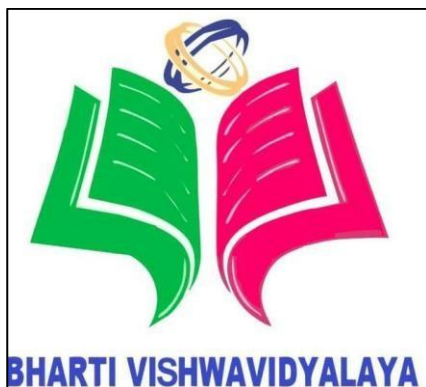


BHARTI VISHWA VIDYALAYADURG (C.G)

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**SCHEME OF EXAMINATION
& SYLLABUS OF
M.Sc–ZOOLOGY
SEMESTER EXAM UNDER
FACULTY OF SCIENCE**

Session: 2021-2022

(Approved by Board of Studies)

EXAMINATION SCHEME

M.Sc.-Zoology

M.Sc. examination will be conducted in four SEMESTERS. Each semester exam shall consist of FOUR THEORY PAPERS AND TWO LAB COURSES.

SEMESTER-I (20 CREDIT)

THEORY

(16 CREDIT)

PAPER Code	COURSE	CREDIT	DURATION	THEORY MARKS	INTERNAL ASSESSMENT	TOTAL MARKS
MZH-101	Biosystematics, Taxonomy and Biodiversity	4	3 Hrs	70	30	100
MZH-102	Structure and Function of Invertebrates	4	3 Hrs	70	30	100
MZH-103	Population Genetics and Evolution	4	3 Hrs	70	30	100
MZH-104	Tools & Techniques in Biology	4	3 Hrs	70	30	100

PRACTICAL (04 CREDIT)

PAPER Code	COURSE	CREDIT	DURATION	THEORY MARKS	INTERNAL ASSESSMENT	TOTAL MARKS
MZOL-105	Lab Course -I	2	8 Hrs	70	30	100
MZOL-105	Lab Course -II	2	8 Hrs	70	30	100

SEMESTER-II (20 CREDIT)**THEORY (16 CREDIT)**

PAPER Code	COURSE	CREDIT	DURATION	THEORY MARKS	INTERNAL ASSESSMENT	TOTAL MARKS
MZH-201	Molecular Cell Biology and Biotechnology	4	3 Hrs	70	30	100
MZH-202	General Physiology and Endocrinology	4	3 Hrs	70	30	100
MZH-203	Developmental Biology	4	3 Hrs	70	30	100
MZH-204	Quantitative Biology and Computer Application	4	3 Hrs	70	30	100

PRACTICAL (04 CREDIT)

PAPER Code	COURSE	CREDIT	DURATION	THEORY MARKS	INTERNAL ASSESSMENT	TOTAL MARKS
MZOL-205	Lab Course -III	2	8 Hrs	70	30	100
MZOL-206	Lab Course -IV	2	8 Hrs	70	30	100

SEMESTER–III (20 CREDIT)**THEORY (16 CREDIT)**

PAPER Code	COURSE	CREDIT	DURATION	THEORY MARKS	INTERNAL ASSESSMENT	TOTAL MARKS
MZH–301	Comparative Anatomy of Vertebrates	4	3 Hrs	70	30	100
MZH–302	Animal Behavior	4	3 Hrs	70	30	100
MZH–303	Environment Physiology and Population Ecology	4	3 Hrs	70	30	100
MZH–304	Immunology and Parasitism	4	3 Hrs	70	30	100

PRACTICAL (04 CREDIT)

PAPER Code	COURSE	CREDIT	DURATION	THEORY MARKS	INTERNAL ASSESSMENT	TOTAL MARKS
MZOL–305	Lab Course -V	2	8 Hrs	70	30	100
MZOL–306	Lab Course -VI	2	8 Hrs	70	30	100

SEMESTER-IV (20 CREDIT)**THEORY (16 CREDIT)**

PAPER Code	COURSE	CREDIT	DURATION	THEORY MARKS	INTERNAL ASSESSMENT	TOTAL MARKS
MZH - 401	Biochemistry	4	3 Hrs	70	30	100
MZH - 402	Neurophysiology	4	3 Hrs	70	30	100

OR *Optional Papers

Optional papers (Group I)*							
	A	Fish (ichthyology) structure and Function	3 Hrs	70	30		100
	B	Cell biology	3 Hrs	70	30	--	100
	C	Entomology	3 Hrs	70	30	--	100
	D	Biology of Vertebrate immune system	3 Hrs	70	30	--	100
Optional paper (Group II)*							
	A	Pisciculture and economic importance of fishes(ichthyology)	3 Hrs	70	30	--	100
	B	Cellular organization and molecular organization	3 Hrs	70	30	--	100

C	Applied entomology	3 Hrs	70	30	--	100
D	Molecular endocrinology and reproductive technology	3 Hrs	70	30	--	100

PRACTICAL (04 CREDIT)

PAPER Code	COURSE	CREDIT	DURATION	THEORY MARKS	INTERNAL ASSESSMENT	TOTAL MARKS
MZOL-405	PROJECT WORK	2	-----	-----	-----	100
MZOL-406	SEMINAR or VIVA	2	-----	-----	-----	100

OR

PAPER Code	COURSE	CREDIT	DURATION	THEORY MARKS	INTERNAL ASSESSMENT	TOTAL MARKS
MZOL-407	Lab Course -VII or Seminar	2	8Hrs	70	30	100
MZOL-408	Lab Course -VIII or Seminar	2	8Hrs	70	30	100

SEMESTER-I
MZH –101
BIOSYSTEMATICS AND BIODIVERSITY

MM 70

UNIT-I

Definition and basic concepts of biosystematics and taxonomy

- Concept of taxonomy
- Chemotaxonomy
- Cytotaxonomy
- Molecular taxonomy and mapping of phylogenetic tree

UNIT-II

Dimensions of speciation and taxonomic characters

- Species, types of species and mechanism of speciation.
- Species concepts and species category.
- Theories of biological classification.
- Taxonomic characters and different kinds.

UNIT-III

Procedure keys in taxonomy.

- Taxonomic procedures-taxonomic collections, preservation, curation
- Taxonomic keys-different kinds of taxonomic keys, their merits and demerits.
- Process of typification and different Zoological types.
- International code of Zoological Nomenclature (ICZN)

UNIT-IV

Biodiversity

- Concept and types of Biodiversity
- Methods of study of terrestrial, aquatic and aerial biodiversity
- Significance of wetland biodiversity
- Conservation methods of biodiversity
- Climate change and biodiversity
- Biosphere reserves

- Threat to biodiversity and IUCN Red list
- Hot spots of Biodiversity- Biodiversity legislation of India, USA,UK,Canada.

