SYLLABUS

M.Sc. ZOOLOGY (PREV.)

Paper I: BIOSYSTEMATICS AND TAXONOMY

3 Hours duration Max. Marks: 100 Periods: 80

Note: - In M.Sc. Zoology Examination the theory paper have the following pattern.
Question paper will have 5 (five) questions in all having equal marks.

i.) Question no. 1 will be compulsory and will have 20 very short answer questions of 1 mark each.
ii.) Question no. 2 and 3 will consists of only short answer type questions with 4 subdivisions of 5 marks each. There will be internal choice in these questions.
iii.) Question no. 4 and 5 will be long answer type questions with internal choice.

1. Definition and basic concepts of biosystematics.
1.1 History of taxonomy.
1.2 Importance and applications of biosystematics in biology.
1.3 Definition and understanding of various taxonomic categories.
1.4 Species concepts and species categories – subspecies and infra species.
2. Modern trends in biosystematics-
2.1 Chemotaxonomy
2.2 Cytotaxonomy
2.3 Molecular taxonomy
2.4 Neotaxonomy
2.5 Numerical taxonomy
3. Molecular perspective on the conservation of diversity
3.1 Diversity and ecosystem process: Theory, achievements and future directions.
4. Dimensions of speciation and taxonomic characters
4.1 Dimensions of speciation – Types of lineage changes; production of additional lineage.
4.2 Mechanism of speciation in panmictic and apotmictic species.
4.3 Species concept and species category. Different species concepts: subspecies and infra species.
4.4 Theories of biological classification; hierarchy of categories.
4.5 Taxonomic characters of different kinds. Origin of reproductive isolation and biological mechanism of genetic incompatibility.
5. Procedure keys in taxonomy.
5.1 Taxonomic procedures (collection, preservation, curetting and process of identification).
5.2 Taxonomic Keys: their kinds, merits and demerits.
5.3 Systematic Publications and different kinds of systematic Publications.
5.4 Process of typification, different zoological types.

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5.5 International Code of Zoological Nomenclature (ICZN) and its operative principles, interpretation and application of important rules and formation of scientific names of different taxa.

6. Evaluation of biodiversity indices

6.1 Shannon-Weinner index, dominance index.

6.2 Similarity and dissimilarity index.

6.3 Association index

Paper - II: STRUCTURE & FUNCTION OF INVERTEBRATES

3 Hours duration Max. Marks: 100 Periods: 80

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iii.) Question no. 4 and 5 will be long answer type questions with internal choice.

1. Organization of coelom:
   1.1 Acoelomate, Pseudocoelomate, Coelomate (Schizo and Enterocoelous)
   1.2 Fate of Blastopore: Protostome, Deuterostome
2. Locomotion:
   2.1 Flagella and ciliary movement in Protozoa.
   2.2 Hydrostatic movement in Coelenterata, Annelida and Echinodermata.
3. Nutrition and Digestion:
   3.1 Patterns of feeding and digestion in lower Metazoa.
   3.2 Filter feeding in Polycheata, Mollusca and Echinodermata.
4. Respiration:
   4.1 Organs of respiration: Gills, lungs and trachea.
   4.2 Respiratory pigments
   4.3 Mechanism of respiration
5. Excretion:
   5.1 Organs of excretion: Coelom, Coelomoducts, Nephridia and Malphigian tubules,
   5.2 Mechanisms of excretion.
   5.3 Excretion and osmoregulation
6. Nervous System:
   6.1 Primitive nervous system Coelenterata and Echinodermata.
   6.2 Advanced Nervous system Annelida, Arthropoda (Crustacea and insecta) and Mollusca (Cephalopoda)
   6.3 Trends in neural evolution.
7. Invertebrate larvae
   7.1 Laarval forms of free-living invertebrates
   7.2 Larval forms of parasites
   7.3 Strategies and evolutionary significance of larval forms

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8. Minor Phyla
   - 8.1 Concepts and significance (Mesozoa, Ctenophora, Rhyncoela,Protostomes, Deuterostomes)
   - 8.2 Organization and general characters

Paper III - MOLECULAR BIOLOGY & BIOTECHNOLOGY

3 Hours duration | Max. Marks: 100 | Periods: 80

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ii.) Question no. 2 and 3 will consists of only short answer type questions with 4 subdivisions of 5 marks each. There will be internal choice in these questions.

iii.) Question no. 4 and 5 will be long answer type questions with internal choice.

