

**MAHARSHI DAYANAND SARASWATI UNIVERSITY,
AJMER**



SYLLABUS

SCHEME OF EXAMINATION AND COURSES OF STUDY

FACULTY OF SCIENCE

M.Sc. ZOOLOGY SEMESTER SCHEME

(WITH EFFECT FROM 2015-16)

NOTICE

Change in Statutes/Ordinances/Rules/Regulations/ Syllabus and Books may, from time to time, be made by amendment or remaking, and a candidate shall, except in so far as the University determines otherwise comply with any change that applies to years he has not completed at the time of change. **The decision taken by the Academic Council shall be final.**

M.Sc. ZOOLOGY

SEMESTER SCHEME

Session 2015-2016

Note:

Syllabus of each question paper is divided in three units. The question paper is divided into three parts. Part-A, Part-B and Part-C.(Total 100 marks).

Part-A (30marks): Part A is compulsory and contains 10 questions (50 words each). At least three questions will be set from each unit and each question carries 3 marks.

Part-B (25 marks): 9 questions (100 words each) will be set taking 3 from each unit and candidate is required to attempt 5 questions taking at least one question from each unit, but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 marks): 6 questions (400 words each) will be set taking 2 from each unit. Candidate is required to attempt 3 questions, taking 1 from each unit. Each question carries 15 marks.

M.Sc. Zoology Semester - I

Paper	Duration	Max. Marks	Min.Pass Marks
Paper-1	3 hours	100	25*
Paper-2	3 hours	100	25*
Paper-3	3 hours	100	25*
Paper-4	3 hours	100	25*
		400	144

*(To pass in all theory papers, the total aggregate marks should be 36% i.e.144)

M.Sc. Zoology Semester- II

Paper	Duration	Max. Marks	Min.Pass Marks
Paper-5	3 hours	100	25*
Paper-6	3 hours	100	25*
Paper-7	3 hours	100	25*
Paper-8	3 hours	100	25*
		400	144

*(To pass in all theory papers, the total aggregate marks should be 36% i.e.144)

Practical	10 hours	400	144
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Combined practicals for semester I & II- (5 Hrs per day for 2 days)

	1200	432
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M.Sc. Zoology Semester- III

Paper	Duration	Max. Marks	Min.Pass Marks
Paper-9	3 hours	100	25*
Paper-10	3 hours	100	25*
Paper-11	3 hours	100	25*
<u>Paper-12</u>	<u>3 hours</u>	<u>100</u>	<u>25*</u>
		400	144

*(To pass in all theory papers, the total aggregate marks should be 36% i.e.144)

M.Sc. Zoology Semester- IV

Paper	Duration	Max. Marks	Min.Pass Marks
Paper-13	3 hours	100	25*
Paper-14	3 hours	100	25*
Paper-15	3 hours	100	25*
<u>Paper-16</u>	<u>3 hours</u>	<u>100</u>	<u>25*</u>
		400	144

*(To pass in all theory papers, the total aggregate marks should be 36% i.e.144)

Practical	5 hours	200	72 (General)
<u>Practical</u>	<u>5 hours</u>	<u>200</u>	<u>72 (Special)</u>
<u>Total</u>		<u>1200</u>	<u>432</u>

Practical work based on combined semesters 1&2

1. Combined practicals for 1 & 2 semesters	400 marks
Exercises based on experimental work	320 marks
Seminar	20 marks
Record	30 marks
<u>Viva voce</u>	<u>30 marks</u>
Total	400 marks

Practical work based on combined semesters 3&4

1. Practical for 3 & 4 semesters (General paper)	200 marks
Exercises based on experimental work	150 marks
Seminar	20 marks
Record	15 marks
<u>Viva voce</u>	<u>15marks</u>
Total	200 marks
2. Practical for 3 & 4 semesters (Special paper)	200marks
Exercises based on experimental work	150 marks
Seminar	20 marks
Record	15 marks
<u>Viva voce</u>	<u>15 marks</u>
Total	200 marks

Note on practical Examination scheme

1. Combined practical Examination(for Semester 1&2) will be of 10 hours duration. 5 hours on the first and 5 hours on the second day. Practical Exam for Semesters 3&4 will be divided in 2 days. First day –General paper and on second day- Special paper.
2. Regarding seminars assessment, each student shall present 2 seminars of 30 minutes duration each (1 for each semester) in the presence of the head of the department or Faculty members appointed by the H.O.D. for the same. The presentation will be oral, and a write-up of the same will be submitted for each seminar. At the time of practical Examination, the seminar evaluation record and/or project record will be placed by the H.O.D. before the Examiner for the purpose of final evaluation by them.