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- Biosystematics & Taxonomy by Dr. R. C. Tripathi, University Book House Jaipur
- Theory & Practice of Animal Taxonomy by V.C. Kapoor, 5th Edition Oxford & IBH Publishing Co.
- Principle of Animal Taxonomy by G.G. Simpson, Oxford & IBH Publishing Co.
- Elements of taxonomy by Earnst Mayer
- Biodiversity by E.O. Vilson, Academic Press Washington
- The Biology of Biodiversity by M. Kato, Springer
- Molecular Markers - Natural History & Evolution J.C. Avise

MZH –102
STRUCTURE & FUNCTION OF INVERTEBRATES

MM 70

UNIT-I

Organization of coelom

- Acoelomates and Pseudocoelomates
- Coelomates: Protostomia and Deuterostomia.

Locomotion

- Flagellar and ciliary movement in Protozoa.
- Hydrostatic movement in Coelenterata, Annelida and Echinodermata.

Nutrition and Digestion

UNIT-II

- Patterns of feeding and digestion in Protozoa
- Filter feeding in polychaeta.

Respiration

- Organs of respiration Gills, lungs and trachea.
- Respiratory pigments.

UNIT-III

Excretion

- Organs of excretion.
- Excretion and osmoregulation

Nervous System

- Primitive nervous system: Coelenterata and Echinodermata.
- Advanced Nervous system: Arthropoda (Crustacea and insecta) and

Mollusca (Cephalopoda)

UNIT-IV

- Invertebrate larvae
- Larval forms of free-living and parasitic invertebrates
- Minor Phyla
- Organization and general characters of (Ctenophore, Rotifera, Ectoprocta)

SUGGESTED READING MATERIALS (ALL LATEST EDITION)

- Invertebrate Structure and function, E.J.W. Barrington English language Book society UK.
- Invertebrate Zoology: Robert Barnes, IV Edition Holt Saunders International Edition japan.
- The Cambridge Natural History Volume 1 - 9. S F Harmer, A.E. Shipley. Today's & Tomorrow's Book agency, New Delhi India.
- A Text book of Zoology Invertebrate: Parker Hasvell, Marshall & Williams. ITBS Publishing & Distributers, Delhi
- The Invertebrates Vol. 1 – 9 Libbic Henrietta Hyman, McGraw Hill Book Company

MZH –103
POPULATION GENETICS & EVOLUTION

MM:70

UNIT-I

- Concepts of evolution and theories of organic evolution: Lamarckism, Darwinism and Synthetic theory of evolution
- Evidences of evolution: anatomical, embryological, palaeontological, physiological and Bio-chemical

Unit-II

- Hardy-Weinberg law of genetic equilibrium
- Detailed account of destabilizing forces.
- Natural selection
- (i) Mutation (ii) Genetic drift (iii) Meiotic drive
- Calculation of genotypic frequency
- Calculation of allelic frequency
- Molecular variation

UNIT-III

- Patterns and mechanisms of reproductive isolation
- Phylogenetic and biological concepts of species
- Gene Evolution, Evolution of gene families
- Factors affecting human disease
- Genetic alterations and human diseases

UNIT-IV

- Origin of higher categories
- Micro-and Macro-evolution
- Evolution of horse, elephant, camel, man

- Ethical legal and social issues in human genetics.

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- Gene & Evolution by Jha A.P. John Publication, New Delhi
- Evolution & Genetics by Merrel- D.J. Holt Rinchert & Wiston INC.
- The Genetics & Origin of Species by Dobzhansky, Columbia University Press.
- Evolution by Dobzhansky, Ayala F.J., Stebbins G.L. & Valentine J.M. Surjeet Publication New Delhi.
- Species Evolution - The Role of Chromosomal Change
King M. Cambridge University Press. Cambridge
- A Primer of Population Genetics
Hartl D.L. Suinaer Associates INC, Massachusetts
- Evolutionary Genetics
Smith J.M. Oxford University Press, New York
- Evolutionary Biology
Futuyama D.J. Suinaer Associates INC publishers, Dunderland
- Evolution
Strikberger M.W. Johns & Bartett Publishers, Boston London

MZH –104
TOOLS & TECHNIQUES IN BIOLOGY

MM:70

UNIT-I

Principles and application of

- Ultracentrifugation
- Electrophoresis
- Chromatography (various types)
- Colorimetry and spectrophotometry
- Flow cytometry.

UNIT-II

Principles and Application of

- Light Microscopy and micrometry
- Phase Contrast microscopy
- Interference microscopy
- Fluorescence microscopy
- Transmission Electron microscopy.
- Scanning Electron microscopy.

UNIT-III

- ELISA
- PCR
- Biological assays-in vivo and invitro
- Principles of cytological and cytochemical techniques
- Fixation: chemical basis of fixation by formaldehyde, glutaraldehyde, chromium salts, mercury salts, osmium salts, alcohol and acetone

- Chemical basis of staining of carbohydrate, protein lipids and nucleic acids.

UNIT-IV

- Nucleic acid hybridization
- Sequencing of proteins and nucleic acids
- Cryopreservation
- Chromosomal isolation and preparation of Cladogram
- Separation of DNA from animal/human sample

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- Introduction to Instrumental Analysis-
Robert Braun, McGraw Hill International Edition
- A biologist guide to principles and techniques of practical biochemistry-
K Wilson and K. H. Goulding ELBs Edition
- Instrumentation-
Upadhyay and Nath, Meerut Publications
- Instrumentation and Techniques-
R.C. Bajpayee, Himalayan Publications

MZOL– 105 LABORATORY COURSE–I

Biosystematics and Taxonomy

- Study of biodiversity among various invertebrates and vertebrates (Listing of all the animals found in and around your house and also try to find out their Zoological names).
- Collection of various insect species.
- Visits to a local animal park or zoo to identify and study the captive fauna and preparation of report.
- Study of adaptive characteristics of various invertebrates and vertebrates in different climate.
- Taxonomic key formation and conversion.
- Study of biodiversity in grassland and pond water and Computation of index
- Other exercise related to theory paper

Structure and function of Invertebrates

- Identification, and taxonomic determination,
- classification and study of distinguishing features of important representatives from various groups (Protozoa to Hemichordata, Ciliary Feeders).
- Study of permanent prepared slides (from Protozoa to Hemichordata).
- Model preparation and study of various organ system of Invertebrates, viz- Digestive, Nervous, Respiratory, reproductive and vascular systems.
- Study of various adaptations among insect fauna
- Collection and study of soil nematodes.
- Collection and study of Apterygota.
- Permanent preparations of different materials to be provided for study.

MZOL– 106 LABORATORY COURSE–II

Population genetics and evolution

- Preparation of human chromosomes map, demonstration of chromosomal deficiencies.
- Study of model-based pedigree analysis.
- Study of evolution of horse and human by model or skeletal evidence.
- Study of evolution through homologous and analogous organs.
- Calculation of Body mass index.
- Morphometric analysis.