1. DNA replication
   - 1.1 Prokaryotic and eukaryotic DNA replication.
   - 1.2 Mechanics of DNA replication.
   - 1.3 Enzymes and accessory proteins involved in DNA replication.
2. Transcription
   - 2.1 Prokaryotic transcription.
   - 2.2 Eukaryotic transcription.
   - 2.3 RNA polymerases
   - 2.4 General and specific transcription factors
   - 2.5 Regulatory elements and mechanisms of transcription regulation.
   - 2.6 Transcription termination
   - 2.7 Transcriptional and post transcriptional gene splicing
3. Post-transcriptional modifications in RNA
   - 4.1 5'- Cap formation.
   - 4.2 End processing and polyadenylation.
   - 4.3 Splicing and editing.
   - 4.4 Nuclear export of mRNA.
   - 4.5 RNA stability.
4. Translation
   - 4.1 Genetic code
   - 4.2 Prokaryotic and eukaryotic translation
   - 4.3 Translation machinery
   - 4.4 Mechanism of initiation, elongation and termination
   - 4.5 Regulation of translation
   - 5.4 Co-and post-translation modifications of proteins
5. Recombination and repair
   - 5.1 Holiday junction.
   - 5.2 FLP/FRT and Cre-Lox recombination.
   - 5.3 Rec A and other recombinases.
   - 5.4 DNA repair mechanisms.

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6. Molecular mapping of genome
   6.1 Genetic and physical maps
   6.2 Physical mapping and map based cloning
   6.3 Southern and fluorescence, in *situ* hybridization for genome analysis.
   6.4 Molecular markers in genome analysis (RFLP, RAPD and AFLP)
   6.5 Application of RFLP in forensic, disease prognosis, genetic counseling and pedigree analysis. Animal tracking and poaching.
7. Transgenic animals and knock-outs
   8.1 Production
   8.2 Applications
   8.3 Embryonic stem cells
   8.4 Care and breeding of experimental animals including bioethics

9 Assisted reproduction technologies
   9.1 Embryo sexing and cloning.
   9.2 Screening for genetic disorders.
   9.3 ICSI, GIFT etc.
   9.4 Cloning of animals by nuclear transfer.

Paper-IV: GENERAL PHYSIOLOGY

3 Hours duration | Max. Marks: 100 | Periods: 80

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ii.) Question no. 2 and 3 will consists of only short answer type questions with 4 subdivisions of 5 marks each. There will be internal choice in these questions.
iii.) Question no. 4 and 5 will be long answer type questions with internal choice.

1. Thermoregulation and cold tolerance
   1.1 Basic principal of metabolism
   1.2 Heat balance and exchange
   1.3 Endotherms Vs Ectotherms
   1.4 Counter current heat exchanger
   1.5 Torpor, hibernation and aestivation
   1.6 Adaptation to very cold environments
2. Ionic and Osmic balance
   2.1 Osmoregulation Vs. osmoconfirming

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- 2.2 Osmoregulation in aquatic and terrestrial environments
- 2.3 Kidney function and diversity
- 2.4 Other osmoregulatory organs
- 2.5 Nitrogenous waste excretion

