

स्नातकोत्तर पाठ्यक्रम की परीक्षा योजना

प्रथम सेमेस्टर सत्र 2019-20 के लिए

विषय – प्राणीशास्त्र प्रथम सेमेस्टर

M.Sc. Zoology

प्रश्नपत्र	प्रश्नपत्र का शीर्षक	अधिकतम अंक		न्यूनतम उत्तीर्णांक	
		सैध्दांतिक	सी.सी.ई	सैध्दान्तिक	सी.सी.ई
प्रथम	Biosystematics, Taxonomy and evolution	85	15	28	05
द्वितीय	Structure and Function of Invertebrates	85	15	28	05
तृतीय	Quantitative biology, biodiversity and wildlife	85	15	28	05
चतुर्थ	Biomolecules and structural Biology	85	15	28	05
	1- Practical -I	50	—	17	—
	2- Practical -II	50	—	17	—

विषय – प्राणीशास्त्र द्वितीय सेमेस्टर

प्रश्नपत्र	प्रश्नपत्र का शीर्षक	अधिकतम अंक		न्यूनतम उत्तीर्णांक	
		सैध्दांतिक	सी.सी.ई	सैध्दान्तिक	सी.सी.ई
प्रथम	Genral and Comparative animal Physiology and Endocrinology	85	15	28	05
द्वितीय	Population Ecology and Environmental physiology	85	15	28	05
तृतीय	Tools and techniques in Biology	85	15	28	05
चतुर्थ	Molecular Cell Biology and Genetics	85	15	28	05
	1- Practical -I	50	—	17	—
	2- Practical -II	50	—	17	—

5/17/19

सत्र 2020-21

III Semester M.Sc. Zoology

प्रश्नपत्र	प्रश्नपत्र का शीर्षक	अधिकतम अंक		न्यूनतम उत्तीर्णांक	
		सैध्दांतिक	सी.सी.ई	सैध्दान्तिक	सी.सी.ई
प्रथम	Comparative Anatomy of Vertebrates	85	15	28	05
द्वितीय	Eco-Toxicology	85	15	28	05
तृतीय	Limnology	85	15	28	05
चतुर्थ	Aquaculture	85	15	28	05
	1- Practical -I	50	—	17	—
	2- Practical -II	50	—	17	—

विषय - प्राणीशास्त्र चतुर्थ सेमेस्टर

प्रश्नपत्र	प्रश्नपत्र का शीर्षक	अधिकतम अंक		न्यूनतम उत्तीर्णांक	
		सैध्दांतिक	सी.सी.ई	सैध्दान्तिक	सी.सी.ई
प्रथम	Animal Behaviour And Neurophysiology(Compulsory)	85	15	28	05
द्वितीय	Gamete ,Biology, Development and Differentiation (Compulsory)	85	15	28	05
तृतीय	Ichthyology (Fish Structure and Functions)	85	15	28	05
चतुर्थ	Pisci Culture and Economic Importance of Fishes (Ichthyology) (Optional)	85	15	28	05
	3- Practical -I	50	—	17	—
	4- Practical -II	50	—	17	—

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एम.ए. एम.कॉम. एम.एस.सी. की सेमेस्टर परीक्षा उत्तीर्ण करने के लिए योजना निम्नानुसार रहेगी:-

1. प्रत्येक प्रश्न पत्र 100 अंकों का होगा। 33 प्रतिशत उत्तीर्णांक होगा।
2. कुल अंको (Aggregate marks) में 40 प्रतिशत अंक प्राप्त करने होंगे अर्थात् 160/400 अंक अर्जित करने होंगे।
3. प्रत्येक सेमेस्टर में दो विषयों में ए.टी./के.टी. की पात्रता रहेगी।

सरल कमांक	कक्षा	सैद्धांतिक/प्रायोगिक प्रश्नपत्रों के लिए निर्धारित		न्यूनतम प्राप्तांक	एग्रीगेट प्राप्तांक
		सैद्धांतिक अंक	प्रायोगिक अंक		
1.	M.A., M.Sc., M.Com. M.H.Sc. (सेमेस्टर प्रणाली नियमित)	85	15	28 05	40%
2.	प्रायवेट परीक्षार्थियों के लिए	100	—	33	40%
				Aggregate Marks 160/400	

(Gyan Prakash)

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Syllabus of M.Sc. I Semester Zoology Session 2019-20

Paper – 1: Biosystematics and Evolution

Marks: 15 (CCE)+ 85(Th.) = 100

Unit I	Definition and basic concepts of biosystematics taxonomy and classification. History of Classification. Types of Taxonomy Chemotaxonomy, Cytotaxonomy and Molecular taxonomy Dimensions of speciation and taxonomic characters. Species concepts : different species concepts. Theories of biological classification.
Unit II	Origin of reproductive isolation, biological mechanism of genetic incompatibility. Taxonomic procedures: Taxonomic collections , preservation ,cureting, process of identification. Taxonomic keys, different types of keys, their merits and demerits. International code of Zoological Nomenclature (ICZN). Operative principles, interpretation and Application of important rules: Formation of Scientific names of various Taxa.
Unit-III	Phylogenetic : gradualism and punctuated equilibrium. Modes of speciation (allopatry & sympatry) Evaluation of biodiversity indices. Evaluation of Shannon-Weiner Index. Evaluation of Dominance Index. Similarity and Dissimilarity Index.
Unit-IV	Concepts of evolution and theories of organic evolution. Neo Darwinism and population genetics: A. Hardy-Weinberg law of genetic equilibrium. B. A detailed account of destabilizing forces: i Natural selection ii Mutation iii Genetic Drift iv Migration v Meiotic drive. Trends in Evolution Molecular Evolution a) Gene evolution b) Evolution of gene families c) Assessment of molecular variation and its significance.
Unit-V	Major trends in the origin of higher categories Micro and macro evolution. Molecular population genetics Pattern of changes in nucleotide and amino acid sequence. Phylogenetic and biological concept of species. Origin and Evolution & Taxonomically important microbes and animals.