Tools and techniques in biology: principles and use of following instruments for different techniques:

- Analysis of electrical conduction using conductivity meter
- Analysis of pH of sample by using pH meter
- Analysis of chemicals /Biochemical's using colorimeter /spectrophotometer
- Separation of compound using chromatography
- Separation of molecules using centrifuge
- Separation of DNA/protein using electrophoresis
- Identification of hormones or the compound using ELISA
- Amplification of Nucleic acid using PCR

Semester II
MZH –201
MOLECULAR CELL BIOLOGY AND BIOTECHNOLOGY

MM:70

UNIT-I

- DNA replication-Enzymes of DNA replication, Mechanism of DNA replication, Regulation of DNA replication.
- DNA damage and repair, causes consequences of DNA damage
- Mutation- Mutagen, molecular basis of mutation & types of mutation.
- DNA repair- Direct, Excision, Mismatch, Recombination and SOS repair.

UNIT-II

- Transcription- RNA polymerase, prokaryotic and eukaryotic mechanism, post transcriptional modification
- Translation- Process of translation, regulation and post translation modification
- DNA recombination-types and models of homologous recombination, biological importance of recombination
- Maintenance of DNA sequence role of methylation, phosphorylation, acetylation and deacetylation.

UNIT-III

- cDNA library- Mechanism and applications
- Molecular markers- RAPD, RFLP, AFLP, SSR etc.
- Genome sequencing- techniques and applications, human genome projects, ethical, legal and social issues
- Gene therapy – gene delivery, gene replacement, augmentation and application

UNIT-IV

- Application of molecular biology in health sectors.
- Application of molecular biology in agricultural sector.
- Application of molecular biology in environment.

- Embryonic stem cell technology and its application.

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- MOLECULAR CELL BIOLOGY by Lodish, W.H. Freeman & Co. New York
- Lehninger's PRINCIPLES OF BIOCHEMISTRY, Fourth Edition - David L [1]. Nelson, Michael M. Cox
- MOLECULAR CELL BIOLOGY by Lodish M. Baltimore, Scientific American books
- ESSENTIALS OF CELL & MOLECULAR BIOLOGY by Roberties & Roberties, Halt Saunders International Edition.
- CELL & MOLECULAR CELL BIOLOGY Gerald Karp, Willey & Sons Co.
- MEDICAL CELL BIOLOGY by Flickinger E.J. Brown J.C. Halt Saunders International Edition.
- CELL BIOLOGY by Powar C.B. Himalaya Publishing House

GENERAL PHYSIOLOGY AND ENDOCRINOLOGY

MM:70

UNIT-I

Digestion and Metabolism

- General organization of alimentary canal
- Mechanism of digestion
- Mechanism of absorption
- Gas Exchange and Acid-base Balance
- Oxygen and Carbon dioxide transport in blood
- Structure and Significance hemoglobin
- Regulation of body pH
- Thermoregulation and Cold Tolerance
- Heat balance and exchange
- Endotherms Vs Ectotherms
- Torpor, hibernation and aestivation

UNIT-II

Muscle Function and Movement

- Anatomy of muscle
- Mechanism of muscle contraction
- Regulation of muscle contraction
- Nervous System
- Neurons and membrane excitation
- Resting Membrane & Action Potential
- Nerve Impulse
- Synapses and neurotransmitters
- Synaptic transmission
- Sensory Transduction
- Auditory receptors
- Chemoreceptor: taste and smell
- Vision and Photoreception – Photo Chemistry of vision

UNIT-III

Endocrinology

- Structure and functions of endocrine glands (Pituitary, pineal, pancreas, adrenal, thyroid etc.)
- Some New Homeones Ghrelin, Leptin, Amylin, Renin, ANF.
- Biosynthesis of hormones (thyroid and gonadal)
- Hormones and Reproduction -Pregnancy, Parturition, Lactation
- Hormonal Control - Estrous Cycle menstrual cycle Menarche Puberty Menopause

UNIT-IV

- Mechanism of Hormone action
- Hormone receptors
- Endocrine disruptors.
- Hormones & Homeostasis

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- Comparative vertebrate Endocrinology – by Gorbman & Bern
- Medical Physiology by Guyton and Hall
- Physiology by Antonio Lucanio
- Human Physiology – by Dr. C. C. Chatterjee
- Comparative Endocrinology – by Barrington
- Applied Animal Endocrinology – by Squires
- Endocrinology – Basic & Clinical principles - by Melmed & Cohn
- T.B. of Endocrinology by Griffin.
- Endocrinology by Hardly.

MZH –203
DEVELOPMENT BIOLOGY

MM:70

UNIT-I

Oogenesis

- Differentiation and growth of oocytes.
- Organization of egg cytoplasm and egg cortex.
- Vitellogenesis
- Spermatogenesis
- Differentiation and ultra-structure of sperm
- Spermatocytogenesis Spermiation

UNIT-II

Fertilization

- Biological role of fertilization.
- Basic requirements of fertilization.
- Activation of egg metabolism
- Capacitation
- Biochemistry of fertilization
- Cleavage
- Characteristics and mechanisms of cleavages, Egg types

UNIT-III

Formative movements

- Fate maps - Organogenesis
- Utility and comparative topographical relationship of the Presumptive areas in early embryos of Amphioxus, Fishes, Amphibian and Birds
- Organogenesis of eye, heart and brain.

UNIT-IV

- Differentiation

- Cell and tissue interactions in development
- Primary embryonic induction
- Competence
- Concept of organizer
- Metamorphosis
- Teratology

SUGGESTED READINGS MATERIALS

- Animal Gametes – Vishmanath, Asia Publishing House
- Foundation of Embrology – Bradley M.Patten, McGraw Publication
- Fertilization in Animals – Brain Dale, Arlond Heiniman, Gulab Vazerani Publication
- Development Biology - N.J. Berril, Tata McGraw Hill Publication N. Delhi
- Embryology of Vertebrates - Nelso

**QUANTITATIVE BIOLOGY AND
COMPUTER APPLICATION**

MM:70

UNIT-I

Introduction to digital computer and application

- Basic knowledge of hardware and software
- CPU (Central Processing Unit)
- Input and Output devices
- Auxiliary storage system
- Operating system and Binary number system

UNIT-II

Computer application

- Introduction to MS-office
 - Word
 - Excel
 - Power point
- Computer application in biostatistics
- Simple computation and elementary knowledge of flow chart

UNIT-III

- Organization of data
- Presentation of data
- Measures of central tendency
- Measures of dispersion

UNIT-IV

Tests of significance

- Chi-square test

- Student's t-test
- Analysis of Variance
- Regression
- Correlation
- Probability