M.Sc ZOOLOGY (Semester Scheme)**Semester-I**

Paper- 1	Taxonomy, Biodiversity and Wild Life
Paper- 2	Structure and function of Invertebrates
Paper- 3	Biochemistry and Immunology
Paper- 4	Fundamentals of Comparative Animal Physiology and Endocrinology

Semester-II

Paper- 5	Cell & Molecular Biology; Biotechnology
Paper- 6	Genetics & Biological techniques
Paper- 7	Evolution
Paper- 8	Statistical Methods in Biology

Semester-III

Paper- 9	Biology of Chordates
Paper- 10	Developmental Biology
Paper- 11	Special Paper A/ B/ C/ D
Paper- 12	Special Paper A/ B/ C/ D

Semester-IV

Paper- 13	Ecology
Paper- 14	Ethology/ Animal Behaviour
Paper- 15	Special Paper A/ B/ C/ D
Paper- 16	Special Paper A/ B/ C/ D

Special Paper A- Cell Biology

Special Paper B- Environmental Biology

Special Paper C- Entomology

Special Paper D- Fish Biology

Semester-I

Paper- 1 : Taxonomy, Biodiversity and Wild Life

Unit-I

1. Principles of Animal Taxonomy:
 - a) Rules of nomenclature
2. Principles of classification -
 - b) Theories of biological classification and their history
 - c) The concept of species, sub species, Polytypic species
 - d) Intraspecific categories
 - e) Evaluation of biodiversity indices, Shannon Weiner Index, Dominance Index, Similarity and Dissimilarity Index
 - f) Trends in Biosystematics-Chemotaxonomy, Cytotaxonomy and Molecular Taxonomy
 - g) International Code of Zoological Nomenclature (ICZN): Formation of Scientific names of various Taxa
 - h) A study of the classification of invertebrates with distinguishing features and examples of various subdivisions

Unit-II

1. Biodiversity- Concept, principles and Types of biodiversity
2. Major biodiversity areas of the world: Biodiversity hotspots
3. Indian Biodiversity: Zones of faunal distribution
4. Major protected areas and their importance
5. Causes for the loss of biodiversity
6. Biodiversity conservation methods

Unit III

1. Wildlife and conservation:
 - a) Wild life reserves and biosphere reserves
 - b) National Parks and Sanctuaries
 - c) Single species/single habitat based conservation programmes – (Project Tiger, Project Gir Lion and Crocodile breeding project)
2. Wildlife in India, Endangered and threatened species
3. Wildlife in Rajasthan with references to reptiles, birds and mammals.
4. India's role and contribution on conservation of wildlife
5. Forestry-Forest resource, erosion, deforestation and afforestation
6. Wildlife protection Act
7. Institutions and their role in conservation-Zoos, Natural history museums, Zoological survey of India, Forest research institute, survey of India, Central marine fisheries research institute and NGOs

Suggested Reading Materials:

- B.H.M.S. – The Preservation of Wild Life in India.
- B.H.M.S.- Wild Animals of India.
- B.K.Tikadar :Threatened animals of India
- Chaudhary A.B.- Sundorbans Mangrove (Ecology and Wild Life).
- Darwin. C. – Origin of Species, Watts & Co. 5 and 6 Johnson's Courts, Fleet Street, E.C. 4, London.
- E. Mayer & Peter D. Ash lock- Principles of Systematic Zoology.
- E. Mayer : Elements of Taxonomy
- E.O.Wilson: Biodiversity, Academic press, Washington
- E.O.Wilson: The diversity of life (the college edition), W W Northem & co.
- G.G. Simpson :Principles of Animal Taxonomy. Oxford IBH Publishing Company
- M. Kato: The biology of diversity. Springer
- Romer, A.S. – Vertebrate Palaeontology, University Chicago Press, Chicago, Illinois.

