Government Arts and Science College
Ratlam (M.P.) 457001

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For the session 2022-23 the syllabus applied respectively in UG I and II have been adopted from Central Board of Studies Bhopal designed according to NEP2020. For UG III and PG the syllabus of the previous session have been followed.

Principal
Govt. Arts and Science College
Ratlam (M.P.)

Principal
Govt. Arts & Science College
Ratlam (M.P.)

विक्रम विश्वविद्यालय,उज्जैन

क्रमांक/अकादमिक/सम्मिलन/2021/ 1091 दिनांक :-25/10/2021

-:: अधिसूचना ::-

सर्व संबंधितो को सुचित किया जाता है कि प्राणिकी अध्ययन मण्डल की बैठक दिनांक 30.09.2021 को पारित नवीन संशोधित M.SC. Zoology पाठ्यक्रम सत्र 2021-23 लागू होगा।

सलंग्न :- M.SC. Zoology पाठ्यक्रम सत्र 2021-2023।

आदेशानुसार

कुलसचिव

क्रमांक/अकादमिक/सम्मिलन/2021/ 1092 दिनांक :-25/10/2021

प्रतिलिपि :-

01. प्राचार्य, समस्त शासकीय/अनुदान प्राप्त अशासकीय/अशासकीय महाविद्यालय,वि.वि.परिक्षेत्र,उज्जैन।
02. अतिरिक्त संचालक,उच्च शिक्षा,उज्जैन संभाग,शा.माधव विज्ञान, महाविद्यालय,उज्जैन।
03. कुलानुशासक, विक्रम विश्वविद्यालय,उज्जैन।
04. प्रभारी ऑनलाईन सेंटर, विक्रम विश्वविद्यालय,उज्जैन।
05. प्रभारी कम्प्यूटर सेंटर विक्रम विश्वविद्यालय,उज्जैन कृपया अधिसूचना को विश्वविद्यालय की वेबसाईट पर प्रसारित करें।
06. उप/सहायक कुलसचिव,परीक्षा/गोपनीय विभाग, विक्रम विश्वविद्यालय,उज्जैन।
07. संकायाध्यक्ष, विद्यार्थी कल्याण विभाग,विक्रम विश्वविद्यालय,उज्जैन।
08. कुलपतिजी/कुलसचिवजी के निज सहायक, विक्रम विश्वविद्यालय,उज्जैन।
की ओर सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित।

सहायक कुलसचिव (अकादमिक)

Dextop/P.Meeting 21/162

Semester wise syllabus

For

Post-Graduation

Session

2021-2023

M.Sc. Zoology

Department of Higher Education

Govt.of M.P

Semester Wise Syllabus for Post-Graduation

Session 2021-2023

M.Sc. Zoology

Department of Higher education, Govt. of M.P.

Learning outcomes:

M.Sc. Zoology course will help to understand the behavior, structure and evolution of animals. Zoologists use a wide range of approaches: from Genetics to Molecular and Cellular biology, as well as Physiological processes, Anatomy, Morphology, Population ecology. The intention is to understand the subject in the evolving biological paradigm in modern times. The key areas of study within the disciplinary/subject area of Zoology comprise of Systematics & evolution, Structure and functions of invertebrates, Biostatistics, Biodiversity, Wildlife, Biomolecules and metabolism, Immunology, Animal Physiology, Instrumentation, Molecular Cell Biology, Genetics, Anatomy of Vertebrates, Developmental Biology, Animal Behavior, neurophysiology, Ecotoxicology, Ichthyology etc. The M.Sc. degree programme in Zoology also deals with skill enhancement courses such as Sericulture, Aquaculture, economic Zoology, Tools and techniques, Fish culture etc. The course also offers specializations in the field of toxicology, Immunology, Molecular Endocrinology and Reproductive Technology, Limnology and Fish culture etc.

Duration of the course

M.Sc. Zoology will be a full time two year program to be covered in 4 semesters each of six months duration. The first year of the program will complete the first and second semester and the second year will complete third and fourth semester,

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1. Course Name : M.Sc. Zoology
2. Semester : I
3. Total Paper : 04
4. Compulsory Paper : 04
5. Optional Paper : 00
6. Practical : 02
7. Practical passing marks : 18 each practical
8. Maximum marks : 300
9. Minimum Passing percentage : 36

Paper No and Name	Total	Theory	CCE
Paper -I Biosystematics, Taxonomy and evolution	50	40	10
Paper –II Structures and Functions of Invertebrates	50	40	10
Paper - III Biostatistics, Biodiversity and Wildlife	50	40	10
Paper - IV Biomolecules and Structural Biology	50	40	10
Practical I based on paper 1-2	50	N/A	N/A
Practical II based on paper 3-4	50	N/A	N/A

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Class	-	M. Sc.
Semester	-	I
Subject	-	Zoology
Paper no. and Title	-	**Paper -I Biosystematics, Taxonomy and Evolution**

Max. Mark-40

Course Outcomes: The paper Imparts knowledge about biosystematics, basics of classification, binominal nomenclature and regarding various theories of evolution, evolutionary process such as variation, speciation, natural selection, origin of primates and man. It enables students to understand the patterns and processes of evolution above the species level and appreciate the differences between the three methods of phylogenetic analysis, evolutionary systematics, and cladistics.

UNIT: - I.

1. Definition and Basic Concepts of Biosystematics.
2. History of Classification.
3. Taxonomy: Chemotaxonomy, Cytotaxonomy and Molecular taxonomy.
4. Theories of biological Classification.

UNIT: - II.

1. Taxonomic Characters: Different kinds. Origin of Reproductive Isolation, Biological Mechanism of Genetic Incompatibility.
2. Taxonomic Procedures: Taxonomic Collections, Preservation, Curetting.
3. Taxonomic keys, Different types of Keys, their Merits and Demerits.
4. International code of Zoological Nomenclature (ICZN): Operative Principals, Interpretations and applications of Important Rules, Formation of Scientific names of various Taxa.

UNIT: - III.

1. Taxonomic Categories, Hierarchy of Categories, Higher Categories.
2. Species Concept: Species Categories, Subspecies, Infraspecific Categories.
3. Shannon Weiner Index.
4. Dominance Index: Similarity and Dissimilarity Index.

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UNIT: - IV.

1. Concepts of Evolution and Theories of Organic Evolution.
2. Concepts of Population Genetics, Hardy-Weinberg Law of Genetic Equilibrium.
3. Destabilizing Forces: Natural Selection, Mutation, Genetic Drift, Migration and Meiotic Drive.
4. Genetic Polymorphism,

UNIT: - V.

1. Concepts and Mechanism of Speciation.
2. Micro and Macro-evolution.
3. Evidences of Organic Evolution.
4. The Origin and Evolution of new genes.

Semester I Paper-I

SUGGESTED READING MATERIAL

1. M. Koto-The. Biology of biodiversity-Springer
2. E.O. Wilson-Biodiversity-Academic Press Washington.
3. G.G.-Simpson-Principle of animal taxonomy Oxford IBH Publication Company.
4. E-Mayer-Elements of Taxonomy
5. Bastchelet F-Introduction to mathematics for life scientists Springer Verlag, Berlin.
6. Skoal R.R. and F.J. Rohiff Biometry-Freeman, San-Francisco.
7. Snecdor, G.W. and W.G. Cocharan Statistical Methods of affiliated-East-West Press, New Delhi.
8. Murry J.D. Mathematical Biology-Springer, Verlag, Berlin.

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Class	-	M. Sc.
Semester	-	I
Subject	-	Zoology
Paper no. and Title	-	**Paper –II Structures and Functions of Invertebrates**

Max. Mark-40

Course Outcomes: The paper imparts knowledge regarding the various Invertebrates species and the regulatory processes. With the study of this paper students gain knowledge in the areas of responses to systematic position, general organization and affinities of all invertebrates. The students will be well equipped to become very competent in research or teaching fields after completion of this course.

UNIT: - I.

1. Origin of Metazoa.
2. Organization of Coelom:
   A. Acoelomates.
   B. Pseudocoelomates.
   C. Coelomates.
3. Locomotion:
   A. Amoeboid, Flagellar and Ciliary movement in Protozoa.
   B. Hydrostatic Movement in Coelenterata, Annelida and Echinodermata.

UNIT: - II.

1. Nutrition and Digestion:
   A. Patterns of feeding and Digestion in Lower Metazoa.
   B. Filter Feeding in Polychaeta, Mollusca and Echinodermata.
2. Respiration:
   A. Organs of Respiration: Gills, Lungs and Trachea, respiratory pigments.
   B. Mechanism of respiration in invertebrates.

UNIT: - III.

1. Excretion:
   A. Excretion in Lower Invertebrates.
   B. Excretion in Higher Invertebrates.
   C. Mechanism of Osmoregulation in Invertebrates.

UNIT: - IV.

1. Nervous System:
   A. Primitive Nervous Systems -Coelenterata and Echinodermata.

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B. Advanced nervous System in Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda).

UNIT: - V.

1. Invertebrate's larval Forms and Their Significance:
   A. Larval Forms of Trematoda and Cestoda.
   B. Larval Forms of Crustacea.
   C. Larval Forms of Mollusca.
   D. Larval Forms of Echinodermata.
2. Structure, Affinities and Life Histories of the following Coelomate Minor Phyla:
   A. Phoronida.
   B. Ectoprocta.

Semester I Paper-II

SUGGESTED READING MATERIAL

1. Hyman, L.H. The invertebrates, Nol. I. Protozoa through Ctenophora, McGraw Hill Co., New York
2. Barrington, E.J.W. Invertebrate structure and function. Thomas Nelson and Sons Ltd., London.
3. Jagerstein, G. Evolution of Metazoan life cycle, Academic Press, New York & London.
4. Hyman, L.H. The Invertebrates. Vol. 2. McGraw Hill Co., New York.
5. Hyman, L.H. The Invertebrates. Vol. 8. McGraw Hill Co., New York and London.
6. Barnes, R.D. Invertebrates Zoology, III edition. W.B. Saunders Co. Philadelphia.
7. Russel-Hunter, W.D. A biology of higher invertebrates, the Macmillan Co. Ltd., London.
8. Hyman, L.H. The Invertebrates smaller coelomate groups, Vol. V. Mc. Graw Hill Co., New York.
9. Read, C.P. Animal Parasitism. Parasitism. prentice Hall Inc., New Jersey.
10. Sedgwick, A.A. Student text book of Zoology. Vol. I, II and III. Central Book Depot, Allahabad.
11. Parker, T.J., Haswell W.A. Text book of Zoology, Macmillan Co., London.

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Class	-	M. Sc.
Semester	-	I
Subject	-	Zoology
Paper no. and Title	-	**Paper - III Biostatistics, Biodiversity and Wildlife**

Max. Mark-40

Course Outcomes: The paper imparts knowledge about endangered species and also about every organism. Conservation increases awareness and understanding of how human life depends on conserving animal species and natural ecosystems. The paper also imparts knowledge about wildlife, wildlife conservation, habitat conservation and biostatistics. It also explains descriptive statistics, explains correlation and regression and fundamental concept of Hypothesis testing.

UNIT: - I.

1. Measures of Central Tendencies: Mean, Median, Mode.
2. T-test, Chi-square Test.
3. Probability, Distribution properties and Probability Theory.
4. Computer added techniques for Data presentation (Tables, Graphs, Pie diagrams and Histograms).
5. Internet and its uses.

UNIT: - II.

1. Experimental Designing and Sampling theory.
2. Analysis of Variance (ANOVA).
3. Correlation – Types of Correlation.
4. Coefficient of Correlation.
5. Regression

UNIT: - III. Biodiversity

1. Concept and Principle and Values of Biodiversity.
2. Causes for the loss of Biodiversity.
3. Biodiversity Conservation Methods.
4. Medicinally Important Plants.

