

MAHARAJA GANGA SINGH UNIVERSITY, BIKANER

**SCHEME OF EXAMINATION AND
COURSES OF STUDY**

SYLLABUS

FACULTY OF SCIENCE

M.SC.

ZOOLOGY



M.Sc. Previous Examination - 2021

M.Sc. Final Examination – 2022

© M.G.S. UNIVERSITY, BIKANER

M.Sc. ZOOLOGY

M.Sc.Previous

Paper I – Taxonomy, Phylogeny, Structure and Function in Invertebrates

Paper II – Biological Chemistry, Immunology and Physiology

Paper III- Molecular Biology, Cytogenetics and techniques in Biology

Paper IV- Evolution, Statistical Methods and Computer Application in Biology

Practical- Based on Paper I to IV in two days

PAPER I: TAXONOMY, PHYLOGENY, STRUCTURE AND FUNCTION IN INVERTEBRATES

3 hours duration

Max marks 75

NOTE: The question paper shall be divided into three sections: Section A (20 marks) shall comprise of 10 compulsory questions of 2 marks each and not more than two questions from each Unit (Answer in not more than 50 words). Section B (25 marks) shall comprise of two questions from each unit and candidate has to attempt five questions selecting one from each Unit, 5 marks for each question (Answer in not more than 200 words) and Section C (30 marks) shall comprise of five questions with not more than one question from each Unit and candidate has to answer any three, 10 marks for each question (Answer in not more than 500 words).

UNIT-I

1. A study of the classification of Invertebrates with distinguishing features and examples of various subdivisions.
2. Introduction to the science of taxonomy, rules of nomenclature.
3. Principles of classification: Theories of biological classification and their history; the species category; the polytypic species; population systematics; intraspecific categories.
4. Methods of classification: taxonomic collection and the processes of identification, taxonomic characters: types of variations (qualitative and quantitative) within a single population, methods of arriving at taxonomic divisions on species level; preparation and use of taxonomic keys.
5. Cytotaxonomy: Importance of cytology and genetics in taxonomy,

UNIT-II

1. Criteria for phylogenetic interrelationship between Invertebrate phyla
2. Origin of Multicellularity(Protozoa, parazoa and metazoan)
3. Origin of radiata (Coelenterata and Ctenophora)
4. Origin of Bilateria from radiata(Importance of Planula larva and Ctenophores)
5. Phylogenetic significance of Rhynchocoela
6. Interrelationship of the Pseudocoelomate groups with special reference to Rotifera, Gastrotricha, Kinorhynca, nematomorpha and Entoprocta.
7. Affinities and evolutionary significance of the unsegmented lesser protostome phyla(Priapulida, Echiuroidea and Sipunculoidea. Echiurida and Sipunculida).
8. Phylogenetic relationship between the coelomate phyla(Annelida, Onychophora, Arthropoda and Mollusca).
9. Affinities and evolutionary significance of the Lophophorate coelomate phyla (Brachiopoda, Phoronida and Ectoprocta).
10. Affinities of the invertebrate deuterostome phyla(Chaetognatha, Echinodermata, Pogonophora and Hemichordata)

UNIT-III

1. Locomotion in Invertebrate

(a) Amoeboid movements: Ultrastructure of cilia and flagella: Ciliary and flagellar movements; molecular and physiological mechanisms involved in the three kinds of movements

(b) Myotomes and muscle fibers in invertebrate structure and their involvement in locomotory action.

© Locomotion in relation to hydrostatics. Coelome, metamerism, arthropodization

(d) An outline of flight mechanism in insects.

2. Filter feeding in higher invertebrates; Feeding mechanisms in insects and echinoderms.

3. Respiration

(a) Respiration in lower invertebrates(Protozoans to Helminthes)

(b) respiration In higher invertebrates(Trachea, Gills, Lungs and Lophophores)

(c) Physiology of respiratory pigments in invertebrates

4. Excretion: Study of structural and functional organization of excretory systems in various invertebrate groups and a survey of various excretory products met within them.

