M. Sc. (Previous) Zoology

There will be four written papers of 100 marks each and Practical 200. Each paper will have four Units.

PAPER I

Non-Chordata

Protozoa :

1. Nutrition
2. Reproduction
3. Parasitism with a brief account of the causative agents of following diseases of man Kala-azar., Diarrhoea & sleeping sickness.

Porifera :

4. Skeleton, canal system and affinities.

Minor Phylum :

5. Brief account and affinities of Ctenophora.

Coelenterata :

6. Polymorphism
7. Coral & Coral reefs

Helminthes :

8. Parasitism in helminthes with a brief account of the life cycle and pathogenicity of (1) Schistosoma, (2) Echinococcus and Wuchereria.
9. Parasitic adaptations.

Minor Phylum :

10. Short notes on Rotifera, Entoprocta, Acanthocephala, Ectorocta, Phoronida, Brachiopoda, Sipunculoidea.

Annelida :

11. Adaptive radiation in Polycheeta.
12. Asexual reproduction
13. Segmental Organs (Excretory Organs)

Mollusca :

14. Torsion in gastropoda
15. Pearl industry

Echinodcrmata: 16. Larval forms

17. Water vascular system

18. Affinities of Echinodermata

Arthropoda: Brief account and affinities of Trilobita and Onychophora

20. Parasitism in Crustacea

21. Larval forms in Crustacea

22. Economic importance of insects and pest control.

PAPER II

Cytogenetics and Biostatistics

Section (A)

Cytogenetics

1. Ultrastructure of animal cell
2. Chemical nature of gene, gene action, genetic code and Protein synthesis.
3. Chromosome structure and its behaviour in cell division.
4. Mendelism, interaction of genes, lethal genes.
5. Sex linked inheritance, linkage and crossing over, chromosome mapping.
6. Sex determination with a note on gynadromorphism
7. Multiple allelism with a note on the blood groups in man.
8. Structural and numerical chromosomal aberrations and their significance.
9. Gene mutation and their artificial production.
10. Cytoplasmic inheritance.

Section (B)

Biostatistics

1. Introduction—graphs, bar diagrams and histograms.

2. Variance and difference of means, standard deviation and standard error.
3. Rates and ratios.
4. Chisquare test.
5. Analysis of variance, degrees of freedom and level of significance

Note : Candidates will be required to attempt atleast one question from section (B) Biostatistics.

PAPAR III

Physiology And Related Biochemistry :

1. Nutrition :	(a) Digestion, digestive enzymes and their role in digestion of carbohydrates, proteins and fats.
	(b) Absorption and biotransformation of digested food.
	(c) Chemical structure and biological significance of carbohydrates, lipids, proteins and amino acids.
	(d) Gastro-intestinal hormones
2. Respiration :	(a) Breathing mechanism and its control.
	(b) O_2 & CO_2 transport.
3. Circulation :	(a) Control of Heart beat, Myogenic and Neurogenic Heart
	(b) Functions of blood with special reference to immunization
4. Osmorequlation	(a) Mechanism of water-salt balance in fresh water, marine and estuarine forms
5. Neuro-muscular system	(a) Ultrastructure and function of muscle fibres
	(b) Origin and conduction of nerve impulse in a nerve fibre through a synapse

6. Excretion
   (a) End products of carbohydrate. protein and fat eatabolism.
   (b) Ultrastructure and function of verterbrate nephron.
7. Molecular Properties : Gibbs-Donnan Equilibrium, $_{p}H$ and Buffer
8. Chemical equilibrium : Law of mass action, Elementary thermodynamics in relation to life, Oxidation-reduction and coupled reactions
8. Enzymes
   (a) Classification, mode of action and factors influencing the enzyme activity
   (b) Co-enzymes
10. Structure and Function of A T P

PAPER IV

Ecology, Taxonomy And Evolution

Ecology :

1. Basic concepts of Ecology, its scope and relationship with other sciences.
2. Ecosystem : Principles and dynamics. development and evolution.
3. Population : Density, biotic potential, mortality rate, natality rate. age, distribution and growth curve.
4. Community : Its organization and dynamics.
5. Fresh water : marine and desert ecology.
6. Effects of radiation and pollution on animal life and Green house Effect.
7. Biogeochemical cycles (C, P, S, O, and N)

Taxonomy :

8. Theories of classification.
9. Taxonomical categories.
10. Zoological nomenclature.

11. Modern trends in taxonomy.

Evolution :

12. Synthetic theory of evolution.
13. Genes in population : Hardy weinberg Law and Sewell wright effect.
14. Isolation-barriers and their role in speciation.
15. Origin of species, speciation.
16. Variations.
17. Micro and Mega evolution.