UNIT: - IV. Wildlife of India

1. Values of Wildlife: Positive and Negative.
2. Wildlife Protection Act.
3. Conservation of Wildlife in India.
4. Endangered and Threatened Species of India.
5. National Parks and Centuries

UNIT: - V. Wildlife and Conservation

1. Project Tiger, Gir Lion Project and Crocodile breeding Project.

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2. Wildlife in M.P. with reference to Reptiles, Birds and Mammals.
3. Remote Sensing -Basic Concepts and Applications.
4. Biosphere reserves.
5. Ecotourism in India.

Semester I Paper-III

SUGGESTED READING MATERIAL

1. Jorgenserr, S.E. Fundamental of Ecological modeling Elsevier New York
2. Lenderen D. Modelling in behavioral ecology. Chapman & Hall London U.K.
3. Sokal, R.R. and F. J. Rohit Biometry Freeman San Francisco
4. Snedecor, G.W. and W.G. cochran, statistical methods, Affiliated East, West Press New Delhi (Indian ed.)
5. Pelon, E.C. The interpretation of ecological data: A primer on classification and ordination.
6. Lewis – Biostatics
7. B.K. Mahajan Methods in Biostatics
8. V.B. Saharia Wildlife in India
9. S.K. Tiwari Wildlife in Central India
10. Georgs & Wilians statistical method
11. R.K. Tondon Biodiversity Taxonomy & Ecology
12. M.P. Arora An Introduction to prevantology
13. P.C. Kotwal Biodiversity and conservation
14. M. Koto: The Biology of Biodiversity. Springer.
15. O. Wildon: Biodiversity. Academic Press Washington,
16. G.G. Simpson: Principles of Animal Taxonomy. Oxford IBH Publication Company.
17. Mayer: Elements of Taxonomy.
18. Dobzansky: Biosystematics.
19. Dallela and Sharma: Animal Taxonomy and Museology.
20. Dodzhansky: The Genetics and origin of species. Columbia University Press.
21. Futuyama D.I. Evolutionary Biology. INC Publishers Dunderland.
22. Jha A.P.: Genes and Evolution – John Publication, New Delhi.

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Class	-	M. Sc.
Semester	-	I
Subject	-	Zoology
Paper no. and Title	-	**Paper - IV Biomolecules and Structural Biology**

Max. Mark-40

Course Outcomes: The paper explains structure of biomolecule and bioenergetics, fundamental understanding of Proteins explains enzyme catalysis and kinetics and describes metabolism-catabolism and different pathways of metabolism and also structural biology of biomolecules.

UNIT: - I. Chemical Foundation of Biology

1. pH, acids, Bases, Buffers.
2. Amino acids
3. Monosaccharide, oligosaccharides and polysaccharides.
4. Nucleotides
5. Nanoparticles and Biomaterials

UNIT: - II.

1. Primary, Secondary, tertiary and quaternary structures of proteins, protein folding and denaturation
2. DNA and RNA: Double helical structure of DNA, Structure of RNA, role of RNA in gene expression
3. DNA replication, Recombination and Repair.
4. Functional importance of lipid storage and membrane lipids
5. Membrane channels and pumps

UNIT: - III.

1. Basic concepts of metabolism: Coupled and interconnecting reactions of metabolism cellular energy resources and ATP synthesis.
2. Glycolysis and Gluconeogenesis.
3. Citric acid cycle.
4. Oxidative phosphorylation: Protein and its regulation.
5. Fatty acid metabolism: Synthesis and degradation of fatty acids.

UNIT: - IV.

1. RNA synthesis and splicing.
2. Biosynthesis of amino acids.
3. Biosynthesis of nucleotides.
4. Biosynthesis of membrane lipids and steroids.
5. Protein synthesis.

UNIT: - V.

1. Enzymes: Terminologies, classification and basics of enzyme kinetics
2. Mechanism of enzyme catalysis
3. Regulation of enzyme action

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4. Concept of free energy and thermodynamics principals in biology
5. Energy rich bonds, compound and biological energy transducers

Semester I Paper-IV

SUGGESTED READING MATERIAL

1. Voet, D, and J.G. Voet. Biochemistry John Wiley & Sons.
2. Freifelder, D. Physical Biochemistry W.H. Freeman & Co.
3. Segal, LH. Biochemical calculations John Wiley and Sons.
4. Creighfon, T.E. Protein Structure and Molecular Properties W.H. Freeman & Co. S. Freifelder, D. Essentials of Molecular Biology.
5. Wilson, K. and K.H. Goulding A Biologists Guide to Principals and Techniques of Practical Biochemistry.
6. Cooper, T.G. Tools of Biochemistry.
7. Hawk, Practical Physiological Chemistry.
8. Garret, R.H. and C.M. Grisham. Biochemistry. Saunders College Publishers.

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Class	-	M. Sc.
Semester	-	I
Subject	-	Zoology
Practical	-	**I (First)**

Course Outcomes: The practical will teach students about dissecting various invertebrates like Squilla, Prawn, Sepia, Loligo, Grasshopper, Honey bee etc. It will also provide students' knowledge about different adaptations, biodiversity and wildlife.

Practical based on paper I and II
I. Biosystematics, Taxonomy and evolution
II. Structures and Functions of Invertebrates

Exercise:

1. Spotting - Classification and identification of various phylum.	10 Marks
2. One major dissection of various systems of invertebrates - Squilla, Prawn, Sepia, Loligo.	10 Marks
3. One minor dissection- Grasshopper, Honeybee, Echimus, Starfish, Aplysia.	5 Marks
4. Mounting material - permanent balsam mount.	5 Marks
5. Spotting related with Adaptations, Homologies, Analogies and modification of month parts.	5 Marks
6. Viva-voce.	10 Marks
7. Practical Records and collection.	5 Marks
Total	**50 Marks**

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Class	-	M. Sc.
Semester	-	I
Subject	-	Zoology
Practical	-	**II (Second)**

Course Outcomes:

Practical based on paper III and IV
III. Biostatistics, Biodiversity and Wildlife
IV. Biomolecules and Structural Biology

Exercise:

1. Exercises based on Biodiversity and wildlife. Mammals, Birds, Reptiles and Fishes	20 Marks
2. Exercise on mean, mode, and Median.	5 Marks
3. Cell division slide preparation of Meiosis and Mitosis.	5 Marks
4. Study of different types of chromosomes/preparation of slides.	5 Marks
5. Viva-voce.	10 Marks
6. Practical Records and collection.	5 Marks
Total Marks	**50 Marks**

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1. Course Name : M.Sc. Zoology
2. Semester : II
3. Total Paper : 04
4. Compulsory Paper : 04
5. Optional Paper : 00
6. Practical : 02
7. Practical passing mark : 18 each practical
8. Maximum marks : 300
9. Minimum Passing percentage : 36

Paper No and Name	Total	Theory	CCE
Paper –I. General and Comparative Animal Physiology and Endocrinology	50	40	10
Paper –II. Population Ecology and Environmental Physiology	50	40	10
Paper – III. Tools and Techniques in Biology	50	40	10
Paper – IV. Molecular Cell Biology and Genetics	50	40	10
Practical I. based on paper 1-2	50	N/A	N/A
Practical II. based on paper 3-4	50	N/A	N/A

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Class	-	M. Sc.
Semester	-	II
Subject	-	Zoology
Paper no. and Title	-	**Paper -I General and Comparative Animal Physiology and Endocrinology**

Max. Mark-40

Course Outcome: The paper develops understanding for the fundamental concept of Animal physiology where paper describes the mechanism of action of pheromones, the fundamental concepts of physiology of digestion, patterns of nitrogen excretion, osmoregulation and thermoregulation.

UNIT: - I.

1. Respiratory pigments through different phylogenic groups.
2. Transport of oxygen and carbon dioxide in blood and body fluids.
3. Regulation of respiration.
4. Physiology of impulse transmission through nerves and synapses.
5. Autonomic nervous system, neurotransmitters and their physiological functions.

UNIT: - II.

1. Patterns of nitrogen excretion in different animal groups.
2. Comparative physiology of digestion.
3. Osmoregulation in different animal groups (Vertebrates).
4. Thermoregulation in homeotherms, poikilotherms and hibernation.
5. Physiology of pregnancy, pregnancy diagnosis tests, parturition, breast lactation and placental hormones.

UNIT: - III.

1. Comparative study of mechanoreception.
2. Comparative study of photoreception.
3. Comparative study of phonoreception.
4. Comparative study of chemoreception.
5. Comparative study of equilibrium reception.

UNIT: - IV.

1. Bioluminescence as means of communication among animals.
2. Pheromones and other semiochemicals as means of communication among animals.
3. Chromatophores and regulation of their function among animals.
4. Hormones, their classification and chemical nature.
5. Mechanisms of hormone action.

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UNIT: - V.

1. Phylogeny of endocrine glands (pituitary, pancreas, adrenal, thyroid).
2. Neuroendocrine system of Invertebrate.
3. Neuroendocrine system of Vertebrate.
4. Hormones and reproduction.

Semester II Paper-I

SUGGESTED READING MATERIAL

1. EJW Barrington-General & comparative Endocrinology -Oxford, Claredon Press.
2. R.H. Williams-Text Book of Endocrinology-W.B. Saunders.
3. C.R. Martin- Endocrine Physiology-Oxford University Press.
4. Molecular Cell Biology-J. Darnell, H. Lodish and D. Baltimore-Scientific American Book USA.
5. Molecular Biology of the cell-B. Alberts, D-Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Pub. New York.

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Class	-	M. Sc.
Semester	-	II
Subject	-	Zoology
Paper no. and Title	-	**Paper - II Population Ecology and Environmental physiology**

Max. Mark-40

Course Outcomes: The paper describes the history, introduction and nature of ecosystem. The paper also explain and describe population & community ecology and narrates on different freshwater and eco-physiological adaptations. The paper also helps to understand the environmental limiting factors, intra and inter-specific relationships, sustainable development, mutualism and homeostasis etc.

UNIT: - I.

1. Populations and their characters.
2. Demography: Life tables, generation time, reproductive value.
3. Population growth: Growth of organisms with non-overlapping, generations, stochastic and time lag models of population growth, stable age distribution.
4. Population regulation: Extrinsic and intrinsic mechanisms.

UNIT: - II.

1. Adaptations: Levels of adaptions, significance of body size.
2. Aquatic environments: Fresh water, marine, shores and estuarine environments.
3. Eco-physiological adaptations to freshwater environments.
4. Eco-physiological adaptations to marine environments.
5. Eco-physiological adaptations, to terrestrial environments.

UNIT: - III.

1. Environmental limiting factors.
2. Inter and intra-specific relationship.
3. Predatory- prey relationship, predator dynamics, optimal foraging theory (patch choice, diet choice, prey selectivity, foraging time).
4. Mutualism.

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UNIT: - IV.

1. Environmental pollution and human health.
2. Conservation management of natural resources.
3. Environmental impact assessment.
4. Sustainable development.

UNIT: - V.

1. Concept of homeostasis.
2. Endothermi and temperature physiological mechanism of regulation of the body temperature.
3. Physiological response to oxygen deficient stress.
4. Physiological response to body exercise.

Semester II Paper-II

SUGGESTED READING MATERIAL

1. Cherrett, J.M. Ecological Concepts. Blackwell Science Publication, Oxford, U.K.
2. Elseth, B.D. and K.M. Baumgartner, population Biology, Van Nostrand Co., New York.
3. Jorgensen, S.E. Fundamentals of ecological modeling. Elsevier, New York.
4. Krebs, C.J. Ecology. Harper and Row, New York.
5. Krebs, C.J. Ecological Methodology. Harper and Row, New York.
6. Eckert, R. Animal Physiology: Mechanism and Adaptation. W.H. Freeman and Co., New York.
7. Hochachka, P.W. and G.N., Somero. Biochemical adaptation. Priceton, New Jersey.