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, Berling.
6. Skoal R.R. and F.J.Rohiff Biometry-Freeman, San-Francisco.
7. Snecdor, G.W. and W.G. Cochran Stastical Methods of affiliated-East-West Press, New Delhi.
8. Murry J.D. Mathematical Biology-Springer, Verlag, Berlin.

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Syllabus of M.Sc. I Semester Zoology Session 2019-20

Paper - 2 : Structure and Functions of Invertebrates

Marks: 15 (CCE)+ 85(Th.) = 100

UNIT - I	1. Theories of Origin of metazoa 2. Organization of Coelom 3. Locomotion. 4. F. I. Structure, affinities and life history of the following minor Phyla - A. Rotifera B. Entoprocta C. Phoronida D. Ectoprocta
UNIT - II	1. Patterns of Feeding and digestion in lower invertebrates. 2. Patterns of Feeding and digestion in higher invertebrates. 3. Organs of respiration and Mechanism in lower invertebrates. 4. Organs of respiration and Mechanism in higher invertebrates.
UNIT - III	1. Excretion in lower invertebrates. 2. Excretion in aquatic higher invertebrates. 3. Excretion in terrestrial higher invertebrates. 4. Mechanism of Osmoregulation in fresh water and Marine Invertebrates.
UNIT - IV	1. Primitive Nervous systems in Coelenterata and Echinodermata. 2. Advanced nervous system in Annelida, 3. Advanced nervous system in Arthropoda. 4. Advanced nervous system in Mollusca.
UNIT - V	1. Larval forms of Trematoda, Cestoda and Annelida. 2. Larval forms of Crustacea. 3. Larval forms of Mollusca. 4. Larval forms of Echinoderms.

* Suggested Reading Material -

1. Hyman, L.H. The invertebrates, Vol. 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. McGraw 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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Syllabus of M.Sc. I Semester Zoology Session 2019-20

Paper - 3: Quantitative Biology, Biodiversity and Wildlife

Marks: 15 (CCE)+ 85(Th.) = 100

UNIT - I	<p>Biostatistics</p> <ol style="list-style-type: none"> 1. Mean - Definition & Calculation. 2. Median - Definition & Calculation. 3. Mode - Definition & Calculation. 4. Standard deviation (SD) - Definition and Calculation. 5. Graphs & Histogram including application. 6. Bar diagram & Pictogram including application.
UNIT - II	<ol style="list-style-type: none"> 1. Sampling theory 2. Experimental designing : Completely randomized design and randomized block design 3. Variance and analysis 4. Co-relation, types of correlation. 5. Karl perones coefficient correlation 6. T- test , Chi square test.
UNIT - III	<p>Biodiversity</p> <ol style="list-style-type: none"> 1. Concept and principal of biodiversity. 2. Causes for the loss of biodiversity. 3. Biodiversity conservation method. 4. National Biodiversity status of india. (vertebrates.) 5. Medicinal uses of various parts of animals.
UNIT - IV	<p>Wildlife of India</p> <ol style="list-style-type: none"> 1. Values of wildlife positive and negative values. 2. Wildlife protection Act.(Legal Provision) 3. Causes for the extinction of Wildlife. 4. Conservation of wildlife in India. 5. Endangered and threatened Indian species. 6. Wildlife Corridor. 7. Dianosaure - Causes of extinction
UNIT - V	<p>Wildlife and conservation</p> <ol style="list-style-type: none"> 1. National Parks and Sanctuaries 2. Project Tiger & Project Gir lion 3. Crocodile - conservation. 4. wildlife in M.P. with references to Reptiles, Birds and mammals 5. Biospheres reserves & Safari Park. 6. Wildlife Crossing.

Ist Semester
Suggested reading materials:

1. M. Koto : The Biology of Biodiversity. Springer.
2. E. O. Wildon : Biodiversity. Academic Press Washington.
3. G.G. Simpson : Principles of Animal Taxonomy. Oxford IBH Publication Company.
4. E. Mayer : Elements of Taxonomy.
5. Dobzansky : Biosystematics.
6. Dallela and Sharma : Animal Taxonomy and Museology.
7. Dodzhansky: The Genetics and origin of species. Columbia University Press.
8. Futuyama D.I. Evolutionary Biology. INC Publishers Dunderland.
9. Jha A.P. : Genes and Evolution - John Publication, New Delhi.