SUGGESTED READING MATERIALS

- Bataschelet. E. Introduction to mathematics for site scientist springer-verlag, berlin
- Lenderen D. Modelling in behavioral ecology. Chapman & Hall London U.K. Snedecor, G.W. and W.G. Cochran, statistical methods, Affiliated East, West Press New Delhi (Indian ed.)
- Muray, J.D. Mathematical Biology, Springer Verlag Berlin Pelon, E.C. The interpretation of ecological data:
- A primer on classification and ordination. A. Lewis. Biostatistics
- B.K. Mahajan Methods in Biostatistics
- J.D. Murrey Mathematical Biology Georgs & Wilians Starticalmethod

MZOL–205 LABORATORY COURSE–I

Molecular biology and Biotechnology

- Isolation of DNA/RNA.
- Study of mitochondria from buccal epithelium by staining with supravital stains.
- Study of cell division mitosis/meiosis by squash and smear preparation of root tip and cockroach/grasshopper testis.
- Study of giant chromosome in the salivary gland of Chironomous larvae or Drosophila.
- Study of Barr body and human chromosome.
- Culture and study of drosophila.
- Study of micronuclei.
- Separation of mitochondria.
- Organelles fractionation.
- Electrophoresis separation of DNA.
- RAPD, RFLP, AFLP.

General physiology and endocrinology

- Estimation of RBC, hemoglobin, hematocrit/PVC, blood group and Rh factor blood clotting time.
- Determination of urea, glucose and ketone bodies in urine.
- Determination of bilirubin ALP, total protein, globulin.
- Demonstration of osmosis.
- Study of histology of endocrine glands in different animal types through permanent slides and microtomy.
- Configuration of hormones by antigen-antibody test system.

MZOL–206 LABORATORY COURSE–II

Development biology

- Study of slides of development of frog.
- Study of development of Hen's egg, by cover glass window method, staining and mounting of blastodisc.
- Study of caudal regeneration in Teleost (Meal time effect).
- Study of embryological slides: spermatogenesis, oogenesis, histology of gonads.
- Study of effect of NaK/urea on growth of fish fingerlings.
- Study of effect of thyroid hormone on metamorphosis of tadpole
- Other exercises related to theory paper

Quantitative biology and computer application

- Preparation of frequency tables and graphs.
- Calculation of standard deviation, variance and standard error of mean.
- Calculation of probability and significance between means using t-test, Chi-square test, ANOVA
- Calculation of correlation, regression and probability distribution.
- Computer software use for computational tasks, data presentation, design task and communication
- Other exercises related to theory paper.

Semester III
MZH –301
COMPARATIVE ANATOMY OF VERTEBRATES
MM:70

UNIT-I

- Origin of vertebrates.
- Origin of fish & Amphibian.
- Origin of reptiles, Birds and Mammals.
 - Classification of Vertebrates and specialty of respective classes.
- Amphibians, Gymnophiona, Neotony, Parental case.
- Reptiles – Extinct reptiles.
- Birds – Palate in Birds.
- Mammals. – New world and old-world Monkeys.

UNIT-II

- Comparative studies of Integument system in vertebrates.
- Comparative study of derivatives of integuments in vertebrates.
- Skeletal system in vertebrates.
- Comparative study of Jaw suspensorium.
- Comparative study of Limbs and Girdles in vertebrates.

UNIT-III

- Comparative study of Respiratory system among vertebrates.
- Comparative study of respiratory pigments among vertebrates
- Comparative study of heart in vertebrates
- Comparative study of Aortic arch in vertebrates

UNIT-IV

- Comparative studies of digestive system in vertebrates.
- Comparative study of brain among vertebrates.
- Comparative study of sense organs among vertebrates.
- Comparative study of urinogenital system among vertebrates.

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- Vertebrate life :- William N. Ferland, F. Harvey pough, Tom J Gode, John B. Heiser
Collier MacNille International edition
- Chordate morphology :-Malcom Jollie Reinhold Publishing Corporation NewYork
- Chordate –Structure & Function :- Arnold G. Khage, B.E. Fry Johanson Mc Millan
Publishing Co. INC. New York
- Comparative Animal Physiology :- Orosser Satish Book Enterprises, Agra
- The Vertebrate Body :- Alfred Sherwood Romer Vakils, Feffer & Simons Publications
Ltd.

MZH –302
ANIMAL BEHAVIOUR

MM:70

UNIT-I

Ethology

- Historical perspectives of Ethology
- Behavioural patterns
- Innate behaviour
- Biological rhythms
 - Types of biological rhythm
 - Biological clock

UNIT- II

Communications

- Auditory
- Visual
- Chemical

Learning and Memory

- Conditioning
- Habituation
- Reasoning
- Reproductive behavior.

UNIT-III

Orientation

- Echolocation in bats
- Bird migration and navigation.
- Fish migration.

- Neural and hormonal control of behavior

UNIT-IV

Hormonal effect on behavioural patterns.

- Social behavior
- Social organization in insects and primates
- Schooling in fishes and Flocking in birds
- Homing, territoriality, dispersal
- Altruism
- Host–parasite relation

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- ANIMAL BEHAVIOR – Mc Farland (English Language Book Society)
- ANIMAL BEHAVIOR – Arora M.P. (Himalaya Publishing House, Mumbai)
- ANIMAL BEHAVIOR - Reena Mathur (Rastogi Publications, Meerut)

MZH –204
ENVIRONMENT PHYSIOLOGY AND
POPULATION ECOLOGY

MM:70

UNIT – I

Population dynamics:

- Demography, life table, reproductive rates, reproductive values
- Population growth, exponential, non-overlapping
- Stochastic and time lag models of population growth
- Population density
- Population evolution
- Community dynamics: Characteristics, development and classification

UNIT-II

- Terrestrial Adaptation in vertebrates
- Aquatic adaptation in vertebrates
- Aerial adaptation in vertebrates
- Cave adaptations in vertebrates

UNIT-III

Stress Physiology

- Basic concepts of environmental stress and strain, Concept of elastic and plastic strain.
- Stress avoidance, stress tolerance and stress resistance.
- Acclimatization, acclimation and adaptation.
- Endothermic and physiological mechanism of regulation of body temperature.