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Class	-	M. Sc.
Semester	-	II
Subject	-	Zoology
Paper no. and Title	-	**Paper -III Tools and Techniques in Biology**

Max. Mark-40

Course Outcomes: The study of this paper teaches students about the basic and fundamental principles behind the working of some common instruments like microscope, spectrophotometer, centrifuge, microtome etc. The paper also imparts knowledge about immunological techniques, recent biotechnological techniques like DNA sequencing, tissue culture, and Polymerase Chain reaction. Northern, Southern and Western blotting which enables students to get acquainted with recent trends and techniques in scientific scenario.

UNIT: - I.

1. Components, Principle, applications of Light Microscope and Electron microscope.
2. Components, Principle, applications of Phase Contrast microscope.
3. Components, Principle, applications of Confocal microscope.
4. Components, Principle, applications of Fluorescent microscope.
5. Components, Principle, applications of Spectrophotometer.

UNIT: - II.

1. Cryopreservation and Freeze drying techniques.
2. Column chromatography.
3. Thin Layer Chromatography.
4. Gel Electrophoresis.
5. Microtomy.

UNIT: - III.

1. Radio isotopes and radioisotopic techniques in biology.
2. Autoradiography.
3. Antigen-antibody reaction and types of Immunoglobulins

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4. Immunodiffusion, Immunoelectrophoresis.
5. ELISA and FIA

UNIT: - IV.

1. Tissue fixation and complete procedure for staining.
2. Histochemical demonstration of Lipids.
3. Essential components and preparation of culture media, cell culture.
4. Sterilization, Inoculation and Microbial identification (bacteria, fungi).
5. Cell viability test and cell immobilization methods.

UNIT: - V.

1. Chromosome bending techniques.
2. Human Karyotype preparation and its significance.
3. Southern Blotting, Northern Blotting and Western Blotting.
4. Polymerase Chain Reaction (PCR).
5. DNA Sequencing.

Semester II Paper-III

SUGGESTED READING MATERIAL

1. Introduction to instrumental analysis-Robert Braun-McGraw Hill.
2. A biologist Guide to principles and Techniques of Practical Biochemistry- K, Wilson and K.H. Goulding EIBS Edn.
3. Clark & Swizer. Experimental Biochemistry. Freeman, 2000.
4. Locquin and Langeron. Handbook of Microscopy. Butterwaths, 1983.
5. Boyer. Modem Experimental Biochemistry. Benjamin, 1993.
6. Freifelder. Physical Biochemistry. Freeman, 1982.
7. Wilson and Wlaker. Practical Biochemistry. Cambridge, 2000.
8. Cooper. The Cell-A Molecular Approach. ASM, 1997.
9. John R.W. Masters. Animal Cell culture- A practical approach, IRL Press.
10. Robert Braun. Introduction to instrumental analysis. McGraw Hill

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Class	-	M. Sc.
Semester	-	II
Subject	-	Zoology
Paper no. and Title	-	**Paper -IV Molecular Cell Biology and Genetics**

Max. Mark-40

Course Outcomes: The paper provides basic knowledge about structure of cell and cell organelles; it provides basic understanding about transport across cell membrane, cell signaling and cell to cell interaction. The second half of the paper deals with modern cytological techniques like genetic counseling, prenatal diagnosis, transgenic animals and gene therapy. It also provides elementary idea of genomics, proteomics, gene mapping and human genome project.

UNIT: - I. Biomembrane

1. Molecular composition, arrangement and functional consequences.
2. Transport across cell membrane diffusion, active transport, pumps, uniports, symports and antiports.
3. Micro filaments, microtubules structure and dynamics.
4. Cell movements' intracellular transport, role of kinesin and dynein.

UNIT: - II. Cell signaling

1. Cell surface receptors.
2. Second messenger system.
3. Signaling from plasma membrane to nucleus.
4. Gap junctions and Connexins.
5. Integrins.

UNIT: – III. Cell -Cell adhesion and communication

1. Ca^{++} dependent homophilic cell - cell adhesion.
2. Ca^{++} independent homophilic cell - cell adhesion.
3. Genome organization, hierarchy in organization.

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4. Chromosomal organization of genes and non - coding DNA.

UNIT: -IV.

1. Sex determination in Drosophila and mammals.
2. Basic concept of dosage compensation.
3. Cytoplasmic inheritance: Kappa Particles and Maternal Inheritance in Limnaea shell coiling.
4. Cytogenetic of human chromosome.
5. Human genome project (HGP) purpose to Implicate.

UNIT: - V. Genetic Diseases and Genomics

1. Human gene therapy.
2. Prenatal diagnosis and genetic counseling.
3. Genetic screening.
4. Structural and functional Genomics.
5. Gene libraries.
6. Transgenic animals and their applications.

Semester II Paper-IV

SUGGESTED READING MATERIAL

1. J. Darnell, H. Lodish and D. Baltimore molecular cell biology scientific American book. Inc. USA.
2. Alberts D. Bray, J. Lewis, M. raff, K. Roberts and J.D. Wattson, molecular biology of the cell. Garland Publishing Inc. New York.
3. John R. W. Animal cell culture: A practical approach masters. Irl. Press.
4. Alberts *et al.,* Essentials cell biology garland publishing Inc. New York 1998.
5. J.M. Barty molecular biology Philip E. Hartman Gene Action L.C. dunn, principles of Genetics.
6. A.M. Winchester genetics.

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Class	-	M. Sc.
Semester	-	II
Subject	-	Zoology
Practical	-	I (First)

Course Outcomes: The practical's will provide students with the knowledge about testing blood groups, analyzing pH, enzyme detection, nitrogenous samples, the students will also learn about handling basic instruments. The practical training of Molecular Endocrinology will teach students about surgical and experimental techniques applied in the subject, the students will also learn techniques like castration and learn different histochemical techniques.

Practical based on paper I and II
I. Paper -I General and Comparative Animal Physiology and Endocrinology
II. Population Ecology and Environmental physiology

Max. Mark-50

Exercise:

1.	Experiment on Hematology Blood group, Total and differential counts.	05 Marks
2.	Demonstration of Enzyme Action and Estimation of pH	05 Marks
	Practical based on ecological adaptations	05 Marks
3.	Detection of protein carbohydrate and fats.	05 Marks
4.	Spotting based on histological slides of endocrine glands.	10 Marks
5.	Detection of Nitrogenous products in given samples.	05 Marks
6.	Viva-voce.	10 Marks
7.	Practical Record and collection.	05 Marks
	Total Marks	**50 Marks**

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Semester	-	II
Subject	-	Zoology
Practical	-	II (Second)

Max. Mark-50

Practical based on paper III and IV
III. Tools and Techniques in Biology
IV. Molecular Cell Biology and Genetics

1. Comments upon the components and applications of analytical instruments: 10 marks
   a. Microscopes
   b. Clolorimeter and Spectrophotometer
   c. Gel electrophoresis
   d. Ultracentrifuge
   e. ESR and NMR spectrometer
   f. Chromatography.
2. Problems based on genetics: 05 marks
3. Separation techniques of RNA, DNA and Protein: 05 marks
4. Practical on antigen antibody reactions: 05 marks
5. Estimation of Gene and Genotypic frequencies in light of Hardy Weinberg law 05 marks
6. Study of polymorphic chromosome in some insect population: 05 marks
7. Viva-voce: 10 marks
8. Practical Record: 05 marks

Total Marks: 50 marks

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1. Course Code
2. Course Name : M.Sc. Zoology
3. Semester : III
4. Total Paper : 04
5. Compulsory Paper : 04
6. Optional Paper : 00
7. Practical : 02
8. Practical passing mark : 18 each practical
9. Maximum marks : 300
10. Minimum Passing percentage : 36

Paper No and Name	Total	Theory	CCE
Paper –I. Comparative Anatomy of Vertebrates	50	40	10
Paper –II. Limnology	50	40	10
Paper – III. Ecotoxicology	50	40	10
Paper – IV. Aquaculture	50	40	10
Practical I. based on paper 1-2	50	N/A	N/A
Practical II. based on paper 3-4	50	N/A	N/A

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Class	-	M. Sc.
Semester	-	III
Subject	-	Zoology
Paper no. and Title	-	**Paper -I Comparative Anatomy of Vertebrates**

Max. Mark-40

Course Outcomes: The paper imparts a basic understanding about vertebrates as it explains the origin of chordates, structure of integuments, respiratory, circulatory and digestive systems. It compares the anatomy of different systems like nervous system, peripheral and autonomic systems and urogenital systems. The paper also make students aware about origin and evolution of vertebrates and tries of explain the different types and mode of adaptations.

UNIT: - I.

1. Origin of Chordates: Concept of Protochordata.
2. Development, structure and functions of integument and its derivatives (glands, scales, feathers and hair).
3. Respiratory system: Characters of respiratory tissue, external and internal respiration. Comparative account of respiratory organs.
4. Comparative account of Digestive System.

UNIT: - II.

1. Evolution of heart.
2. Evolution of aortic arches and portal systems.
3. Blood circulation in various vertebrates groups.
4. Comparative account of jaw suspensorium and vertebral column.

UNIT: - III.

1. Evolution of urinogenital system in vertebrates.
2. Comparative account of organs of olfactory and taste.
3. Comparative anatomy of brain and spinal cord (CNS).
4. Comparative account of peripheral and autonomous nervous system.

UNIT: - IV.

1. Comparative account of lateral line system.

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2. Comparative account of electroreception.
3. Flight adaptations in vertebrates.
4. Aquatic adaptations in birds and mammals.

UNIT: - V.

1. Origin, evolution general organization and affinities of Ostracoderms.
2. General organization, specialized, generalized and degenerated characters of Cyclostomes.
3. Origin, evolution general organization of early Gnathostomes.
4. General account of Elasmobranchii, Holocephali, Dipnoi and Crossopterygii.

Semester III Paper-I

SUGGESTED READING MATERIAL

1. Carter, G.S., Structure and habit in vertebrate evolution - Sedgwick and Jackson, London.
2. Kingsley, J.S. Outlines of Comparative Autonomy of Vertebrates, Central Book Depot. Allahabad,
3. Kent, C.G. Comparative anatomy of vertebrates.
4. Malcom Jollie, Chordata morphology, East - West Press Pvt. Ltd., New Delhi.
5. Milton I lildergrand. Analysis of vertebrate structure. IV. Ed. John Wiley and Sons Inc., New York.
6. Smith, H.S. Evolution of Chordata structure. Hold Rinchart and Winstoin Inc. New York.
7. Sedgwick, A.A. Students Text Book of Zoology, Vol.II.
8. Walter, H.E, and Sayles, L.D. Biology of vertebrates, MacMillan & Co. New York.
9. Romer, A.S. Vertebrate Body, IIIrd Ed. W.B. Saunders Co., Philadelphia.
10. Young J.Z. Ilife of vertebrates. The oxford University Press, London.
11. Parker & Haswell to III Rev. by Marshall willians latested Macmillan Co. Itd.
12. Young J.Z. Life of mammals. The Oxford University Press, London.
13. Weichert, C.K. and Presch, W. Elements of chordate anatomy, 4" Edn. McGraw Hall Book Co., New York.

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Class	-	M. Sc.
Semester	-	III
Subject	-	Zoology
Paper no. and Title	-	**Paper -II Limnology**

Max. Mark-40

Course Outcomes: The general aim of the course is to give students knowledge relevance for their future career in limnology, in research or with an applied focus. The paper allows students to analyze and evaluate abiotic and biotic conditions in aquatic systems and account for structure and dynamics of water bodies' organism communities. The students could carry out basic sampling and analyses in freshwater field/laboratory systems, plan and carry out experiment/field studies, present and evaluate experiment/field studies both orally and in writing.