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Suggested Readings Materials

- Bataschelet. E. Introduction to mathematics for site scientist springer-verlag, berling
- Jorgensen, S.E. Fundamental of Ecological modeling E. sevier New York
- Lenderen D. Modelling in behavioral ecology. Chapman & Hall London U.K.
- Sokal, R.R. and F. J. Rohit Biometry Freeman San Francisco
- 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 ordination.
- A. Lewis - Biostatistics
- B.K. Mahajan Methods in Biostatistics
- V.B. Saharia wildlife in India
- S.K. Tiwari wildlife in central India
- J.D. Murrey Mathematical Biology
- Georjs & Wilians Startical method
- R.K. Tondon Biodiversity Taxonomy & Ecology
- M.P. Arora An Introduction to preventology
- P.C. Kotwal Biodiversity and conservation

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Paper – 4 : Biomolecules and Structural Biology

Marks: 15 (CCE)+ 85(Th.) = 100

Unit-I	<p>Chemical Foundation of biology - I</p> <ol style="list-style-type: none"> 1. pH, PK, acids bases, buffers, weak bonds 2. Acid soluble pool of living tissues . 3. Nanoparticles. 4. Structure of amino acid and peptides. 5. Primary, secondary, tertiary and quaternary structures of proteins, protein folding and denaturation.
Unit-II	<p>Chemical Foundation of biology – II</p> <ol style="list-style-type: none"> 1. Structure and types of Nucleotides. 2. DNA: Double helical structure of DNA, 3. DNA replication, recombination and repair 4. RNA: Structure of RNA, role of RNA in gene expression 5. Functional importance of lipid storage and membrane lipids
Unit-III	<p>Carbohydrate and Fat metabolism:</p> <ol style="list-style-type: none"> 1. Basic concepts of metabolism: Coupled and interconnecting reactions of metabolism cellular energy resources and ATP synthesis 2. Glycolysis and gluconeogenesis, glycogenolysis. 3. Citric acid cycle 4. Oxidative phosphorylation. 5. Fatty acid metabolism.
Unit-IV	<p>Biosynthesis:</p> <ol style="list-style-type: none"> 1. RNA synthesis and splicing 2. Biosynthesis of amino acids 3. Biosynthesis of nucleotides 4. Protein synthesis and its regulation. 5. Biosynthesis of membrane lipids and steroids and fatty acids.
Unit-V	<p>Enzymes and Thermodynamics:</p> <ol style="list-style-type: none"> 1. Enzymes: Terminologies, classification and basics of enzyme kinetics 2. Mechanism of enzyme catalysis 3. Regulation of enzyme action 4. Concept of free energy and thermodynamic principles in biology 5. Energy rich bonds, compound and biological energy transducers resonance, isomerisation.

Suggested Readings:

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

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SEMESTER - I

Practical : Ist

Devi Ahilya Vishwavidyalaya, Indore

	M.M, 50
1. Spotting - Classification and identification of various phylum. ✓	10
2. One major dissection of various systems of invertebrates - Squilla, Prawn, Sepia, Loligo.	10
3. One minor dissection- Grasshopper, Honeybee, Echinus, Starfish, Aplysia.	5
4. Mounting material - permanent balsum mount	5
5. Spottings related with <u>Adaptation</u> . Homologics, Analogics and modification of mouth parts :	5
6. Viva Voce.	10
7. Pratical Records, collection	5
Total Marks	50

Class: M.Sc.
SEMESTER - I
Practical : IInd

	M.M, 50
1. Problem based on Biodiversity and wild life. Mammals and Fishers group (Spots 5 +5)	20
2. Exercise on mean, mode, & Median. ✓	5
3. Cell division preparation of slid on Meiosis & Mitosis.	5
4. Preparation of different types of chromosomes.	5
5. Viva - Voce	10
6. Practical Record and collection.	5
Total Marks	50

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PAPER - I: General and Comparative Animal Physiology and Endocrinology

Marks: 15 (CCE)+ 85(Th.) = 100

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. Comparative physiology of digestion 2. Patterns of nitrogenous excretion in different animal groups 3. Osmoregulation in different animal groups 4. Thermoregulation in homeotherms, poikilotherms and hibernation 5. Physiology of pregnancy, placental hormones, pregnancy diagnosis tests, parturition and breast and lactation (human being)
Unit-III	1. Comparative study of mechanoreception 2. Comparative study of photoreception 3. Comparative study of phonoreception & equilibrium reception 4. Comparative study of chemoreception 5. Comparative study of Lateral line systems in Fishes.
Unit-IV	1. Bioluminescence 2. Pheromones (Invertebrates & vertebrates) 3. Chromatophores and regulation of their function among animals 4. Hormones, chemical nature and their classification. 5. Mechanisms of hormone action (a) proteinous Hormones (b) steroidal Hormones.
Unit-V	1. Structure & Function of pituitary, pancreas, adrenal and thyroid. 2. Phylogeny of endocrine glands (pituitary, pancreas, adrenal, thyroid) 3. Ontogeny of endocrine glands 4. Neuroendocrine system in vertebrates. 5. Hormone receptors . signal transduction mechanisms 6. Hormones and reproduction a. Seasonal breeders b. Continuous breeders

Paper-I List of Books

SUGGESTED READING MATERIAL

1. EJW Barrington-General & comparative Endocrinology-Oxford, Clarendon 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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PAPER - VI: Population Ecology and Environmental physiology