M. Sc. Previous Zoology Practical

Candidates will be expected to submit the collection and microscopical preparations and a note-book containing a complete record of Laboratory work, seminars and field work. Atleast one excursion will be held to enable the students to familiarize with Indian Fauna. The excursion will be compulsory and the institution will be expected to provide the financial assistance for the excursion, a part of which will be borne by the students also.

The duration and distribution of marks shall be as follows :—

Duration : Two Days. 5 hours each day.

FIRST DAY

Major Dissection	20 Marks
Minor Dissection	10 Marks
Permanent Preparations A & B with identification	15 ,,
Spotting (10 spots of Protozoa to helminthes and Minor Phyla)	20 ,,
Physiology & Biochemistry experiment	15 ,,
	80 Marks

SECOND DAY

Major Dissection	20 Marks
Cytology Preparation	10 ,,
Spotting (10 spots of Annelida to Echinodermata and Cytology)	20 ,,
Comments & Ecology experiments	10 ,,
Viva-Voce	20 ,,
Record note-book and microscopical preparations, Collection and Report on Seminars and Excursions.	40 ,,
	120 Marks

Total Marks : 200

MAJOR DISSECTIONS

General Anatomy and nervous system of :-

Mollusca :—Unio, Mytilus, Pila, Apiysia Sepia, Loligo, and Octopus.

Arthropoda :—Squilla, Palamnaeus, Periplaneta, Grasshopper, Wasp and Honeybee.

MINOR DISSECTIONS

Anneliaa :—Pheretima (Nerve Ring and Reproductive system).
Hirudinaria : Alimentary canal

Arthropoda :—Palamnaeus (Book Lung)

Echinodermata :—Aslerias [General Anatomy and water vascular system)
Echinus (General Anatomy and Aristotle Lantern)
Holothuria (General Anatomy only)

PERMANENT-PREPARATION/MOUNTING

Protozoa :— Amoeba, Paramecium, Euglena, Noctiluca, Ceratium Elphidium, Polystomella, Radiolarion, Foraminifera.

Porifera :— Gemmule, Spicules and Spongin fibres.

Coelenterata :— Hydra, Obelia, Obelia medusa, Companularia, Sertularia, Eudendrum, Diphyes.

Helminthes :— Trematode-Larvae (Different stages)
Taenia : Proglottid and Scolex
Fasciola sp. and Oxyuris and Ancylostoma.

Annelida : Pheretima : Blood Gland, Nephridium, Ovary and Setae.

Arthropoda :— Mysis, Nauplius, Daphnia, Cypris, Cyclops, Zoea and Megalopa.

Scorpion :— Book-Lung, Sting-Apparatus, Poison gland and Pecten.

Grasshopper :—Tantorium

Periplaneta :—Testes, Salivary glands, Trachea Tantorium and Malpighian Tubules and Gizzard.

Palaemon : Hastate Plate, Statocyst.

Mollusca :— Unio : Sections of Gill, Mantle and Shell.

Pila : Radula and Ospharidim; Glochidium and Veliger larvae.

Echinodermate :—Polian Vesicle. Pedicellariae, Tube-foot and Bipinnaria Larva.

Minor Phyla :— Sagitta, Bugula, Phoronis, Rotifer.

Examination of Culture :

(a) Amoeba, Euglena and Paramecium : Examination of Culture and preparation of permanent mounts.

In Paramecium experiments will be made to study feeding with Congro Red and Yeast and staining the nucleus with Congro and

Yeast and staining the nucleus with methyl green and restraining active movements by adding Mucilage.

(b) Monocystis :—Examination of contents of seminal vesicles of Pherctima for different life history stages and making permanent preparation.

(c) Examination of Opalina, Balantidium and Nyclotherus (Rectal ciliates) from the rectum of Frog and their permanent preparations.

SPOTTING

MUSEUM SPECIMENS

Phylum—Porifera

Hyalonema, Sycon, Euspongia, Euplectella, Clathrina, Olynthus, Microcioud Hircinea, Poterion, Chalina, Halichondria, Cliona, Leucosolenia, Grantia, Ephidatia, Spongilla.