Semester-I

Paper- 2: Structure and function of Invertebrates

Unit-I

1. Organization of Coelom:
 - a) Acoelomates, Pseudo coelomates and Coelomates
 - b) Protostomia and Deuterostomia

2. Locomotion:
 - a) Amoeboid, Flageller and Ciliary movement in protozoa
 - b) Hydrostatic movements in Coelenterata
 - c) Annelida and Echinodermata
 - d) Molecular and physiological mechanisms involved in different kinds of movements

3. Nutrition and Digestion:
 - a) Patterns of Feeding mechanisms and digestion -
 - b) Amoeboid feeding, Ciliary feeding, Filter feeding, Parasitic mode of feeding
 - c) Feeding mechanisms in insects and echinoderms

Unit-II

1. Respiration
 - a) Organs of respiration : Gills, lungs and trachea.
 - b) Respiratory pigments.
 - c) Mechanism of respiration.

2. Excretion:
 - a) Excretion in lower invertebrates
 - b) Excretion in higher invertebrates
 - c) Organs of excretion: Coelom, Coelomoducts, Nephridia and Malphigian tubes.
 - Mechanism of Excretion.
 - Mechanism of Osmoregulation.

3. Nervous System
 - a) Primitive Nervous systems: Coelentrata and Echinodermata
 - b) Advanced nervous system : Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda)
 - c) Receptors: structural and functional organization of the mechanoreceptors, chemoreceptors and photoreceptors.

Unit-III

1. Reproduction:
 - a) Reproduction in Protozoa, Porifera
 - b) Reproduction in Metazoa: Asexual Reproduction in Coelenterata and Polychaetes
 - c) Sexual Reproduction, Parthenogenesis
 - d) Endocrine glands, hormones and role of hormones in moulting.
 - e) Invertebrate larval forms and their evolutionary significance
2. Structure affinities and life history of the following minor Phyla
 - a) Rotifera
 - b) Entoprocta
 - c) Phoronida
 - d) Ectoprocta

Suggested Reading Materials:

- Barnes, R.D. Invertebrates Zoology, III edition. 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., New York.
- Hyman, L.H. The invertebrates, Nol. I. protozoa through Ctenophora, McGraw Hill Co., New York
- Hyman, L.H. The Invertebrates. Vol. 2. McGraw Hill Co., New York.
- Hyman, L.H. The Invertebrates. Vol. 8. McGraw Hill Co., New York and London.
- Jagerstein, G. Evolution of Metazoan life cycle, Academic Press, New York & London.
- Parker, T.J., Haswell W.A. Text book of Zoology, Macmillan Co., London.
- Read, C.P. Animal Parasitism. Parasitism. prentice Hall Inc., New Jersey.
- Russel-Hunter, W.D. A biology of higher invertbrates, the Macmillan Co. Ltd., London.
- Sedgwick, A.A. Student text book of Zoology. Vol. I,II and III. Central Book Depot, Allahabad.

Semester-I

Paper- 3: Biochemistry and Immunology

Unit-I

1. Enzymes: Terminologies, classification and basics of enzyme kinetics
2. Basic concepts of metabolism: Coupled and interconnecting reactions of metabolism
3. Cellular energy resources and ATP synthesis
4. Basic chemical concepts: a study of chemical bonds and functional groups

Unit-II

1. Organic constituents in the living systems:
2. Definition, general properties, classification, configuration and importance of Carbohydrates, Proteins and Lipids.
3. Primary, Secondary, tertiary and quaternary structures of proteins, protein folding and denaturation
4. Nucleoproteins:
 - a) DNA & RNA: Double helical structure of DNA, Structure of RNA, role of RNA in gene expression
 - b) DNA replication, recombination and repair
 - c) RNA synthesis and splicing

Unit-III

1. Overview of the immune system: components of the immune system, principles of innate and adaptive immunity, the recognition and effector mechanisms of the adaptive immunity- antigen and immunogenicity, clonal selection theory.
2. Antigen recognition by immune cells
3. Effector mechanisms and regulation of immune responses
4. Immunity in health and disease