Marks: 15 (CCE)+ 85(Th.) = 100

Unit - I	<p>1. Population and its characteristics – Size & density, Dispersion, Natality, Mortality, Age distribution, Biotic Potential.</p> <p>2. Population Growth and Population Dynamics: Population growth paterus (J & S Shaped), Population cycles.</p> <p>3. Factors affecting population: Population Regulation – Extrinsic and intrinsic factors.</p>
Unit-II	<p>1. Environmental Limiting Factors: Liebig Law of Minimum, Shelford's Law of Tolerance, Combined concept of Limiting factors.</p> <p>2. Physical Factors workings as Limiting Factors.</p> <p>3. Biotic Factors (a) Inter-specific Biotic Factors, (i) Positive Interactions – Scavenging, Proto-cooperative Symbiosis (Mutualism & Commensalism). (ii) Negative Interactions – Ammensalism, Competition, Parasitism, Predation, Antibiosis.</p> <p>(b) Intra-specific Biotic Factors: colonization, Aggregation, Social organization.</p>
Unit-III	<p>(a) Eco – physiological Adaptations –</p> <ol style="list-style-type: none"> 1. Aquatic (Primary & Secondary aquatic animals) Adaptation. 2. Aerial or Volant Adaptation. 3. Desert Adaptation. 4. Fossorial Adaptation. 5. Cursorial Adaptation. 6. Scansorial Adaptation. 7. Deep Sea Adaptation. <p>b. Protective Adaptation – Mimicry: Protective, Aggressive and conscious.</p>
Unit-IV	<p>1. Environmental Degradation (Pollution & Human health): Air, Water, Soil, Thermal, Noise, Plastic and their Control.</p> <p>2. Natural Resources & their conservation: Water, Soil, Forest, Mineral resources.</p> <p>3. Environmental impact assessment and Sustainable development</p>
Unit-V	<p>1. Radiation Ecology: Kinds of Radiations, Sources of Radiations, Effect of Radiations, Control of Radiation pollution.</p> <p>2. Global Warming & Green House effect: causes of green House effect, Effects of green house gases, ozone depletion.</p> <p>3. Physiological response to body exercise, Meditation, Yoga and their effects.</p>

Suggested Readings:

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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PAPER - III: Tools and Techniques in Biology

Marks: 15 (CCE)+ 85(Th.) = 100

Unit - I	<p>1. General Principle, Instrumentation and applications of</p> <p>a) Colorimeter b) Spectrophotometer c) Flame photometer d) Light, Electron microscope and phase contrast microscope</p> <p>2. Separation techniques:-</p> <p>a) Centrifugation – Ultracentrifugation, Density gradient & differential Centrifugation. b) Chromatography- Principle and Applications of Paper, TLC, Affinity, Gel and HPLC. c) Electrophoresis – Principles and Applications of PAGE and Agarose gel electrophoresis.</p>
Unit-II	<p>1. Microbiological Techniques:-</p> <p>a) Types of Bacterial culture media and sterilization. b) Inoculation Methods. c) Microbial assay of vitamins and amino acids. d) Different Staining techniques for Bacterial identification. e) Basic design and Applications of Fermentor.</p> <p>2. Cryotechniques</p> <p>a) Cryopreservation of cells, tissues, organs and organisms. b) Freeze fracture and freeze drying method.</p>
Unit-III	<p>1. Radioactivity:-</p> <p>a) Types and applications of different Radioisotopes . b) Measurement of radioactivity. c) Autoradiography.</p> <p>2. Immunological techniques and its applications:-</p> <p>a) Immunodiffusion (single and double). b) Immunoelectrophoresis. c) Immunofluorescence & Immunoblotting d) ELISA & RIA.</p>
Unit-IV	<p>1. Microtomy</p> <p>a) Types of microtomes b) Fixatives & fixation of tissue c) Dehydration of tissue and paraffin block preparation d) Sectioning, stretching & staining (Single & Double)</p> <p>2. Cell culture techniques.</p> <p>a) Design and functioning of tissue culture laboratory b) Essential components and Preparation of tissue culture media.</p>
Unit-V	<p>1. Cytological techniques</p> <p>a) Karyotyping & Giant chromosome. b) Chromosome banding techniques (G,C,Q, R, banding) c) Flow cytometry.</p> <p>2. Molecular biology techniques</p> <p>a) In situ hybridization (FISH and GISH) b) Southern and northern hybridization. c) DNA Sequencing method. d) Polymerase Chain reaction (PCR):- Principle, procedure & applications.</p>

Suggested Readings:

1. Biophysical Methods: Tools and Techniques in Biology Part I-Microscopy - Author Name: Dr. Nisha Raghav and Dr. Ravindra Pratap Raghava
2. Biological Instrumentation and Methodology: (Tools and Techniques of Biology) - Author Name: Dr. P.K. Bajpal, Published by S. Chand & Company Ltd
3. Tools, Techniques and Assessment in Biology: A Course Guide for Students and Teachers - Author Name: John Adds, Erica Larkcom, Nelson Thornes
4. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology by Andreas Hofmann (Editor), Samuel Clokie (Editor)
5. Molecular Biology and Biotechnology– by Ramawat K.G. (Author), Goyal Shaily (Author)
6. Fundamentals and Techniques of Biophysics and Molecular Biology by Pranav Kumar (Author)

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Syllabus of M.Sc. II Semester (Zoology) Session 2019-20

PAPER-8: Molecular Cell Biology and Genetics

Marks: 15 (CCE)+ 85(Th.) = 100

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 and microtubules structure and dynamics 4. Cell movements, intracellular transport, role of kinesins and dynein. 5. Transportation of proteins through golgi post translational modifications.
Unit-II	Cell. Cell signalling 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 ⁺⁺ dependant homophilic cell . cell ahension 2. Ca ⁺⁺ independent homophilic cell . cell ahension 3. Genome organization, hierarchy in organization 4. Chromosomal organization of genes. 5. Non Coding DNA and its importance.
Unit-IV	Sex determination 1. Sex determination in drosophila and mammals. 2. Basic concept of dosage compensation 3. Cytogenetic of human chromosomes 4. Human genome project (HGP) & its significance. 5. Transgenic animals & their applications
Unit-V	Genetic Diseases and Genomics 1 Human genetic disorders and gene therapy. 2 Prenatal diagnosis & genetic counseling 3 Genetic screening 4 Structural and Functional Genomics. 5 Gene libraries