Phylum—Coelenterata.

Aurelia, Zoanthus, Porpita, Pennatula, Gorgonia Fungia, Telisia, Eudendrium, Alcyonium, Tubipora, Meandrina, Coralliumrubrvm Pleroides, Adamsia (Sea anemone). Phgsalia, Hydractina, Millepora, Velella, Charybdea, Favia.

Phylum—Helminthes.

Ascaris male and female, Taehia solium Liver fluke.

Phylum—Annelida

Aphrodite, Amphitrite, Nereis, Sipuncnlus, Pheretima, Heteronereis, Cyaetopterus, Pontobdella, Arenicola, Sabella, Lumbricus, Bonellia peripatus, Syllis Hirudinaria.

Phylum :—Arthropoda

Limulus, Balanus, Julus, Hermit crab, Hippa, Grasshopper, Scorpion, Cicada, Spider, Prawn, Sacculina on crab, Praying mantis, Scolopendra, Lepas, Sgullia, Palaemon Scorpion, Gryllotalpa, Schistocerca.

MUSEUM SPECIMENS

Phylum – Mollusca

Chiton, Sepia, Loligo, Pecten. Patella, Octopus, Aplysia, Mytilus, Doris, Cyprea, Haliotis, Oyster, Solenocurtis, Nautilus shell, Isochiton.

Phylum - Echinodermata

Antedon, Echinus, Pentacerus, Brittle star, Clypeaster.

STUDY OF SLIDES

Phylum – Protozoa.

Paramecium w. m., Entomoeba cyst w. m. in liver abscess, trophozoite abscess, Eugtena w. m., Monocystis trophozoite in section, Noctiluca, Paramoeciu ı fission w. m. Paramoecium conjugation w. m., Heliozoa w. m., Polystomella, Vorticella, Ceratium, Actinospherium, Nyctotheeus, Foraminifera shell w. m. Volvox vegetative, Radolarian ooze, Amoeba, Plasmodium, Trypanosoma.

Phylum—Porifera

Sponge Gemmules, Gemmules internal structure, Leucosotenia w. m., Sycon T. S. and L. S., Sycon & Ciliatum spicuies, Spongin fibres. Grantia T. S.

Phylum—Colentrata.

Ephyra of Aurelia w. m., Companularia, w. m., Diphyes w. m., Hydra—Bud w. m., L. S. through gonad testis, Sec. gonad testis. T.S. vegetative.

Obelia—Medusa, Aydroid, gonothecad, colony.

Pinnaria w. m. Plumularia, Sertularia w. m,, Tubularia w. m. sea anemone T. S,, stomoedium, Sea anemone T. S. below stomodaecum. Eudendrium w. m, Nematocyst of physalia, Gorgonium spicules, Spicules of Alcyynium.

Phylum—Helminthes

Ascaris T.S. male and female, Ascaris T.S. general structure (T. S. ant.

region), Planaria w. m, Planaria T. S.. Liver fluke ovary, Liver fluke Redia w. m. Liver fluke, T.S. Proboscis, Fasciola hepatica w.m. Fasciola sporocyst, Echinococcus w. m., Echinococcus hydrated cyst, Tapeworm scolex w. m., T. S. Gravid Proglottid Taenia Wuchreia brancofti w. m. in blood, Trichinella spiralis in muscles w.m., Cercaria larvae, Metacercaria, Fasciola T. S. through acetabulum Amphistoma w. m. Tubifex w. m., Schistosoma.

Phylum—Annelida

Hirudinaria—T. S. crop, T, S. through uterus, T. S. through reproductive region, T. S. through Jaw.

Nereis T. S. body, Parapodium Nereis, young Nereis entire, Earthworm T. S. through spermathecae through typhlosole, through blood gland, through pharynx, through gizzard, through clitellar region., Earthworm L. S., State of earthworm.

Phylum—Arthropoda.

Culex larva, Cypris, sting apparatus of honeybee, Cycoys male and female. Mouth parts of housefly, Housefly proboscis (lateral view), Butterfly mouth parts Larva of May fly, Cockroach gizzard T. S., Malpighian tubules of Cockroach, Nauplius larva, Astacus fluviatilis, Dapnnia, Collembola spring tale w. m. Crayfish T. S. thorax, Lepas entire, Periplanata v. s. eye, Hastate plate of Palaemon, Periplanta orientalis Head and mouth parts, T. S. statocyst of Palaemon, pecten of Scorpion. zoea larva, Sacculina T. S.