5. Osmoregulation and ionic regulation: Survey of principal mechanisms in fresh water, marine and terrestrial invertebrate forms.

UNIT-IV

1. Structural and functional organization of nervous systems and receptor

(a) Plan of nervous systems in the Coelenterates, Platyhelminthes, Annelida, Arthropoda, Mollusca and Echinodermata. Structural and functional complexities of brain and ganglionic structures.

(b) Receptors: Structural and functional organization of the mechanoreceptors, chemoreceptors and photoreceptors.

2. Endocrine system: A survey of endocrinal structures and their hormones role of neurosecretions and hormones in developmental events of insects and crustaceans.

3. Reproduction

Asexual and sexual reproduction met within different invertebrate groups, Parthenogenesis. Larval forms met within different invertebrate group and their significance

UNIT-V

Parasitism: general consideration, Types of parasites, type of hosts, symbiosis and commensalism.

Protozoan parasites: Distribution, habit and habitat, structure life cycle and disease caused by selected pathogenic protozoan parasites of man. *Entamoeba histolytica*, *Trypanosoma gambiense*, *Leishmania donovani* and *Plasmodium vivax*.

Helminthes parasites: General characters, organization and larval forms of Platyhelminthes and nemathelminthes.

Distribution, habit and habitat, structure and life cycle of economically important helminth parasites of man and domesticated animals: *Echinococcus granulosus*, *Hymenolapsis nana*, *Schistosoma haematobium*, *Paragonimus westermani* and *Trichinella spiralis*.

Arthropod parasites of public health importance: Biology, disease transmitted, caused, prevention and control of bedbug, fleas, lice

Suggested reading material

- Avise, J.C. Molecular markers. Natural History and Evolution. Chapman and Hall. New York.
- Barnes, R.D. Invertebrate Zoology, W. B. Saunders Co. Philadelphia.
- Barrington, E.J.W. Invertebrate Structure and Function. Thomas Nelson and Sons Ltd. London.
- Hyman, L. H. The Invertebrates smaller coelomate groups Vol V. Mc Graw Hill Co. NewYork.
- Hyman L.H. The Invertebrates Vol.2. McGraw Hill Co. NewYork
- Hyman, L.H. The Invertebrate Vol.8. McGraw Hill Co. NewYork and London.
- Hyman, L.H. The Invertebrates Vol.I. Protozoa through Ctenophora. McGraw Hill Co. NewYork.
- Jagerstein, G. Evolution of Metazoa life cycle, Academic Press, Newyork and London
- Kato, M. The Biology of Biodiversity, Springer
- Mayer,E. Elements of taxonomy
- ParkerT.J. and Haswell, W.A. Text book of Zoology. Macmillan and Co. London.
- Read, C.P. Animal Parasitism. Prentice Hall Inc.NewJersy
- Russel Huntler,W.D. A biology of higher invertebrate. The Macmillan Co. Ltd.
- Sedgwick, A.A. Students text book of Zoology Vol I,II,II. Central Book depot. Allahabad.
- Simpson G.G. Principals of Animal taxonomy. Oxford IBH Publishing Company.
- Tikadar,B.K. Threatened Animals of India.ZSI Publication. Calcutta
- Wilson,E.O.Biodiversity. Academic Press. Washington
- Wilson, E.O. The diversity of life. W.W. Northem and Co.
- Meglitsch, Schram. Invertebrate Zoology. Oxford
- Kotpal, R.L. Invertebrate phylum series(Protozoa to Echinodermata)Rastogi publication.
- Chaterjee: Parasitology
- Chandler and Read, Introduction to Parasitology
- Noble and Noble: Parasitology
- Smith: Animal parasitology

PAPER II: BIOLOGICAL CHEMISTRY, IMMUNOLOGY AND PHYSIOLOGY

3 hours duration

Max marks 75

NOTE: The question paper shall be divided into three sections: Section A (20 marks) shall comprise of 10 compulsory questions of 2 marks each and not more than two questions from each Unit (Answer in not more than 50 words). Section B (25 marks) shall comprise of two questions from each unit and candidate has to attempt five questions selecting one from each Unit, 5 marks for each question (Answer in not more than 200 words) and Section C (30 marks) shall comprise of five questions with not more than one question from each Unit and candidate has to answer any three, 10 marks for each question (Answer in not more than 500 words).