Suggested Reading Materials:

- Cooper, T.G. Tools of Biochemistry
- Creighton, T.E. Protein Structure and Molecular Properties W.H. Freeman & Co.
- Freifelder, D. Essentials of Molecular Biology
- Freifelder, D. Physical Biochemistry W.H. Freeman & Co.
- Garland Science Publishing, New York, USA.
- Garret, R.H. and C.M. Grisham. Biochemistry. Saunders college Publishers.
- Hawk, Practical Physiological Chemistry
- Immuno Biology- The immune system in health and disease, Janeway, Travers, Walport and Shlomchik, (6th Ed., 2005),
- Immunology, David, Brostoff and Roitt, (7th Ed., 2006), Mosby & Elsevier Publishing, Canada, USA.
- Kuby Immunology, Richard, Thomas, Barbara, Janis, (5th Ed., 2003), W. H. Freeman and company, New York, USA.
- Segal, I.H. Biochemical calculations John Wiley and Sons
- Voet, D. and J.G. Voet. Biochemistry John Wiley & Sons.
- Wilson, K. and K.H. Goulding A Biologists Guide to Principals and Techniques of Practical Biochemistry

Semester-I

Paper- 4: Fundamentals of Comparative Animal Physiology and Endocrinology

Unit-I

1. Respiratory pigments through different phylogenetic groups
2. Transport of oxygen and carbon dioxide in blood and body fluids, Regulation of respiration
3. Physiology of impulse transmission through nerves and synapses, neurotransmitters and their physiological functions
4. Nerve innervations, denervation and muscle function
5. Physiology of muscle tissue: A detailed study of bio-physical and bio-chemical events underlying contraction and relaxation process
6. Physiological properties of cardiac, skeletal and visceral muscles
7. Patterns of nitrogen excretion in different animal groups, Osmoregulation in different animal groups
8. Thermoregulation in homeotherms, poikilotherms and hibernation

Unit-II

1. Nutrition, digestion and absorption :
 - a) Role of amino acids, lipids, carbohydrates, vitamins, minerals etc in nutrition
 - b) Mechanism of secretion and action of all types of digestive juices met in the mammalian digestive pathway
 - c) hormonal and nervous regulation of secretion of digestive juices
 - d) Physiological mechanisms involved in absorption of end products of digestion
2. Circulatory system:
 - a) Physiology of RBC and the mechanism of transport of gases of blood
 - b) Physiology of leucocyte function; anti body production
 - c) Physiological basis and clinical significance of blood groups
 - d) Biochemistry and physiology of blood clotting
 - e) Cardiac cycle in man
 - f) Homeostasis and nervous regulation of heart function in man

Unit-III

1. Excretion:Biophysics, Biochemistry and physiology of functions performed by vertebrate nephron
2. Endocrine physiology: 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. Neuroendocrine system- Hormone receptors . signal transduction mechanisms.

Suggested Reading Materials:

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

Semester-II

Paper- 5: Cell & Molecular Biology; Biotechnology

Unit-I

1. Principles of light, interference, polarizing, phase contrast and electron microscopes,(SEM and TEM).
2. Structural, Chemical and functional organization of the following organelles:
 - a) Cell membrane
 - b) Mitochondria
 - c) Golgi Complex
 - d) Endoplasmic Reticulum (ER)

Unit-II

1. Structural, Chemical and functional organization of the following organelles:
 - a) Ribosomes
 - b) Lysosomes, Peroxisomes and related particles
 - c) Centrosome
 - d) Nucleus and Chromosomes
 - Interphase Nucleus
 - Different types of Chromosomes, autosomes, polytene and lamp brush chromosomes
 - Nucleolus
2. Nucleic acids:
 - a) Structural organization of RNA & DNA, different theories; DNA Replication; Transcription; Translation
 - b) Synthesis of Nucleotides, Salvage pathway, DNA damage and repair, amplification and rearrangement
3. Cell Division: A detailed study of mitosis and meiosis with special reference to chemical and physical changes, mechanisms of Centriole cycle, spindle formation and anaphase movement of chromosomes.
4. Molecular mapping of genomes and elementary idea of Bio informatics