UNIT -IV

Stress physiology in different conditions

- Osmoregulation in aqueous and terrestrial habitats.
- Physiological response to oxygen deficient stress.
- Physiological response to body exercise.
- Effect of meditation and yoga

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- ECOLOGY with special reference to animal & man by S. Charles, Kendeigh Prentice hall of India Pvt. Ltd. New Delhi
- ELEMENTS OF TROPICAL ECOLOGY by Yanney Ewusie (English language Book Society, Heine mann educational book publication)
- FUNDAMENTALS OF ECOLOGY by Odum P.
- ANIMAL PHYSIOLOGY, MECHANISM AND ADAPTATION - Eckert, R., W, H, freeman and Co.
- BIOCHEMICAL ADAPTATION - Hochachka, P.W, and Somero S.N, Princeton, New Jersey
- ANIMAL PHYSIOLOGY: ADAPTATION AND ENVIRONMENT.-Shiemidt Nielsen, Cambridge
- GENERAL & COMPARATIVE ANIMAL PHYSIOLOGY By Hoar W.S. Princeton Hall of India
- ENVIRONMENTAL PHYSIOLOGY by Willmer, P.G. Stone & Johanson I, Blackwell Science-Oxford

UNIT-I

- Cells and organs of immune system
- Antigen and antibody structure
- Antigen-Antibody interaction
- Monoclonal antibody
- Primary and Secondary lymphoid organs

UNIT-II

- B-cell generation, activation and differentiation
- T-cell maturation, activation and differentiation
- T-cell receptors
- Complement system
- Cytokines

UNIT-III

- Major histocompatibility organ
- Cell mediated cytotoxic response
- Hypersensitivity reaction
- Autoimmune diseases
- Transplantation immunology
- Vaccine development

UNIT-IV

- Immune response in cancer, AIDS, SARS-Cov2
- Immune response to helminthes parasite infection
- Immune response to protozoan parasite infection
- Immune response to bacterial infection

- Immune response to viral infection

SUGGESTED READING MATERIALS

- Immunology by Kuby, W.H. Froeman USA.
- Fundamental of Immunology by W. Paul.
- Essential Immunology by I.M. Roitt, ELBs Edition.
- Immunology by Richard M. Hyde, Robert A. Patnode, A Wiley Medical Publications.
- Reproductive Physiology by Gayton.

MZOL–305

LABORATORY COURSE–I

Comparative anatomy of Vertebrates

- Identification, classification and study of distinguishing features of important representatives, museum specimens and slides (Protochordates and Chordates).
- Comparative studies of integumentary and reproductive system of major vertebrate classes.
- Comparative study of embryos of fish, amphibia and aves.
- Comparative study of skull & jaw of vertebrates.
- Comparative study of fins of fishes.
- Other exercise related to theory paper.

Animal Behavior

- To study the photo tactic response in earthworm or grain/pulse pest.
- To study the geotaxis behavior of earthworm.
- To study the food preference and cleaning behavior of housefly.
- To study the food preference in tribolium or grain/pulsepests.
- To study the web construction and habituation in spider.
- Estimation of body temperature and pulse rate on daily time scale.
- Estimate the time perception among various individuals at two different time points on daily time scale.
- Toxicological response of fish opercular and surfacing activity.

MZOL-306

LABORATORY COURSE-II

Immunology and Parasitism

- Total and differential counting of leucocytes.
- Preparation of blood film & identification of cell.
- Determination of agglutination reaction.
- Study of permanent slides (for spotting); thymus, lymph nodes, spleen, bone marrow, blood cells, stages of cancer cells.
- ODD test for antigen-antibody pattern.
- DOT ELISA test.
- Rocket Immuno electrophoresis.
- Study of parasites in fish, birds and other vertebrates.

Environmental Biology, Population ecology

- Study of biotic community in a pond/grassland ecosystem.
- Study of population growth rate (curve) in protozoan culture.
- Population dynamics of *Tribolium* sp.
- Study of biogeochemical cycles by way of models.
- Visit to some natural habitats and manmade habitats to study the human impact on environment.
- Determination of heavy metals from water & soil, viz. As, Fluoride, cadmium, chromium, iron, lead etc.
- Determination of BOD from sewage samples.
- Determination of COD from sewage sample.
- Determination of dissolved oxygen from water sample.
- Determination of total dissolved solid, conductivity and hardness of water sample.

SUGGESTED READING MATERIALS

- Immunology by Kuby, W.H. Froeman USA.
- Fundamental of Immunology by W. Paul.
- Essential Immunology by I.M. Roitt, ELBs Edition.
- Immunology by Richard M. Hyde, Robert A. Patnode, A Wiley Medical Publications.
- Reproductive Physiology by Gayton,
- Water analysis for fresh and waste water (Dissolve oxygen and chloride).
- Other exercises related to theory paper.

SEMESTER – IV
(MZH 401)
BIOCHEMISTRY(Compulsory)

MM 70

UNIT-I

Amino acids-Structure and classification

- Structure of proteins
- Biosynthesis of amino acids
- Catabolism of protein

UNIT-II

- Structure & classification of carbohydrate
- Metabolism of carbohydrate
- Structure & classification of lipid
- Biosynthesis of fatty acid

UNIT-III

Vitamins

- Water- and Fat-soluble vitamins,
- Chemistry, occurrence and physiological role.
- Enzymes Classification and nomenclature.
- Mechanism of enzyme action
- Kinetics of enzymes
- Enzyme immobilization

UNIT-IV

- Vitamins- Structure and Classification
- Metabolism of nucleic acid
- Hormonal regulation of carbohydrate metabolism
- Hormonal regulation of protein metabolism
- Hormonal regulation of lipid metabolism

Suggested Reading

- Lehninger Principles of Biochemistry, Fourth Edition, David L. Nelson, Michael M. Cox
Publisher: W. H. Freeman
- Biochemistry by Donald Voet, hardcover: 1616 pages, Publisher: Wiley; 3 edition
- Principles of Biochemistry with a Human Focus by Reginald H. Garrett, Charles M. Grisham
Publisher: Brooks Cole
- The Molecular Basis of Cell Cycle and Growth Control by
 - Gary S. Stein (Editor), Renato Baserga, Antonio Giordano, David T. Denhardt,
Publisher: Wiley-Liss
 - Experiments in Biochemistry: A Hands-On Approach by Shawn O. Farrell, Ryan T. Ranallo,
Publisher: Brooks Cole

MZH 402 (Compulsory)
NEUROPHYSIOLOGY

MM 70

UNIT - I

- Histogenesis and types of nerve cells
- Histological structure of nerves system
- Physiological properties of nerve fiber
- Synapse and synaptic transmission

UNIT - II

- Spinal cord – arrangement of grey and white matter
- The spinal nerves
- The tract- ascending tract
- The tract- descending tract

UNIT - III

- Cerebrum
- Brain stem – mid brain, pons varolii, medulla oblongata
- Cerebellum
- Thalamus

UNIT - IV

- Autonomic nervous system; sympathetic and para-sympathetic nervous system with special comparison to hormonal mechanism of transmission through autonomic nervous system
- Reflex action; varieties, characteristics, unconditional reflex, electrophysiology of spinal reflexes
- Sensation
- Electro encephalography and its physiological basis.