UNIT-I

- 1. Chemistry of Carbohydrates:** definition, general properties, classification (Monosaccharides, Disaccharides, Polysaccharides) Sugar derivatives; Metabolism of carbohydrates
- 2. Chemistry of Lipids:** definition, general properties and classification, fatty acids: Simple and compound lipid, Steroids, metabolism of lipids, Biomedical importance of lipids.
- 3. Chemistry of proteins and Amino acids:** definition, general properties of amino acids and proteins, Metabolism of proteins, Biomedical importance of proteins and Vitamins
- 4. Chemistry of Nucleic Acids:** Definition, general properties, classification and importance of Nucleic acids.
- 5. Enzymes:** Chemistry of enzymes, Nomenclature, specificity and metabolism of enzymes, Competition and noncompetitive inhibition, Allosteric inhibition.
- 6. Inborn errors of metabolism**

UNIT-II

Introduction and historical background of immunology, Antigens, Antibody, antibody structure and diversity, MHC, mechanism of immune response. HLA class I, II, III molecules, Humeral and cell mediated immunity, Hypersensitivity reaction: type I, II, III and IV. Primary and secondary immune deficiency disease, CID, AIDS, vaccination/Immunization. Active and passive immunization, novel approach for various vaccines, process of vaccination, prokaryote parasite (Viral and bacterial). Eukaryotic parasite (Fungal, protozoa, trematodes, cestodes, nematodes and arthropod disease).

UNIT-III

Physiology of Digestion, respiration and Circulation

Mechanism of secretion and action of all types of digestive juices met within the mammalian digestive pathway, Physiological mechanisms involved in the absorption of the end products of digestion, digestive glands and process of digestion, digestive disorders.

Chemistry of respiration with particular reference to mammals, respiratory path, respirator pigments, ventilation, modified forms of respiration, respiratory disorders.

Blood, Physiology of blood clotting, heart, transport mechanism, nervous regulation of heart function in man, conductile and contractile mechanism of heart, cardiac cycle in man, ECG, regulatory mechanism of heart, circulatory disorders(hypertension, Hypotension, Anaemia, Myocardial infarction etc.)

UNIT-IV

Physiology of Excretion, Muscle tissue and Nervous tissue.

Various nitrogenous waste products, Kidney, Architecture of nephron, role of kidney in osmoregulation, mechanism and regulation of urine formation, disorders of excretion.

Morphology and functional architecture of the contractile apparatus in muscle tissue; Study of the biophysical and biochemical events underling contraction and relaxation process. Muscular disorders.

Biochemistry and molecular physiology of genesis, conduction of nerve impulse and transmission across synaptic junctions, neurotransmitters, reflex action.

UNIT-V

1. Physiology of the receptor system: general mechanism involved in stimulus transduction at receptor sites: Functional architecture and stimulus processing in eye, ear and olfactory epithelium.

2. **Endocrine physiology:** Cellular mechanisms of hormone action in target tissues (Hormone receptors, membrane receptors, nuclear receptors, G protein), Hypothalamic control of pituitary activity and phenomenon of neurosecretion; genesis types and general functions of hormones of various endocrine glands (Hypophysis, adrenal, thyroid, parathyroid, testis, and ovary, Islets of Langerhans).

3. **Reproduction:** Endocrinological control of the testicular, ovarian and uterine functions, physiological aspects of implantation and parturition and lactation. Reproductive abnormalities (Gonorrhoea, Syphilis, genital herpes, prostrate problems, vaginitis, Uterine tumors, menstrual complications).