Suggested Readings

- J. Darnell, H. Lodish and D. Baltimore molecular cell biology scientific American book. Inc. USA
- B. Alberts D. Bray, J. Lewis, M. raff, K. roberts and J.D. Wattson. molecular biology of the cell. Garland Publishing Inc. New York.
- John R. W. animal cell culture A practical approach masters. Irl. Press
- Alberts et all Essentials cell biology garland publishing Inc. New York 1998
- J.M. Barry molecular biology
- Philip E. Hartman Gene Action
- L.C. dunn. principals of Genetics
- A.M. Winchester genetics

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Practical : Ist

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M.M. 50

General & Comarative Physiology and Endocrinology
Population Ecology and Environmental Physiology.

Exercise :

- | | |
|--|----|
| 1. Experiment on Hematology Blood group, Total and different counts. | 5 |
| 2. Demonstration of Enzyme Action, and chromatography | 10 |
| 3. Estimation of pH | 5 |
| 4. Detection of protein carbohydrate and fats. | 5 |
| 5. Endocrinological spots comments on prepared histological slides. | 10 |
| 6. Detection of Nitrogenous products in given samples. | 5 |
| 7. Viva Voce. | 5 |
| 8. Practical Records and collection. | 5 |

50

Total Marks

SEMESTER - II

Practical : IInd

M.M. 50

Tools and Techniques for biology.
Molecular cell Biology and Genetics

- | | |
|--|----|
| 1. Comments upon the structure and application of analytical instruments | 10 |
| i. Colorimeter | |
| ii. Spectrophotometer | |
| iii. Ultracentrifuge | |
| iv. ESR and NMR spectrometer | |
| v. Microtomy | |
| vi. Chymographic Instruments | |
| 2. Problem and based on genetics | 10 |
| 3. Estimation techniques based for RNA and DNA | 10 |
| 4. Estimation of Gene and Genotypic frequencies in light of Hardy Weinberg law based on facial traits. | 5 |
| 5. Demonstration of chromosome polymorphism isozyme polymorphism in some insect population. | 5 |
| 6. Viva - Voce | 5 |
| 7. Practical Record | 5 |

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Total Marks

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Syllabus of M.Sc. III Semester Session 2020-21

Paper - ~~1~~ Comparative Anatomy of Vertebrates

Marks: 15 (CCE)+ 85(Th.) = 100

Unit-1	<ol style="list-style-type: none"> 1. Origin of Chordata: Protochordata and Euchordata. 2. Vertebrate morphology: Shape, size, colour and their importance. 3. Comparative account of integument and its derivatives in vertebrates. 4. Comparative account of respiratory organs in vertebrates. 5. Comparative account of Alimentary Canal in vertebrates.
Unit-2	<ol style="list-style-type: none"> 1. Comparative account of heart in vertebrates. 2. Comparative account of Evolution of aortic arches and portal systems in vertebrates. 3. Comparative account of blood and blood circulation in vertebrates. 4. Comparative account of girdles and limb bones of vertebrates. 5. Comparative account of jaw suspensorium and vertebral column.
Unit-3	<ol style="list-style-type: none"> 1. Comparative account of Kidney in vertebrates. 2. Comparative account of Reproductive organs in vertebrates. 3. Comparative account of olfactory organ and taste buds. 4. Comparative account of brain and spinal cord in vertebrate. 5. Comparative account of Cranial and spinal nerves in vertebrates.
Unit-4	<ol style="list-style-type: none"> 1. Comparative account of electroreceptors. 2. Anatomical aerial adaptations in vertebrates. 3. Anatomical aquatic adaptations in vertebrates. 4. Anatomical terrestrial adaptation in vertebrates. 5. Origin, evolution, general organization and affinities of Ostracoderms.
Unit-5	<ol style="list-style-type: none"> 1. General organization of Cyclostomes. 2. Specialized and degenerated characters of Cyclostomes. 3. General organization of Gnathostomes. 4. General account of Elasmobranchi and Holocephali. 5. General account of Dipnoi and Crossoptergii.

Suggested Readings :

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 Pres Pvt. Ltd., New Delhi.
5. Milton I lildergränd. 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. life of vertebrates. The Oxford University Press, London
11. Parker & Haswell to III Rev. by Marshall willians latested Macmillan Co. Ltd.
12. Young J.Z. Life of mammals. The Oxford University Press, London
13. Weichert, C.K. and Presch, W. Elements of chordate anatomy, 4th Edn. McGraw Hall Book Co., New York.