UNIT: - I.

1. Limnology- Definition, historical development and scope of Limnology.
2. Types of freshwater habitats and their ecosystem –
   a) Ponds, Streams and rivers.
   b) Lakes - Origin and classification.
3. Morphometry -Use of various morphometric parameters and Zonation.

UNIT: - II.

Physico - Chemical Characteristics.

1. Light and Temperature-
   a) Light as an ecological parameter in freshwater.
   b) Temperature- Radiation, Stratification and Heat Budget.
2. a) Dissolved Solids - Carbonate, Bicarbonates, Phosphate and Nitrate.
   b) Physico - Chemical characteristics of freshwater with special reference to different parameters-
   Turbidity, dissolved gases (Oxygen, Carbon dioxide, Hydrogen Sulphide), Seasonal changes in dissolved gases and pH.

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UNIT: - III.

1. Study of Biota
    a) Phytoplankton, Zooplankton and their inter-relationship.
    b) Aquatic insects, birds and their environmental significance.
2. Ecological classification of aquatic fauna higher aquatic plants and their significance.

UNIT: - IV.

1. Methods of water quality testing BOD and COD.
2. Sewage-Definition, composition and its treatment.
3. Bio-indicators- Aquatic flora and fauna in relation to water quality in an aquatic environment.

UNIT: - V.

1. Causes of pollution of Aquatic Resources, their management and conservation.
2. Resource Conservation - Aquatic pollution, control, legislation, regulation on discharge of industrial effluents and domestic wastes in rivers and reservoirs.
3. Use and misuse of inland waters.

Semester III Paper-II

SUGGESTED READING MATERIAL

Anathakrishnan	:	Bio-resources Ecology
Goldman	:	Ecology
Pawlosuske	:	Physico-chemical methods for water
Wetzal	:	Limnology
Trivedi & Goyal	:	Chemical and biological methods for water pollution studies
Welch	:	Limnology Vols. 1-11
Perkins	:	Ecology
Arora	:	Fundamentals of environmental biology

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Class	-	M. Sc.
Semester	-	III
Subject	-	Zoology
Paper no. and Title	-	**Paper -III Eco-Toxicology**

Max. Mark-40

Course Outcomes: The paper focuses on general principles of environmental biology, biotic and abiotic factors of ecosystem, kinds of environmental pollution and indicator organisms, Energy Flow, Productivity, Pollution and Toxicology.

UNIT: - I.

1. General principles of environmental biology, ecosystem and their components.
2. Abiotic and biotic factors of ecosystems
3. Communities of the environment, their structure and significance.
4. Energy flow in environment: Ecological energetics.

UNIT: - II.

1. Productivity, Production and analysis.
2. Recycling and reuse technologies for solid and liquid wastes and their role in environmental conservation.
3. Remote sensing -basic concepts and applications of remote sensing techniques in environmental conservation.
4. Environmental indicators and their role in environmental balance.

UNIT: - III.

1. Kinds of environmental pollution and their control methods.
2. Radioactive compounds and their impact on the environment.
3. Vehicular exhaust pollution causes and remedies.
4. Noise pollution.

UNIT: - IV.

1. Toxicology- Basic concepts, Principles and various types of toxicological agents.
2. Toxicity testing principles, hazards, risks and their control methods.

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3. Food toxicants and their control methods.
4. Public Health Hazards due to environmental disasters.

UNIT: - V.

1. Pesticides, types, nature and their effects on environment.
2. Important heavy metals and their role in environment.
3. Agrochemical use and misuse, alternatives.
4. Public Occupational Health Hazards and their Control.

Semester III Paper-III

SUGGESTED READING MATERIAL

1. Clark : Elements of ecology
2. Odum : Fundamentals of Ecology
3. South Woods : Ecological methods Chemical and biological methods for water
4. Trivedi and Goel : Pollution studies

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Class	-	M. Sc.
Semester	-	III
Subject	-	Zoology
Paper no. and Title	-	**Paper -IV Aquaculture**

Max. Mark-40

Course Outcomes: The paper teaches students about the basic concepts of aquaculture, it to understand the techniques involved in aquaculture practices, to get detailed information about aquaculture, to provide a basic idea about the importance of live feed in culture systems. The learners will be aware of all the techniques involved in aquaculture. At the end of the course, student can able to gain the knowledge on the aquaculture practices.

UNIT: - I.

1. Aquaculture: history, definition, scope and importance.
2. Fishery resources of India in general and Madhya Pradesh in particular.
3. Abiotic and biotic factors of water necessary for fish life.
4. Ecological characteristics of lakes and rivers.
5. General ecological characteristics of reservoirs of India.

UNIT: - II.

1. Fish culture: - Mono, Poly, mixed and composite Fish culture.
2. Fresh water prawn culture and its prospects in India.
3. Culture of Oysters and pearl culture.
4. Sewage fed fish culture, paddy cum fish culture.

UNIT: - III.

1. Fish breeding in natural conditions, bundh breeding, hypophysation and stripping.
2. Transport of live fish and seed.
3. Different types of crafts and gears used for fish catching.
4. Plankton- its definition, culture and identification.
5. Common weeds of fish ponds and methods of their eradication.

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UNIT: - IV.

1. Fresh water fish farm engineering: selection of site, construction of fish farm and soil chemistry.
2. Designing, layout and construction of different types of fish ponds.
3. Setting and management of fresh water aquarium.
4. Preservation and processing of fish.
5. By products of fish Industry and their utility.

UNIT: - V.

1. Water pollution, its effects on fisheries and methods of its abatement.
2. Common fish diseases and their control.
3. Biochemical composition and nutritional value of fish.
4. Fisheries economics and marketing.
5. Fisheries managements and extension.

Semester III Paper-IV

SUGGESTED READING MATERIAL

1. C.B.L. Shrivastava : Fishes of India
2. Jhingaran : Fish and fisheries of India
3. S.S. Khanna : An Introduction to fishes
4. R.S. Rath : Fresh water Aquaculture
5. Gopalji Shrivastava : Fishes of U.P. & Bihar
6. H.D. Kumar : Sustainability & Management of Aquaculture & Fisheries
7. AJ.K. Mainan : Identification of fishes
8. R. Sanatam : A Manual of fresh water Aquaculture
9. S.K. Gupta : Fish & Fisheries
10. P.D. Pandey : Fish & Fisheries
11. K.P. Vishwas : Fish & Fisheries

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Class - M. Sc.
Semester - III
Subject - Zoology
Practical - I (First)

Practical based on paper I and II
I. Comparative Anatomy of Vertebrates
II. Limnology

Max. Mark-50

1. Study of Specimens, slides and bones related to theory papers.
2. Major Dissection- Various systems of Labeo, Wallago, Torpedo.
3. Minor Dissection-
   (a) Accessory respiratory organs of Anabas, Clarias, Heteropneustes.
   (b) Herdmania
   (c) Amphioxus
4. Estimation of DO, chloride, BOD, COD, Hardness, pH and Alkalinity of water.
5. Study of fresh water ecosystem.
6. Study of Planktons.

Scheme for Practical Examination

1.	Major Dissection	10 Marks
2.	Minor Dissection	04 Marks
3.	Spotting	12 Marks
4.	Limnological exercise	10 Marks
5.	Practical Record	05 Marks
6.	Viva-voce	05 Marks
7.	Collection	04 Marks
	Total	**50 Marks**

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Class - M. Sc.
Semester - III
Subject - Zoology
Practical - II (Second)

Practical based on paper III and IV
III. Eco-Toxicology
IV. Aquaculture

Max. Mark-50

1. Preparation and Maintenance of Aquarium.
2. Study of common weeds of fish ponds.
3. Methods of culture related to theory papers.
4. Study of abiotic factors of water related to fish life.
5. Determination of different toxic chemicals in samples of soil, water and air.
6. Toxicological testing methods, General tests, acute toxicity test and LD50 test.
7. Identification and comments on Aquaculture animals.

Scheme of Practical examination

1. Spotting	16 Marks
2. Exercise on toxicology	10 Marks
3. Study of culture methods related to theory	05 Marks
4. Maintenance of aquarium	05 Marks
5. Practical Record	04 Marks
6. Viva-voce	05 Marks
7. Collection	05 Marks
Total	**50 Marks**

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1. Course Name : M.Sc. Zoology
2. Total Paper : 04
3. Semester : IV
4. Compulsory Paper : 02
5. Optional Paper : 02
6. Practical : 02
7. Practical passing mark :18 each practical
8. Project : Yes
9. Maximum marks (Theory and Practical) : 300
10. Minimum Passing percentage : 36
11. Project work : 50
12. Project work passing marks : 18

Paper No and Name	Total	Theory	CCE
Compulsory theory paper			
Paper –I. Animal Behavior and Neurophysiology	50	40	10
Paper –II. Gamete Biology, Development and Differentiation	50	40	10
Paper – III. Optional (special paper) **Group-1** (A) Fish (Icthyology) structure Function or	50	40	10
(B) Cell Biology or	50	40	10
(C) Entomology or	50	40	10
(D) Wildlife conservation or	50	40	10
(E) Biology of vertebrates Immune system	50	40	10
Paper – IV. Optional (special paper) **Group-2** (A) Pisci culture and economic importance of fishes (Ichthyology)	50	40	10
(B) Cellular organization and molecular organization or	50	40	10
(C) Applied entomology or	50	40	10
(D) Environment & Biodiversity conservation	50	40	10

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or			
(E) Molecular endocrinology and reproductive technology	50	40	10
or			
(F) Limnology and fish productivity	50	40	10
or			
(G) Applied aquaculture	50	40	10
or			
(H) Protein Nucleic acids and metabolic regulation	50	40	10
or			
(I) Sericulture	50	40	10
or			
(J) Neurotoxicology	50	40	10
or			
(K) Microbial ecology and biology of parasitism	50	40	10
Practical I. based on paper 1-2 theory paper	50	N/A	N/A
Practical II. based on optional paper from Group 1 and Group 2 50 or (25+25)	50	N/A	N/A
Project: Job Oriented Project (JOP) Work	50	N/A	N/A

* Student has choice to opt one paper each (special paper) from Group1 and Group-2

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Class	-	M. Sc.
Semester	-	IV
Subject	-	Zoology
Paper no. and Title	-	**Paper -I Animal Behavior and Neurophysiology (Compulsory)**

Course Outcome:

Max. Mark-40

Course Outcomes: The paper teaches students about the relationship of behavior and Cognition, it explains about rhythmic and social behavior. The paper give insight about basic concepts of neuron and synaptic physiology, it also certifies neural and hormonal control of the behavior, neurotransmitter and neurodegenerative diseases.

UNIT: - I.

1. Ethology as a branch of biology and Ethogram (Analysis of Animal Behavior)
2. Animal psychology, classification of behavioral patterns, analysis of behavior.
3. Reflexes and complex behavior.
4. Perception of the environment: mechanical, electrical, chemical, olfactory, auditory and visual.
5. Evolution and ultimate causation: Inheritance behavior and relationships.

UNIT: - II.

1. Neural and hormonal control of behavior.
2. Genetic and environmental components in the development of behavior.
3. Motivation: Drive, timing and interaction of drives, physiological basis of motivation, hormones and motivation.
4. Communication: Chemical, visual, light and audio, evolution of language (primates).

UNIT: - III.

1. Ecological aspects of behavior: Habitat selection, food selection Timer optimal foraging theory, anti-predator defenses, aggression, homing territoriality, dispersal, host parasite relations.