Suggested reading material

- Alberts et al. molecular Biology of the cell, Garland
- Barrington, EJW. General and comparative endocrinology. Oxford Clarendon Press.
- Bentley, P.J. Comparative Animal endocrinology, CUP.
- Gorbman et al. Comparative endocrinology. John Wiley and sons.
- Hadley, Endocrinology, Prentice Hall
- Hoar' general and comparative physiology, Prentice hall
- Lodish et al. Molecular cell Biology, Freeman
- Martin, C.R. Endocrine physiology, OUP.
- Nielson, S. Animal physiology, CUP
- Prosser and Brown. Comparative animal physiology. Satish book enterprises.
- Williams, R.H. text book of endocrinology. WB Saunders.
- Gyton, s Human physiology
- Ganongs. Review of medical physiology. Lange medical
- Vander shermann, Human Physiology. McGraw Hill
- Chatterjee, C.C. Human Physiology, Vol. I and II.
- Mathews et al. Biochemistry. Pearson education.
- Jain, J.L. Biochemistry. S, chand. New Delhi
- Voet and Voet. Biochemistry, Wiley eastern
- Lehninger, Biochemistry. CBS
- Rama Rao. A text book of biochemistry. UBSPD.
- Armstrong, F.B. biochemistry. Oxford.
- Soni, K.C. Animal physiology, CBC. Jaipur
- Stryer, L. Biochemistry. Freeman
- Marieb. Human anatomy and physiology, Pearson education.
- Sembulungam. K. Medical physiology, Jaypee.

PAPER III: MOLECULAR BIOLOGY, CYTOGENETICS AND TECHNIQUES

3 hours duration

Max marks 75

NOTE: The question paper shall be divided into three sections: Section A (20 marks) shall comprise of 10 compulsory questions of 2 marks each and not more than two questions from each Unit (Answer in not more than 50 words). Section B (25 marks) shall comprise of two questions from each unit and candidate has to attempt five

questions selecting one from each Unit, 5 marks for each question (Answer in not more than 200 words) and Section C (30 marks) shall comprise of five questions with not more than one question from each Unit and candidate has to answer any three, 10 marks for each question (Answer in not more than 500 words).

UNIT-I

- 1. History and Scope of Molecular Biology**
- 2. Detailed structure of DNA and RNA, B-DNA, Z-DNA, Topological structure of DNA, t-RNA, micro RNA**
- 3. DNA Replication:** Process and difference between Prokaryotic and Eukaryotic DNA replication. DNA and RNA polymerase, Structure and function. Accessory proteins involved in DNA replication, regulation of replication.
- 4. Protein Synthesis:** Mechanism of transcription in prokaryote and Eukaryotes. Role of sigma and Rho factor in transcription, Split gene, processing of Hn-RNA (capping, tailing and splicing) Translation (Initiation complex, elongation and termination) Post and cotranslational modification
- 5. Gene regulation in prokaryote and Eukaryote-** Lac operon, tryo operon of E.Coli, Enhancer and silencer, Non coding gene.

UNIT-II

- 1. Molecular recombination and repair of DNA-** Holliday junction, rec A and other recombinase, Mobile genetic element (transposon). Integrons, retroposons, DNA repair (direct repair, nucleotide excision repair NER, base excision repair BER, Mismatch repair MMR).
- 2. Cell cycle.** Cancer and Apoptosis (cell death), mitosis promoting factors MPF, Anaphase promoting factors APF, CDKs and cyclins, p53, onchogenes (SIS and RAS), tumour suppressor gene (TS)
- 3. Genetic engineering recombinant technology,** restriction endonuclease, gene transfer techniques, Transgenic organism, genetic engineering and its application, gene therapy, cloning of animals.
- 4. mapping and identifying a disease gene,** genetic mapping of locus (DNA markers-RFLP, microsatellite, SNP), genetic mapping of complex trait.

UNIT-III

- 1. Human karyotype-** Banding techniques, Human genome, Human chromosome and genetic map, chromosomal mapping, human pedigree analysis)
- 2. Somatic cell genetics-** cell fusion, heterokaryon
- 3. Imprinting of genes**
- 4. Molecular cytogenetics-** FISH, GISH, DNA finger printing, PD-Loop techniques, chromosomal painting, PCR, DNA chip and microarrays.
- 5. Genome organization-** C value paradox, prokaryotic genome, viral genome and eukaryotic genome.
- 6. Somatic cell genetics-** Cell fusion and hybrids agents and mechanism of fusion; Heterokaryon-selecting hybrids and chromosome segregation.