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Paper - ~~10~~: Eco- Toxicology

Marks: 15 (CCE)+ 85(Th.) = 100

Unit-1	<ol style="list-style-type: none"> 1. General principles of Environmental Biology with emphasis on ecosystems. 2. Abiotic and biotic factors of ecosystems. 3. Communities of the environment, their structure & significance. 4. Energy flow in environment : Ecological energetics.
Unit-2	<ol style="list-style-type: none"> 1. Productivity, Production and analysis. 2. Recycling and reuse, reduce technologies for solid and liquid wastes and their role in environmental conservation. 3. Remote sensing –basic concepts and its uses in biological systems. 4. Environmental indicators and their role in environmental balance.
Unit-3	<ol style="list-style-type: none"> 1. Kinds of environmental pollution, causes and their control methods. 2. Radioactive compounds and their impact on the environment. 3. Vehicular exhaust pollution, causes and remedies. 4. Noise pollution causes and remedies.
Unit-4	<ol style="list-style-type: none"> 1. Toxicology- Basic concepts, principles and various types of toxicological agents. 2. Toxicity testing principles, hazards, risks and their control methods. 3. Food toxicants and their control methods. 4. Public Health Hazards due to environmental disasters.
Unit-5	<ol style="list-style-type: none"> 1. Pesticides, types, nature and their effects on environment. 2. Important heavy metals, their role in environment and diseases caused by them. 3. Agrochemical use and misuse, alternatives. 4. Plastic pollution and remedies.

Suggested Readings :

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

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Syllabus of M.Sc. III Semester Session 2020-21

Paper - ~~II~~ **Limnology**

Marks: 15 (CCE)+ 85(Th.) = 100

Unit-1	1. Limnology – Definition, historical and scope. 2. Fresh water resources of India and their Management. 3. Lotic ecosystem of freshwater and their fishery (a) Rivers (b) Springs (streams). 4. Lentic ecosystem of fresh water and their fishery (a) Ponds (b) Lakes (c) Reservoir
Unit-2	1. Physical characteristics of fresh water fishery Resources – Depth, Light, Temperature, Turbidity. 2. Chemical characteristic of fresh water fishery resources – Part A – Minerals i.e., Carbonate, Bicarbonate, Phosphate, Sulphate, chloride, Nitrate, Nitrite. 3. Chemical characteristics of fresh water fishery resources Part B – Gases – CO ₂ and DO. 4. Estimation and Role of BOD and COD in the fish culture.
Unit-3	1. Phytoplankton-Definition, Types, seasonal variation and role in fish culture. 2. Zooplankton Definition, Types, seasonal variation and role in fish culture. 3. Aquatic insects and their importance in fish culture. 4. Aquatic birds and their importance in fish culture.
Unit-4	1. Aquatic (fresh water) pollution: its causes effect on fishes and remedy. 2. Pollution status of River Ganga and their remedy including Ganga action plan i.e. measures taken to clean river Ganga. 3. Pollution status of River Yamuna action plan i.e. measures taken to clean river Yamuna. 4. Bioindicator and their relationship with water quality.
Unit-5	1. Sewage – Definition, Composition, treatment and use in pisciculture. 2. Hydrophytes and their role in fish culture. 3. Uses and Misuses of various inland water resources. 4. Legislations to regulate fresh water pollution.

Suggested Readings :

- Anathakrishnan : Bioresources Ecology
Goldman : Limnology
Odum : Ecology
Pawlosuske : Physico- chemical methods for water
Wetzel : Limnology
Trivedi & Goyal : Chemical and biological methods for water pollution studies
Welch : Limnology Vols. I-II
Perkins : Ecology
Arora : Fundamentals of environmental biology

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Unit-1	<ol style="list-style-type: none"> 1. Aquaculture: history, definition, scope & importance. 2. Fishery resources of India in general & Madhya Pradesh in particular. 3. Abiotic & biotic factors of water necessary for fish life. 4. Ecological characteristics of lakes & rivers. 5. General ecological characteristics of reservoirs of India.
Unit-2	<ol style="list-style-type: none"> 1. Fish culture:- Mono, Poly, mixed and composite Fish culture. 2. Fresh water prawn culture and its prospects in India. 3. Culture of Mussels, clams, oysters & pearl oysters. 4. Sewage fed fish culture, paddy cum fish culture 5. Frog culture.
Unit-3	<ol style="list-style-type: none"> 1. Stripping and bundh breeding 2. Hypophysation and breeding. 3. Transport of live fishes & seeds. 4. Different types of crafts & gears used for fish catching. 5. Common weeds of fish ponds and methods of their eradication.
Unit-4	<ol style="list-style-type: none"> 1. Fresh water fish farm engineering: selection of site, construction of fish farm & soil chemistry. 2. Designing, layout & construction of different types of fish ponds. 3. Fresh water aquarium - Setting and management of fresh water aquarium. 4. Fish preservation & processing. 5. By products of fish Industry & their utility.
Unit-5	<ol style="list-style-type: none"> 1. Water pollution, its effects on fisheries and methods of its abatement. 2. Bacterial and viral diseases in fishes and their control. 3. Protozoan and Helminthes diseases in fishes and their control. 4. Biochemical composition and nutritional value of fish. 5. Fish marketing.

Suggested Readings :

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. A.J.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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: III

: Zoology

: Related to I & II Theory Papers

Semester
Subject
Practical I

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.

Scheme for Practical Examination		M.M. 50
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

Semester
Subject
Practical I

: III

: Zoology

: Related to III & IV Theory Papers

Scheme of practical examination

M.M. 50

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

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Semester
Subject

: III
: Zoology

: Related to III & IV Theory Papers

Practical II

1. Study of plankton.
2. Preparation and Maintenance of Aquarium.
3. Study of common weeds of fish ponds.
4. Methods of culture related to theory papers.
5. Study of abiotic factors of water related to fish life.
6. Determination of different toxic chemicals in samples of soil, water and air.
7. Toxicological testing methods, General tests, acute toxicity test and LD 50 test.
8. Identification and comments on Aquaculture animals.