Suggested Reading

- The Brain: Our Nervous System by Seymour Simon
- Mass Action in the Nervous System by Walter J. Freeman
- Human Anatomy and Physiology with Interactive Physiology 10- System Suite, 8th Edition by Elaine N. Marieb and Katja N. Hoehn (Jan 10, 2010)
- Neuroanatomy by H.G.Snell
- Clinical Neurophysiology-Guide for Authors - Elsevier
 - Foundations of Cellular Neurophysiology (Bradford Books): Daniel Johnston, Optional papers

MZH 403-A (Optional paper)
Ichthyology (Fish) structure and Function

The following optional papers are being suggested as below

- Fish (Ichthyology) structure and function
Or
- Cell Biology Or
or
- Entomology
Or
- Biology of vertebrate's immune system

MZH 404-A (Optional paper)
(Pisci culture and economic importance of fishes Ichthyology)

The following optional papers are being suggested as below

- Pisci culture and economic importance of fishes Ichthyology)
Or
- Cellular organization and molecular organization
Or
- Applied entomology
Or
- Molecular endocrinology and reproductive technology
 - Student has choice to opt for one paper each (special paper) from group 1 and group 2

403-A (optional paper)

Ichthyology (Fish) Structure and Function

Unit-1

- Origin and evolution of fishes
- Classification of fishes as proposed by Berg
- Fish integument
- Locomotion
- Alimentary canal and digestion

Unit-2

- Accessory respiratory organs
- Air bladder and its functions
- Weberian ossicles their homologies and functions
- Excretion and osmoregulation
- Acoustico-lateral line system

Unit-3

- Luminous organs
- Colouration in fishes
- Sound producing organs
- Deep sea adaptations
- Hill stream adaptations

Unit-4

- migration in fishes
- Sexual cycle and fecundity
- Parental care in fishes
- Early development and hatching
- Poisonous and venomous fishes.

(Optional)

Cell Biology

Unit-1

- Molecular organization of eukaryotic chromosomes: structure of nucleosome particles and higher order compaction of mitotic chromosomes, chromatin remodeling
- specialized chromosomes: structural organization and functional significance of polytene chromosomes.
- DNA methylation and DNA Aase-1 Hypersensitivity in relation to gene activity and chromatin organization.
- Specialized chromosomes II : structural organization and functional significance of lampbrush chromosome.
- Organization and significance of heterochromatin.

Unit-2

- Structural organization of Eukaryotic genes, interrupted genes and overlapping genes and their evolution
- Gene families: organization, evolution and significance
- Transposable genetic elements of prokaryotes and eukaryotes Gene imitation and molecular mechanism of occurrence of mutation repair mechanism
- Organization of eukaryotic transcriptional machinery promoter enhancer's transcription factors polymerase activators and repressors.
- DNA binding domains of transcription apparatus zinc finger steroid receptors hemeon domains HILIX-loop, Helix and Leucine Zipper.

Unit-3

- Eukaryotic transcription of Eukaryotic transcriptional control.
- Environmental modulation of gene activity (stress response) stress genes and stress proteins
- Molecular basis of thalasemia's, muscular dystrophy, cystic fibrosis

- DNA rearrangement
- Amplification during development with special response to
- ciliates
- Choriongenic
- 5 S-RNA

Unit-4

- Drosophila development
- Cleavage
- Gastrulation
- Origin of Anterior –Posterior (Maternal effect genes and segmentation genes)
- Drosophila development II origin of dorsal ventral polarity
- Basic idea of homeotic selector genes and homeotic mutation
- Basic idea of organization of homeoboxes
- Evolutionary significance of homeoboxes

Suggested Reading Materials:

- Robertis, De and Robertis Cell and molecular biology Lea and Febiger.
- Watson Hopkis Roberts Steitz Weiner, Molecular Biology of the Gene the Benjamin, Cummings Publishin Companyinc.
- Bruce A; berts Bray ewis Raff Roberts Watson Molecular Biology of the Cell,Garland Publishinginc.
- Watson Gilman Witkowski Zoller Recombinant DNA Scientific American Books.
- Karp Gerald Cell Biology.
- Lewin B., Genes VII.
- King Cell Biology, Kaniel L. Hartl, Elizabeth W. Jones.
- Genetics Principals and Analysis, Jones and Bartlett Publishers.
- Kuby, Immunology, W.H. Freeman and Company.
- Roitt Male Snustad Immunology.

(Optional)
Entomology

Unit-1

- Insect head types and modification as per their habit and habitat
- Modification of mouth parts and feeding behaviour
- Structure types and function of antennae
- Hypothetical wing venation
- Structure of cuticle and pigment

Unit-2

- Sclerotisation and tanning of the cuticle
- Structure of alimentary canal and Physiology of digestion
- Malpighian tubules – anatomical organization , Transport mechanism
- Structure of circulatory system
- Cellular elements in the haemolymph

Unit-3

- Structure of compound eye and Physiology of Vision
- Sound Production in insect
- Structure and function of endocrine glands
- Pheromones

Unit-4

- Embryonic membranous up to the formation of blastoderm
- Metamorphosis
- Insecticide effects on CNS
- Important pest of Soybean Modern concept of pest management suggested.

Suggested Reading Materials:

- The Insect: Structure and function by R.F. Chapman
- Comparative Insect physiology, Biochemistry and Pharmacology .Vol :1-13. Edited by G.A. Kerkut and L.I. Gilbert.
- Entomophagous Insect by Clausen
- Entomology by Gilbert
- Principles of Insect Physiology by Wigglesworth.
- Fundamentals of Entomology by Elzinga
- Hand book of economic Entomology for South India by Ayyar.
- Insect cytogenetics by R.E.F.Symposium.
- Insects and plants by Sting, Lawton and Southwood.
- Insect and hygiene by Busvine.
- Insect Physiology by Wigglesworth.
- Insect morphology by Mat Calf and Flint
- Applied Agricultural Entomology by Dr. Lalit Kumar Jha

(Optional)

Biology of vertebrate immune system

Unit-1

- Tissues of Immune system- Primary lymphoid organs, structure and functions
- (Thymus and Bursa of Fabricius)
- tissues of Immune system- Secondary lymphoid organs, structure and functions
- (Spleen, lymphnode and Payers patches)
- Antigen processing
- Antigen presentation

Unit-2

- T-cell lineage and receptors
- T-cell activation
- B-cell lineage and receptors
- B-cell activation
- Immunoglobulin structure, Biological and physical properties of immunoglobulin
- Gene model for Immunoglobulin gene structure

Unit-3

- Generation of antibody diversity (Light and heavy chain)
- Immunization
- Immediate type of hypersensitivity reaction of Anaphylactic type-1.
- Antibody dependent cytotoxic type II reaction.
- Complex mediated type III reaction

Unit-4

- Delayed type cell mediated hypersensitivity type IV reaction.
- Enzyme linked immunosorbent assay (ELISA) technique and its applications.
- Immuno fluorescence technique (Direct & Indirect and Sandwich antibody labeling techniques.
- Immunodiffusion techniques (Mancini and Ouchterlony immunodiffusion techniques)
Monoclonal antibody technology (Hybridoma technology)

(Optional)

Pisci Culture and Economic Importance of Fishes (Ichthyology)

Unit-1

- Collection of fish seed from natural resources and transportation of fish seed.
- Breeding in fish, Bundh breeding and Induced breeding.
- Types of ponds required for fresh water fish culture farms.
- Management of fish farm.
- Physiochemical factors of freshwater for fish farming.