Phylum—Mollusca

Raduia [Aplysia and Pila], Glochidium larva, Limax T. S. head, T. S. gill Mytilus, Redula of Pila, Sepia embryo T. S. eye, Sepia embryo T. S. body, T. S. shell Unio, T. S. Mantle Unio, T. S. gill lamina Unio, T. S. through body Unio, Veliger larva, Unio T. S through post region.

Phylum—Echinodermata

Ophiopluteus larva w. m., Pluteus larva w. m., Starfish embryology, Starfish young w. m., Starfish tubefeet w. m. Pinnaria larva, Antedon pennule.

Minor phyla

Sagitta, Rotifera, Achinotrocha larva, Bugla, Cristatella, Lucifer, Cresis.

CYTOLOGY SLIDES

Different stages of Mitosis, Interphase, Prophase, Metaphase, Anaphase, Telophase, Different stages of Meiosis. Ist prophase Leptotene, Zygotene, Pachytene, Diplotene, Metaphase I, Anaphase I, Tetophase, Diakinesis, Chiasma formation, Metaphase II, Anaphase II, Telophase II, Golgi Apparatus, Mitochondria.

M. Sc. (Previous) Physiology and Biochemistry Experiments

1. Estimate of total leucocyte and erythrocyte number per cubic mm. of frogs, pigeon and human's blood.
2. Differential count of Leucocyte in the fish, frog, pigeon and rat blood.
3. Determination of clotting time of mammalian blood and its comparison with that of frog's blood.
4. Determination of hemoglobin (gn%) in human blood; also to calculate the colour index and the mean corpuscular hemoglobin concentration concentration (M C H C)
5. Formation of hemin or hematin crystals.
6. Cell permeability of R. B. C. of human blood in saline solution of different concentration.
7. Blood groups test of human blood.
8. pH determination of blood, urine and different parts of alimentary canal of frogs.
9. Determination of rate of heart beat of amphibians and action of cold, heat and drugs such as :—Atropine, adrenaline of its normal beat.

10. Formation of Urea crystal.
11. Action of amylase, pepsin and lipase on their respective substrates.
12. Chemical tests ror urine urea, sugar, proteins, ketone, and lipids.
13. Determination of respiratory rate of rats or fish.

ECOLOGY EXPERIMENTS

1. Study of adaptive modifications in animals due to different ecological conditions.
2. Recording of physical factors like temperature, humidity, rainfall and pressure.
3. Estimation of O_2 and CO_2 concentrations of fresh wa er bodies.
4. Determination of the primary productivity of a fresh water body (Dark and light bottle method.)
5. Qualitative and quantitative study of plankton of a fresh water body.
6. Experim nts showing percent preference of light by insects.

CYTOLOGY EXPERIMENTS

1. Preparation of temporary mounts of Polytene chromosomes and bar bodies.
2. Preparation of temporary mounts to demonstrate stages of meiosis and mitosis.
3. Study ef permanent slides of salivary gland, chromosomes, lampbrush chromosomes, stages of mitosis and meiosis and chromosomal aberrarions.
4. Study of living cells with vital dyes.
5. Collection and culture methods for Drosophila.
6. Study of Drosophila (wild type and mutant flies, vestigeal wings, white eye, sepia eye)
7. Study of the life cycle of Drosophila (From prepared slides).
8. Demonstration of salivary gland chromosomes of Drosophila and Chironomus larva.

M. Sc. Final Zoology

There will be four written papers of 100 marks each and a practical of 200 marks.

Paper I and II will be compulsory for all the candidates. Paper III and IV may be opted from any of the followig groups (to be announced at least one year prior to the date fo examinaticn).

(a) Fishes (including Fisheries), (b) Entomology, (c) Cytology

(d) Animal Physiology and Biochemistry.

Each theory paper will have four units.

PAper I- CHORDATA

1 Reproduction and colony formation in ascidians.
2. Notes on : Salpa. Doliolum, Pyrosoma, Branchial Basket and distinction between petromyzon and Myxine
3. General characters and classifiction of Fishes.
4. Evolution and Phylogeny of Fishes.
5. Structure and affinities of Ostracoderms and placoderms
6. Fins and locomotion in Fishes.
7. Air Blader and Weberian ossicles of Fishes
8. Origin of Tetrapoda.
9. Structure and affinities of Gymnophiona and Stegocephalia
10. Structure and affinities of Dipnoi and Holocephali.
11. Temporal region in Reptiles and its role in the classification.
12. Origin and Evolution of Reptiles
13. Brief account of structure and affinities of Rhynchocephalia. Chelonia and Dinosaurs.