3. Gas exchange and acid base balance
   - 3.1 Oxygen and carbon dioxide transport in blood
   - 3.2 The role of hemoglobin
   - 3.3 Responses to altitude and hypoxia
   - 3.4 Swim bladder inflation in fish
   - 3.5 Regulation of body pH
   - 3.6 Gas transfer in air and water, gas exchange design and function
4. Muscle function and movement
   - 4.1 Anatomy of muscle
   - 4.2 Regulation of Contraction
   - 4.3 Excitation-contraction coupling
   - 4.4 Molecular theory of muscle contraction
5. Nervous system
   - 5.1 Anatomy of nervous system
   - 5.2 Neuron and membrane excitation
   - 5.3 Electrochemical potential
   - 5.4 Action potential
   - 5.5 Transmission between neurons
   - 5.6 Synapses and neurotransmitters
   - 5.7 Memory and learning
6. Sensory Transduction
   - 6.1 Sensing and environment
   - 6.2 Auditory receptors
   - 6.3 Chemoreceptors; Taste and smell, homing in salmon
   - 6.4 Mechanoreceptors: Tactile systems and escape responses
   - 6.5 Vision and photoreception
   - 6.6 Thermoreception and infrared detection: Prey detection in snakes.
   - 6.7 Echolocation in bats

7. Digestion and Metabolism
   - 7.1 Nutritional uptake and distribution
   - 7.2 Effects of starvation

8. Stress Biology
   - 8.1 Basic concepts of environmental stress and strain, concept of elastic and plastic strain, stress resistance, stress avoidance and stress tolerance.
   - 8.2 Adaptation, acclimation and acclimatization
   - 8.3 Concepts of homeostasis

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8.4 Physiological response to oxygen deficiency stress
8.5 Physiological response to body exercise
8.6 Meditation, yoga and their effects.

9. Endocrinology
9.1 Aims and scope of endocrinology
9.1.1 Discovery of hormones
9.1.2 Hormones as messengers
9.1.3 Classification of hormones
9.2 Phylogeny of endocrine glands (Pituitary, pancreas, adrenal, thyroid etc.)
9.3 Ontogeny of endocrine glands.
9.4 Neuroendocrine system and neurosecretion
9.5 General principles, structure and hormone action
9.6 Hormones, growth and development
9.7 Hormones and reproduction.

Paper- V: BIOCHEMISTRY

3 Hours duration Max. Marks: 100 Periods: 80

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iii.) Question no. 4 and 5 will be long answer type questions with internal choice.

1. Covalent properties of Proteins
1.1 Structure and chemistry of amino acids
1.2 Protein sequencing
1.3. Peptide synthesis
1.4 Covalent modifications
1.5 Protein size and composition
1.6 Protein splicing
2. Proteins:
2.1 Secondary and tertiary structures
2.2 Globular and fibrous proteins.
2.3 Protein folding and thermodynamics

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2.4 Folding Overview: the Levinthal paradox
2.5 Ramchandaran plots and amino acid propensities
2.6 Chaperion-assisted protein folding
2.7 Amino acid sequence variation and protein misfolding diseases

3. Allostery (Hemoglobin), Myoglobin structure and oxygen binding
3.1 Hemoglobin subunits cooperatively, the Hill coefficient.
3.2 Quaternary structure changes and Sickle cell and other molecular diseases

4. Carbohydrates: Structure and biological importance of -
4.1 Monosaccharide,
4.2 Oligosaccharides
4.3 Polysaccharides (Storage and structural polysaccharides, glycosaminoglycans)
4.4 Glycoconjugates (glycoprotein and proteoglycans)

5. Fats:
5.1 Fatty acids: structure, nomenclature, acyl glycerols, phospholipids, sphingolipids, glycolipids, lipoproteins
5.2 Terpenoids and sterols: structure, properties and function
5.3 Function of lipids
5.4 Signal transducing molecules

6. Vitamins
6.1 Classification, structure, occurrence and functions of fat soluble vitamins
6.2 Classification, structure, occurrence and biological functions water soluble vitamins
6.3 Phenolics and alkaloids: structure, biological properties and functions

7. Nucleic acid structure
5.1 Nucleotides, Primary structure of nucleic acid
5.2 Secondary and tertiary structures of nucleic acids
5.2 Duplex stability
5.3 Hybridization
5.4 RNA structure, hairpin and pseudoknot structures, t-RNA
5.5 DNA and RNA helical geometrics (A-Z), bending, triplexes, quadruplexes.