Unit-2

- Composite fish culture
- Prawn culture and pearl industries in India.
- Fisheries resources of C.G.
- Riverine fisheries.

Unit-3

- Costal fisheries in India
- Offshore and deep sea fishery's in India
- Role of fisheries in rural development
- Sewage fed fisheries

Unit-4

- Methods of fish preservation
- Marketing of fish in India.
- Economic importance and by product of fishes
- Fish disease.

Suggested Reading Materials: Paper III A & IV A

- JR. Norman - The History of fishes.
- Nagaraja Rao - An introduction to fisheries.
- Lagler Ichthyology.

- Herclen Jones Fishmigration.
- Marshal The life offishes.
- Thomas - Diseases offish.
- Greenwood - Inter relationship of fishes.
- Gopalji, Srivastava - Freshwater fishes of U.P. and Bihar.
- Brown -Physiology of fishes Vol. I & II.
- Hoar and Randall -Fish physiology of fishes Vol. 1 & IX.
- Gunther Sterba C.N.H.-Freshwater fishes of the world
- W. Lanham -The Fishes.
- G.V. Nikolsky -The ecology of Fishes,
- Borgstram -Fish as food Vol. I & II.
- Nilsson -Fish physiology -Recent Advances.
- P.B. Myle and J.J. Cech Fishes An Introduction to Ichthyology.
- Carl E. Bond -Biology offishes.
- M. Jobling -Environmental Biology of fishes.
- Santosh Kumar & Manju Ternbhre -Fish and Fisheries.
- S.K. Gupta-Fish and Fisheries
- K.P. Vishwas -Fish andFishries.
- Jhingaran -Fish andFishries.

(Optional)

Cellular Organization and Molecular Organization.

Unit-1

- General organization and characterizes of viruses (Examples SV 40 and HIV).
- Yeast : Structure, reproduction and chromosome organization: Basic Ideas of its applications as vectors for gene cloning.
- Molecular organization of Respiratory chain assemblies, ATP / ADP
- Translocase and F₀F₁ ATPase.
- Cell cycle: Cell cycle control in mammalian cells and xenopus.
- Cytochemistry of Golgi complex and its role in cell secretion.,

Unit-2

- Peroxisomes and training of paroxysmal proteins.
- Nucleolus: Structure and Biogenesis and functions of lysosomes.
- Intracellular digestion : Ultra structure and function of lysosomes.
- Synthesis and targeting of mitochondrial proteins.
- Secretary pathways and translocation of secretary proteins across the EPR membrane.

Unit-3

- Genome complexity: C- value [paradox and cot value].
- DNA sequences of different complexity.
- Difference between normal cells and cancer cells.
- Biochemical changes.
- Cytoskeleton changes.
- Cell surface changes.
- Genetic basis of human cancer

Unit-4

- Chromosomal abnormalities in human cancer.
- General idea of onchogens and proto onchogens.
- Onchogenec and cancer.

- Transforming Agents.
- Tumor Suppressor genes.
- Receptor – Ligand interaction and signal transduction. Cross – talk among various signaling pathways.

Suggested Reading Materials:

- DeRobertis and De Robertis Cell and Molecular Biology.
- Lea and Febiger. W. Watson Hopking reberts steits, Weiner molecular biology of the gene, the Benjamin / Cummings Publishin Company Inc.
- Bruce alberts, Bray, Lewis, Raff, Roberts, Watson molecular Biology of the cell garland publishing inc.
- P.K. Gupta, Molecular Cell Biology Rastogi Publication.
- Watson Gilman Witkowski, Zoller Recomdinant D.N.A. scientific American Books.
- Gerald Karp. Cell Biology.
- Lewin B. Genes VII.
- King Cell Biology.
- Baniel L. HArtl Elizabeth W. Jones, Genetics Principles and analysis. Jones and Bartlett Publisher.
- Lodish, Berk Zipursky, Matsudaira Baltimore Dernell Molecular Cell Biology W.H.Freeman and company.
- J. Travers Immunology current Biology limited.
- Kubey Immunology W.H. Freeman and Company.
- Riott, Male snustad Principles of genetics john weley and sons Inc.

404 -C (Optional) Applied Entomology

Unit-1

- Classification according to Imms
- Classification of apterygota upto families.
- Classification of following insect orders
- (a) Orthoptera (b) Hemiptera (c) diptera.
- Classification of following insect order
- (a) Hymenoptera (b) Lepidoptera (c) Coleoptera
- Collection and preservation of insects.

Unit-2

- Insect pest-Management strategies and tools
- Biological control, Genetic control, Chemical control
- Pests of Cotton
- Pests of sugarcane
- Pests of paddy
- Pests of stored food grains
- Pests of citrus fruits and mango
- Pests of pulses
- House hold insect pests

Unit-3

- Insects in relation to forensic science
- Insects migration, population fluctuation and factors
- Insects of medical and veterinary importance
- Ecological factors affecting the population and development of Insects

Unit-4

- Mulberry and non mulberry sericulture

- Apiculture
- Lac culture
- Insects as human food for future.

404-D(Optional)
Molecular Endocrinology and Reproductive Technology

Unit I

Definition and scope of molecular endocrinology.

Chemical nature of Hormones-

- Protein & polypeptides.
- Amino acid derivative
- Steroids
- Phospholipids derivative
- (tissue hormones)

Purification and characterization of Hormones.

UNIT-2

Receptor.

- Membrane Receptor.
- Nuclear Receptor.
- Orphan Receptor
- G-Protein
- Nuclear Receptor

UNIT-3

- Hormone – Transduction
- G-Protein & Cyclic Nucleosides.
- Calcium calmoduline & phospholipids.
- Miscellaneous Second Messengers.
- Phosphorylation & other non transcriptional effect of Hormones.
- Genetic control of formation of Hormone.

- Transcription.
- Post transcription.
- Translation.
- Post translation
- Secretion of Hormone.

UNIT-4

- Multiple ovulation and embryo transfer Technology.
- Study of estrous cycle by vaginal smear technology
- Surgical technique-
- Castration
- Ovariectomy
- Vasectomy
- Tubectomy
- Laprotomy.

