION – 2021–22
M. Sc. III Semester
(SPECIAL PAPER) IV
COMPOSITION OF BIOSPHERE
Course code ZOO CC 327-D

Theory

L	T	P	C
4	0	0	4

12hrs/unit (Total: 60 Hrs)

Objective: From this paper the students were study about the scope of Ecology and Biodiversity of flora and fauna

Unit I

- Structure and functions, Abiotic and Biotic components, energy flows, Food chains, Food web, Ecological pyramids, types and diversity.
- Ecological Succession, Population, Community ecology and Parasitism, Prey – predator relationships.

Unit II

- Common flora and fauna in India
- Aquatic : Phytoplankton, Zooplankton and Macrophytes.
- Terrestrial : Forests
- Endangered and Threatened Species

Unit III

- Biodiversity and its conservation : Definition, ‘Hotspot’s of Biodiversity, Strategies for
- Biodiversity conservation. National Parks and Sanctuaries. Gene pool.
- Microflora of Atmosphere : Air Sampling techniques. Identification of aeroallergens. Air – borne diseases and allergies.
- Environmental Biotechnology : Fermentation Technology, Vermiculture technology, Biofertilizer technology.

Unit IV

- Sun as source of energy; solar radiation and its spectral characteristics.
- Fossil fuels-classification, composition, physico-chemical characteristics and energy
- Content of coal, petroleum and natural gas.
- Principles of generation of hydroelectric power, tidal, Ocean Thermal Energy
- Conversion, wind, geothermal energy; solar collectors, photovoltaics, solar ponds.
- Nuclear energy-fission and fusion; magnetohydrodynamic power.
- Bioenergy-energy from biomass and biogas, anaerobic digestion.
- Energy use pattern in different parts of the world.

Unit V

- Environmental implication of energy use.
- CO₂ emissions, global warming.

- Air and thermal pollution.
- Radioactive waste and radioactivity from nuclear reactors.
- Impact of large-scale exploitation of Solar, Wind, Hydro and Ocean energy.

Suggested Readings:

1. Ecology and Environment, Sharma, P.D., Rastogi Publication, Meerut
2. Ecology From Individuals to Ecosystems, Begon M., Townsend C. R., Haper J.H.; Blackwell Publishing, USA.
3. Fundamentals of Ecology Odum, E.P., Barrett, G.W.
4. Introduction to Environmental Engineering & Science Gilbert M. Masters
5. Environmental Biology -- A.G.Agarwal.
6. Environmental Science by G.Tyler Miller

Learning outcome:

At the completion of this lesson, students will be able to:

1. Define and differentiate between biosphere and other spheres
2. Describe the different biomes that make up the biosphere
3. Describe the different life forms in the biosphere
4. They will understand and interpret the lithosphere, atmosphere, hydrosphere and biosphere.

M.Sc. COURSE, SESSION – 2021–22
M. Sc. III Semester
(SPECIAL PAPER) IV
COMPOSITION OF BIOSPHERE
PRACTICAL
Course code: ZOO CC 328-D

L	T	P	C
0	0	2	1

List of Practicals

- A visit to aquatic ecosystem and methods for water and plankton collection
- Plankton identification and quantification from river / lake water samples. 2
- Vegetation studies by line, quadrates and belt transect methods and their analysis
- Studies on different types of eco-system models.
- Food chains and food webs in different eco systems.
- Light as limiting factor in photosynthesis.
- Different biogeochemical cycles.
- Interspecies relationships: prey-predator relation, mutualism, commensalisms & parasitism etc.

SYLLABUS FOR M.Sc. COURSE IN ZOOLOGY

PG IV SEMESTER

SESSION – 2021-2022



**DEPARTMENT OF ZOOLOGY
SCHOOL OF BIOLOGICAL SCIENCES (SBS)
DR. HARI SINGH GOUR VISHWAVIDYALAYA
SAGAR (M.P.) 470 003**

M. Sc. IV Semester- Zoology			
Core Course Code		Paper Title	Credits
P – I ZOO CC 421	Theory	Gamete Biology	04
ZOO CC 422	Practical	Gamete Biology	01
P- II ZOO CC 423	Theory	Tools and Techniques for Biology	04
ZOO CC 424	Practical	Tools and Techniques for Biology	01
P- III Special Paper			
ZOO CC 425-A	Theory	Cytogenetics	04
ZOO CC 426-A	Practical	Cytogenetics	01
ZOO CC 425-B	Theory	Insect Physiology and Biochemistry	04
ZOO CC 426-B	Practical	Insect Physiology and Biochemistry	01
ZOO CC 425-C	Theory	Fish Taxonomy and Ecology	04
ZOO CC 426-C	Practical	Fish Taxonomy and Ecology	01
ZOO CC 425-D	Theory	Environmental Pollution	04
ZOO CC 426-D	Practical	Environmental Pollution	01
P-IV Special Paper			
ZOO CC 427-A	Theory	Molecular Cell Biology	04
ZOO CC 428-A	Practical	Molecular Cell Biology	01
ZOO CC 427-B	Theory	Applied Entomology	04
ZOO CC 428-B	Practical	Applied Entomology	01
ZOO CC 427-C	Theory	Aquatic Resources of Fishes	04
ZOO CC 428-C	Practical	Aquatic Resources of Fishes	01
ZOO CC 427-D	Theory	Environmental Management	04
ZOO CC 428-D	Practical	Environmental Management	01
Total Credits			20

P.G. COURSE, SESSION 2021-2022
M.Sc. FOURTH SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO CC 421
GAMETE BIOLOGY

Theory

L	T	P	C
4	0	0	4

12hrs/unit (Total : 60 hrs)

Objectives: To make students aware about male and female gamete formation and their role in sex determination etc.

Unit-I

- Heterogamy in eukaryotes
- Comparative account of differentiation of gonads in a mammal and an invertebrate
- Leydig cells
Morphology
Differentiation
Function and its regulation
- Spermatogenesis
Morphological basis in Rodents
Morphological basis in any Invertebrate
Gamete specific gene-expression and genomics
- Biochemistry of Semen
Semen composition and formation
Assessment of sperm functions
Y-specific probes

Unit-II

- Fertilization
Pre-fertilization events
Biochemistry of fertilization
Post-fertilization events
- Collection and cryopreservation of gametes and embryos
- Ovarian follicular growth and differentiation
Morphology
Endocrinology
Molecular Biology
Oogenesis and vitellogenesis
Ovulation and ovum transport in mammals

Unit-III

- Biology of sex-determination and sex-differentiation a comparative account
- Multiple ovulation and embryo transfer technology (MOET)
In vitro oocyte maturation
Superovulation

In vitro fertilization

- Transgenic animals and knock-outs
- Production
- Applications
- Embryonic stem cells

Unit-IV

- Care and breeding of experimental animals including bioethics
- Assisted reproduction technologies
- Embryo sexing and cloning
- Screening for genetic disorders
- ICSI, GIFT etc.
- Cloning of animals by nuclear transfer

Unit-V

- Teratological effects of Xenobiotics
- Immunocontraception
- Gamete specific antigens
- Antibody mediated fertilization block and termination of gestation
- Other contraceptive technologies
- Surgical methods
- Hormonal methods
- Physical barriers
- IUCD

Suggested Reading Material

1. Austen, C.R and Short, RV. Reproduction in animals.
2. Schatten and Schatten. Molecular biology of fertilization.
3. F.T. Longo. Fertilization, Chapman & Hall.
4. R.G. Edwards. Human Reproduction.

Learning Outcomes:

After studying this course the students will be able to

1. Understand the production of gametes, gamete specific gene expression and differentiation of gonadal development in males and females.
2. Catch on the events of fertilization, molecular biology of ovarian growth and differentiation in mammals.
3. Have knowledge about embryo transfer technology and applications of embryonic stem cells.
4. Get the idea of teratological effects of xenobiotics, screening for genetic disorders and immuno-contraception.
5. Understand assisted reproductive technologies, surgical and hormonal methods of contraception.

P.G. COURSE, SESSION 2021-2022
M.Sc. FOURTH SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO CC 422
GAMETE BIOLOGY
Practical

L	T	P	C
0	0	2	1

List of Practicals

1. Demonstration of different types of Ovarioles in insects. e.g. in (i) Cockroach/Grasshopper (Panoistic type) (ii) *Dysdercus/Bagrada/Sphaerodema* (Acrotrophic type) and (iii) *Musca/Drosophila* (polytrophic type).
2. Squash preparation of testes of male insects to demonstrate spermatogenesis.
3. Section of ovaries of mammals showing oogenesis, development of graafian follicles and corpus luteum.
4. Section of testes of a mammal (rat/rabbit) showing spermatogenesis.
5. Effect of xenobiotics on teratogenesis using snail egg masses as model material.
6. Development of chick showing morphogenesis & organogenesis by using 2,4,6,8,10 days incubated hen's eggs.