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Paper 13 - ANIMAL BEHAVIOUR AND NEUROPHYSIOLOGY

Marks: 15 (CCE)+ 85(Th.) = 100

Unit-1	<ol style="list-style-type: none"> 1. Introduction: Ethology as a branch of biology, Classification of behavioral patterns, analysis of behavior (ethogram). 2. Reflexes and complex behavior. 3. Perception of the environment: mechanical, electrical, chemical, olfactory, auditory and visual. 4. Evolution and ultimate causation: Inheritance behavior and relationships.
Unit-2	<ol style="list-style-type: none"> 1. Neural and hormonal control of behavior. 2. Genetic and environmental components in the development of behavior. 3. Motivation: (a) Drive, timing and interaction of drives, (b) physiological basis of motivation, (c) hormones and motivation, (d) aggregation. 4. Communication: Chemical, visual, light and audio, evolution of language (primates).
Unit-3	<ol style="list-style-type: none"> 1. Ecological aspects of behavior: Habitat selection, food selection, optimal foraging theory, anti-predator defenses, aggression and homing territoriality, dispersal, host-parasite relations. 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-4	<ol style="list-style-type: none"> 1. Reproductive behaviour. Evolution of sex and reproductive strategies, mating systems, courtship, sexual selection, parental care. 2. Social behaviour. aggregations, schooling in fishes, flocking in birds, herding in mammals, group selection, kin selection, altruism, reciprocal altruism, inclusive fitness. social organization in insects and primates. 3. Parental behaviour.
Unit-5	<ol style="list-style-type: none"> 1. Thermoregulation: Homeothermic animals, poikilotherms & Hibernation. 2. Bioluminescence. 3. Vocalization & Communication in birds. 4. Hormone, drugs and human behaviour.

Recommended Readings -

- Eibl-Eibesfeldt, I. Ethology. The biology of Behaviour. Holt, Rinehart & Winston, New York.
- Gould, J.L. The mechanism and Evolution of Behaviour.
- Krebs, J.R. and N.B. Davies : Behavioural Ecology. Blackwell, Oxford, U.K.
- Hinde, R.A. Animal Behaviour : A Synthesis of Ethology and Comparative Psychology. McGraw Hill, New York.
- Alcock, J. Animal Behaviour : An Evolutionary approach. Sinauer Assoc. Sunderland, Massachusetts, USA.
- Bradbury, J.W. and S.L. Vehrencamp. Principles of Animal Communication. Sinauer Assoc. Sunderland, Massachusetts, USA.

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Paper 14 Gamete Biology, Development and Differentiation

Marks: 15 (CCE)+ 85(Th.) = 100

Unit-I	<ol style="list-style-type: none"> 1. Comparative account of gonads in mammals. 2. Spermatogenesis: Morphological basis in rodents. Gamete specific gene expression and genomics. 3. Biochemistry of Semen: Semen composition and formation, assessment of sperm function. 4. Fertilization: Pre fertilization events, fertilization events and post fertilization events. 5. Biochemistry of fertilization.
Unit-II	<ol style="list-style-type: none"> 1. Ovarian follicular growth and differentiation : morphology, type of ovaries, 2. Endocrinology of mammals, molecular biology. 2. Oogenesis and vitellogenesis, ovulation and ovum transport in mammals. 3. Biology of sex determination and sex differentiation a comparative account. 4. Multiple ovulation and embryo transfer technology : in vitro oocyte maturation, super ovulation.
Unit-III	<ol style="list-style-type: none"> 1. Hormonal regulation of ovulation, pregnancy and parturition. 2. Hormonal regulation of development of mammary gland and lactation. 3. Hormonal regulation and Physiology of placenta. 4. Cryopreservation of gametes and Embryo. 5. Teratological effects of xenobiotics.
Unit-IV	<ol style="list-style-type: none"> 1. Cell commitment and differentiation. 2. Germ cell determinants and germ cell migration. 3. Development of gonads. 4. Melanogenesis. 5. Frog and Chick embryology.
Unit-V	<ol style="list-style-type: none"> 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.

Suggested Readings :

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. Developmental Biology, Sinauer Associates Inc. Massachusetts.
5. Ethan Bier, the cold Spring. The cold spring Harbor laboratory Press, New York.
6. Balinsky B.I. Introduction to Embryology Sanders; Philadelphia.
7. Berril N.J. and Karp. G. Development Biology. McGraw Hill New York.
8. Davidson, E.H. Gene Activity During Early Development. Academic Press, New York.

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Unit-I	<ol style="list-style-type: none"> 1. Origin and evolution of fishes. 2. Classification of fishes as proposed by Berg. 3. Fish integument and its derivatives. 4. Fins and girdles: structure and types. Origin and evolution of paired fins 5. Mechanism of Locomotion.
Unit-II	<ol style="list-style-type: none"> 1. Alimentary canal and digestion. 2. Accessory respiratory organs. 3. Air bladder and its functions. 4. Weberian ossicles their homologies and functions. 5. Brain and cranial nerves.
Unit-III	<ol style="list-style-type: none"> 1. Excretion and osmoregulation. 2. Acoustico-lateral line system. 3. Luminous organs. 4. Colouration in fishes. 5. Electric organs in fish.
Unit-IV	<ol style="list-style-type: none"> 1. Poisonous organs in fishes. (Poisonous and venomous fishes). 2. Sound producing organs. 3. Deep sea adaptations. 4. Hill stream adaptations. 5. Migration in fishes.
Unit-V	<ol style="list-style-type: none"> 1. Reproductive system 2. Sexual cycle and fecundity. 3. Parental care in fishes. 4. Early development and hatching. 5. Biology of fish fry and fingerlings.