14. Origin and evolution of Birds.
15. Palate in Birds.
16. Brief account of Limbles Lizards, Snake venom and antivenine, Ratitae and Flight Mechanism.
17. Origin and evolution of Mammals.
18. General Organization, distribution and affinities of prototheria and Metatheria.
19. Dentition in mammals.
20. Aquatic adaptations in mammals.
21. Evolution of Man

PAPER II DEVELOPMENTAL BIOLOGY AND ANIMAL BEHAVIOUR

1. Fertilization and its biochemical aspects.
2. Cleavage.
3. Gastrulation.
4. Germ layers and their fate,
5. Development of Brain, Eye and Heart in chick.
6. Amniogenesis and placentation in Mammals.
7. Induction and organizer concept.
8. Ageing and cellular Death.
9. Role of nervous system and receptors in behaviour.
10. Orientation with particular reference to Birds and Batsi.
11. Migratory behaviour of Fishes and Birds.
12. Reproductive behaviour, courtship, mating and parental care in fishes and Amphibia.
13. Territorial behaviour in Birds.
14. Pheromones and their role in reproduction.

GROUP–A

PAPER III- (a) FISH AND FISHERIES

1. Skin and scales in fishes
2. Colouration and colour change in fishes
3. Food and feeding habits of fishes, alimentary canal and physiology of digestion
4. The respiratory system, accessory respiratory organs and physiology of respiration
5. The cardiovascular system and Physiology of circulation.
6. Excretion and osmoregulation
7. Nervous system
8. Urinogenital system
9. The swimbladder and weberian oscicles and their homologies.
10. Endocrins organs.
11. Migration in fishes.
12. Electric, luminous and sound producing organs.
13. Larvivorous fishes and their significance.
14. Viviparity.

PAPER IV (a) :

The Syllabvs proposed for paper IV (a) is as follows :—

1. Preparation and maintenance of fish aquarium.
2. Fisheries of Indian including molluscan and crustacean fisheries.
3. Hill-stream and Deep sea fishes.
4. Different types of fishering gears and crafts.
5. Problems of fishing industry caused by physio-chemical Properties of fishery waters and effects of pollution.
6. Plankton in relation to fish, production.

7. Fish bye-product industry with special reference to fish oil, fish manure, i.e., in glass etc.
8. Breeding of fish under natural and artificial conditions and pond culture.
9. Pre ervations of fishes, refrigeration, smoking and timming.
10. Some important diseases of cultured fishes and remedial measures.

PAPER III : ENTOMOLOGY

(Insect Morphology, Physiology, Development and Ecology)

1. Insect Morphology :

(i) Structure of head, thorax and abdomen and their principal modifications. Elementary knowledge of musculature of head and thorax.

(ii) Structure of the digestive, excretory, respiratory, circulatory, nervous and endocrine systems.

(iii) Reproductive organs, male and female genitalia and their principal modifications.

(iv) Physiology of digestion, Role of enzymes and digestion of different types of food.

(v) Physiology of malpighian tubules and their secondary functions.

(vi) Production and reception of sound.

(vii) Light producing organs, Physiology of photoluminescence. Theory of mosavision.

(viii) Hormones Neurosecretion.

2. Development.

(i) Structure of the insect egg, maturation, cleavage, early embryonic development.

(ii) Germ layers, blastokinesis, segmentation.

(iii) Organogenesis.

(iv) Metamorphosis, types of metamorphosis, Physiology and hormonal cor trol of metamorphosis, significance of metamorphosis.

(v) Types of Larvae and pupae, significance of larval life.

3. Ecology :

(i) General principles of ecology. Habitats and communities of insects.

(ii) Abiotic factors and their effect on insect development and population with special reference to temperature and humidity.

(iii) Biotic factors, Associations and insect behaviour. Parasitism in insects. Insects predators, symbiosis, Parental care and social life in insects.

PAPER IV : ENTOMOLOGY

(Systematics. Phylogeny and Economic Entomology)

1. Principles of Insect Classification :

(i) Fundamentals of classifications, Basis of classification.

(ii) Brief history of insect classification.