P.G. COURSE, SESSION 2021-2022
M.Sc. FOURTH SEMESTER (GENERAL PAPER)
Paper code ZOO CC 423
TOOLS AND TECHNIQUES FOR BIOLOGY
Theory

Objectives:

To introduce students about the modern biology tools and instrumentation, and their working principles

Unit-I

Basic Biochemical Assessments

- Assay: definition and methods for assay development
- Biological Assays: cell viability and cell proliferation assays
- Microbiological assays: microbial growth culture, antibiotics sensitivity test
- Principle types and uses of spectrophotometer
- Principle and applications of PCR and Real-Time PCR

Unit-II

Microscopic Tools and culture techniques

- Principles of light, phase-contrast, fluorescence and confocal microscopy
- Electron microscopy (SEM & TEM)
- Cell culture techniques: biosafety cabinets, sterilization methods, autoclaving
- Mammalian cell culture: adherent and suspension cell culture, basal culture media
- Microbial cell culture: culture media types and uses, inoculation, and growth monitoring
- Fermenters: basic mechanism, types and application

Unit-III

Cryotechniques and molecular separation Techniques

- Cryopreservation for cells. Tissue, organisms
- Cryotechniques for microscopy: freeze fracturing and freeze etching
- Separation techniques in biology: Polyacrylamide and Agarose Gel Electrophoresis
- Chromatography: Size-exclusion and Ion-Exchange
- Cell fractionation: density gradient and differential centrifugation
- Cell separation by flow cytometry

Unit-IV

Computational and Radiometric Techniques

- Computer aided techniques: data presentation using MS Excel
- Software based densitometric analysis and molecular weight determination

- Radioisotope and mass isotope techniques in biology
- Autoradiography
- Magnetic Resonance Imaging

Unit-V

Immunological and Organ Ablation Techniques

- Immunological techniques: ELISA, Western Blotting, Immunohistochemistry
- Surgical Techniques
- Organ ablation: Ovariotomy and Vasectomy
- Perfusion techniques
- Stereotaxy
- Parabiosis

Suggested Readings:

1. Animal Cell Culture-A Practical approach, Ed. John R.W. Masters, IRL Press.
2. Introduction to Instrumental analysis, Robert Braun, McGraw Hill International Edition
3. A Biologist's Guide to Principles and Techniques of Practical Biochemistry, K. Wilson & K. H. Goulding, ELBS Edn.

Learning Outcome:

After successfully completing this course, the students will be able to:

1. Learn the theoretical basis of technique, its principle of working and its application.
2. Learn the safety hazards and precautions associated with the use of any equipment.
3. Understand the technique of cell and tissue culture.
4. Students will be able to familiarise with the commonly used techniques and procedures like microscopy, microbial assays and cryotechniques,
5. Learn about the various separation and analytical techniques in molecular biology and biochemistry.
6. Gain an overview of various computer aided techniques for data presentation and data analyses in Zoology.
7. Learn the theoretical basis of radioisotope and mass isotope techniques in biology.
8. Will develop an understanding of various immunological and surgical techniques.
9. Learn about the use of biosensors and their applications.
10. Develop capability to explore various research issues and their solutions

P.G. COURSE, SESSION 2021-2022
M.Sc FOURTH SEMESTER (GENERAL PAPER)
Paper code ZOO CC 424
TOOLS AND TECHNIQUES FOR BIOLOGY
Practical
L T P C
0 0 2 1

List of practicals

1. Application of spectrophotometer for validation of Beer –Lambert Law
2. To perform assessment of enzyme activity
3. Demonstration of PCR
4. Demonstration of microscopy: phase-contrast, fluorescence, confocal and electron
5. Application of centrifugal techniques in cell fractionation
6. Demonstration of protein precipitation
7. Estimation of proteins and nucleic acids
8. Separation of proteins by SDS-PAGE
9. Separation of nucleic acids by Agarose gel electrophoresis
10. software based densitometric analysis and molecular weight determination.

M.Sc. COURSE, SESSION - 2021-2022

**M. Sc. IV Semester
(SPECIAL PAPER) III**

CYTOGENETICS

Course Code ZOO CC 425-A

Theory

L	T	P	C
4	0	0	4

12Hrs./unit (Total: 60 Hrs.)

Objective:

The course is geared to impart a basic understanding about euchromatin and heterochromatin, sex determination, genetic code etc.

Unit – I

- Structure of eukaryotic chromosome
- Euchromatin and Heterochromatin
- Organization of genes and chromosomes

Unit – II

- Normal human karyotype, G – banding
- Human sex chromosomes and determination of sex
- Human chromosomal abnormalities: Sex chromosomal anomalies, autosomal anomalies
- Structure of chromatin and chromosomes

Unit – III

- Genetic map of the human chromosome
- Somatic cell genetics, hybrid and their applications, heterokaryon
- Cytogenetic effect of ionizing and non – ionizing radiation

Unit – IV

- Genetic transfer in bacteria (bacterial recombination): conjugation, transduction, transformation
Types of bacteriophages
- Conformations of nucleic acids (A-, B-, Z-DNA, t-RNA, micro-RNA) and their stability, Cvalue Paradox
- Mobile DNA, transposons and repetitive DNA

Unit – V

- The genetic code, codon – anticodon recognition
- Structure and types of RNA
- Properties of t – RNA for pairing and proof reading
- Concept of gene therapy

Suggested Readings:

1. Cooper GM. The Cell: A Molecular Approach. 2nd edition. Sunderland (MA): Sinauer Associates; 2000.
2. Molecular Biology of the Gene Watson J. D., Baker T. A., Bell S. P., Gann Alexander C S H L Pres
3. Cell and Molecular Biology: Concepts and Experiments Karp G. Wiley Publication
4. Molecular Biology of the Cell Alberts B., Johnson A., Lewis J., Raff M., Roberts K., Walter P. Garland Science

Learning Outcome:

Students gain knowledge on:

1. Evolution of various chromosomal aberrations (structural and numerical), their applications
2. Basics of nucleic acid structure and function, mechanisms and molecules governing processes of replication and the advancement in the field
3. Genetic codon and anticodon.
4. Basic biochemical process and pathways in a cell
5. Motivate the learner to refresh and delve into the basics of cell biology

M.Sc. COURSE, SESSION - 2021-2022

M. Sc. IV Semester

(SPECIAL PAPER) III

CYTOGENETICS

Course code ZOO CC 426-A

PRACTICAL

L	T	P	C
0	0	2	1

List of Practicals

1. UV Spectrophotometer estimation of DNA, RNA and protein
2. Isolation and purification of genomic DNA & RNA and plasmid
3. Isolation and separation methods for analysis of proteins
4. Separation of proteins by SDS-PAGE
5. Separation of DNA by agarose gel electrophoreses

M.Sc. COURSE, SESSION - 2021-2022
M. Sc. IV Semester
(SPECIAL PAPER) III
INSECT PHYSIOLOGY AND BIOCHEMISTRY
Course code ZOO CC 425-B
Theory

L	T	P	C
4	0	0	4

12Hrs/Unit (Total: 60 Hrs.)

Objective: To develop understanding of Insect biochemical and physiological functions

Unit – I

- Integument: Moulting and sclerotization
- Physiology of digestion and assimilation of nutrients

Unit – II

- Physiology of circulation and biochemistry of haemolymph
- Physiology of respiration in terrestrial and aquatic insects

Unit – III

- Physiology of excretion
- Physiology of reproductive system
- Physiology of nervous system

Unit – IV

- Insect immunity: Cellular and humoral
- Coloration in insects
- Bioluminescence: Structure of bioluminescent organs and physiology of bioluminescence.

Unit – V

- Carbohydrate, protein and lipid metabolism
- Detoxification mechanism in insects
- Physiology and biochemistry of ageing

Suggested Readings:

1. Advances in Insect Physiology (vols. 1-28), Academic Press, 1986-2001
2. Chapman: The Insects: Structure and Function (4th ed.), ELBS, 1998
3. Kerkut and Gilbert: Comprehensive Insect Physiology, biochemistry and pharmacology (vols 1-13), Pergamon, 1985
4. Gilbert et al.: Comprehensive Molecular Insect Science (Volume 1- 7), Elsevier, 2005
5. Gullan & Cranston: The Insects: An Outline of Entomology (4th ed.) Blackwell, 2010
6. Gupta: Insect Hemocytes, Cambridge University Press, 1979
7. Imms: A General Text Book of Entomology (2 vols.), Asia Publishing House, 1997
8. Rockstein: Biochemistry of Insects, Academic Press, 1978
9. Wigglesworth: Principles of Insect Physiology, ELBS, 1972

Learning outcome:

A student after completion of this course will be able to:

1. Become familiar with various physiological systems operating in insects.
2. Identify the influence/control (neuronal and/or hormonal) within each system
3. Develop a sense how physiology can be infused in major research topics in entomology
4. Understand the feasibility of using Insects, as eukaryotic model for translational research in higher vertebrates (especially in human beings).