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2. Biological rhythms: Circadian and circannual rhythms, orientation and navigation, migration of fishes, turtles and birds.
3. Learning and memory: Conditioning, habituation, insight learning, association learning and reasoning.

UNIT: - IV.

1. Courtship, sexual selection.
2. Parental care.
3. Aggregations, schooling in fishes, flocking in birds, herding in mammals.
4. Group selection, kin selection, altruism, reciprocal altruism.
5. Social organization in insects and primates.

UNIT: - V.

1. Thermoregulation: Homeothermic animals, poikilotherms and Hibernation.
2. Mechanoreceptors
3. Photoreceptors and Phonoreceptors
4. Chemoreceptors
5. Equilibrium receptors
6. Bioluminescence

Semester IV Paper-I

SUGGESTED READING MATERIAL

1. Eibl-Eibesfeldt, I. Ethology. The biology of Behavior. Holt, Rinechart & Winston, New York.
2. Gould, J.L. The mechanism and Evolution of Behavior.
3. Kerbs, J.R. and N.B. davies: Behaviourable Ecology. Blackwell, Oxford, U.K.
4. Hinde, R.A. Animnal Behavior: A Synthesis of Ethology and Comparative Psychology. McGraw Hill, New York.
5. Alcock, J. Animal Behavior: An Evolutionary approach. Sinauer Assoc. Sunderland, Massachsets, USA
6. Bradbury, J.W. and S.L. Vehrencamp. Principles of Animal Communication. Sinauer Assoc. Sunderland, Massachsets, USA.

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Class	-	M. Sc.
Semester	-	IV
Subject	-	Zoology
Paper no. and Title	-	**Paper - II Gamete Biology, Development and differentiation (Compulsory)**

Paper Outcome: Students will learn the genetic basis of differentiation, molecular basis of fertilization, ovarian follicular growth, genetic basis of sex differentiation and hormonal regulation in developmental biology.

Max. Mark-40

UNIT: - I.

1. Comparative account of differentiation of gonads in mammals and invertebrate.
2. Spermatogenesis: Morphological basis in rodents and in any invertebrates. Gamete specific gene expression and genomics.
3. Biochemistry of Semen: Semen composition and formation, assessment of sperm function.
4. Fertilization Prefertilization events Biochemistry of fertilization post fertilization events.

UNIT: - II.

1. Ovarian follicular growth and differentiation: morphology, endocrinology, molecular biology oogenesis and vitellogenesis, ovulation and ovum transport in mammals.
2. Biology of sex determination and sex differentiation a comparative account.
3. Multiple ovulation and embryo transfer technology in vitro oocyte maturation, superovulation.

UNIT: - III.

1. Hormonal regulation of ovulation, pregnancy and parturition.
2. Hormonal regulation of development of mammary gland and lactation.
3. Endocrinology and Physiology of placenta.
4. Cryopreservation of gametes and Embryo.
5. Teratological effects of xenobiotics on gametes.

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UNIT: - IV.

1. Cell commitment and differentiation.
2. Germ cell determinants and germ cell migration.
3. Development of gonads.
4. Melanogenesis.

UNIT: - V.

1. Creating new cell types, the basic evolutionary mystery.
2. Cell diversification in early Amphibian embryo, totipotency and pluripotency
3. Embryonic stem cells, renewal by stem cells, epidermis.
4. Connective tissue cell family.
5. Haemopoietic stem cells: Blood cells formation, stem cell disorders.

Semester IV Paper-II

SUGGESTED READING MATERIAL

1. Long J.A. Evan H.M. 1922: the oestrous cycle in the Rat and its associated phenomenon.
2. Nalbandou, A.C. - Reproductive physiology.
3. Prakash A.S. 1965-66 Marshall's, Physiology Reproduction (3 Vol.).
4. Gilbert, S.F. Developmenal Bialogy, Sinauer Associated Inc. Massachulsetts.
5. Ethan Bier, the cold spring. The cold spring Harbor laboratory Press, New York.
6. Balinsky B.I. Introduction to Embryology sanders, Phliedelphia.
7. Berril N.J. and Karp. G. Development Biology. MeGraw Hill New York.
8. Davidson, E.H. Gene Activity during Early Development. Academic Press, New York.

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Class - M. Sc.
Semester - IV
Subject - Zoology
Practical - **General Practical-I**

Practical based on Paper- I and II (Compulsory)
I. Animal Behavior and Neurophysiology
II. Gamete Biology, Development and differentiation

Max. Mark-50

1. **Exercise on Animal behavior**
   a. Taxes
   b. Reflexes
   c. Biological clocks
   d. Social behavior
   e. Learning behavior
   f. Reproductive behavior
2. **Developmental Biology**
   a. Study of embryological slides
   b. Study of gametes of frog and chick
   c. Study of fate maps Study of different stages of spermatogenesis and oogenesis

Scheme for Practical:

1. Examination Exercise based on animal behavior	20 Marks
2. Exercise based on developmental biology	16 Marks
3. Practical record	05 Marks
4. Viva-voce	04 Marks
5. Collection	05 Marks
Total	**50 Marks**

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Class	-	M. Sc.
Semester	-	IV
Subject	-	Zoology
Paper no. and Title	-	**Paper –III A Icthyology (Fish) Structure and Function (Optional)**

Max. Mark-40

Course Outcomes: The paper allows understanding of the taxonomic and phylogenetic relationships of fish and fish-like vertebrates within the context of all vertebrate groups. The paper also imparts knowledge about the main patterns of morphological, behavioral, and physiological diversification that have allowed fish populations to occupy different ecological roles.

UNIT: -I.

1. Origin and evolution of fishes.
2. Classification of fishes as proposed by Berg.
3. Fish integument.
4. Locomotion.

UNIT: -II.

1. Alimentary canal and digestion.
2. Accessary respiratory organs.
3. Air bladder and its functions.
4. Weberian ossicles their homologues and functions.

UNIT: -III.

1. Excretion and osmoregulation
2. Acoustico-lateral line system.
3. Luminous organs.
4. Colouration in fishes.

UNIT: -IV.

1. Sound producing organs.
2. Deep sea adaptions.
3. Hill stream adaptions.
4. Migration in fishes

UNIT: -V.

1. Sexual cycle and fecundity.
2. Parental care in fishes.
3. Early development and hatching.
4. Poisonous and venomous fishes.

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Semester IV Paper-III

SUGGESTED READING MATERIAL

1. Leo.S.Berg Classification of fishes (fossiliged & Recent).
2. Francis day Vol I & II Fishes of India.
3. C.B.LShrivastava, Fish Biology.
4. K.S.Mishra: An aid to classification of Fishes.
5. Gopalji Shrivastava: Indian of fishes of U.P.& Bihar.
6. B.Qurashi: Identification of fishes.
7. W.D.Rusell: Aquatic Productivity.
8. A.J.K.Mainan: Identification of fishes.
9. K.F.Lagler: Ichthyology.
10. N.R.Rao: An Introduction of fishes.
11. J.F.Norman: An History of fishes.
12. S.S.Khanna: An Introduction of fishes.
13. R.L.Rath: Fresh water Aquaculture.
14. H.R.Singh: Advance in fish Biodiversity.
15. H.D.Kumar: Sustainability & Management of Aquaculture & Fisheries.
16. Arugun & Natarajan: Fresh water Aquaculture.
17. Arugun & Natarajan: Santanu-Costal Aquaculture.
18. R.Sanatham: A manual of fresh water Aquaculture.

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Class	-	M. Sc.
Semester	-	IV
Subject	-	Zoology
Paper no. and Title	-	**Paper –III B Cell Biology (Optional)**

Max. Mark-40

UNIT: -I.

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

UNIT: -II.

1. Structural organization of Eukaryotic genes, interrupted genes and overlapping genes and their evolution.
2. Gene families: organization, evolution and significance.
3. Transposable genetic elements of prokaryotes and eukaryotes Gene imitation and molecular mechanism of occurrence of mutation repair mechanism.

UNIT: -III.

1. Organization of eukaryotic transcriptional machinery promoter enhancers' transcription factors polymerase activators and repressors.
2. DNA binding domains of transcription apparatus zinc finger steroid receptors hemeo domains HILIX-loop, Helix and Leucine Zipper.
3. Eukaryotic transcription of Eukaryotic transcriptional control.
4. Environmental modulation of gene activity (stress response) stress genes and stress proteins

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5. Molecular basis of thalassemia's muscular dystrophy cystic fibrosis

UNIT: -IV.

1. DNA rearrangement.
2. Amplification during development with special response to
   a. Ciliates
   b. Chlorine gene
   c. 58 RNA
3. Origen of Anterior –Posterior (Maternal effect genes and segmentation gene)

UNIT: -IV.

1. Drosophila development II origin of dorsal ventral polarity.
2. Basic idea of homoetic selector genes and hemeotic mutation.
3. Basic idea of organization of homeoboxes
4. Evolutionary significance of homeoboxes

Semester IV Paper-III

SUGGESTED READING MATERIAL

1. Robertis, De and Robertis Cell and molecular biology Les and Febiger.
2. Watson Hopkis Roberta Steitz Weiner, Molecular Biology of the Gene the Benjamin, Cummings Publishing Company inc.
3. Bruce A; berts Bray ewin Raff Robens Watson Molecular Biology of the OFF Cell Gartand Publishing inc.
4. Watson Gilman Witkowski Zoller Recombinant DNA Scientific American Books
   a) Karp Gerald Cell Biology
   b) Lewin, Genes VII
   c) King Cell Biology
   d) Kaniel L. Harti, Elizabeth W Jones. Genetics Principals and Analysis, Jones and Banlett Publishers.
5. Kuby, Immunology, W.H. Freeman and Company.
6. Roitt Male Snastad Immunology.

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Class	-	M. Sc.
Semester	-	IV
Subject	-	Zoology
Paper no. and Title	-	**Paper- III C Entomology (Optional)**

Course Outcome: Student will learn about morphology, physiology and ecology of insects. They can understand about the interrelationship between insect and environment. The syllabus also based on concept of insect pest and their control measures to avoid economic loses.

Max. Mark-40

UNIT: - I.

1. Insect head types and modification as per their habit and habitat.
2. Modification of mouth parts and feeding behavior.
3. Structure types and function of antennae.
4. Hypothetical wing venation.

UNIT: - II.

1. Structure of cuticle and pigment.
2. Selerotisation and tanning of the cuticle.
3. Structure of alimentary canal and Physiology of digestion.
4. Malphighian tubules anatomical organization, Transport mechanism.

UNIT: - III.

1. Structure of circulatory system.
2. Cellular elements in the haemolymph.
3. Cell mediated and humoral immunity.
4. Structure of compound eye and Physiology of Vision.

UNIT: - IV.

1. Sound Production in insect.
2. Structure and function of endocrine glands.
3. Pheromones.
4. Embryonic memhranous up to the formation blastoderm.

UNIT: - V.

1. Metamorphosis.
2. Insecticide effects on CNS.
3. Important pest of Soybean.
4. Modern concept of pest management.

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Semester IV Paper-IV

SUGGESTED READING MATERIAL

1. The Insect: Structure and function by R.F. Chapman.
2. Comparative Insect physiology, Biochemistry and Pharmacology Vol. 13. Edited by G.A. Kerkut and L.I. Gilbert.
3. Entomophagous Insects by Clausen Entomology by Gilbert.
4. Principles of Insect Physiology by Wigglesworth.
5. Fundamentals of Entomology by Elzinga.
6. Hand book of economic Entomology for South India by Ayyar.
7. Insect cytogenetics by R.E.F. Symposium.
8. Insects and plants by Sting, Lawton and southwood.
9. Insect and hygiene by Busvine.
10. Insect Physiology by Wigglesworth.
11. Insect morphology by Mat Calf and Flint.