Unit-III

1. Cytophotometry, flow cytometry, fixation, staining and staining methods.
2. Principles and applications of Tracer technique, Radiation and radioactive isotopes, Effect of radiations on biological system, ELISA test.
3. Cell and tissue culture in animal systems, Primary Culture, Cell line, Cell clone, gene transfer methods in animals.
4. Transgenic biology- Production & application of Transgenic animals, Embryonic stem cells; Molecular basis, signal transduction in bacteria and animals, Complementation and molecular recognition, liposomes.
 - a) Molecular markers in genome analysis
 - b) Molecular biology of Cancer, Oncogenes, Chemical Carcinogenesis, transposons
5. Assay: Chemical & Biological; in vitro and in vivo assays.

Semester-II

Paper- 6: Genetics & Biological techniques

Unit-I

1. Mendel's laws and their significance, Current status of Mendelism
2. Linkage and crossing over: Chromosome maps, Cytological basis of crossing over
3. Detailed study of Mutation and mutagenic agents:
 - a) Classification and types of mutations
 - b) Molecular basis of Mutations
 - c) Mutagenic agents
4. Variations in Chromosome numbers: Haploidy; Polyploidy, Aneuploidy, Euploidy and Polysomy.
5. Genetic interactions
6. Multiple gene inheritance

Unit-II

1. Multiple Alleles
2. Cytoplasmic inheritance and maternal effects
3. Sex determination: XY, XO, ZW and other mechanisms, genic balance theory; gynandromorphs
4. Evolution of sex chromosomes
5. Molecular genetics: Structure, function and duplication of Nucleic acids, genetic code, structure and regulation of genes, DNA finger printing, recombinant DNA technology, In situ hybridization, genetic engineering
6. Human heredity: Important human characters and their inheritance
 - a) Principles of Eugenics
 - b) Genetic Counselling
 - c) Genetic disorders
 - d) Sequencing human genome

Unit-III

1. Bacterial genetics:
 - a) Bacterial mutation, conjugation and transduction
 - b) Lysogenic and lytic cycle in bacteriophage, Plasmids
 - c) Regulation of gene expression in Prokaryotes and Eukaryotes (Operon concept) DNA fingerprinting.
2. Principles methods and application of Genetic Engineering; Recombinant DNA technology; In situ hybridization.

3. Microbiological techniques
 - a) Media preparation and sterilization
 - b) Inoculation and growth monitoring
 - c) Use of fermentors
 - d) Biochemical mutants and their use
 - e) Microbial assays
4. Separation techniques in Biology; Cell culture techniques and Cryotechniques
5. Principles and applications of tracer techniques in biology; Effect of radiation on biological systems

Suggested readings

- Molecular biology of the gene: J D Watson, N H Hopkins, J W Roberts, J A Stcitiz, and A M 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 Raff, K Roberts and J D Watson. Garland publishing Inc. New York.
- Gene VI: 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 Fritsch and T Maniatis. Cold spring Harbor laboratory press, New York
- Animal cell culture- A practical approach, ed John R W Masters, IRL press
- Introduction to instrumental analysis: Robert Braun, McGraw Hill International Editions
- A Biologists guide to Principles and techniques of Biochemistry, K. Wilson and K.H. Goulding, ELBS Edu.

Semester-II

Paper- 7: Evolution

Unit-I

1. Concept of Evolution and Theories of Evolutionary thought:
 - a) Greek thought to Lamarck
 - b) Darwin and theory of evolution
 - c) The period after Darwin
2. Characteristics of evolution- extinction, replacement, irreversibility of specialization etc.
3. A detailed account of destabilizing forces and mechanisms of Evolution:
 - a) Natural selection
 - b) Mutations
 - c) Genetic Drift
 - d) Migration
 - e) Meiotic drive
4. Quantifying genetic variability
 - a) Genetic structure of natural populations
 - b) Phenotypic Variations
 - c) Models explaining changes in genetic structure of populations
 - d) Factors affecting human disease frequency