M.Sc. COURSE, SESSION – 2021-2022
M. Sc. IV Semester
(SPECIAL PAPER) III
INSECTS PHYSIOLOGY AND BIOCHEMISTRY
Course code ZOO CC 426-B
PRACTICAL

L	T	P	C
0	0	2	1

List of Practicals

1. Salivary glands of *Drosophila* larvae and *Chironomus* larvae.
2. Physiology experiments to show: (i) functions of malpighian tubules (ii) insects produce moisture from the spiracles during flight
3. Study of histochemical techniques in insect tissues
4. Study of protein, carbohydrate and lipid estimation in insect tissues
5. Determination of haemocyte count of a given insect
6. Identification of different types of haemocytes

M.Sc. COURSE, SESSION – 2021-2022
M. Sc. IV Semester
(SPECIAL PAPER) III
FISH TAXONOMY AND ECOLOGY
Course code ZOO CC 425-C

Theory

L	T	P	C
4	0	0	4

12hrs/unit (Total: 60 hrs)

Objective:

The objective of this course is to synthesize knowledge of stock assessments, management regimes, and policy choices to explain what it takes to develop a “sustainable” fishery.

Unit – I

Taxonomy

Classification of fishes upto families.

Phylogenetic analysis of bony fish: morphological analysis: mtDNA polymorphisms; comparison of protein sequences and construction of phylogenetic tree.

Unit – II

Riverine fisheries-

Important river systems and their hydrological conditions flora and fauna with and fauna with special reference to fisheries, dams and their impact on riverine fisheries, fish ladders, interlinking of rivers and likely impact on fisheries, Cold water fisheries – ecology of hill streams, biology of important cold water fishes of India, recreational fishing.

Unit – III

Lacustrine fisheries

Origin of lakes and lake morphology, light, temperature and density relationship in the lacustrine ecosystems, heat energy and water movements, oxygen and other dissolved gases in lakes, pH and redox potential, fisheries profile and potential of major Indian lakes.

Unit – IV

Estuarine fisheries-

Major estuarine systems of India, hydrograph, flora and fauna with special reference to fisheries Marine fisheries- coastal and deep sea fisheries, permanent and seasonal stratification, upwelling, the photic

zone, control of primary production by light and nutrients availability, chemical properties of sea water, biology of important fishes (sardine, mackerel, tune), marine protected areas.

Unit –V

Aquatic pollution-

Types and sources, impact of pollution on aquatic organisms, ecosystem analysis bio-indicators, biomonitoring environmental factors and fish health, xenobiotics. Waste management national and international standards.. Extension services – basic principles and emerging issues of extension, role of information and communication technology in fisheries extension.

Suggested Literature:

1. Computers in Fisheries Research, Megrey, B.A. and Mokshess, E. (2009), Springer, USA
2. Biological Invasions in Marine Exosystems Ecological, Management and Geographic Perspectives, Rilov, G. and Jeffrey, A.C. (2009), Springer-Verlag, GERMANY
3. Handbook of Fisheries and Aquaculture, Indian Council of Agricultural Research, ICAR, (2006), DIPA.

Learning Outcome

Students will learn the need to incorporate social information in fisheries and wildlife management

M.Sc. COURSE, SESSION – 2021-2022
M. Sc. IV Semester
(SPECIAL PAPER) III
FISH TAXONOMY AND ECOLOGY
Course code ZOO CC 426-C
PRACTICAL

L	T	P	C
0	0	2	1

List of Practicals

Aquatic Resources and Their Conservation

1. Identification of Indian common fish faunal resources from cold water, warm water, marine water and ornamental fishes.
2. Physic-chemical parameters of freshwater bodies.
3. Biological analysis of water and estimation of primary productivity.
4. Collection of phytoplankton and zooplankton from natural resources and their identification.
5. Study of benthic macro invertebrates in natural water bodies.
6. Study of fishing gears and nets with the help of models.
7. Simulated experiments on population.
8. Salinity tolerance in select fishes.
9. Determination of age and growth; gonadosomatic index
10. Length-weight relationship and condition factor determination.
11. Experiments on chemoreception using different attractants and repellents.
12. Toxicity testing with zooplankton/fish.
13. Visit to a coastal/ mariculture farm and study the socio-economic status of the fisherman community.

M.Sc. COURSE, SESSION – 2021-2022

M. Sc. IV Semester

(SPECIAL PAPER) III

ENVIRONMENTAL POLLUTION

Course code ZOO CC 425-D

Theory

L	T	P	C
4	0	0	4

12Hrs./unit (Total: 60 Hrs)

Objective: To develop sensitivity for the natural, physical and human resources in the immediate environment

Unit-I

- Air: Natural and anthropogenic sources of pollution. Primary and Secondary pollutants.
- Transport and diffusion of pollutants. Gas laws governing the behaviour of pollutants in the atmosphere. Methods of monitoring and control of air pollution So₂, No_x, CO, SPM.
- Effects of pollutants on human beings, plants, animals, materials and on climate. Acid Rain.
- Air Quality Standards.
- Water : Types, sources and consequences of water pollution. Physico-chemical and
- Bacteriological sampling and analysis of water quality. Standards, sewage and waste water treatment and recycling. Water quality standard.
- Soil : Physico-chemical as bacteriological sampling as analysis of soil quality. Soil Pollution
- Control. Industrial waste effluents and heavy metals, their interactions with soil components.
- Soil micro-organisms and their functions, degradation of different insecticides, fungicides and weedicides in soil. Different kinds of synthetic fertilizers (NP & K) and their interactions with different components of soil.

Unit-II

- Noise : Sources of noise pollution, measurement of noise and Indices, effect of meteorological parameters on noise propagation. Noise exposure levels and standards. Noise control and abatement measures. Impact of noise on human health.
- Marine : Sources of marine pollution and control. Criteria employed for disposal of pollutants in marine system-coastal management.
- Radioactive and Thermal Pollution.

Unit-III

- Introduction to environmental impact analysis.
- Environmental impact Statement and Environmental Management Plan.
- EIA guidelines 1994, Notification of Government of India.
- Impact Assessment Methodologies.
- Procedure for reviewing Environmental impact analysis and statement.
- Guidelines for Environmental audit.

Unit-IV

- Introduction to Environmental planning.
- Base line information and predictions (land, water, atmosphere, energy, etc.).
- Restoration and rehabilitation technologies.
- Landuse policy for India.
- Urban planning for India.
- Rural planning and landuse pattern.

Unit-V

- Concept and strategies of sustainable development.
- Cost-Benefit analysis.
- Environmental priorities in India and sustainable development.

Suggested readings:

1. Peavy, H., Rowe D. & Tchobanoglous, G. (1985). Environmental Engineering. New York: McGraw-Hill.
2. Milnes, R. (2014). Environmental engineering: principles and practice. Hoboken: Wiley.
3. Manahan, S. E. (2009). Fundamentals of environmental chemistry (3rd ed.). Boca Raton: CRC Press/Taylor and Francis.
4. Keith, L. H. (Ed.) (1996). Principles of environmental sampling (2nd ed.). Washington, DC: American Chemical Society.

Learning Outcome

Students will learn various processes/skills like observation, discussion, explanation, experimentation, logical reasoning, through interaction with immediate surroundings.

M.Sc. COURSE, SESSION – 2021-2022
M. Sc. IV Semester
(SPECIAL PAPER) III
ENVIRONMENTAL POLLUTION
Course code ZOO CC 426-D
Practical

L	T	P	C
0	0	2	1

List of Practicals:

1. Comparative analysis of air sampling from clean and polluted area using key parameters.
2. Collection and Interpretation of Weather data.
3. Field visit to river/lake and water and wastewater treatment plants.
4. Water analysis of municipal and industrial wastes for the detection of DO, BOD, COD, CO₃, HCO₃, Cl₂, Alkalinity pH, turbidity and temperature.
5. Soil analysis for the detection of N, P, K, NO₃ SO₄, Cl₂, CO₃ etc.
6. Waste water treatment methods.
7. Detection of heavy metals in water samples.