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Syllabus based on Entomology special paper III of semester IV

1. Dissection: Honey bee- Nervous System, Sting apparatus
   (a) Grasshopper Nervous System
   (b) Silkworm - Nervous System, Silk gland, Spiracles
2. Spotting- Histological slides and specimen.
3. Identification of Insects
4. Practical Record
5. Viva- voce.

Scheme of Entomology practical (IV Semester)

Syllabus based on Entomology special III paper of IV semester .The duration of examination shall be 2 ½ hours.

Total - 25 marks

1. Dissection:	05 marks
2. Spotting:	05 marks
3. Identification of insect up to family:	05 marks
4. Practical Record:	05 marks
5. Viva- voce:	05 marks

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Class	-	M. Sc.
Semester	-	IV
Subject	-	Zoology
Paper no. and Title	-	**Paper –III D Wildlife Conservation (Optional)**

Max. Mark-40

UNIT: -I.

1. Wildlife
   (a) Values of wildlife - positive and negative.
   (b) Our conservation ethics.
   (c) Importance of conservation.
   (d) Causes of depletion.
   (e) World conservation strategies.
2. Habitat analysis, Evaluation and management of wildlife.
   (a) Physical parameters Topography, Geology, Soil and water.
   (b) Biological Parameters - food, cover, forage, browses and covers estimation.
   (c) Standard evaluation procedures - remote sensing and GIS.
3. Management of habitats.
   (a) Setting back succession.
   (b) Grazing logging.
   (c) Mechanical treatment.
   (d) Advancing the successional process.
   (e) Cover construction.
   (f) Preservation of general genetic diversity

UNIT: -II.

1. Population estimation.
   (a) Population density, Natality. Birth rate, Mortality, fertility schedules and sex ratio computation.
   (b) Feacal analysis of ungulates and carnivores, Faecal samples, slide preparation, Hair identification, Pug marks and census method.
2. National Organization.
   (a) Indian board of wildlife.
   (b) Bombay Natural History Society.
   (c) Voluntary organization involved in wildlife conservation
3. Wildlife Legislation Wildlife Protection act 1972, its amendments and implementation.

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UNIT: -III.

4. Management planning of wildlife in protected areas.
5. Estimation of carrying capacity.
6. Eco tourism / wildlife tourism in forests.
7. Concept of climax persistence.
8. Ecology of perturbance.

UNIT: -IV.

1. Management of excess population & translocation.
2. Bio- telemetry.
3. Care of injured and diseased animal.
4. Quarantine.
5. Common diseases of wild animal.

UNIT: -V.

1. Protected areas National parks & sanctuaries, Community reserve.
2. Important features of protected areas in India.
3. Tiger conservation - Tiger reserve in M.P, in India.
4. Management challenges in Tiger reserve.

Semester IV Paper-III

SUGGESTED READING MATERIAL

3. Gopal Rajesh: Fundamentals of wildlife management
4. Agrawal K.C: Wildlife India
5. Dwivedi A.P (2008): Management wildlife in India
6. Asthana D.K: Environment problem and solution
7. Rodgers N.A & Panwar H.S Planning of wildlife/ Protected area Network in India vol. the report, wildlife Institute of India Dehradun.
8. Odum E.P :Fundamentals of Ecology
9. Saharia V.B: Wildlife in India
10. Tiwari S.K :Wildlife in Central India
11. EP Gee :Wildlife of India
12. Negi SS :Wildlife conservation (Natraj Publishers)

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Class	-	M. Sc.
Semester	-	IV
Subject	-	Zoology
Paper no. and Title	-	**Paper –III E Biology of vertebrates immune system (Optional)**

Max. Mark-40

UNIT: -I.

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

UNIT: -II.

1. T-cell lineage and receptors
2. T-cell activation
3. B-cell lineage and receptors
4. B-cell activation.

UNIT: -III.

1. Immunoglobulin structure, Biological and physical properties of immunoglobulin.
2. Gene model for Immunoglobulin gene structure.
3. Generation of antibody diversity (Light and heavy chain).
4. Immunization

UNIT: -IV.

1. Immediate type of hypersensitivity reaction of anaphylactic type-1.
2. Antibody dependent cytotoxic type II reaction.
3. Complex mediated type III reaction.
4. Delayed type cell mediated hypersensitivity type IV reaction.

UNIT: -V.

1. Enzyme linked immunosorbent assay (ELISA) technique and its applications.
2. Immunofluorescence technique (Direct & Indirect and Sandwich antibody labeling techniques).
3. Immunodiffusion techniques (Mancini and ouchterlony immunodiffusion).
4. Monoclonal antibody technology (Hybridoma technology).

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Semester IV Paper-**III E**

SUGGESTED READING MATERIAL

1. Kuby, Immunology, W.H. Freeman, U.S.A.
2. W. Paul. Fundamentals of Immunology. I.M.
3. Roitt. Essential Immunology, EIBS Edition

List of practical:

1. Demonstration of various routes of immunization in mammalian model
   a. Intraperitoneal
   b. Subcutaneous or intra muscular
   c. Caudal
2. Demonstration of collection of blood from various routes.
   a. Cardiac puncture
   b. Intra-orbital sinus puncture
   c. Cardiac vein
3. Demonstration and identification of different components of reticuloendothelial system mainly the major lymphoid organs in situ in mammalian model , like spleen, thymus, bone marrow, and Peyres,s patches
4. Detailed histological structure of major lymphoid organs like spleen, thymus, Bone marrow, Bursa of Fabricius, Mesenteic lymphnode, and Peyer's patches.
5. Demonstration of antigen and antibody reaction through simple experiments
   a. Agglutination
   b. Immunodiffusion
   c. Immunoelectrophoresis
   d. ELISA

Scheme of Practical examination

1. Immunological exercise No.1:	10 Marks
2. Immunological exercise No.2:	16 Marks
3. Spotting:	08 Marks
4. Viva-voce:	06 Marks
5. Practical record:	06 Marks
Total	**50**

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Class	-	M. Sc.
Semester	-	IV
Subject	-	Zoology
Paper no. and Title	-	**Paper –IV A Pisciculture and Economic Importance of Fishes (Ichthyology) (Optional)**

Max. Mark-40

Couse outcome: Syllabus is based on fish breeding of major carps, management of hatcheries. It gives knowledge about composite fish culture fisheries resources and its economic importance in India.

UNIT: -I.

1. Collection of fish seed from natural resources.
2. Dry bundh breeding of carps.
3. Wet bundh breeding of carps.
4. Hypophysation and breeding of Indian major camps.

UNIT: -II.

1. Drug useful in induced breeding of fish.
2. Types of ponds required for fish culture farms.
3. Management of hatcheries, nurseries and rearing ponds.
4. Management of stocking ponds.

UNIT: -III.

1. Composite fish culture.
2. Prawn culture and pearl industries in India.
3. Fisheries resources of MP.
4. Riverine fisheries.

UNIT: -IV.

1. Costal fisheries in India.
2. Offshore and deep sea fishery's in India.
3. Role of fisheries in rural development.
4. Sewage fed fisheries

UNIT: -V.

1. Methods of fish preservation.
2. Marketing of fish in India.
3. Economic importance and by product of fishes.
4. Shark liver oil industry in India.
5. Transport of live fish &fish seed.

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Semester IV Paper-IV A

SUGGESTED READING MATERIAL

1. JR. Norman - The History of fishes.
2. Nagaraja Rao - An introduction to fisheries.
3. Lagler Ichthyology.
4. Herclen Jones Fish migration.
5. Marshal- The life of fishes.
6. Thomas - Diseases of fish.
7. Greenwood - Inter relationship of fishes.
8. Gopalji, Srivastava - Freshwater fishes of U.P. and Bihar.
9. Brown -Physiology of fishes Vol. 1 & II.
10. Hoar and Randall -Fish physiology of fishes Vol. 1 & IX.
11. Gunther Sterba C.N.H.-Freshwater fishes of the world.
12. W. Lanharn -The Fishes.
13. G.V. Nikolsky -The ecology of Fishes.
14. Borgstram -Fish as food Vol. 1 & II.
15. Nilsson -Fish physiology -Recent Advances.
16. P.B. Myle and J.J. Cech- Fishes An Introduction to Ichthyology.
17. Carl E. Bond -Biology of fishes.
18. M. Jobling -Environmental Biology of fishes.
19. Santosh Kumar & Manju Ternbhre -Fish and Fisheries.
20. S.K. Gupta -Fish and Fisheries.
21. K.P. Vishwas -Fish and Fisheries.
22. Jhingaran -Fish and Fisheries.

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Class	-	M. Sc.
Semester	-	IV
Subject	-	Zoology
Practical	-	**II (Special Paper) Ichthology (III & IV)**

Time: 5 hour **Max. Mark 50**

Exercise:

1. Major dissection Nervous system of Walago, Mystus, Labco, Toredo: 10 Marks
2. Minor dissection of internal car, accessory, respiratory, organ, pituitary glands, webrian ossicles: 03 Marks
3. Mounting preparation of permanent slides: 03 Marks
4. Age determination of fish with the help of scales: 03 Marks
5. Identification of fish: 08 Marks
6. Spotting of museum specimen slides and bones: 08 Marks
7. Viva-voice: 05 Marks
8. Practical record, collection: 10 Marks

Total: **50 Marks**

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Class	-	M. Sc.
Semester	-	IV
Subject	-	Zoology
Paper no. and Title	-	**Paper –IV B Cellular Organization and Molecular Organization (Optional)**

Max. Mark-40

UNIT: -I.

1. General organization and characterizes of viruses (Examples SV 40 and HIV).
2. Yeast: Structure, reproduction and chromosome organization: Basic ides of its applications as vectors for gene cloning.
3. Molecular organization of respiratory chain assemblies, ATP ADP Translocase and FOF: ATPase.
4. Cell cycle: Cell cycle control in mammalian cells and xenopus.

UNIT: -II.

1. Cytochemistry of Golgin complex and its role in cell secretion.
2. Peroxisomes and training of paroxysmal proteins.
3. Nucleouls: Structure and Biogenesis and functions of lysosomes.
4. Intracellular digestion: Ultrastructure and function of lysosomes.

UNIT: -III.

1. Synthesis and targeting of mitochondrial proteins.
2. Secretary pathways and translocation of secretary proteins across the EPR membrane.
3. Genome complexity: C- value (paradox and cot values).
4. DNA sequences of different complexity.

UNIT: -IV.

1. Difference between normal cells and cancer cells.
2. Biochemical changes.
3. Cytoskeleton changes.
4. Cell surface changes.
5. Genetic basis of human cancer.
6. Chromosomal abnormalities in human cancer.

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UNIT: -V.

1. General idea of oncogenes and proto oncogenes.
2. Oncogene and cancer.
3. Transforming Agents.
4. Tumor Suppressor genes.
5. Receptor - Ligand interaction and signal transduction.

Semester IV Paper-IV B

SUGGESTED READING MATERIAL

1. DeRobertis and De Robentis Cell and Molecular Biology. Lea and Febiger.
2. We Watson Hopking reberts steits, Weiner molecular biology of the gene, the Benjamin / Cummings Publishing Company Inc.
3. Bruce albert's, Bray, Lewis, Raff, Robents, Watson molecular Biology of the cell garland publishing inc.
4. P.K. Gupta, Molecular Cell Biology Rastogi Publication.
5. Watson Gilman Widkowski, Zoller Recombinant D.N.A. scientific American Books.
6. Gerald Karp. Cell Biology.
7. Lewin B. Genes VIL 8. King Cell Biology.
8. Baniel L. HArd Elizabeth W. Jones, Genetics Principles and analysis. Jones and Bartleti Publisher.
9. Lodish, Berk Zipursky, Matsudaira Balhimore Demel Molecular Cell Biology W.H. Freeman and company.
10. J. Travers Immunology current Biology limited.
11. Kubey Immunology W.H. Freeman and Company.
12. Riott, Male snustad Principles of genetics john weley and sons Inc.