UNIT-IV

- 1. Biosensors**
- 2. Immunological techniques based on Ag-Ab interactions, ELISA, radioimmunoassay (RIA)**

3. **Separation techniques and radioisotope and mass techniques in Biology:** electrophoresis, centrifugation, MRI,
4. Cryo-techniques, for microscopy, Freeze dying

UNIT-V

1. DNA sequencing and genome libraries: preparation of template DNA, Automated DNA sequencing, DNA sequence storage and analysis.

2. Animal and Human genomics: C. elegans, Drosophila genome, Mouse genome, Human genome, genome of other animals.

3. Molecular evolution: Concept of neutral evolution, molecular divergence and molecular clock, molecular tools in phylogeny, classification and identification, proteins and nucleotide sequence analysis; origin of genes and proteins, gene duplication and divergence.

4. Genetic evidences for modern human origins-Tracing human history through mitochondrial DNA. The Neanderthal genome, another archaic human genome.

Suggested reading material

- **Atherly, A.G., J.R.Girton and J.F.McDonald.** The Science of genetics. Saunders College Publishing, Harcourt Brace College, NY.
- Alberts, B., D.Bray, J.Lewis, M.Raff, K.Roberts and J.D.Watson:** Molecular biology of the Cell, Garland Publishing Inc. New York.
- Braun, Robert:** Introduction to Instrumental analysis, McGraw Hill International edition.
- Brooker, R.J.** Genetics: Analysis and Principles. Benjamin/Cummings, Longman Inc.
- Brown, T.A(Ed):** Molecular Biology Lab Fax, Bios Scientific Publishers Ltd., Oxford.
- Dabre, P.D.,** Introduction to Practical Molecular Biology, John Wiley and Sons Ltd., New York.
- Darnell, J.H.Lodish and D. Baltimore:** Molecular Cell Biology Scientific American Book, Inc.,USA.
- Fairbanks, D.J. and W.R.Anderson.**Genetics- The Continuity of Life. Brooks/Cole Publishing Company ITP,NY,Toronto.
- Gardner, E.J., M.J.Simmons and D.P.Snustad.** Principles of Genetics. John Wiley and Sons.Inc.NY.
- Griffiths, A.J.F., J.H. Miller,D.T.Suzuki,R.C.Lewontin and M.W.Gelbari.** An introduction to genetic analysis. W,H.Freeman and Company, New York.
- John R.W. Masters Ed.** Animal cell culture- A practical approach, IRL Press.
- Lewin, B.** Genes.VIII to XII volume . OUP, Newyork
- Meyers, R.A.** Molecular biology and Biotechnology. A comprehensive desk reference,(Ed), VCH Publishers, Inc., New York.
- Sambrook, J., E.F.Fritsch and T. Maniatis:** Molecular cloning: a laboratory manual, Cold Spring harbor Laboratory Press, New York.
- Snustad, D.P. and M.J.Simmons.** Principles of genetics. John Wiley and Sons.Inc. NY.
- Watson,J.D., N.H.Hopkins, J.W.Roberts, J.A. Steitz and A.M.Weiner.** Molecular biology of gene, The Benjamin/Cummings Pub.Co.,Inc., California.

Wilson, K and K.H. Goulding: A biologist guide to principles and techniques of practical biochemistry. ELBS Edn.

Karp, G. Cell and Molecular biology, Wiley eastern.

Menninger. Cell structure and function. Saunder College publishing.

Primrose. Principles of gene manipulation and genomics. Blackwell

Gupta, P.K. cell and Molecular Biology. Rastogi publication.

Rana, SVS. Biotechniques. Rastogi publications.