M.Sc. COURSE, SESSION – 2021-2022

M. Sc. IV Semester

(SPECIAL PAPER) IV

MOLECULAR CELL BIOLOGY

Course code ZOO CC 427-A

Theory

L	T	P	C
4	0	0	4

12hrs/unit (Total : 60 hrs)

Objective: To introduce molecular processes like replication, transcription, translation with gene transfer methods, gene amplification through PCR, RAPD-PCR.

Unit – I

- DNA replication: unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons
- DNA damage and repair mechanisms
- Transcription (gene expression): mechanism and regulation, transcription factors and machinery
- RNA processing, RNA editing and splicing
- Post transcriptional modifications

Unit – II

- Translation: mechanism and regulation
- Post translational modifications
- Control of gene expression at transcription and translation levels
- Regulation of gene expression by non-coding RNAs
- Antisense molecules in regulation of gene expression and gene silencing, CRISPR-CAS System

Unit – III

- Molecular markers: RFLPs, RAPDs, Minisatellites, Microsatellites
- Genetic maps of mouse & fruitfly using molecular markers
- Cytogenetics maps using molecular markers: flow sorting, PFGE, microdissection, radiation hybrids
- Physical maps using molecular markers: deletions ISH, YAC

Unit – IV

- Gene cloning techniques, Enzymes used in genetic engineering
- Cloning vectors: plasmids, phages, cosmids, phagemids, viruses, transposons, YAC, MAC
- PCR: working mechanism and applications

Unit – V

- DNA fingerprinting, DNA foot printing
- DNA isolation and sequencing
- Southern, northern and western blotting, Dot blots and Slot blots
- Gene transfer methods in animals: transgenic animals

Suggested readings:

1. Molecular all biology : Lodish, et al.
2. Molecular all biology : Bruce Alberts, et al.
3. Cell Biology : DeRoberts.
4. Cell and molecular biology, :Gerad karp
5. Molecular cell biology : David Baltimore.
6. Cell Biology :Sc Rostogi.

Learning outcome:

Students will be able to explain basic molecular processes in eukaryotic cells, with emphases on

- 1) How molecular and cellular structures influence function
- 2) The Central Dogma of Molecular Biology and the how flow of genetic information is regulated to control cell behaviour
- 3) Metabolism and how energy is produced, stored, and expended in the course of building cellular structures and executing functions;
- 4) How physical and chemical signals perceived at the molecular level can result in changes of levels of biological systems, including individual cells and multicellular organisms.

M.Sc. COURSE, SESSION – 2021-2022

M. Sc. IV Semester

(SPECIAL PAPER) IV

MOLECULAR CELL BIOLOGY

Course code ZOO CC 428-A

Practical

L	T	P	C
0	0	2	1

List of Practicals

1. Study of normal human karyotype
2. Study of chromatin by Feulgen staining
3. Demonstration of PCR
4. Primer and siRNA designing
5. Cloning using bacterial plasmids
6. RAPD, RFLP
7. DNA Fingerprinting
8. Western Blotting

M.Sc. COURSE, SESSION – 2021-2022

**M. Sc. IV Semester
(SPECIAL PAPER) IV
APPLIED ENTOMOLOGY
Course code ZOO C 427-B**

Theory

L	T	P	C
4	0	0	4

12hrs/unit (Total: 60 hrs)

Objectives: To Introduce students how insects become pests and what are the common pests of our crops and what damage they cause.

Unit – I

- Basic principles of insect control
- Chemical control: insecticides, their classification and mode of action
- Insect resistance to insecticides, 3rd generation pesticides, chemosterilants and radiations

Unit – II

- Insect pest control: role of hormones, pheromones, antifeedents, attractants, repellents, plant products
- Biological control: Principle, procedure, success and limitation

Unit – III

- Beneficial insects: Life cycle & Polymorphic forms of Honey Bee & Termite
- Importance of beneficial insects: apiculture, sericulture, lac culture
- Integrated pest management (IPM)

Unit – IV

- Biology and Control of insect pests of:
- Cash crop: soybean, sugar cane
- Oil seeds: cotton, sunflower, mustard
- Cereal: pea, arhar, masoor, moong

Unit – V

- Stores grain pests wheat, gram and rice
- Vegetable: cabbage, bhindi, brinjal, tomato, potato
- Fruits: mango, citrus, papaya

Suggested readings:

1. David and Ramamurthy: Elements of Economic Entomology (6th ed.), Namrutha, 2011
2. Ishaaya and Degheele: Insecticides with novel modes of action: Mechanism and Application Springer-verlag, 1998.
3. Ishaaya : Biochemical sites of insecticide action and resistance Springer-Verlag, 2001
4. Norris et al: Concepts in Integrated Pest Management, Prentice-Hall, 2002
5. Pedigo: Entomology and Pest Management (4th ed.), Prentice Hall, 2002

6. Racheigl and Racheigl: Biological and biotechnological control of insect pests, CRC Press, 1998.
7. Srivastava: A text book of applied entomology, Vol I & II (1993, Kalyani Publishers)

Learning Outcome:

1. Understand the economic importance of insect (both beneficial and non- beneficial insects).
2. Knowledge of how they interact with their environment, other species and humans.
3. Gain the knowledge of classification and identification of insects with the help of identification keys.
4. Role of insect in pest control, forensic sciences, medical sciences, veterinary sciences and also their role in IPM and spread of several diseases.

M.Sc. COURSE, SESSION – 2021-2022

**M. Sc. IV Semester
(SPECIAL PAPER) IV
APPLIED ENTOMOLOGY
Course code ZOO C 428-B
PRACTICAL**

L	T	P	C
0	0	2	1

List of practical:

1. Collection, identification and classification of insects belonging to the different orders
2. Collections of insects of medical importance and their life cycle
3. Collection of polymorphic forms of honey bee and termites
4. Effect of an insecticides on a household pest

M.Sc. COURSE, SESSION – 2021-2022
M. Sc. IV Semester
(SPECIAL PAPER) IV
AQUATIC RESOURCES OF FISHES
Course code ZOO CC 427-C
Theory

L	T	P	C
4	0	0	4

12hrs/unit (Total: 60 hrs)

Objective: To be familiar with different fish and their diversity and how they are employed in Fish culture. Our aim is to provide our majors with the knowledge, skills and motivation required to ensure the conservation of fish and aquatic resources that are faced with increasing societal demands and increasing loss or degradation of habitat.

UNIT-I

Inland Fisheries

- Riverine Fisheries
- Estuarine Fisheries
- Lake Sterine Fisheries
- Cold water Fisheries

UNIT-II

Marine Fisheries

- Stratification of marine habitat
- Group of marine fisheries
- Coastal Fisheries
- Deep Sea Fisheries

UNIT-III

Fish Culture

- Selection of site and Layout of fish pond
- Construction and maintenance of fish farm
- Types of cultivable fishes
- Composite fish culture
- Sewage fed fisheries

UNIT-IV

Fishing Methods in India

- Marine fishing crafts and gears

- Inland fishing crafts and gears
- Unconventional fishing methods

UNIT-V

Fish Preservation and Processing

- Fish spoilage, rigor mortis, rancidity, enzymatic spoilage, microbial spoilage
- Principles of fish preservations
- Methods of preservation, problems associated with fish preservations
- Fishery by-products

Suggested Readings:

1. Computers in fisheries research. Megrey, B. A. and Moksness, E. (2009), Springer, USA
2. Biological Invasions in Marine Ecosystems Ecological Management and Geographic Perspectives. Rilov, G. and Jeffrey, A. C. (2009), Springer, Germany
3. Handbook of Fisheries and Aquaculture, Indian Council of Agricultural Research, ICAR, (2006)

Learning Outcome

1. Describe how physical and biological factors of aquatic ecosystems determine the distribution and abundance of fish populations
2. Describe the scientific and social factors that determine goals for fisheries management and conservation, and identify appropriate management strategies that can be used to achieve these goals.
3. Develop the ability to guide (consultancy) layman individual in his/her difficulties during the construction as well as to run a fish farm successfully.

M.Sc. COURSE, SESSION – 2021-2022

M. Sc. IV Semester

(SPECIAL PAPER) IV

AQUATIC RESOURCES OF FISHES

Course code ZOO CC 428-C

Practical

L	T	P	C
0	0	2	1

List of Practical

1. Documentation of endangered fishes
2. Physico-chemical parameters of freshwater bodies.
3. Phytoplankton and zooplankton from natural resources
4. study of fishing gears and nets
5. Determination of age and growth; gonadosomatic index
6. Toxicity testing with zooplankton/fish
7. Visit to a fish farm and study the socio-economic status of the fisherman community

M.Sc. COURSE, SESSION – 2021-2022
M. Sc. IV Semester
(SPECIALPAPER) IV
ENVIRONMENTAL MANAGEMENT
Course code ZOO CC 427-D
Theory

L	T	P	C
4	0	0	4

12hrs/unit (Total : 60 hrs)

Objective:

1. To understand the interaction of organisms with their environment.
2. To describe the structure and function of disaster management
3. To explain how to work on waste management.