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Scheme of Practical Examination Based on IV B Cellular Organization and Molecular Organization (Optional)

Practical List:

1. Preparation of mitotic chromosome from bone marrow.
2. Karyotype preparation any animal.
3. Calculation of mitotic index (in bone marrow or in root tip cells).
4. Demonstration of mitochondria, Golgi body, RNA, DNA in tissue section any tissue.
5. Sex chromatin demonstration.
6. Study of Electron micrographs of pro and eukaryotic cells.
7. Karyotype preparation of human syndromes from books.
8. G&C banding in mitotic chromosomes.
9. Gel Electrophoresis (PAGE) for protein.
10. Polytene chromosome preparation.
11. Meiosis -slide preparation in testis or in Anther.
12. Study of mutants of Drosophila w.m.
13. Histochemical localization of age pigment.
14. Demonstration of Alkaline Phosphatase/Ascorbic acid.
15. Slides of cancerous tissue.

Scheme of Practical Examination Based on Paper III(B) and IV (B)

	Max. Mark-35
1. Demonstration of mitochondria/ Golgi body /RNA/DNA in tissue section (any one):	06 Marks
2. Calculation of mitotic index or Preparation of mitotic chromosomes (in Bone marrow or Allium root tips):	06 Marks
3. Demonstration Meiosis (anther/testis):	05 Marks
4. Separation of Protein by PAGE or Histochemical Demonstration of age pigment or Demonstration of	
5. Alkaline Phosphatase or Ascorbic acid in any tissue (plant/animal): Spotting on - Drosophila mutants (w.m) Karyotype of human syndromes Permanent slides of cytology Electron micrographs Chromosomal aberrations (Total 08 spots, I.5 mark each):	05 Marks 12 Marks
6. Viva-voce:	08 Marks
7. Practical Record:	08 Marks
Total:	**50 Marks**

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Class	-	M. Sc.
Semester	-	IV
Subject	-	Zoology
Paper no. and Title	-	**Paper –IV C Applied Entomology (Optional)**

Max. Mark-40

UNIT: -I.

Classification according to imms

1. Classification of apterygota up to families.
2. Classification of following insect orders
   (a) orthoptera (b) hemiptera (c) diptera.
3. Classification of following insect order.
   (a) hymenoptera (b) lepidoptera (c) coleoptera
4. Collection and preservation of insects.

UNIT: -II.

1. Insect pest-Management strategies and tools.
2. Biological control.
3. Genetic control.
4. Chemical control.

UNIT: -III.

1. Pests of Cotton.
2. Pests of sugarcane.
3. Pests of paddy.
4. Pests of stored food grains.
5. Pests of citrus fruits and mango.
6. Pests of pulses.
7. Household insect pests.

UNIT: -IV.

1. Insects in relation to forensic science.
2. Insects migration, population fluctuation and factors
3. Insects of medical and veterinary importance.
4. Ecological factors affecting the population and development of insect

UNIT: -V.

1. Mulberry and non mulberry sericulture.
2. Apiculture.
3. Lac culture.
4. Insects as human food for future.

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Scheme of Practical Examination Based on Entomology Paper III and IV C (Optimal)

Max. Mark-50

1. Study of museum specimens of different orders and families of insects.
2. Study of permanent slides.
3. Taxonomic identification of insects.
4. Dissection major - Nervous system of grasshopper and cockroach.
5. Reproductive system of cockroach male and female.
6. Minor - honey bee sting and tentorium of grasshopper.
7. Taxonomical identification of egg, larva & pupa.
8. Collection and preservation of insects.

Scheme of practical exam (III & IV C)

Major dissection:	08 Marks
Minor dissection:	05 Marks
Slide preparation:	10 Marks
Spotting:	08 Marks
Taxonomical identification:	04 Marks
Identification of egg, larva and pupa:	04 Marks
Collection & record:	05 Marks
Viva-voce:	05 Marks
Total Marks:	**50 Marks**

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Class	-	M. Sc.
Semester	-	IV
Subject	-	Zoology
Paper no. and Title	-	**Paper –IV D Environment and Biodiversity Conservation (Optional)**

Max. Mark-40

UNIT: -I.

1. Basic concept of Environmental Biology Scope and Environmental Science.
2. Biosphere and Biogeochemical cycles.
3. Environmental monitoring and impact assessment.
4. Environmental and sustainable development.
5. Water conservation, rain water harvesting, water shed management.

UNIT: -II.

1. Cause, effects and remedial measure of Air pollution, Water pollution.
2. Noise, radioactive and thermal pollution.
3. Agriculture pollution Basic concepts of Bioaccumulation.
4. Solid waste management.

UNIT: -III.

1. Global warming and disaster management Cause of global warming.
2. Impact of global warming-acid rains and ozone depletion, greenhouse effect.
3. Control measures of global warming
   (a) Afforestation (b) reduction in the use of CFCS
4. Disaster management -floods, earthquake, Cyclones landslides.
5. Environmental legislation.

UNIT: -IV.

1. Natural Resources

Forest-

- Use and over exploitation of forests.
- Timber extraction.

Land-

- Degradation, Landslides.
- Soil-erosion and desertification.

Water-

- Use and over utilization of surface and ground water.
- Floods, Drought dams- benefits and problems.

Mineral-

- Use and exploitation.

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- Environmental effect of extracting and using mineral resources.

Food-

- World food problem
- Effects of modern agriculture and overgrazing

Energy-

a. Conventional and nonconventional energy resources.
b. Using of alternate energy sources

2. Role of an individual in conservation of natural resources Equitable use of resources for sustainable life.

UNIT: -V.

1. Conservation of Biodiversity.
2. Biodiversity crisis - habitat degradation poaching of wildlife.
3. Socio economic and political causes of loss of biodiversity.
4. In-situ and ex-situ conservation of biodiversity.
5. Value of biodiversity.
6. Hot spots of Biodiversity.

Semester IV Paper- III D and IV D

SUGGESTED READING MATERIAL

1. Arora	:	Fundamentals of environmental biology
2. Anathakrishnan	:	Bioresources ccoloay.
3. Bottain	:	Environmental studies.
4. Boubey	:	Ecology of population
5. Clark	:	Elements of ecology.
6. Dowdoswell	:	An introduction to animal ecology
7. Goldman	:	Limnology.
8. Kormondy	:	Concepts of ecology.
9. May	:	Model ecosystems
10. Odum	:	Ecology
11. Perkins	:	Ecology
12. Simmons	:	Ecology of estuaries and costal water
13. Pawlosuske	:	Physico-chemical methods for water
14. South Woods	:	Ecological methods
15. Trivedi and Goel	:	Chemical and biological methods for water pollution studies
16. Willington	:	Fresh water biology
17. Wetzal	:	Limnology
18. Welch	:	Limnology Vols. I-II

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Scheme of Practical Examination Based on Wildlife conservation, Environment & Biodiversity (Optimal)

Max. Mark-50

1. Identification and comments upon wildlife animals.
2. Study of endangered species.
3. Study of local birds and their habit habitats.
4. Study of ecosystem.
5. Study of local Biodiversity.
6. Distribution of wildlife India. (National parks and sanctuaries).
7. Soil and water analysis.
8. Interspecific relationship - Naturalism, Symbiosis, Mutualism, Commensalism, Parasitism, Predation Competition.
9. Field - expedition and project report
10. Viva- voice
11. Practical Record & collection.

Scheme of practical exam

Spotting:	10 Marks
Endangered species / interspecific relationship:	10 Marks
Soil & water analysis:	05 Marks
Field expedition:	10 Marks
Viva-voce:	05 Marks
Practical Record/ collection:	10 Marks
Total Marks:	**50 Marks**

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Class	-	M. Sc.
Semester	-	IV
Subject	-	Zoology
Paper no. and Title	-	**Paper –IV E Molecular Endocrinology and Reproductive Technology (Optional)**

Max. Mark-40

Course Outcomes: This paper provides as a foundation for the further study of endocrinology at the cellular & molecular level as well as it provides a firm basis for understanding normal hormonal control. The module will describe basic endocrinology and its regulation in man. The paper discusses the underlying pathologies of important endocrine diseases and will provide a basic understanding of the molecular mechanisms of hormone action and will include a description of the main hormone receptors and their signal transduction pathways.

UNIT: -I.

1. Definition and scope of molecular endocrinology.
2. Chemical nature of hormones.
3. Purification and characterization of hormones.
4. Production of hormone by r DNA technology

UNIT: -II.

1. Structure - function relationship in hormones comparative analysis and evolutionary perspectives.
2. Eicosanoids and hormone action.
3. Concentration and transport of hormones in the blood.
4. Genetic analysis of hormonal disorders.

UNIT: -III.

1. Hormonal regulation of energy metabolism.
2. Hormonal antagonism.
3. Hypothalamic nuclei and their physiological function.
4. Endocrine Immune interaction.

UNIT: -IV.

1. Extraction and estimation of pregnanediol from urine.
2. Extraction of Gonadotrophin from urine.

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3. Bioassay of Androgen.
4. Bioassay of progesterone.

UNIT: -V.

1. Contraception.
2. Multiple ovulation and embryo transfer technology
3. Study of estrous cycle by vaginal smear technology.
4. Surgical technique-castration, ovariectomy, vasectomy, tubectomy and laprotomy.

Semester IV Paper- IV E

SUGGESTED READING MATERIAL

1. Benjamin Lewim - Genes VI/ VI, oxford University press.
2. Lodish etal- Molecular Cell Biology.
3. Zarrow, M.X, Yochin J.M. and Machrthy, J.L- Experimental Endocrinology.
4. Chatterji C.C. Human Physiology (Vol.- II)
5. S. Bentley, PJ.- Comparative Vertebrate endocrinology.
6. Hadley Mac. E- Endocrinology.
7. Chinoy, NJ. Rao, M.V, Desara, KJ. and High land, H.N. - Essential techniques in reproductively physiology and Endocrinology
8. Norris, D.O. - Vertebrate Endocrinology

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Scheme of Practical Examination Based on IV E Molecular Endocrinology and Reproductive Technology (Optional)

List of Practical:

1. Purification of any protein hormone.
2. Assay of steroid dehydrogenase.
3. Isolation and characterization of steroid / prostaglandin.
4. Assay for protein phosphorylation by e AMP dependent protein - Kinase. S.
5. Histological studies of endocrine glands.
6. Cytological studies of endocrine gland.
7. Histochemical studies of endocrine glands.
8. Study of vaginal histology during estrus cycle.
9. Demonstration of estrus cycle study by vaginal smear technique.
10. Hitological demonstration of glycogen during reproductive cycle and pregnancy.
11. Effect of testosteronre, estradiol and progesterone.
    a. Male reproductive study by weigh Volume measurement.
    b. Female reproductive study by weight/ Volume measurement.
12. Study of accessory reproductive structure after castration or ovariectomy.
13. Sperm count.
14. Demonstration of surgical technique.
    a. Castration b. Ovariectomy c. Laparotomy d. Vaseetomy e. Tubectomy etc.
15. Demonstration of perfusion technique for the firation of endocrine tissue.
16. Implantation of endocrine gland/tissue.