Soni, K.C. Modern cell biology

Soni, K.C. Biotechnology volume I to V

Wilson and Walker. Principles and techniques of Biochemistry and Molecular biology. Cambridge University press.

PAPER IV: EVOLUTION, STATISTICAL METHODS AND COMPUTER APPLICATION IN BIOLOGY

3 hours duration

Max marks 75

NOTE: The question paper shall be divided into three sections: Section A (20 marks) shall comprise of 10 compulsory questions of 2 marks each and not more than two questions from each Unit (Answer in not more than 50 words). Section B (25 marks) shall comprise of two questions from each unit and candidate has to attempt five questions selecting one from each Unit, 5 marks for each question (Answer in not more than 200 words) and Section C (30 marks) shall comprise of five questions with not more than one question from each Unit and candidate has to answer any three, 10 marks for each question (Answer in not more than 500 words).

UNIT-I

1. Theories of evolutionary thought:

(a) Greek thought to Lamarck

(b) Darwin and theory of evolution

© the period after Darwin

2. Genetic basis of Evolution: genetic and quantitative aspects of evolution; population as a unit of evolution; gene frequency; gene pool; evolution, the result of change in gene frequency; genetic equilibrium and Hardy Weinberg Law; Mutation pressure; selection pressure; effects of population size; random and non-random reproduction; genetic drift (Sewall-Wright effect)

UNIT-II

1. Variation: Somatic and germinal variations, chromosomal variations; gene mutations, rate, direction and nature of mutations, natural and induced mutations, mutagens.

2. Isolation and its role in species formation

(i) Speciation; definition of species, sub-species and races; speciation a gradual or a sudden process. Allopatric and sympatric speciation.

(ii) Isolating mechanisms; geographical, ecological, physiological, biochemical, anatomical, developmental, behavioral, psychological and social.

(iii) Effects of Isolation: restriction of random dispersal and random mating; character displacement; reduction of fertility

(iv) Failure of isolating mechanism, gene flow, migration, Heterosis

UNIT-III

1. Adaptational diversity and nature of adaptations; adaptive radiations and occupation of new environments and niches; mimicry and coloration.

2. Ecology and evolution

3. natural selection, critical evaluation of the concepts of struggle for existence and survival of the fittest; the modern concept of natural selection's adaptation and differential reproduction; Nedarwinism and Neolamarckism.

4. Characteristics of evolution: Extinction, replacement, irreversibility of specialization etc.

UNIT-IV

1. Objective and significance; important terms and symbols; graphs (bar diagrams, histograms, frequency polygon, line diagrams, pie diagram)

2. Frequency distribution and centering constants (Mean Median and Mode)

3. Measures of variation (Standard deviation, variance, standard error of the mean)

4. Rates and ratios.

5. Sampling variation of proportions. Significance of difference in proportions (t-test)

6. Chi-square test.

7. Correlation and regression.

UNIT-V

1. Analysis of variance (ANOVA)

2. Probability distributions: Binomial, Poisson and Normal

3. Mathematical Modeling

(a) Types of models- statistical, empirical, mechanistic, stochastic

(b) Properties of models-generality, precision, realism

© building a model planning (Conceptualisation), implementation, evaluation, sensitivity analysis).

(d) Detailed treatment of selected specific models from different areas of Biology (examples)

i. Cycling of nutrients in an ecosystem/eutrophication model.

ii. Optimal clutch size in birds

iii. Morphogenesis

iv. Genetic drift

4. Computer application in zoological study; software used in biomedical sciences (Image analysis, system automation).

Suggested reading material

- Ball, Marion J.: What is a computer?, Houghton Mifflin Company, Boston, Massachusetts, 1972
- Batschelet, E. Introduction to mathematics for life scientists. SpringerVerlag, Berlin.
- Brightman' Richard W. and Jeffrey M Dimsdale: Using microcomputer, Galgotia Publication Pvt. Ltd., 1987
- Desmonde, William H: Computers and their uses, Prentice Hall, Inc., Englewood Cliffs; New Jersey, 1964
- Dobzhansky, Th. Genetics and Origin of Species. Columbia University Press. '
- Dobzhansky, Th., FJ. Ayala GL Stebbines and J.M. Valentine. Evolution. Surjeet Publication, Delhi. '