2. Fossil insects and Insects Phylogeny :

(iii) Fossilization of Insects and general survey of fossil orders of insects with special reference to Palaeodyctioptera.

(iv) Ancestry of insects and the evolution of holometabolic insects.

3. Insect Orders :

(i) Principles of construction and use of dicliotomus keys in the insect identification, characters of taxonomic importance Cemstock-Needhan nomenclature of wing vanation.

(ii) Detailed knowledge of the special structure, habits and importance of the following orders, with special reference to the families mentioned :—

1. Ephemerida
2. Placoptera
3. Odonata
4. Embioptera
5. Orthoptera-Acrididae, Gryilidae, Tettigonidae, Locust and Phase theory of Locust.
6. Phasmida
7. Dermaptera
8. Blattaria
9. Mantoidae
10. Phithioptera-Anoplura and Malophaga
11. Psocoptera
12. Isoptera
13. Thysanoptera
14. Tricoptera
15. Aptera
16. Protura
17. Collembola
18. Thysanura

1. Heteroptera : Pentatomide, Coreidae, Pyrrhocoridae, Reduvidae. Lygaeledae, Tingidae, Belostomatidae, Nepidae, Gerridae.
2. Homoptera : Flgoridae, Membracidae, Jassidae, Aleurodae, Psyllidae, Aphidae and Coccidae.
3. Coleoptera : Carabidae, Dytiscidae, Paussidae, Staphylinidae. Dermestidae, Hydrophyllidae, Chrysomelidae, Meloidae.

Coccinellidae, Buprestidae, Elateridae. Tenerbrionidae, Cerembycidae, Scarabacidae, Cu-culionidae.

4. Trichoptera.

5. Lepidoptera : Noctuidae, Sphingidae, Pyrallidae, Geometridae, Bombycidae. Papilionidae, Nympnalidae, Pieridae and Lycinidae.

6. Hymenoptera—Ten hredenidae, Cynipidae, Ichneumonidae, Braconidae, Evanidae, Chalcidonae Serphidae, Vespidae, Formicoidae, Apidae.

7. Diptera—Tipulidae, Mycetophylidae, Psycholidae, Chironomidae, Simulidae Culcidae, Itonididae, Tabanidae, Asilidae, Syrphidae, Drosophilidae, Muscidae, Trypetidae, Hippoboscidae.

8. Aphonaptera

9. Economic Importance :

(i) Insects in relation to man. Insects as friends, enemies, benefactors.

(ii) Insects injurious to agriculture and forestry. Life histories of the following pests of agriculture :

(Paddy, Cotton, Sugarcane, Rice and Vegetables)

Dysdercus Roenigli, Aphis gossypii. Leptocorisa variocornis, Hispa armigera, Sitophilus oryzae (Calandra oryazae) Bruchus chinesis, Bagrada picta, Aulacophora fuveicollis. Epilachnasp.

(iii) Insects injurious to industry.

(iv) Insects in medicine and veterinary science.

(v) Silkworm, Honeybee, Lac Insect.

(vi) General principles of insect control.

(vii) Elementary knowledge of insecticides.

PAPER III CYTOLOGY AND CYTOGENETICS

(EXTRA NUCLEAR CYTOLOGY)

1. Elementary concept of the methods in Cytology and theory microscopy
   (a) Phase contrast, Interference, Polarizing, ultra violet and Electron microscopy. (b) Histoimmunology (c) Autoradiography (d) Biological computing and (e) Tissue culture.
2. Protoplasm—Physical, chemical and Biological properties.
3. Viruses. Protokaryota, Mesokaryota.
4. Plasma membrane :—Various models of molecular structure, Chemistry, specializations and function, Phagocytosis, Pinocytosis.
5. Endoplasmic reticulum :—Configurations of cytoplasmic membrane, types of E.R. Granular and Agranular. Modifications of agranular reticulums and Myeloid body.
6. Golgi Apparatus :—Morphology, Ultra structure, Cytochemistry functions, and origin.
7. Ribosomes :—Physical characteristics and structure, stoichiometry, and biogenesis.
8. Mitochondria:—Morphology, distribution, Ultrastructure compartmentation and molecular organization, Variations in mitochondrial patterns, Pathological changes and Role of mitochondria in cell physiology.
9. Lysosomes and related bodies :—Morphology, chemistry and origin of lysosomes. Cytolysosomes, peroxisomes Glyoxysomes and Sphersomes.
10. Lilia and Flagella :— Structure, chemical composition, Specialization, Physiology of ciliary action.
11. Microtubules, Microfilaments, vacuoles and crystals.
12. Stratification of extra nuclear cell components in centrifuged cells.
13. Cytomorphological aspects of cell secretion.
14. Role of Cytoplasm in heredity.