8. Enzyme mechanisms
8.1 Principles of enzyme catalysis
8.2 Proteases and polymerases
8.3 Coenzymes and Cofactor
8.4 Chemistry and structure of ribozymes

9. Inborn errors of metabolism

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Paper-VI: BIOSTATISTICS AND POPULATION GENETICS

3 Hours duration Max. Marks: 100 Periods: 80

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iii.) Question no. 4 and 5 will be long answer type questions with internal choice.

Biostatistics:

1. Principles and practice of statistical methods
   - 1.1 Scope & Applications of biostatistics
   - 1.2 Collection, organization and representation of data
   - 1.3 Basic statistics- mean, median and mode.
   - 1.4 Statistics of dispersion, coefficient of variation.
   - 1.5 Standard errors; Confidence limits.
   - 1.6 Probability distributions(binomial, Poisson and normal)
   - 1.7 Tests of statistical Significance
   - 1.8 Simple correlation and regression
   - 1.9 Analysis of Variance

Population Genetics:

2. Concepts of evolution and theories of organic evolution (Lamarckism, Darwinism, Mendelism)
3. Neo- Darwinism
   - 3.1 Hardy-Weinberg law of genetic equilibrium
   - 3.2 Detailed account of destabilizing forces- Natural selection, Mutation, Genetic drift, Migration, Meiotic drive
   - 3.3 Genetic structure of natural populations
   - 3.4 Phenotypic variations / plasticity
   - 3.5 Models explaining changes in genetic structure of population
4. Molecular population genetics
   - 4.1 Gene duplication and divergence
   - 4.2 Patterns of change in nucleotide and amino acid sequences
   - 4.3 Emergence of Non Darwinism- Neutral hypothesis
5. Genetics of Quantitative traits in populations
   - 5.1 Analysis of quantitative traits
   - 5.2 Quantitative traits and natural selection

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5.3 Estimation or heritability
5.4 Genotype-environment interactions
5.5 Molecular analysis of quantitative traits
5.6 Inbreeding depression and heterosis

6. Genetics of speciation
   6.1 Phylogenetic and biological and other concepts of species
   6.2 Patterns and mechanisms of reproductive isolation
   6.3 Models of speciation (Allopatric, sympatric, parapatric)

7. Molecular Evolution
   7.1 Gene Evolution
   7.2 Evolution of gene families, Molecular drive
   7.3 Micro- and Macro-evolution

8. Molecular Phylogenetics
   8.1 How to construct phylogenetic trees
   8.2 Phylogenetic inference-distance methods, parsimony methods, maximum likelihood Method
   8.3 Immunological techniques
   8.4 Amino acid sequence and phylogeny
   8.5 Molecular Clocks.

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BIOSYSTEMATICS AND TAXONOMY

SUGGESTED BOOKS

- Biodiversity, E.O. Wilson, academic Press; Washington.
- Principle of Animal Taxonomy; G.G. Simpson. Oxford IBH Publishing Company.
- Elements of Taxonomy. E. Mayer.
- The diversity of life (The College Edition), E.O.Wilson. W.W. Northern & co.
- Theory and Practice of Animal Taxonomy. V.C. Kapoor. Oxford & IBH Publishing Co. Pvt. LTD.
- Advancement in Invertebrate Taxonomy and Biodiversity. Rajeev Gupta. Agrobios International.

STRUCTURE & FUNCTION OF INVERTEBRATES

SUGGESTED BOOKS

- Invertebrate Zoology Author: R. S. K. Barnes3.The invertebrates. Vol.1. Protozoa through Ctenophora, Hyman, L.H. McGraw Hill Co., New York.,
- The Invertebrates. Vol.2. Hyman, L.H. McGraw Hill Co., New York
- The Invertebrates smaller coelomate groups, Vol.5. Hyman, L.H. McGraw Hill Co., New York. 17
- The Invertebrates. Vol.8. Hyman, L.H. McGraw Hill Co., New York. and London
- Invertebrate structure and function. Barrington, E.J.W. Thomas Nelson and Sons Ltd. London
- Invertebrates Richard C. Brusca , Gary J. Brusca and Nancy J. Haver
- A Biology of higher invertebrates, Russel-Hunter, WD. McMillan Co. Ltd., London
- Student Text Book of Zoology. Vol.I.II and III. Sedgwick.A. Central Book Depot, Allahabad.
- Text book of Zoology. Parker, T.J., Haswell. W.A.Macmillan Co., London.
- Biology of the Invertebrates by Jan A. Pechenik
- Invertebrate Zoology Lab Manual Robert L. Wallace , Walter K. Taylor
- The Invertebrates: A Synthesis - R. S. K. Barnes Peter P. Calow P. J. W. Olive D. W. Golding J. I. Spicer