Unit I

- Sources and generation of solid wastes, their characterization, chemical composition and classification.
- Different methods of disposal and management of solid wastes (Hospital Wastes and Hazardous Wastes)
- Recycling of waste material.
- Waste minimization technologies.
- Hazardous Wastes Management and Handling Rules, 1989.

Unit II

- Resource Management, Disaster Management and Risk analysis.
- Environment protection-issues and problems.
- International and National efforts for Environment Protection.
- Provision of Constitution of India regarding Environment (Article 48A and 58A).
- Environmental Policy Resolution, Legislation, Public Policy Strategies in Pollution Control.

Unit III

- Wildlife Protection Act, 1972 amended 1991.
- Forest Conservation Act, 1980.
- Indian Forests Act (Revised) 1982.
- Air (Prevention and Control of Pollution) Act, 1981 as amended by Amendment Act, 1987 and Rule 1982, Motor Vehicle Act, 1988.
- The Water (Prevention and Control of Pollution) Act, 1974 as amended up to 1988 and Rules 1975.
- The Environment (Protection) Act, 1986 and Rules 1986.
- Scheme of labelling of environmentally friendly products (Ecomark), Public Liability Insurance Act, 1991 and Rules 1991.

Unit IV

- Environmental Education and Awareness. Environmental Ethics and Global imperatives.
- Global Environmental problems-ozone depletion, global warming and climatic change.
- Current Environmental issue in India. In context to Narmada Dam and Tehri Dam etc.

- Soil Erosion, Formation and reclamation of Usar, Alkaline and Saline Soil.
- Waste lands and their reclamation.
- Desertification and its control.
- Vehicular pollution and urban air quality.

Unit V

- Depletion of Nature resources.
- Biodiversity conservation and Agenda – 21.
- Waste disposal, recycling and power generation, Fly ash utilization. Water Crises- Conservation of water.
- Environmental Hazards.
- Eutrophication and restoration of Indian lakes. Rain water harvesting. Wet lands conservation.
- Epidemiological issues (e.g., Goitre, Fluorosis, Arsenic).

Suggested readings:

1. Introduction to Environmental Management, Mary K. Theodore, Louis Theodore, CRC Press
2. Blackwell's Concise Encyclopedia of Ecology by Peter Calow

Learning Outcome

Students will be able to understand the role of environment in sustaining life and importance of environmental knowledge.

M.Sc. COURSE, SESSION – 2021-2022
M. Sc. IV Semester
(SPECIALPAPER) IV
ENVIRONMENTAL MANAGEMENT
Course code ZOO CC 428-D
PRACTICAL

L	T	P	C
0	0	2	1

List of Practicals

1. Detection of pesticide residues by TLC.
2. Calculation of LC₁₀₀, LC₅₀, LC₀, sub-lethal concentration, LD₁₀₀, LD₅₀, LD₀ and sub-lethal doses.
3. Measurement of sounds by DB meter in silent, industrial, residential and commercial zones.
4. Biodegradation of pesticides.
5. Models of non-conventional energy resources
6. Vermiculture and composting.
7. Wild life: endangered and frightened species
8. Biosphere reserves, National parks and wildlife sanctuaries in India.

Learning Outcome

Students will be able to understand the importance of living as well as non-livings for the healthy environment

SYLLABUS FOR ELECTIVE COURSES IN ZOOLOGY

PG II & III SEMESTER

SESSION – 2021-2022



**DEPARTMENT OF ZOOLOGY
SCHOOL OF BIOLOGICAL SCIENCES (SBS)
DR. HARI SINGH GOUR UNIVERSITY
SAGAR (M.P.) 470 003**

M.Sc. COURSE, SESSION – 2021-2022
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 229T

Genetic Engineering

Theory

L T P C

3 0 0 3

09 hrs/unit (Total: 45 hrs)

Objectives: This course will introduce students about the modern biology with cutting edge technology of new biology.

Unit-I Tools

- 1.1 Recombinant DNA technology
- 1.2 Restriction enzymes and other enzymes for DNA manipulation
- 1.3 Vector types: cloning & expression
- 1.4 Probes

Unit-II Cloning strategies

- 2.1 Genomic libraries
- 2.2 cDNA library
- 2.3 Bacteriophages: Lambda phage, M13
- 2.4 Polymerase Chain Reaction

Unit-III Screening of clones

- 3.1 Preparation of probes
- 3.2 Southern hybridization
- 3.3 Northern Blotting
- 3.4 Immuno-screening

Unit-IV Characterization of clones

- 4.1 Sequencing of DNA
- 4.2 Microarray types
- 4.3 Applications of microarray
- 4.4 DNA chip fabrication technology

Unit-V Applications:

- 5.1 Transgenic organism and genetically modified organisms
- 5.2 Site-directed mutagenesis
- 5.3 Generation of knock out animals
- 5.4 Gene therapy

Books Recommended

- 1. Brown: Gene Cloning & DNA analysis (2001, Blackwell)
- 2. Lewin: Genes IX (2008, Jones & Bartlett)
- 3. Lodish et al : Molecular cell biology (6th edition 2007, Freeman)

4. Asubel et al : Current protocol in molecular biology (1944, Wiley)
5. Sambrook & Russell : Molecular cloning (2001, Cold Spring Harbour

Learning Outcome:

- I. The students will build up insights regarding the tools and techniques used in genetic engineering.
- II Understanding the applications of recombinant DNA technology and genetic engineering, viz. Gene therapy, Microarray, DNA sequencing etc.
- III Applying their knowledge in solving variety of problems in improvements like creating transgenic crops, animals etc.

M.Sc. COURSE, SESSION – 2021-2022
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 229 OE
Genetic Engineering
Theory
L T P C
2 0 0 2

09 hrs/unit (Total: 45 hrs)

Objectives: This course will introduce students about the modern biology with cutting edge technology of new biology.

Unit-I Tools

- 1.3 Recombinant DNA technology
- 1.4 Restriction enzymes and other enzymes for DNA manipulation
- 1.3 Vector types: cloning & expression

Unit-II Cloning strategies

- 2.1 Genomic libraries
- 2.2 Bacteriophages: Lambda phage, M13
- 2.3 Polymerase Chain Reaction

Unit-III Screening of clones

- 3.1 Preparation of probes
- 3.2 Southern hybridization
- 3.3 Northern Blotting

Unit-IV Characterization of clones

- 4.1 Sequencing of DNA
- 4.2 Microarray types
- 4.3 Applications of microarray
- 4.4 DNA chip fabrication technology

Unit-V Applications:

- 5.1 Transgenic organism and genetically modified organisms
- 5.2 Site-directed mutagenesis
- 5.3 Gene therapy

Suggested Readings:

- 1. Brown: Gene Cloning & DNA analysis (2001, Blackwell)
- 2. Lewin: Genes IX (2008, Jones & Bartlett)
- 3. Lodish et al : Molecular cell biology (6th edition 2007, Freeman)
- 4. Asubel et al : Current protocol in molecular biology (1944, Wiley)

5. Sambrook & Russell : Molecular cloning (2001, Cold Spring Harbour

Learning outcomes

- I. The students will build up insights regarding the tools and techniques used in genetic engineering.
- II Understanding the applications of recombinant DNA technology and genetic engineering like Gene therapy, Microarray, DNA sequencing etc.
- III Applying their knowledge in solving variety of problems or may apply in improvements like creating transgenic crops, animals etc.

M.Sc. COURSE, SESSION – 2021-2022
PG THIRD SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO SE 329-A
FREE RADICALS, OXIDATIVE STRESS AND ANTIOXIDANTS

Theory

L	T	P	C
3	0	0	3

09 Hrs./unit (Total: 45 Hrs.)

Objectives: To introduce students about the free radical generation during pathology and their types and how they affect the health of an organism.

Unit I

Introduction

- General aspects of Oxidative stress;
- Types of free radicals and their formation;
- Reactive oxygen species (ROS)/ Reactive Nitrogen species (RNS);
- Interaction with biological molecules.

Unit II

Antioxidant Mechanisms

- Mechanisms of antioxidant action;
- Repair systems and inducible defenses against oxidant stress;
- Vitamins and antioxidant enzymes.