Unit II

1. Molecular population genetics
 - a) Patterns of change in nucleotide and amino acid sequences
 - b) Ecological significance of molecular variations
 - c) Emergence of Neo-Darwinism- neutral hypothesis
2. Genetics of quantitative traits in populations
 - a) Quantitative traits and natural selection
 - b) Estimation of heritability
 - c) Genotype-environment interactions
 - d) Inbreeding depression and heterosis
 - e) Molecular analysis of quantitative traits
 - f) Phenotypic plasticity
3. Genetics of speciation - Definition of species, sub species and races, Speciation a gradual or a sudden process
4. Isolation and its role in species formation:
 - a) Isolating mechanisms- Geographical, Ecological, Physiological, Bio-Chemical, Anatomical, Developmental, Behavioural, Psychological and Social
 - b) Effects of Isolation- Restriction of random dispersal and random mating, character displacement, reduction of fertility
 - c) Failure of isolation mechanisms, gene flow, migration, heterosis

Unit-III

1. Population as a unit of Evolution, gene frequency, gene pool, result of change in gene frequency
2. Genetic equilibrium and Hardy- Weinberg law
3. Adaptational diversity and nature of adaptations, adaptive radiations and occupation of new environments and niches
4. Mimicry and colouration
5. Molecular Evolution
 - a) Gene Evolution
 - b) Assessment of molecular variation
6. Origin of higher categories
 - a) Major trends in origin of higher categories
 - b) Micro and Macro Evolution
7. Molecular Phylogeny
 - a) Phylogenetic trees
 - b) Phylogenetic inferences
 - c) Nucleic acid phylogeny-DNA, DNA hybridizations, Restriction enzyme sites, Nucleic acid comparisons and homologies.

Suggested readings

- Dobzhansky, Th. F.J. Ayala, G.L. Stebbins and J.M. Valentine Evolution. Surject Publication, Delhi.
- Hartl, D.L. A Primer of Population Genetics. Sinauer Associates, Inc. Massachusetts.
- Jha, A.P. Genes and Evolution. John Publication, New Delhi.
- King, M. Species Evolution- The Role of chromosomal change. The Cambridge University Press, Cambridge.

Semester-II

Paper- 8: Statistical Methods in Biology

Unit-I

1. Principles and practice of Statistical methods in biological research, samples and populations
2. of Objectives and significance, important terminology and symbols
3. Graphical and tabular presentation of data - bar diagrams, histograms, frequency polygons, pie diagrams and line diagrams

Unit-II

1. Basic statistics – average (mean, median, mode)
2. Statistics of dispersion, coefficient of variation
3. Standard error. Confidence limits
4. Probability distribution (Binomial, Poisson and normal)

Unit-III

1. Tests of statistical significance
2. Simple correlation and regression
3. Analysis of variance (ANOVA)
4. Computer applications in Zoological study: fundamentals of computer, elementary idea of operating system, software used in bio medical sciences (image analysis and system automation)

Suggested readings

- Sokal R.R. and F.J. Rohlf. Biometry. Freeman, San Francisco.
- Snedecor, H.W. and W.G. Cochran. Statistical methods. Affiliated East-West Press, New Delhi (Indian ed.).
- Green, R.H. Sampling design and statistical methods for environmental biologists. John Wiley & Sons, New York.
- Murray, J.D. Mathematical biology. Springer-Verlag, Berlin.

Practical Work based on Semesters I & II

Invertebrates:

1. Identification, classification & study of distinguishing features of important representatives from various groups - Protozoa to Hemichordata.
 2. Study of permanent prepared slides - Protozoa to Hemichordata.
 3. Anatomy-
 - a) Nervous system and General Anatomy of commercially available mollusks - Sepia & Loligo.
 - b) General Anatomy, Nervous System & Reproductive System of Cockroach, Grasshopper.
 - c) Study of the arms of Seastar (Starfish), Water Vascular System of Starfish.
 - d) General Anatomy of a Holothurian
 - e) Aristotle's Lantern of Sea-Urchin with the help of Charts, Models or Digital techniques.
- Note:** *External features and anatomy should be studied preferably by digital techniques and alternatives. Whenever live animal is studied it should be either pest or culturable species without painning them.*
4. Permanent preparations and their study -
 - a) Preparations of cultures of Amoeba, Paramecium, Vorticella and Euglena. Study of these protozoans using vital dyes.
 - b) Permanent preparations of trematodes, cestodes and nematodes found as parasites in sheep and pig.
 - c) Permanent preparations and study of various parts of Grasshopper.