BIOCHEMISTRY

SUGGESTED BOOKS

- Biochemistry by Albert's R.H. Frey P.A. and Jencks W.P. Jones, & Bartlett Publisher, Boston/London. 1992
- Lehninger Principles of biochemistry by Nelson D.L. and Cox M.M. Macmillan/Worth Publishers. 2000
- Stryker L. Biochemistry. W.H.Freeman and Co. New York, 2001
- Fundamentals of Biochemistry by Voet D. Voet J.G. and Pratt C.W.. Johan Wiley and sons Inc. New York, 1999
- Principles and Techniques of Practical Biochemistry by Wilson K. and Walker J. Cambridge University Press, Cambridge, 1994
- Principles of Biochemistry by Zubay G.L.Parson W.W and Vence D.E. Wm.C.Brown Publishers, Oxford, England, 1995
- Harper's biochemistry by Murray, Granner, Mays Rodwell, McGraw Hill Publication, 2000

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Biochemistry by Mathew,C.K.,Van Holde,K.E.,Ahren,K.G. Pearson education Pvt.Ltd.,Delhi,India,2003

• Principles of Biochemistry by Horton,H.R., Morsan, L.A., Scrimgeour,K.G.,Perry,M.D,Rawn,J.D., Pearson Educations,International,2006.

• Biochemistry (The Molecular basis of Life)by McKee,T.,McKee,J.R. Mc Grew Hill Companying.

• Biochemistry and molecular Biology by Elliott,W.H. ,Elliott,D.C.Oxford University Press,Oxford,2003.

• Lippincott's Illustrated Review by Champe,P.C.,Harvey,R.A. Lippincott Williams & Wilkins,Philadelphia

BIOSTATISTICS AND BIOINFORMATICS

RECOMMENDED BOOKS

• Sokal, R. R. and Rolf F. J. Biometry : Freeman, San Francisco, US
• Snedecor, H. W. and Cochran, W. G. Statistical Methods. Affliated East-West Press, New Delhi.
• Green R.H.Sampling Design and Statistical methods for Environmental Biologist, John Wiley & Sons, New York
• Attwood, T.K. and Parry Smith, D. J. (2006) Introduction to Bioinformatics. P 240, Pearson Education, Singapore
• Bourne, P. E and Weissig, H. (Eds.) (2003) Structural Bioinformatics. P.649, Wiley –Liss, New Jersey, USA.
• Lesk, A. M. (2005) Introduction to Bioinformatics. 2nd ed., Oxford Press.
• Krane, D. E and Raymer, M. L. (2006)
• Fundamental concepts of Bioinformatics. P.314,Pearson Education, Singapore
• Mount, D. W. (2001)Bioinformatics: Sequence and Genome Analysis, P. 564, Cold Spring Harbor Laboratory Press, New York, USA.
• Tisdall, J. D. (2001)Beginning Perl for Bioinformatics. p. 368, O'relly, California, USA.
• David W. Mount, Bioinformatics: Sequence and Genome Analysis, Second Edition.
• Jae K. LeeStatistical Bioinformatics: A Guide for Life and Biomedical Science Researchers.
• Allan Bluman **Elementary Statistics: A Brief Version** (5th Edition

EVOLUTION AND POPULATION GENETICS

SUGGESTED BOOKS

• Genetics and Origin of Species. Dohnzhansky, Th., F.J.Alaya, G.L.Stebbines and J.M. Valentine, Surjeet Publication, Delhi

• Evolutionary Biology, Futuyamma, D.J.Suinuaner Associates, INC Publishers, Sunderland.