Unit III

Oxidative Stress: Molecular mechanisms and biological effects

- Free radical mediated damage to biomolecules
- Mitochondrial biology and oxidative stress
- Oxidative stress in Cancer Biology.

Unit IV

Techniques to Analyse Free Radicals

- Electron spin resonance (ESR) or electron paramagnetic resonance (EPR)
- spectroscopy;
- Dichlorofluorescein diacetate (DCF-DA), Diaminofluorescein diacetate (DAF-2DA),
- Dihydroethidium (DHE) dyes
- Assays of antioxidant enzymes.

Unit V

Free Radicals in Health and Disease

- Toxicity of oxygen;
- Pathological systems and toxic responses;
- Pathological and Physiological Significance.

Suggested Readings:

- An introduction to Free Radical Chemistry by AF. Parsons, 2000.
- Free Radicals: An Introduction by AF. Trotman-Dickenson, 1959.
- Cellular antioxidant defence mechanisms by Ching Kuang Chow, 1988.
- Free Radicals, oxidative stress and antioxidants. Pathological and physiological significance. Edited by Tomris Ozben. NATO ASI Series, Series A: Life Sciences Vol. 296.
- Laboratory Techniques in biochemistry and molecular biology by C.A. Rice-Evans, A.T. Diplock, M.C.R. Symons.

Learning Outcome:

Students will be able to learn about free radicals, oxidative stress and antioxidants which are important in dealing with health and diseases, aging, neurodegenerative disorder, cancer etc.

M.Sc. COURSE, SESSION - 2021-2022
M. Sc. III Semester
PAPER V (ELECTIVE COURSE)
Course Code ZOO SE 329 B
FREE RADICALS, OXIDATIVE STRESS AND ANTIOXIDANTS

PRACTICAL

L	T	P	C
0	0	2	1

Practical Course:

- 1 Detection of mitochondria free radical production.
- 2 Estimation of lipid peroxidation in the cells
- 3 Detection of protein bound carbonyls in the cells
- 4 Detection of free radical (OH, NO) by fluorescence microscopy.
- 5 Antioxidant enzyme assay
- 6 Model preparation to study the mechanisms of action of free radicals and antioxidants.

M.Sc. COURSE, SESSION – 2021-2022
PG THIRD SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO OE 329
FREE RADICALS, OXIDATIVE STRESS AND ANTIOXIDANTS

Theory

L	T	P	C
2	0	0	2

09 Hrs./unit (Total: 45 Hrs.)

Objectives: To introduce students about the free radical generation during pathology and their types and how they affect the health of an organism.

Unit I

Introduction

- General aspects of Oxidative stress;
- Types of free radicals and their formation;
- Reactive oxygen species (ROS)/ Reactive Nitrogen species (RNS);
- Interaction with biological molecules.

Unit II

Antioxidant Mechanisms

- Mechanisms of antioxidant action;
- Repair systems and inducible defenses against oxidant stress;
- Vitamins and antioxidant enzymes.

Unit III

Oxidative Stress: Molecular mechanisms and biological effects

- Free radical mediated damage to biomolecules
- Mitochondrial biology and oxidative stress
- Oxidative stress in Cancer Biology.

Unit IV

Techniques to Analyse Free Radicals

- Electron spin resonance (ESR) or electron paramagnetic resonance (EPR)
- spectroscopy;
- Dichlorofluorescein diacetate (DCF-DA), Diaminofluorescein diacetate (DAF-2DA),
- Dihydroethidium (DHE) dyes
- Assays of antioxidant enzymes.

Unit V

Free Radicals in Health and Disease

- Toxicity of oxygen;
- Pathological systems and toxic responses;
- Pathological and Physiological Significance.

Suggested Readings:

- An introduction to Free Radical Chemistry by AF. Parsons, 2000.
- Free Radicals: An Introduction by AF. Trotman-Dickenson, 1959.
- Cellular antioxidant defence mechanisms by Ching Kuang Chow, 1988.
- Free Radicals, oxidative stress and antioxidants. Pathological and physiological significance. Edited by Tomris Ozben. NATO ASI Series, Series A: Life Sciences Vol. 296.
- Laboratory Techniques in biochemistry and molecular biology by C.A. Rice-Evans, A.T. Diplock, M.C.R. Symons.

Learning Outcome:

Students will be able to learn about free radicals, oxidative stress and antioxidants which are important in dealing with health and diseases, aging, neurodegenerative disorder, cancer etc.

M.Sc. COURSE, SESSION – 2021-2022
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 229 A
Medical Biochemistry
L T P C
3 0 0 3

09 Hrs./unit (Total: 45 Hrs.)

Unit-I 1.1 Biochemical basis of diseases/disorders, diagnosis and treatment

1.2 Molecular deficiency disorders

1.2.1 Enzyme deficiency: inborn errors of metabolism

1.2.1.1 Alkaptonuria

1.2.1.2 Phenylketonuria

1.2.1.3 Lesh-Nyhan syndrome

1.2.2 Protein defects/ deficiency

1.2.2.1 Cystic fibrosis

1.2.2.2 Sickel cell anaemia

1.2.2.3 Thalassemia

Unit-II Transport/storage associated disorders

2.1 Hypercholesterolemia and atherosclerosis

2.2 A-Beta-lipoproteinemia

2.3 Tay-Sachs disease

2.4 Gout

Unit-III Apoptosis and its implications in health and disease

- 3.1 Process of apoptosis
 - 3.1.1 Induction and biochemical changes
 - 3.1.2 Execution
 - 3.1.3 Phagocytosis of apoptotic bodies
- 3.2 Regulation of apoptosis
- 3.3 Implications
 - 3.3.1 Programmed cell death and development
 - 3.3.2 Development of immunological tolerance
 - 3.3.3 Neurological disorders

Unit-IV Cancer

- 4.1. Biochemical alterations during carcinogenesis
- 4.2. Regulatory mechanisms as targets for cancer therapy

Univ-V 5.1 Drug action, abuse and catabolism

- 5.1.1 Mechanisms
- 5.1.2 Drug addiction, alcohol toxicity
- 5.1.3 Catabolism of drugs
- 5.2. Recent trends in therapy**
 - 5.2.1 Biomolecules as diagnostic markers and therapeutic agents
 - 5.2.2 Gene technology and gene therapy
 - 5.2.3 Drug delivery and targeting
- 5.3. Medical gerontology

Suggested Readings:

1. Murray et al: Harper's Illustrated Biochemistry (27th ed 2006, McGraw Hill)
2. Ganong: Review of Medical Physiology (21st ed 2003, Lange Medical Publications)
3. Alberts et al: Molecular Biology of the Cell (4th ed 2002, Garland)
4. Goldsby et al: Immunology (5th ed 2003, Freeman)
5. Bhagvan: Medical Biochemistry (4th ed 2004, Hap)
6. Goodman et al: The Pharmacological Basis of Therapeutics (7th ed 1991, Macmillan Publishers)
7. Smith & Marks: Basic Medical Biochemistry (2nd ed 2005, LWW Lippincott's)
8. Chatterjea & Shinde: Medical Biochemistry (6th ed 2005, Jaypee brothers)
9. Bennett & Brown: Clinical Pharmacology (9th ed 2005, Elsevier)
10. Saini & Kaur: Clinical Biochemistry (1st ed 2001, CBS Publ)

M.Sc. COURSE, SESSION –2021-2022
LIST OF PRACTICALS
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
Medical Biochemistry
Course Code ZOO E 229 B

1. Study of pathological condition in rat/mouse model: liver cirrhosis, diabetes and ascites tumor
2. Analysis of enzymatic/biochemical markers from serum/tissues of rat/mouse model
 - 2.1 Studies on the anti-oxidant enzymes (SOD, catalase and GPx) in normal and diseased rats
 - 2.2 Native-PAGE analysis of LDH isoforms
 - 2.3 Spectrophotometric assay of SGOT (AST) and SGPT (ALT)
 - 2.4 Estimation of bilirubin concentration
3. Study of apoptosis in liver cirrhotic/tumor model
 - 3.1 Analysis of DNA-degradation pattern using agarose gel electrophoresis
 - 3.2 Western blot analysis of release of cytochrome C from mitochondria
 - 3.3 Expression analysis of Bcl2, Bax and pro-apoptotic factors (Caspase3 and 9)
4. Demonstration of expression of a gene/protein during aging

M.Sc. COURSE, SESSION – 2021-2022
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 229 A
Environmental Health
L T P C
3 0 0 3

09 Hrs./unit (Total: 45 Hrs.)

Unit I: Molecular toxicology

1.1 Basic understanding of environmental health impact

Unit II: Epigenetic traits and determinants

2.1 Basic understanding of tools and techniques used for pragmatic analysis of human Exposome

Unit III: Impact assessment of technological advancements

- 3.1 Synthetic pesticides
- 3.2 radiation and nuclear technology
- 3.3 cell phones
- 3.4 genetically modified products.