Bio-Chemistry -

1. Identification of Proteins, Carbohydrates and Lipids, using latest methods and techniques.
2. Identification of different kinds of mono-, di- and polysaccharides.
3. Quantitative estimation of the following by Spectrophotometer, semi-autoanalyser method-
 - a) Carbohydrates - Glucose and Glycogen.
 - b) Proteins - Total proteins
 - c) Lipids - Phospholipids and Cholesterol
 - d) Nucleic acids - DNA & RNA
 - e) Enzymes - Acid and Alkaline Phosphatase
4. Paper chromatography, Thin layer chromatography, Unidimensional chromatography using amino acids.
5. Paper electrophoresis and Gel (SDS PAGE) and Agarose electrophoresis. Determination of serum protein through paper and gel (SDS and Agarose electrophoresis).
6. Study of digestive enzymes in different parts of the alimentary canal, including salivary glands of Cockroach.

Physiology -

1. Simulations of operation of oscilloscope for recording neuro-electric activity and electro-cardiogram using digital techniques/alternatives.
2. Simulation of Kymographic recording of muscle twitch, summation of twitches, colonic contractions, tetanus, fatigue and staircase phenomenon using digital techniques/alternatives.
3. Simulations of Kymographic recordings of the heart beat & the study of the effect of electrical stimulation, various ligatures, drugs etc. using digital techniques/alternatives.
4. Study of spinal and convulsive reflexes using digital techniques/alternatives.
5. Photometric determination of haemoglobin in blood sample.
6. Sedimentation Rate (ESR) , haemolysis and crenation.

7. Determination of blood-urea value.

Cell Biology –

1. Observation of cellular organization of testes of Cockroach and Grasshopper by Acetocarmine, Fuelgen staining preparations/ slides/ digital techniques.
2. Study of mitosis in Onion root tip and mammalian bone marrow cells.
3. Study of giant chromosomes in the salivary gland of Chironomus larva, Drosophilla.
4. Vital and supra-vital staining (with Neutral red and Janus green B) of cells of the testis of any insect pest/ rodent pest to study mitochondria.
5. Chromosome counts in cells of the testis of an insect pest/ bone marrow cells of rodent pest.
6. Study of prepared microscopic slides, including those showing various cell types, mitosis and giant chromosomes.
7. Preparations and staining of Barr bodies.

Genetics –

1. Culture and identification of male and female Drosophila.
2. Identification of wild and mutant forms of Drosophila.
3. Mono- and Dihybrid inheritance in Drosophila.
4. Simple problems based on Mendalism to be done by the students.
5. Identification of blood groups in man.
6. Demonstration of sex chromatin.

Statistical Methods in Biology –

1. Preparation of frequency tables and graphs.
2. Preparation of histograms, bar diagram and line graph using computer.
3. Problems based on statistical average etc.

Molecular biology and Microbiology –

1. SDS PAGE of soluble proteins and determination of molecular weight.
2. Culture and staining of non-pathogenic bacteria.
3. Exercise based on DNA fingerprinting, DNA sequencing.

Seminar –

Students have to prepare and present paper on the related topics or recent advances/research in the field of life sciences/ topics related to the papers included in the semester. Student shall prepare and use power point presentations, models, slides etc. for seminar.

Note:

- (i) Use of animals for dissection and practical work is subject to the conditions that these are not banned under the Wildlife Protections Act.
- (ii) Those Institutions which are already having Zoology Museums should not procure Museum Specimens now onwards and should use charts/slides/models/photographs and digital alternatives in case of need. Those new institutions which are not having Zoology Museum in their Department should provide learning related to zoological specimens with the help of charts/slides/models/photographs and digital alternatives and visit of students to already established museums.