- Futuyama, DJ. *Evolutionary Biology*, Sinauer Associates, INC Publishers, Dunderland.
- Green, R.H. *Sampling design and statistical methods for environmental biologists*. John Wiley & Sons, New York.
- Gupta, Amar and Hoo-min D Toong: *Insight into personal computers*, IEEE Press, 1985
- Hartl, D.L. *A Primer of Population Genetics*. Sinauer Associates, Inc, Massachusetts.
- Jha, A. P. *Genes and Evolution*. John Publication, New Delhi.
- Jorgensen, S.E. *Fundamentals of ecological modeling*. Elsevier, New York.
- Kemeny, John G.: *Man and the Computer*, Charles Scribner's Sons, New York, 1972
- King, M. *Species Evolution-The role of chromosomal change*. The Cambridge University Press, Cambridge.
- Lendren, D. *Modelling in behavioral ecology*. Chapman & Hal, London, UK.
- Merrel, D.J. *Evolution and Genetics*. Holt, Rinehart and Winston, Inc.
- Murray, J.D. *Mathematical biology*: Springer-Verlag, Berlin.
- Pielou, E. C. *The interpretation of ecological data: A primer on classification and ordination*.
- Rajaiaman D and Rajaraman V: *Computer Primer*, Prentice Hall, India, 1986
- Rossi, Claude J.De: *Computer- Tools for Today*, Childrens Press, Chicago, Illinois, 1972
- Smith, J.M. *Evolutionary Genetics*. Oxford University Press, New York.
- Snedecor, G.W and W.G. Cochran. *Statistical methods*. Affiliated East'West Press, New Delhi (Indian ed.).
- Sokal, R.R. and F.J. Rohlf. *Biometry*. Freeman, San Francisco.
- Strikberger, M.W. *Evolution*. Jones and Bartett Publishers, Boston London.
- Swartzman, G.L, and S.P O. Kaluzny. *Ecological simulation primer*. Macmillan, New York.

Practical Work Based on Paper I to IV
(Total No. of laboratory hrs. 480)

1 Invertebrates:

Identification, classification & study distinguishing features of important Representatives from various groups' (Protozoa to Hemichordata).

2. Study of permanent prepared slides (From protozoa to Hemichordata)

3. Anatomy:

(i) Reproductive, excretory, nervous & circulatory systems of an annelids (earthworm and leech).

(ii) Nervous system and general anatomy of Patella, Lamellidens, Mytilus, Sepia, Loligo, Octopus and Aplysia.

(iii) General Anatomy, Reproductive and Nervous Systems of Cockroach, Grasshopper Crab and Prawn.

(iv) Study of sections of the arm of a starfish; water vascular system of starfish; general anatomy of a holothurian; Aristotle's lantern of a sea-urchin: complete as well as disarticulated arrangement of the parts of Aristotle's lantern.

4. Permanent Preparation and Their Study :

(i) Preparation of cultures of Amoeba, Paramecium and Euglena; Study of these protozoans using vital dyes.

(ii) Permanent preparations and study of Amoeba, Paramecium and Euglena from cultures, Vorticella from the pond water; flagellates' from the gut of white ant and housefly, Trypanosomes in the blood of house rat, lifecycle stages of Monocystis from the seminal vesicle of earthworm.

(iii) Collection and study of live Hydra, its fixation and permanent preparation.

(iv) Collection, fixation & permanent preparations of trematodes; cestodes & nematodes found in sheep and pig in the stool of infected persons.

(v) Permanent preparation of various parts of dissection carried out of the animals mentioned in para-3 Anatomy section and study of the structures.

(vi) Permanent preparations of different materials to be provided for study,

5. Biological Chemistry:

i. Identification of Protein, carbohydrates and lipid in various tissues.

ii. Identification of different kinds of mono, di and polysaccharides in biological and chemical materials.

iii. Quantitative estimation of the following by spectrophotometer and semi auto analyser methods in various tissues,

(a) Carbohydrates: glycogen and glucose.