Suggested Readings : Paper III A & IV A.

1. J.R. Norman - The History of fishes.
2. Nagaraja Rao - An introduction to fisheries
3. Lagler - Ichthyology.
4. Herden Jones - Fish migration.
5. Marshall - 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. I & II.
10. Hoar and Randall - Fish physiology of fishes Vol. I & II.
11. Günther Serby C. N. H. - Freshwater fishes of the world Vol. VII.
12. W. Lam Van - The Fishes.
13. G.V. Nikolsky - The ecology of Fishes.
14. Borgstram - Fish as food Vol. I & II.
15. Nilsson - Fish physiology - Recent Advances
16. P.B. Nile and J.J. Cech - Fishes - An Introduction to Ichthyology.
17. Carl L. Bond - Biology of fishes.
18. M. Jobling - Environmental Biology of fishes.
19. Santosh Kumar & Manju Tembhe - Fish and Fisheries.
20. S.K. Gupta - Fish and Fisheries.
21. K.P. Vas - Fish and Fisheries.
22. Jitaganan - Fish and Fisheries.

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Syllabus of M.Sc. IV Semester Session 2020-21

Paper-IV: ~~Pisci~~ Culture and Economic Importance of Fishes

Marks: 15 (CCE)+ 85(Th.) = 100

Unit-I	<ol style="list-style-type: none"> 1. Collection of fish seed from natural resources. 2. Streeping method of breeding. 3. Dry bundh breeding of carps. 4. Wet bundh breeding of carps. 5. Hypophysation and breeding of Indian major carps.
Unit-II	<ol style="list-style-type: none"> 1. Drugs/hormones useful in induced breeding of fish. 2. Types of ponds required for fish culture. 3. Management of hatcheries and nurseries. 4. Management of rearing ponds and stocking ponds.
Unit-III	<ol style="list-style-type: none"> 1. Composite fish cultures 2. Prawn culture techniques. 3. Pearl culture technique. 4. Fisheries resources of MP 5. Riverine fisheries in India and their problems.
Unit-IV	<ol style="list-style-type: none"> 1. Costal fisheries in India, its problems and solution. 2. Offshore and deep sea fisheries of India, its problems and solution. 3. Role of fisheries in rural development 4. Sewage fed fisheries
Unit-V	<ol style="list-style-type: none"> 1. Methods of fish preservation 2. Marketing of fishes in India. 3. Economic importance and by product of fishes 4. Shark liver oil, its characteristics, manufacture and importance. 5. Transport of live fish & fish seed.

Suggested Readings:

1. Carp and Pond Fish Culture: Including Chinese Herbivorous Species, Pike, Tench, Zander, Wels Catfish, Goldfish, African Catfish and Sterlet Book by Chris Seagrave, Gizella Tamas, and Laszlo Horvath.
2. Freshwater Aquaculture: A Handbook for Small Scale Fish Culture in North America Book by William O. McLarney.
3. Fish Hatchery Management - Book by Robert G. Piper.
4. Pisciculture: An Address on the Artificial Breeding of Fish, Their Habits, Etc., Delivered Before the Detroit Scientific Association Book by Clark N W.
5. A Textbook of Pisciculture and Aquarium Keeping Book by H. S. Jagtap, S. N. Mukherjee, and V. K. Garad
6. Aquaculture and Fisheries Paperback – 2014 by N Arumugam.
7. A Text Book of Fish Biology and Fisheries by S S Khanna (Author)
8. Fresh Water Aquaculture – R.K. Rath.
9. General and Applied Ichthyology by S.K. Gupta, P.C. Gupta.
10. An Introduction to Fishes – S.S. Khanana, H.R. Singh.

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Semester
Subject
Title of Subject Group
Paper No.

: IV
: Zoology
: General Practical
: Paper- I & II (Compulsory)
Animal behavior and gamete biology

1. Exercise on Animal behavior
 - a. Taxes
 - b. Reflexes
 - c. Biological clocks
 - d. Social behavior
 - e. Learning behavior
 - f. Reproductive behavior

2. Developmental Biology
 - ✓ Study of embryological slides
 - ✓ Study of gametes of frog and chick
 - ✓ Study of fate maps
 - ✓ Study of different stages of spermatogenesis and oogenesis

Semester
Subject
Title of Subject Group
Paper No.

: IV
: Zoology
: General Practical
: Paper- I & II (Compulsory)
Animal behavior and gamete biology

Max Marks

: 50

Scheme for Practical Examination

1. Exercise based on animal behavior
2. Exercise based on developmental biology
3. Practical record
4. Viva Voce
5. Collection

20
16
05
04
05

Total 50 Marks

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Devi Ahilya Vishwavidyalaya, Indore
M.Sc. IV sem Ichthyology practical examination scheme based on


paper III(a) and IV (a)

Zoology
Practical II (Special Paper)
Ichthyology (III & IV)

M: M 50

Time: 5 hour

1. Major dissection Nervous system of Walago, Mystus, Labeo, Torpedo.	10
2. Minor dissection of internal ear, accessory, respiratory, organ, pituitary glands, Weberian ossicles.	03
3. Mounting preparation of permanent slides.	03
4. Age determination of fish with the help of scales	03
5. Identification of fish	08
6. Spotting of museum specimen slides and bones.	08
7. Viva Voice.	05
8. Practical record, collection.	5+5 10
Total	50


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