• A Primer of Population Genetics. Hart, D.L. Suinuaer Associate, Inc, Massachusetts.

• Genes and Evolution. Jha A.P. John Publication, New Delhi

• Species Evolution- The role of chromosomal change. King, M. Cambridge University Press, Cambridge.

• Evolution and Genetics Merral, D.J.Holt, Rinchart and Winston, Inc.

• Evolutionary Genetics. Smith,J.M. Oxford University Press, New York.

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• Evolution. Strickberger, M.W.Jones and Barlett Publishers, Boston London

• Evolution and population genetics, Rashmi Sisodia, Paragon, International Publishers.

• Encyclopedia of Evolution Vol I and Vol II- By Mark Pagel, Oxford University Press

PHYSIOLOGY

SUGGESTED BOOKS

• Eckert Animal Physiology Mechanisms and Adaptation. R. Eckert (ed), 5th edition, W.H. Freeman and Company, New York.

• Biochemical Adaptation. P.W. Hochachka and G.N. Somero (eds), Priceton Univ. Press, Princeton, New Jersey.

• General and Comparative Animal Physiology, W.S. Hoar (ed), Prentice Hall of Indian.

• Animal Physiology: Adaptation and Environment, K.S. Schiemdt Neilsen (ed), University Press, Cambridge, UK.

• A regulatory Systems Approach. Strand, F.L. Physiology: Macmillan Publishing Co., New York.

• Practical Biochemistry, L. Lummer (ed), Tata McGraw Hill

• Environmental and Metabolic Animal Physiology, C.L. Prosser (ed), Wiley-Liss Inc., New York.

• Environmental Physiology, P.Willmer, G. Stone, and I. Johnson (eds), Blackwell Publishing, Oxford, UK.

• Adaptation to Environment: Essays on the Physiology of Marine Animals. R.C. Newell (ed), 1976. Butterworths, London, UK.

• Physiological Ecology: An evolutionally approach to resource use. Townsend, C.R. and P. Cawlow. Blackwell Sci. Inc. Pub., Oxford, UK.

• Optima for Animals. R.M. Alexander (ed), Princeton Univ. Press. Princeton, New Jersey.

• Comparative Physiology: Life in water or land. P. Dejours, L. Bolis, C.R. Taylor and E.R. Weibel (eds), Liviana Press, Padova, Italy.

• Animals and Temperature: Phenotypic and Evolutionary Adaptation. I.A. Johnson & A.F. Bennett (eds), Cambridge Univ. Press, Cambridge, UK.

• Physiological Animal Ecology. G.N. Louw, Longman Publishing Group, Harloss, UK.

• An Introduction to General and Comparative Endocrinology, E.J.W. Barrington (ed), Clarendon Press, Oxford.

• Comparative Vertebrate Endocrinology. P.J. Bentley (ed), Cambridge University Press.

• Text Book of Endocrinology, R.H. Williams (ed), W.B. Saunders, Company, Philadelphia.

• Endocrine Physiology. C.R. Martin (ed), Oxford Univ. Press, New York.

• Comparative Endocrinology, A. Gorbman et al., John Wiley & Sons.

MOLECULAR BIOLOGY & BIOTECHNOLOGY

SUGGESTED BOOKS

प्रभारी अधिकारी
परीक्षा-शाखा

• Molecular Biology of the Gene. I.D Watson, N.H. Hopkins, J.W. Roberts, J.A. Steiz and AM Weiner The Benjamin/Cummings Pub. Co., Inc., California.
• Molecular Cell Biology, J. Darnell H.Lodish and D. Baltimore Scientific American Books, Inc., USA.
• Molecular Biology of the cell. B.Alberts, D.D.Bray, J.Lewis, M.Rafif, K. Roberts and J.D.Watson. Garland Publishing inc., New York.
• Gene IV, Benjamin Lewin. Oxford University Press, UK.
• Molecular Biology and Biotechnology. A comprehensive desk reference, R.A.Meyers (Ed.), VCH Publishers, Inc., New York.
• Molecular Cloning: A Laboratory Manual, J.Sambrook, E.F.Fristsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York.
• Introduction to Practical Molecular Biology, P.D.Dabre, John Wiley& Sons Ltd. New York.
• Molecular Biology Lab Fax, T.A.Brown (Ed.), Bios Scientific Publishers Ltd., Oxford

ECONOMIC ZOOLOGY

RECOMMENDED BOOKS:

• Economic Zoology by G.S Shukla & V.B. Upadhyay, 1991-92 Rastogi Publications, Meerut, India.