Suggested Reading Materials:

- Benjamin Lewis – Genes VII/ VIII, oxford University press.
- Lodish - Molecular Cell Biology.
- Zarrow, M.X., Yochin J.M. and Machrthy, J.L. – Experimental Endocrinology.
- Chatterji C.C.- Human Physiology (Vol- II).
- Bentley, P.J. – Comparative Vertebrate endocrinology.
- Hadley Mac. E.- Endocrinology.
- Chinoy, N.J. Rao, M.V., Desarai, K.J. and High land, H.N. – Essential techniques in reproductively
- physiology and Endocrinology. Norris, D.O. – Vertebrate Endocrinology.

405 LAB COURSE-I
(COMPULSARY)

PAPER- I

BIOCHEMISTRY

1. Estimation of antioxidant enzymes.
2. Estimation of amylase. analitattative shudy of amylase
3. analitattative study of protein
4. analitattative study of CBH
5. Estimation of protein by Lowry method.
6. Estimation of Oil in seeds.
7. Estimation of Carbohydrate by anthrone reagent.
8. Other exercise related to theory paper.

PAPER- II NEUROPHYSIOLOGY

1. Study of slides of nervous system.
2. Neck nerve of squirrel by using alternate methods like clay modeling.
3. Study of Brain through Model.
4. Study of Cranial nerve of Bird, Amphibian, Reptile and Mammals by using alternate methods like clay modeling.
5. Other exercise related to theory paper.

406 LAB COURSE-II
OPTIONAL (SPECIAL PAPER) GROUP 1

PAPER-III(A) FISH (ICHTHYOLOGY) STRUCTURE AND FUNCTION

1. Anatomy of various organ systems and mounting of fish materials
2. Cranial nerves of teleost fishes: Wallago , Mystus, Labeo and other fishes by using alternate methods like clay modeling
3. Osteology of fish: Scoliodon, carps, catfishes, murrels etc.
4. Accessory respiratory organs of air breathing fish by using alternate methods like clay modeling
5. Study of histological (permanent) slides
6. Study of museum specimens of the concerned group
7. Other exercise related to theory paper.

PAPER –III(B) CELL BIOLOGY

1. Study of mitosis from onion root tip.
2. Study of meiosis in grasshopper testis.
3. Study of polytene chromosome in Dipteran Larvae.
4. Demonstration of Barr-Body in Human Cheek cell.
5. Estimation of DNA.
6. Estimation of RNA.
7. Other exercise related to theory paper.

PAPER –III(C) ENTOMOLOGY

1. Anatomy of common grasshopper, cockroach, honey bee, wasp and dysdercus, mylabris, belestoma (Giant water Bugs) by using alternate methods like clay modeling.
2. Dissection by using alternate methods like clay modeling and exposure of:

- i. Sting apparatus of honey bee and wasp.
 - ii. Tympanal organs of grasshoppers.
 - iii. Testes of cockroach
 - iv. Aristae of house fly.
 - v. Different types of mouthparts of insects.
 - vi. Different types of wings and antennae of insects.
 - vii. Tentorium of grasshoppers.
3. Identification and comment on insects of different orders and families.
 4. Identification with the help of keys of common insects from different orders and families.
 5. Other exercise related to theory paper.

PAPER-III(D) BIOLOGY OF VERTEBRATE IMMUNE SYSTEM

1. Dissection by using alternate methods like clay modeling of primary and secondary immune organs from mice:
 - a) Preparation of single cell suspension from bone marrow and spleen (spleenocytes) of mice.
 - b) Cell counting and viability testing of the spleenocytes prepared.
2. Preparation and study of phagocytosis by splenic/peritoneal macrophages.
3. Raising polyclonal antibody in mice, serum collection and estimating antibody titre in serum by following methods:
 - a) Ouchterlony (double diffusion) assay for Antigen -antibody specificity and titre.
 - b) ELISA
4. Antibody purification from the serum collected from immunized mice: affinity purification/chromatography.
5. Immuno electrophoresis.
6. Demonstration of Western blotting:
 - a) Protein estimation by Lowry's method /Bradford's method
 - b) SDS-PAGE.
 - c) Immunoblot analysis.
7. Other exercise related to theory paper

OPTIONAL (SPECIAL PAPER)

GROUP 2

PAPER –IV(A) PISCI CULTURE AND ECONOMIC IMPORTANCE OF FISH (ICTHYOLOGY)

1. Systematic identification of freshwater fishes with particular reference to C.G.
2. Age determination with the help of scales / otolith
3. Pigmentary behaviour in fish
4. Qualitative zooplankton analysis
5. Nutrient analysis of water
6. Analysis of gut contents
7. Microtomy of fish materials
8. Other exercise related to theory paper

PAPER-IV(B) CELLULAR ORGANIZATION AND MOLECULAR ORGANIZATION

1. Histochemical demonstration of Mitochondria
2. Histochemical demonstration of Golgi complex
3. Histochemical demonstration of Lactate dehydrogenase
4. Histochemical demonstration of Succinate dehydrogenase
5. Isolation and characterization of Nuclei from liver
6. Isolation and characterization of Mitochondria
7. Isolation of DNA from any tissue
8. Separation of lipids using thin layer chromatography
9. Separation of various proteins using column chromatography
10. Study of metaphase chromosomes from rat bone marrow
11. G banding of metaphase chromosomes
12. C- banding of metaphase chromosomes
13. Estimation of Mitotic Index
14. Measurement of cell size using oculometer.
15. Other exercise related to theory paper

PAPER- IV(C) APPLIED ENTOMOLOGY

1. Insect collection and preservation for systematic studies
2. Identification of different insects upto orders
3. Identification of insects upto families of economically important insect up to orders
4. Identification of insects upto species: Mosquitoes, honeybees, stored grain beetles, aquatic insects, important crop and household pests
5. Analysis of honey and its quality control
6. Field studies of insects to understand their habit, habitat environmental impact, beneficial and harmful activities etc.
7. Study of beneficial insects, benefits derived from them and useful products
8. Study of destructive insects, damage caused by them and damaged products
9. Study of insecticidal formulations and insect control appliances
10. Experiments on insect control like LC-50 /LD-50, knock down and recovery effect, repellency/antifeedance tests, percentage damage tests for leaf eating insects, and stored grain pests
11. Other exercise related to theory paper

PAPER- IV(D) MOLECULAR ENDOCRINOLOGY AND REPRODUCTIVE TECHNOLOGY

1. Chromatography method (separation of Androgen & Progesterone).

Bioassay of α -Ketosteroids.

2. Bioassay of Gonadotropins.
3. Study of slide related to endocrine glands.
4. Estimation of cholesterol.
5. Estimation of catecholamine.
6. Dissection by using alternate methods like clay modeling of endocrine glands.
7. Other exercise related to theory paper.