Scheme of practical Examination

Experiments on molecular endocrinology/ Reproductive technology:	10 Marks
Surgical / Experimental Techniques:	08 Marks
Histochemical/ Histological techniques:	08Marks
Spotting 1 to 5:	10 Marks
Viva-voce:	08 Marks
Practical Record:	06 Marks
Total:	**50 Marks**

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Class	-	M. Sc.
Semester	-	IV
Subject	-	Zoology
Paper no. and Title	-	**Paper –IV F Limnology and Fish Productivity (Optional)**

Max. Mark-40

Course Outcomes: The general aim of the course is to give students knowledge relevance for their future career in limnology, in research or with an applied focus. The paper allows students to analyze and evaluate abiotic and biotic conditions in aquatic systems and account for structure and dynamics in biogeochemical cycles and organism communities. The students could carry out basic sampling and analyses in freshwater field/laboratory systems, plan and carry out experiment/field studies, present and evaluate experiment/field studies both orally and in writing.

UNIT: -I.

1. Basic principal and development of science of limnology.
2. Morphometry, Origin and Classification of Lake systems of the world.
3. Saprobien system indicator organisms and water quality monitoring.
4. Waste water treatment.
5. Aquatic macrophytes and their control.

UNIT: -II.

1. Light and its relation in fresh water.
2. Heat and its relation in fresh water.
3. Role of oxygen and Carbon-dioxide in freshwater.
4. Role of organic and inorganic Carbon in freshwater.

UNIT: -III.

1. Aspects of primary productivity in freshwater.
2. Role of physicochemical characteristics in freshwater.
3. Plankton its role in freshwater.
4. Characteristics Bethic Biota, their substrate preference and significance.

UNIT: -IV.

1. Fresh water resources in India and their quality.
2. Wetland and its management.

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3. Fishery and management of reservoir.
4. Inland fish breeding.

UNIT: -V.

1. Riverine fisheries.
2. Fish production in pond and its management.
3. Indian cultivable fishes and their crop potential in India.
4. Preservation processing transport and marketing of fish.

Semester IV Paper- IV F

SUGGESTED READING MATERIAL

1. E.P. Odum - Fundamental of Ecology
2. R.G. Wetzel - Limnology.
3. P.S. Welsch - Limnology.
4. P.S. Welsch - Practical limnology.
5. R.G. Wetzel - Laboratory guide of Limnology.
6. J. Schwocrbel - Principles of Limnology.
7. KA. Ruttner - Fundamentals of Limnology.
8. Hutchinson -A Treatise on Limnology Vol.- 1 & 2.
9. V.G. Cole- Limnology.
10. G.A. Cole - Limnology.
11. W.T. Edmondson - Fresh water Biology.
12. R.W. Pennak - Freshwater invertebrates on N. America.
13. J.G. Needham and P.R. Needham - A Guide to freshwater invertebrates.
14. G.T. Tonapi - Freshwater animals of India.
15. S. Krishan Swamy - A Guide to the study of freshwater organism.
16. G.W. Prescott - Freshwater Algae.
17. Deshikachary - A guide for identification of Algae.
18. Published by International Biological program- I.B.P. Hand Books Nos. 1 & 2.
19. H.L. Goltermann - Chemical analysis of freshwaters.
20. K.S. Rao & Suresh Jain - Limnological methods & Principles of fish productivity.
21. O.P. Lind -Practicals Limnology.
22. H.B.N. Hynes - Biology of Running waters.
23. L. Klein - River pollution Vols. 1 & II.

Scheme of Practical Examination Based on IV F Limnology and Fish Productivity

(Optional)

List of Practical:

1. Soil Analysis.
   a. Particulate analysis.
   b. Moisture content.
   c. Total organic carbon.
   d. Estimation of Phosphate.
   e. Estimation of Nitrates.
   f. Estimation of Na, K. Ca, Mg. 2.
2. Mapping and Drawing techniques.
3. Study of aufwuch communities.
   a. Study of Sponges.
   b. Study of Ectoprocta
   c. Study of epineustic communities.
4. Water analysis.
   a. Estimation of dissolved oxygen
   b. Estimation of pH.
   c. Estimation of Alkalinity-
      (i) Carbonates.
      (ii) Bicarbonate.
      (iii) Free CO.
   d. Phosphate.
   e. Nitrate.
   f. Silicate.
   g. Calcium, Magnesium.
   h. Chlorophyll.
   i. Conductivity.
   j. B.O.D.
   k. CO.D.
   l. Total Solids.
   m. Redox potential.
5. Plankton study.
   a. Study and identification of phytoplankton.
   b. Study and identification of Zooplankton.
   c. A collection of common plankton organism to be submitted by the student in the form of slides.
6. Benthic study.
   a. Collection techniques.
   b. Isolating techniques of benthic fauna.
   c. Identification of benthic macro invertebrates.
   d. Field techniques of pollution monitoring.

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7. Productivity studies.
    a. Estimation of primary productivity.
        i. Lentic locale.
        ii. Lotic locale.
    b. Estimation of secondary productivity.
8. Ageing and growth techniques of fish.
    a. Scales preparation and ageing.
    b. Tagging technique.
    c. Growth rate study (From hatched embryos).
9. Identification of late fry and fingerlings.
10. Induced breeding technique.
11. Gonadectomy and Thyroidectomy.
12. Oxygen consumption levels and metabolic rates of some food fishes.
    a. Heteropneustes
    b. Cyprimur carplo.
13. Behavioral studies of fish.
    a. Agnostic behavior.
    b. Schooling
14. Proximate analysis of fish muscle.
    a. Red muscle.
    b. White muscle.
15. Fecundity and Ova diameter of some fishes.
16. Sexing of some fishes.
17. Techniques of estimating fish populations
18. Estimation of:
    a. Conditioning factor.
    b. L/wt relationship.
    c. Fish maturity.

Scheme of Practical Examination

Max. Marks: 50

1. Major Limnological Exercise:	12 Marks
2. Minor Limnological Exercise:	08 Marks.
3. Estimation (Two):	16 Marks.
4. Practical record:	08 Marks.
5. Viva-voce:	06 Marks
Total	**50 Marks**

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Class	-	M. Sc.
Semester	-	IV
Subject	-	Zoology
Paper no. and Title	-	**Paper –IV H Proteins, Nucleic acids and Metabolism regulation (Optional)**

Max. Mark-40

UNIT: -I.

1. Protein primary and secondary structures.
2. Protein tertiary and quaternary structures.
3. Purification of proteins.
4. Protein analytical methods (Spectroscopy and X-ray crystallography).

UNIT: -II.

1. Protein folding.
2. Lipoproteins.
3. G-protein and hormonal signaling.
4. Signal transduction pathways.

UNIT: -III.

1. Forces stabilizing nucleic acid structure.
2. Fractionation and analysis of nucleic acids.
3. DNA damage and repair.
4. DNA Methylation

UNIT: -IV.

1. Transfer RNA and its amino acylation.
2. Restriction endonucleases and restriction fragment length polymorphism (RFLP).
3. Polymerase chain reaction.
4. Gene cloning

UNIT: -V.

1. Proteins biosynthesis.
2. Mitochondrial electron transport.
3. Biosynthesis of purine nucleotides.
4. Biosynthesis of pyrimidine nucleotides.

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Semester IV Paper- IV H

SUGGESTED READING MATERIAL

1. Biochemistry, D. Voet and J.G. Voet, John wiley & sons. Inc. New York.
2. Text Book of Biochemistry, T.M. Devlin Wiley- Leiss, New York.
3. Principles of Biochemistry, G.L. Zubey; W.W. Parson and D.E. Vance, Wm.C. Brown publisher, U.S.A.
4. Principles of Biochemistry, A.L. Lehninger, A.L. Nelson; M.M. Cox. Worth Pulisher, Inc. USA.

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Scheme of Practical Examination Based on IV H Proteins, Nucleic acids and Metabolism regulation (Optional)

List of Practical:

1. Standard curve preparation of proteins.
2. Quantitation of Proteins.
3. Quantitation of DNA.
4. Quantitation of RNA.
5. Standard curve preparation of DNA and RNA.
6. Verification of Beer's Law.
7. Paper and thin layer chromatography.
8. Differential centrifugation and fractionation of cytoplasmic organelles.
9. Purification of protein by column chromatography.

Scheme of Practical Examination

Max. Marks: 50

Preparation of Standard curve/ verification of Beer's Law:	10 Marks
Quantitation of protein/ DNA RNA of purification:	12 Marks
Separation of compuneh by paper chromatography/ TLC/ Column chromatography:	14 Marks
Viva-voce:	08 Marks
Practical Record:	06 Marks
Total	**50 Marks**

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Class	-	M. Sc.
Semester	-	IV
Subject	-	Zoology
Paper no. and Title	-	**Paper -IV I Sericulture (Optional)**

Max. Mark-40

Course Outcome: The syllabus is based on agro-based industry and is very applied in view of generation of employment in rural and urban areas. Students learn about silk rearing, moriculture (plant cultivation). Student will get good opportunity in research and industries.

UNIT: -I. Introduction and Moriculture

1. Silk Producing Organisms.
2. Planning for profitability in sericulture.
3. Propagation of Mulberry.
4. Cultural Practices.

UNIT: -II. Plant pathology and Biology of *Bombyx mori*

1. Diseases of mulberry plant.
2. Classification of races of *Bombyx mori*.
3. Silk gland of *Bombyx mori*.
4. Structure and chemical composition of silk.

UNIT: -III. Rearing facilities and Operation

1. Rearing house and Rearing appliances for rearing of silk worms.
2. Disinfection operation before rearing.
3. Maintenance of optimum conditions for rearing.
4. Feeding, Bed cleaning and spacing

UNIT: -IV. Moulting, mountaning and Silk Worm disease

1. Moultanism and care during moulting.
2. Characteristic features of a ripe silk worm, mounting, Process of spinning and harvesting of cocoons.
3. Pebrine (Protozoan disease).

4. Bacterial, Fungal and Viral disease of silk worm.

UNIT: -V. Cocoon marketing, silk reeling and Non-mulberry silk worms

1. Cocoon Quality, testing, and grading.
2. Silk reeling operation.
3. Tasar culture.
4. Ericulture and Muga culture.

Semester IV Paper- IV I

SUGGESTED READING MATERIAL

1. Hand book of Silk Worm rearing by Masanori, Shimiza, D. Agri.
2. Sericulture Manual -2
3. Sericulture Manual -3 by S. Kishanaswamy.
4. Introduction to Sericulture by Dr. (Mrs.) G. Ganga Dr. (Mrs.) Sulochana chetty.
5. Principles of Sericulture by Hisao Aruga.
6. A Manual of non-mulberry Silks Sericulture Vol.-I by Dr. M.S. Jolly,*et al*,.
7. Sericulture and Silk Industries by Tripurari Sharan.
8. Sericulture Manual -1 Malberry cultivation by Dr. G. Rang swami.
9. Sericulture Manual -2 Silkworm rearing by Dr. S. Krishnaswami.
10. Sericulture Manual -3 Silk reeling by Dr. S. Krishnaswami
11. Mulberry cultivation by Zheng, Ting-Zing.
12. Silkworm rearing by Pva Pang Chesan.
13. Silk worm training manual by Sco Hotim.

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Scheme of Practical Examination Based on IV I Sericulture (Optional)

Syllabus based on sericulture special IV paper of IV semester. The duration of examination shall be 2 ½ hours.

Total - 25 marks

1. Dissection / Rendita or Denier: 05
2. Propagation / Preparation of Bed: 05
3. Spotting: 05
4. Viva-voice: 05
5. Practical Record: 05

Syllabus based on sericulture special IV paper of IV semester

1. Dissection of Silk gland' Nervous System of Silkworm.
2. Propagation of Mulberry by cutting method.
3. Preparation of Bed for Silkworm rearing.
4. Spotting related to special Sericulture theory paper.
5. Find out the Rendita or Denier.
6. Practical Record.

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