• Fish& Fisheries by Kamaleshwar Pandey & J.P Shukla 2007. Rastogi Publications, Meerut, India.

• Fish & Fisheries of India by V.G. Jhingran 1982, Hindustan Pub, Corp. India.

• A hand book on Economic Zoology by Jawid Ahsan and Subhas Prasad Sinha, S. Chand & company Ltd. Ramnagar

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M.Sc. (Previous) Zoology

PRACTICAL EXERCISES -2017)

I. **Anatomy:**

a. Major:

1. **Leech:** Reproductive, excretory, nervous and haemocoelomic systems.
2. **Crab:** Nervous system.
3. **Scorpion:** Nervous and reproductive systems.
4. **Mollusca:** General anatomy of Aplysia and Nervous systems of Patella, *Lamellidens*, *Mytilus*, *Sepia* and *Aplysia*.

b. Minor:

5. C. S. of arm of Starfish.
6. General anatomy of Holothurians.
7. Aristotle's lantern of Sea urchin and disarticulated parts of Aristotle's lantern.

II. **Museum Specimens:** Identification, classification and distinguishing features of important representatives from various groups (Protozoa to Hemichordata).

III. **Study of Permanent Preparations** (Protozoa to Hemichordata):

Amoeba, *Entamoeba*, *Polystomella*, *Actinophrys*, *Euglena*, *Noctiluca*, *Volvox colony*, *Trypanosoma*, *Giardia*, *Opalina*, *Nyctotherus*, *Balantidium*, *Vorticella*, *Monocystis*, *Plasmodium*, *Sycon* T. S. and L.S., Gemmule, Obelia colony, Obelia medusa, Aurelia tentaculocytes, T. S. *Fasciola hepatica* sections through various regions of the body, *Hirundinaria* body sections through various regions, *Daphnia*, *Cypris*, *Cyclops*, T. S. Peripatus.

Larva: Aurelia-planula, Redia, Cercaria, Meta-cercaria, Onchosphere, Cysticercus, Trochophore, Nauplius, Zoea, Mysis, Phyllosoma, Veliger, Glochidium, Bipinnaria, Ophiopluteus, Echinopluteus, Auricularia, Tornaria.

IV. **Biological Chemistry:**

(i) Identification of protein, carbohydrate and lipid in various tissues/body fluids/food material.

(ii) Identification of different kinds of mono-, di- and poly-saccharides in biological and chemical materials.

(iii) Verification of Beer-Lambert's Law.

(iv) Quantitative estimation of the following in various tissues:

a) Carbohydrates: Glycogen, glucose.
b) Proteins: Total proteins.
c) Lipids: Phospholipids and cholesterol.
d) Nucleic acid: DNA and RNA.
e) Enzymes: Acid and alkaline phosphatases.

V. **Physiology:**

(i) Study of the following with the help of Computer Assisted Learning (CAL) (please see E-pharm programme).

A. The effect of K^+, Ca^{++}, acetylcholine and epinephrine on the isolated heart of frog and conclude your data with the graphic representation Computer Assisted Learning (CAL) be included.

B. The effect of various doses of acetylcholine and Nor-ephinephrine on blood pressure, heart rate and respiratory rate of the rabbit.

C. The effects of Atropine Epinephrine, Ephedrine and Eserine on Rabbit's eyes. Other such exercises can be framed from the E-Pharm software.

(ii) Determination of blood pressure, pulse rate, heart beat and respiration rate.

(iii) Photometric determination of hemoglobin in blood sample.

(iv) Determine of MCV, MCH, MCHC and colour index of the given sample of blood.