GROUP—C

PAPER IV CYTOLOGY AND CYTOGENETICS

(Nuclear Cytology and Cytogenetics)

1. Cytologic and cytochemical techniques :— Cell culture, fixation, chemical basis of staining, cytochemical and histochemical methods.
2. Nucleus :—Number, position, size, shape and significance of nucleus.
3. Nuclear Membrane :— Ultrastructure, Nuclear pores and annuli, chemical composition and origin.
4. Nuclear transport : Role of the pore complex on nuclear sap.
5. Nucleolus :—Morphology, Ultrastructure, Thermosensitivity, Chemistry and functions.
6. Chromortin :— Distribution and structure, Heterochromortin and its properties, classification of heterochromatin.
7. Sex chromortian and Dosage compensation.
8. Morphology, Ultrastructure, and Physical and chemical organization of chromosomes.
9. Giant chromosomes :— Salivary and lamp-brush and their functional significance.
10. Chromosomal Mechanism of sex Determination :—Simple and multiple systems, Genic balance mechanism and dominant Y system.
11. Sex Determination in Mama :—Human sex anomalies, Autosomal disorders, Cancer and Chromosomes.
12. Cytological aspects of fertilization:—Transportation of gametes, gametic union, nuclear fusion, and Abnormal fertilizations.
13. The Cytology of Parthenogenesis :— Haplodiploidy, Thelytoky and cyelical parthenogenesis.

14. Chromosomal Polymorphism :—Inversion, translocation, fusion and dissociation polymorphism. Adaptive significance of inversion polymorphism.

15. Chromosomal Rearrangements and speciortion with special reference to insects and mammals.

16. Genetic code and genetic engineering.

GROUP—D

Paper III : ANIMAL PHYSIOLOGY

1. Nutrition : (a) Balanced diet for human beings. Role of vitamins and minerals.

   (b) Structure, function and control of secretion in salivary. gastric, intestinal gland, pancreas and liver in vertebrates.

2. Excretion (a) Urine formation and its constituents.

   (b) Excretory products in different animals.

   (c) Renal clearance and control, acid base balance.

3. Respiration : Respiratory organs, regulation and mechanism of respiration. Respiratory gas exchange and transport. Adaptations in parasitic, aquatic, deep sea, and high altitute. Effects of abnormal concentrations of respiratory galses. R.Q.

4. Temperature Regulation : Regulatory centres and vasomotor reflexes.

5. Circulation : (a) Types of heart, regulation of beat, cardiac, cycle effects of drugs and salts, electrocardiogram and blood volume. Immunization.

   (b) Blood, Respiratory pigments O_2 and CO_2 carriage in blood.

6. Biological membranes and Osmotic and ionic regulation in aquatic and terrestrial animals.

7. Muscles :— The structure and function, chemistry and molecular physiology.

8. Nervous system :- (a) Properties of nerve motor unit, Transmission of impulse. Humoral mediation of nervous stimulation.
(b) Central automonic and peripheral system. Brain centres. Blectroencephalogram. Types of reflexes.

9. Reproductive System :— Male and female reproductive organs in human body, hormonal control, ovulator implantation, Menstural cycle and its endocrinology.

10. Endocrine System :— Structure and function of pituitary, thyroid parathyroid, adrenal, thymus, and islets of langerhans.

11. Principles and uses of common physiological apparatus.

GROUP—D

Paper IV : BIOCHEMISTRY

1. Molecular Properties : Electronic configuration of an atom, Association of atoms into molecules. Physical properties of molecules (Diffusion, Osmosis, Gibbs Donnan Equilibrium. Colloids Ions and radicals, Viscosity and Surface Tension)

2. Biochemical Techniques :—Introductory idea of calorimetry, chromatography and electrophoresis.

3. Bioenergetics : Law of mass action, Laws of thermodynamics, free energy, changes in biochemical process, sources of free energy and chemical equilibrium.

4. Biological effects of radiation.

5. Chemical kinetics : Orders and molecularity of reactions with biological examples, activitation energy, oxidation. reduction, pK and pH [Handerson Harselbalch equation] pH scale. Buffers and Buffering mechanism of the body.