Unit IV: Occupational medicine

- 4.1 Detection and control of environmentally transmitted microbial hazards
- 4.2 industrial hygiene
- 4.3 occupational safety management

Unit V: Environmental law, regulation and policy

5.1 Articulate the implications of human-environmental interactions for social decision making

5.2 environmental regulation and allocation of public health resources

M.Sc. COURSE, SESSION – 2021-2022
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
Environmental Health
Course Code ZOO E 229 B
L T P C
0 0 2 1

List of practicals:

1. Histone modifications and DNA methylation
2. Hands-on-experience to exposome analytics (HPLC, GC etc.) used for evaluating dose-response and exposure-response relationship
3. Basic toxicogenomic profiling through software-user interface

M.Sc. COURSE, SESSION – 2021-2022
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 229 A
Cancer Biology & Therapeutics
Theory
L T P C
3 0 0 3

09 Hrs/unit (Total: 45 Hrs.)

Unit I: Origin, progress and dissemination of the disease, common forms and their diagnosis.

Unit II: Genetic and epigenetic association

1.1 Heritable traits

1.2 histone modifications and DNA methylation

1.3 micro RNAs and their role

Unit III: Radio-protectors, 109pecim-modulators and chemo-prevention

3.1 Anti-carcinogenicity of novel drug prototypes isolated from herbal/plant sources

Unit IV: Cellular therapy

4.1 Basic introduction to cellular engineering methods including Dendritic cell based nano-therapeutics

Unit V: Translational oncology

5.1 Basic understanding to epithelial-mesenchymal transition

5.2 Stem cell therapeutics

5.3Pharmaco-surveillance and nano-medicine

M.Sc. COURSE, SESSION – 2021–22
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
Course Code ZOO E 229 B
Cancer Biology & Therapeutics
Practical
L T P C
0 0 2 1

List of Practicals:

1. Cancer cell culture
2. Dendritic cell culture
3. Immunophenotyping
4. Isolation and characterization of active principles from herbal sources
5. Preparation of molecular vectors and characterization

M.Sc. COURSE, SESSION – 2021-2022
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 229 A

Vermibiotechnology

Theory

L T P C

3 0 0 3

09 Hrs./unit (Total: 45 Hrs.)

Unit 1.0: Earthworms

- 1.1 Basic structure
- 1.2 Life cycle
- 1.3 Life span
- 1.4 Identification of earthworm

Unit 2.0: Ecological Groups of Earthworms

- 2.1 Ecological requirements of earthworms
- 2.2 Earthworm species used in vermiculture

Unit 3.0: Vermicompost

- 3.1 Vermicompost materials
- 3.2 Preliminary treatment of composting materials
- 3.3 Method of vermicompost production
- 3.4 Benefits of vermicompost
- 3.5 Nutrient profile of vermicompost
- 3.6 Problems and their solutions

Unit 4.0: Vermiwash

- 4.1 Composition of vermiwash
- 4.2 Method of preparation
- 4.3 Method of application
- 4.4 Benefits of vermiwash

Unit 5.0: Wormery

- 5.1 Methods to establishment of wormery unit
- 5.2 Harvesting of earthworms
- 5.3 Grading and counting of earthworms
- 5.4 Transportation of live worms and cocoons
- 5.5 Precautions and requirements of wormery
- 5.6 Factors effecting the worm production
- 5.7 Vermi –entrepneurship

M.Sc. COURSE, SESSION – 2021–22
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
Course Code ZOO E 229 B
Vermibiotechnology

Practical

L T P C

0 0 2 1

List of Practicals

- 1: Collection and Identification of the epigeic earthworm species suitable for vermicomposting.
- 2: Different techniques for developing small and high scale vermireactors.
- 3: Grading and counting of Coccons and their method of transportation.
- 4: Preparation of Vermiwash and Vermimeal.

M.Sc. COURSE, SESSION – 2021-2022
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 229 A

Neurobiology

Theory

L T P C

3 0 0 3

09 Hrs./unit (Total: 45 Hrs.)

Unit-I Plasticity of brain and neurogenesis

Unit-II Organization of nervous system

- 2.1 Brain structure
- 2.2 Neurons and glia
- 2.3 Cerebrospinal fluid
- 2.4 Neural network
- 2.5 Blood brain barrier
- 2.6 Autonomic nervous system

Unit-III Axonal and synaptic transmission

- 3.1 Types of neurons
- 3.2 Membrane potential and action potential
- 3.3 Types of synapses
- 3.4 Excitatory and inhibitory post-synaptic potential
- 3.5 Chemical transmission, neurotransmitters (acetylcholine, catecholamines, serotonin and GABA), neuropeptides

Unit-IV 4.1 Molecular basis of learning and memory

- 4.2 Brain and 113pecimen113
- 4.3 Brain imaging using CAT, PET and MRI

Unit-V 5.1 Brain aging

- 5.2 Neuropathology and physiology
 - 5.2.1 Strokes
 - 5.2.2 Epilepsy
 - 5.2.3 Alzheimer disease
 - 5.2.4 Huntington disease
 - 5.2.5 Parkinson disease
 - 5.2.6 Hepatic Encephalopathy

Suggested Readings:

1. Ganong: Review of Medical Physiology (22nd ed 2005, Lang Medical Publications)
2. Guyton and Hall: Text Book of Medical Physiology (11th ed 2006, W.B. Saunders)
3. Keel et al: Samson Wright's Applied Physiology (14th ed 1989, Oxford Press)
4. West: Best and Taylor's Physiological Basis of Medical Practice (11th ed 1981, Williams and Wilkins)

5. Longstaff: Neuroscience (2002, Viva Books)
6. Shepherd: Neurobiology (1994, Oxford Univ Press)
7. Squire et al: Fundamental Neuroscience (2003, Academic Press)
8. Eric Kandel: Principles of Neural Science (2000, Mc Graw Hill)

M.Sc. COURSE, SESSION – 2021–22

PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY

Course Code ZOO E 229 B

Neurobiology

L T P C

0 0 2 1

List of Practicals:

1. Studies on learning and memory in rat/mouse model by Morris-Water-Maze Test or by using a zigzag or T-shaped maze in an animal model of Hepatic Encephalopathy
2. Behavioural analysis through motor function tests (catalepsy test, footprinting test, rotarod test).
3. a). Isolation of neurons and glia by differential centrifugation
b). Characterization of isolated cells types using specific marker

M.Sc. COURSE, SESSION – 2021-2022
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 229 A

Biological Methods to Study the Tissue

Theory

L T P C

3 0 0 3

09 hrs/unit (Total : 45 hrs)

Unit –I: Preparation of material for microtomy

- Rearing of animals
- Selection of tissue
- Tissue fixation: preparation of different fixatives for tissue fixation
- Processing for paraffin wax block preparation of tissue

Unit-II: Microtomy

- Principle and about the microtome
- Sharpening of razor
- Cutting of paraffin wax block
- Preparation of dehydration rack
- Preparation of different stains

Unit-III: Detection of Protein, Carbohydrate and Lipid in different tissue while applying the following

- Mercuric Bromophenol Blue Stain for detection of protein
- Periodic acid Schiffs reagent for detection of carbohydrate
- Sudan Black B for detection of lipid

Unit-IV: Detection of nucleic acids in different tissue

- Methyl green pyronin for detection of DNA and RNA
- Double staining method e.g. haemotoxylin-Eosin

Unit-V: Microscopic observation

- By simple microscope
- By compound microscope
- By phase-contrast microscope

M.Sc. COURSE, SESSION – 2021–22

PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY

Course Code ZOO E 229 B

Biological Methods to Study the Tissue

L T P C

0 0 2 1

List of practicals

1. Preparation of different types of fixatives
2. Preparation of different stains
3. Paraffin block preparation of different tissue
4. Microtomy
5. Preparation of sections of different tissue
6. Dehydration and staining to detect protein, carbohydrate and lipids
7. Nucleic acid staining
8. Microscopy : dissecting and compound microscope

M.Sc. COURSE, SESSION – 2021-2022
PG THIRD SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 329 A

Molecular Medicine

Theory

L T P C

3 0 0 3

09 hrs/unit (Total : 45 hrs)

Unit I: Technology & Society

- 1.1 Historical perspectives
- 1.2 evolution & dynamics of modern biology

Unit II: Biomedical basis of disease: From Gene to Protein to Disease

- 2.1 Cause and molecular/cellular progression of key diseases including infectious
- 2.2 inherited diseases
- 2.3 emphasising specially on cancer