(v) Demonstration of the following in blood: Clotting time, erythrocyte sedimentation rate, haemolysis and crenation.

(vi) Determination of the urea in urine/blood.

(vii) Determination of the glucose in urine.

(viii) Study of digestive enzymes in different parts of the alimentary canal.

VI. **Cell & Molecular Biology & Biotechnology:**

(i) Squash and smear preparations of testis of cockroach and grasshopper, aceto-orecin, Feulgen and Giemsa staining of these preparations.

(ii) Study of mitosis in onion root tip.

(iii) Study of giant chromosomes in the salivary gland of *Chironomus* or *Drosophila* larva.

(iv) Vital and supravital staining (with neutral red and Janus Green B) of cells of the testis of any insect or mammal to study the mitochondria.

(v) Chromosome counts in cells of the testis of an insect or mammal or cells of the bone marrow of a mammal.

(vi) Study of prepared microscopic slides, including those showing various cell types, mitosis, meiosis and giant chromosomes.

(vii) Paper chromatography: Unidimensional chromatography, using amino acids from purified samples and biological materials.

(viii) Electrophoresis: Paper/Horizontal / Vertical – Proteins/DNA/ RNA.

VII. **Genetics:**

(i) Culture of Drosophila and study of its life cycle.

(ii) Identification of male and female *Drosophila*.

(iii) Identification of wild and mutant forms of *Drosophila*.

(iv) Monohybrid and dihybrid inheritance in *Drosophila*.

(v) Simple problems based on Mendelism.

(vi) Identifications of blood groups in humans.

(vii) Demonstration of sex chromatin (Barr bodies).

VIII. **Statistical Methods in Biology:**

(i) Preparation of frequency tables and graphs/line diagrams/bar diagrams/histogram/Pie charts.

(ii) Calculation of standard deviation, variance and standard error of mean.

(iii) Calculation of probability and significance between means using t-test and Chi-square test.

(iv) Plotting the slope of a line on a graph; calculations of the slope of a line, coefficient correlation and regression.

(v) Exercise based on population genetics.

OBSERVATIONAL AND FIELD STUDIES

There are unlimited amounts of alternative practicals that can be carried out using observational and other works in the field. Field work also may be encouraged for the students to recognize their social and environmental responsibility. Non-invasive and non-

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harmful practical exercises for the study of Anatomy, Physiology, Ethology, Epidemiology and Ecology may be designed.

M.Sc. (Previous) Zoology

PRACTICALS

Scheme of Practical Examination

Total Marks-200 — Total Duration: 2 days (5 hrs. per day)

I Day (I, II & III Papers) — Time: 5 hrs.

Max Marks: 100		Marks
1.	Anatomy	
	a. Major	6
	b. Minor	4
2.	Biodiversity Study	12
3.	Spotting No. 1 – 8	24
4.	Cell & Molecular Biology & Biotechnology	12+12
5.	Practical Record	10
6.	Viva-voce	10
7.	Seminar	10
		Total = 100

II Day (IV, V & VI Papers) — Time-5 hrs.

Max Marks: 100		Marks
1.	Gen. Physiology	20
2.	Biochemistry	20
3.	Quantitative Biology & Population Genetics	15
4.	Spotting (1 to 5)	15
5.	Practical Record	10
6.	Viva-voce	10
7.	Seminar	10
		Total = 100

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Notes:

1. With reference to anatomy and study of museum specimens, candidates must be well versed in the study of various systems with the help of charts/models/CD-ROMs, multimedia computer based simulations including computer assisted learning (CAL) and other softwares.
2. With reference to permanent preparations and microscopic slides, the exercise may be substituted with diagrams/ photographs/ models/ charts etc.
3. Candidates must keep a record of all work done in the practical class and submit the same for inspection at the time of the practical examination.
4. The candidates may be asked to write detailed methodology wherever necessary and separate marks may be allocated for the same.
5. Mounting material for permanent preparations would be as per the syllabus or as available through collection and culture methods.
6. It should be ensured that animals used in the practical exercise are not covered under the Wildlife Act 1972 and amendments made subsequently.

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