(b) Proteins: total proteins.

(c) Lipid: Phospholipids and cholesterol.

(d) Nucleic acids: DNA and RNA.

(e) Enzymes: acid and alkaline phosphatase.

iv. Paper chromatography and thin layer chromatography:- uni-dimensional chromatography, using amino acids from purified samples and biological materials.

v. Paper electrophoresis and Gel (SDS page and Agarose) electrophoresis; Determination of serum protein through paper and gel (SDS and Agarose electrophoresis)

vi. Study of digestive enzymes in different parts of the alimentary canal (including salivary glands of the cockroach).

6. Physiology:

i. Demonstration of the use and operation of oscilloscope for recording neuro-electric activity and electro-cardiogram.

ii. Kymographic recording of muscle twitch, summation of twitches, tonic contractions, tetanus, fatigue and staircase phenomenon from the sciatic nerve muscle preparation of rat.

iii. Kymographic recording of the rat heart beat & the study of the effect of electrical stimulation, various ligatures, drugs, etc.

iv. Study of spinal and convulsive reflexes in rat.

v. Photometric determination of haemoglobin in blood sample.

vi. Demonstration of the following in blood: clotting time, erythrocyte sedimentation rate, haemolysis and crenation.

vii. Determination of blood urea value.

viii. Enzyme activity of LDH and SDH.

7. Cell Biology:

- i. Squash & smear preparations of testis of cockroach and grasshopper, Acetocarmine & Fuelgen staining of these preparations.
- ii. Study of mitosis in onion root tip and mammalian bone marrow cells.
- iii. Study of giant chromosomes in the salivary gland of Chironomus larva and Drosophila.
- iv. Vital and supra-vital staining (with neutral red and Janus Green B) of cells of the testis of an insect or mammal to study the mitochondria.
- v. Preparation of multi-polar nerve cell from the spinal cord of a mammal.
- vi. Chromosome counts in cells of the testis of an insect or mammal or cells of the bone marrow of a mammal.
- vii. Study of prepared microscopic slides, including those showing various cell types, mitosis, meiosis and giant Chromosomes.
- viii. Preparation and staining of bar bodies.
- ix. RNA and DNA estimation.

8: Genetics:

- i. Culture and identification of male and female Drosophila.
- ii. Identification of wild and mutant forms of Drosophila.
- iii. Monohybrid & Dihybrid inheritance in Drosophila.
- iv. Simple problems based on Mendelism to be done by the students.
- v. identification of blood groups in man.
- vi. Demonstration of sex chromatin.
- vii. Problems based on gene interaction to be done by the students.

9. Statistical Methods in Biology:

- i Preparation of frequency tables and graphs.
- ii. Calculation of standard deviation, variance and standard error of the mean.
- iii. Calculation of probability & significance between mean using t -test.
- iv. Calculation of significance using Chi-square test.
- v. Plotting the slope of a line on a graph, calculations of the slope of a line, coefficient and regression. Students shall have to maintain a complete record of the work done.
- vi. Preparation of histogram, bar diagram and Line graph using computer.

Note: Use Of animals for dissection and practical work is subject to the conditions that these are not banned under the wildlife protection act.

M.Sc.Previous
PRACTICAL EXAMINATION SCHEME

BOARD FIRST: DAY FIRST	DURATION 5 HRS	
1.Exercise in Biological Chemistry		08
2.Exercise in Cell biology		08
3.Exercise in Taxonomy		06
4.Exercise in Statistical Methods		09
5.Spots 1-7		14
6. Seminar/Field/Tour report		10
7. Viva-voce		10
8. Class record		10
Grand Total		75 Marks

BOARD SECOND: DAY SECOND	DURATION 5 HRS	
1. Dissection		12
2. Slide preparation		06
3. Spots 1-7		14
3. Exercise in Physiology		13
4. Exercise in genetics		10
5. Viva Voce		10
6. Class record		10
Grand Total		75 Marks