Unit III: Analytical Technology

- 3.1 Basic principles of DNA sequencing
- 3.2 flow cytometry
- 3.3 laser scanning confocal microscopy
- 3.4 Real Time PCR

Unit IV: Genetic & Molecular Epidemiology

- 4.1 Basic principles
- 4.2 Bioinformatic tools
- 4.3 key tests and data interpretation using cutting-edge platforms

Unit V: Translational Research

- 5.1 Integrating pharmacogenetic approaches to health-care systems

M.Sc. COURSE, SESSION – 2021-2022

M. Sc. II Semester

ELECTIVE COURSE PRACTICAL

Course Code ZOO E 329 B

Molecular Medicine

L T P C

0 0 2 1

Practical Course:

1. Hands on experience to basic molecular tools and techniques
2. Medline database search and basic bioinformatics.

M.Sc. COURSE, SESSION – 2021-2022
PG THIRD SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 329 A
Methods in Molecular Biology

Theory
L T P C
3 0 0 3

09 hrs/unit (Total : 45 hrs)

Unit-I: Methods in Protein Biochemistry

- 1.1 Protein purification and separation methods
- 1.2 Application of centrifugation techniques
- 1.3 Chromatographic separation techniques
- 1.4 Electrophoresis – principle and methods

Unit-II: Protein Purification and Characterization

- 2.1 Protein isolation from plants and animal tissues, and cell cultures
- 2.2 Protein quantification
- 2.3 Catalytic identification of enzymes on electrophoresis

Unit-III: Methods in Nucleic Acids – DNA

- 3.1 DNA isolation from plants and animal tissues, and cell cultures
- 3.2 DNA purification methods
- 3.3 DNA quantification
- 3.4 Agarose gel electrophoresis – principle and methods (DNA and RNA)

Unit-IV: Methods in Nucleic Acids – RNA

- 4.1 Total RNA isolation from plants and animal tissues, and cell cultures
- 4.2 RNA purification and quantification
- 4.3 Agarose gel electrophoresis for RNA

Unit-V: Basics of gene expression analysis

- 5.1 Polymerase chain reaction – principles and methods
- 5.2 Real-Time PCR
- 5.3 Application of RNA for PCR amplification in analysis of gene expression

Suggested Reading Material

- 1. Principles and Techniques of Biochemistry and Molecular Biology, Keith Wilson, John M. Walker.
- 2. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc., USA.

M.Sc. COURSE, SESSION – 2021-22
M. Sc. III Semester
ELECTIVE COURSE PRACTICAL
Course Code ZOO E 329 B
Methods in Molecular Biology

L T P C
0 0 2 1

List of Practical:

1. Demonstration of spectrophotometry
2. Demonstration of chromatographic techniques
3. Isolation of Protein from plant/animal tissues
4. Demonstration of protein precipitation
5. Estimation of protein by spectrophotometer
6. Separation of proteins by SDS-PAGE
7. Isolation of nucleic acids from plant/animal tissues
8. Estimation of nucleic acids by spectrophotometer
9. Separation of nucleic acids by 121pecime gel electrophoresis
10. Demonstration of PCR and RT-PCR

M.Sc. COURSE, SESSION – 2021-2022
PG THIRD SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 329 A

Bioinformatics

Theory

L T P C

3 0 0 3

09 Hrs./unit (Total: 45 hrs)

Unit 01: Introduction

- 1.1 History and Scope of Bioinformatics
- 1.2 Definitions of Bioinformatics
- 1.3 Importance of Bioinformatics

Unit 02: Computers, Internet, World Wide Web and NCBI

- 2.1 Computers and Programs
- 2.2 Internet
- 2.3 World Wide Web & Browsers
- 2.4 EMBnet& NCBI

Unit 03: DNA, RNA and Proteins

- 3.1 Principles of DNA sequencing
- 3.2 Principles of RNA sequencing
- 3.3 Principles of Protein sequencing
- 3.4 Gene & Protein Expression Analysis
- 3.5 DNA microarray
- 3.6 Human Genome Project

Unit 04: Databases, Tools and their Uses

- 4.1 Importance of databases
- 4.2 Nucleic acid sequence databases
- 4.3 Protein sequence databases
- 4.4 Primary sequence databases- GenBank; NCBI; EMBL; ODBI
- 4.5 Subsidiary sequence databases-SWISS-PROT; TrEMBL; UniProt
- 4.6 Organism specific resources-OMIM; Unigene
- 4.7 Database Formats; Medline; PubMed; Web of Science
- 4.8 Uses of databases

Unit 05: Analyzing and Retrieving Databases

- 5.1 Sequence alignment methods
- 5.2 Pairwise and Multiple sequence alignment
- 5.3 Analyzing Protein sequences

5.4 Analyzing DNA sequences

5.5 Analyzing RNA sequences

5.6 BLAST; ClustalW

5.7 Phlogenetic Trees-Phylip

Suggested Readings:

1. “Understanding Bioinformatics” by Marketa J. Zvelbil; Publisher-Garland Science; ISBN-10:0815340249.

2. “Introduction to Bioinformatics” by Arthur M. Lesk; Publisher-Oxford University Press; ISBN-10:0199208042.

3. “Basic Bioinformatics” by S. Iganacimuthu; Publisher-Narosa; ISBN-978-81-7319-540-9.

4. “Bioinformatics for Dummies” by Jean-Michel Claverie, Publisher-For Dummies; ISBN-10:0470089857.

M.Sc. COURSE, SESSION – 2021-2022
M. Sc. III Semester
ELECTIVE COURSE PRACTICAL
Course Code ZOO E 329 B
L T P C
0 0 2 1

List of Practical:

1. Demonstration of PubMed in searching scientific literature using authors name, fields, limits etc.
2. Demonstration of BLAST in comparing Protein Sequences.
3. Demonstration of ClustalW in Multiple sequence alignment.
4. Demonstration of Rasmol in Protein structure visualisation.
5. Designing PCR primers.

**M.Sc. COURSE, SESSION – 2021-2022
PG THIRD SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 329 A**

Molecular Reproduction & Development

Theory

L T P C

3 0 0 3

09 Hrs./unit (Total: 45 Hrs.)

Unit I:

Male reproductive physiology

- Overview of spermatogenesis and male infertility factors

Unit II:

Female reproductive physiology

- Overview of oogenesis and factors affecting female fertility regulation

Unit III:

Development

- Principles of animal development
- Maternal information
- Induction and regulation of gene expression during development

Unit IV:

Developmental genetics

- Organization of human genome
- Pattern of mendelian inheritance
- Genomic imprinting

Unit V:

Biochemical basis of genetic diseases

- Human genetic disorders
- Genetics of childhood cancer
- Genetic counselling and prenatal diagnostics

M.Sc. COURSE, SESSION – 2021-2022
M. Sc. III Semester
PAPER V (ELECTIVE COURSE) PRACTICAL
Course Code ZOO E 329 B

L	T	P	C
0	0	2	1

1. Basic evaluation of male and female reproductive tract in a mammalian model
2. Introduction to human genome mapping
3. Chromosomal analysis using software interface

**M.Sc. COURSE, SESSION – 2021-2022
PG THIRD SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 329 A**

Molecular Taxonomy and DNA Barcoding

Theory

L T P C

3 0 0 3

09 Hrs./unit (Total: 45 Hrs.)

Unit 1.

Basics of Molecular Taxonomy

- Description, Illustration and communicating molecular biodiversity
- DNA barcode for Tree of Life

Unit 2.

Molecular Taxonomy tools and Protocols

- Introduction of mitochondrial DNA for molecular taxonomy
- Techniques of extraction of mDNA.
- Amplification technique of markers
- Quantification and documentation of DNA and PCR product

Unit 3.

Barcode analysis Software

- Introduction of alignment of sequence
- Phylogenetic analysis of ecological communities using DNA barcode

Unit 4.0: Laboratory Information Management System (LIMS) for DNA Barcoding

Unit 5.0: Introduction of Barcode of Life Data Base (BOLD)

M.Sc. COURSE, SESSION – 2021-2022
M. Sc. III Semester
PAPER V (ELECTIVE COURSE) PRACTICAL
Molecular Taxonomy and DNA Barcoding
Course Code ZOO E 329 B

L	T	P	C
0	0	2	1

- 1 Collection and preservation of biological Specimens for Molecular studies.
- 2 Extraction and Quantification of mDNA of preserved 128Specimen
- 3 Amplification of *coi* gene.
- 4 Bioinformatics based sequence assembly, alignment and analysis.