6. Action of enzymes : Enzyme kinetlcs, factors influencing the enzyme activity, effect of activators and inhibitors, isoenzymes.

7. Chemical structure and biological significance of : Carbohydrates, lipids, proteins and Vitamins. Nucleic acids and their role in protein synthesis.
8. Metabolism : Basal metabolism. H.M.P. pathway and oxidative phosphorylation.

M. Sc. FINAL ZOOLOGY PRACTICAL

Candidates will be expected to submit the collection and microscopical preparations and a note-book containing a complete record of Laboratory work, seminars and field work. Atleast one excursion will be held to enable the students to familiarize with Indian Fauna. The excursion will be compulsory and the institution will be expected to provide the financial assistance for the excursion, a part of which will be borne by the students also.

The duration and distribution of marks shall be as follows :—

Duration : Two days : 5 hours each day.

FIRST DAY (GENERAL)

Major dissection other than fishes	20 Marks
Minor dissection	10 ,,
Embryology experiment	10 ,,
Permanent preparation with identification	10 ,,
Spotting (10 spots)	20 ,,
Microtomy	10 ,,
Viva-Voce	10 ,,
Sessional record [Both general and special]	30 ,,
	120 Marks

SECOND DAY [FISHES/ENTOMOLOGY]

Major dissection	20 Marks
Minor dissection	10 ,,
Spotting [5 spots]	15 ,,
Identification of local fauna	15 ,,
Experiment	10 ,,
Viva-Voce	10 ,,
	80 Marks

SECOND DAY [PHYSIOLOGY/CYTOLOGY]

Major experiment	40 Marks
Minor experiment/Comments on spots or Apparatus	30 ,,
Viva-Voce	10 ,,
	80 Marks

Total marks 200

MAJOR DISSECTIONS

Pisces : General anatomy of Scoliodon, Dasyatias, Labeo and Wallago.

Scoliodon :—Afferent Branchial Artery.
Efferent Branchial Artery.
Cranial nerves V, VII, IX, X.

Amphibia : Frog :— Cranial Nerves V, VII, IX, X.

Aves : Columba :—Air Sacs.

Mammalia : Squirrel :— Neck Nerves.

MINOR DISSECTION

Pisces : Membranous Labyrinth.

Amphibia : Hyoid Apparatus, Columella auris.

Aves : Arterial and Veinous systems of Pigeon, Flight Muscles, Perching Muscles.

Reptilia : Arterial and veinous system of Uromatix.

Mammalia : Ear Ossicles, Muscles. Arterial and veinous system of rat Male and female urinogenital system.

PERMANENT PREPARATION/MOUNTING

Protochordata : Salpa, Doliolum, Oikopleura, and Branchiostoma (oral hood, Pharyngeal wall, Velum)
Herdmania (Neural Complex, Spicules, Phary.)

Pisces : Placoid, Ctenoid, Ganoid, and Cycloid Scales.
Ampulla of Lorenzini.

Amphibia : Rana : Buccal Epithelium, Striated and

Aves : Columba : Pecten, Columella, Filoplume.

Mammalia : Rat : Medullated and Non-medullated.

EXPERIMENTS ON EMBRYOLOGY

1. Study of the life history stages of frog.
2. Removal of egg membranes and mounting.
3. Study of morphogenetic movements in the embryo of frog with vital dyes.
4. Hormonal control of amphibian metamorphosis.
5. Incubation and mounting of chick embryos.

6. Study of the embryological slides of frog, chick and any mammal.
7. Microtomy of embryonic stages.

SPOTTING

MUSEUM SPECIMENS

Protochordates :

Balanoglossus, Herdmania, Branchiostoma.

Cyclostomes :

Petromyzon, Myxine; Ammocoetus larva of Petromyzon.

Fishes :

Echeneis, Tetradon [Globe fish], stegostoma, Pteroid, Anguilla, Diodon. Ostraction cubicus, Sphryna, Trygon [Sting ray] Astrape [Electric ray] Hippocampus, Rostrum of Pristis, Syngnathus, Acipensor, Anabas.

Amphibia :

Uraeotyphlus, Siren, Alytes, Axolota larva, Rhacophorus, Bufo, Hyla, Ambystoma, Ichthyophis, Salamander, Pipa.

Reptiles :

Draco, Gecko, Calotes, Pharynosoma, Typholops, Chammaeleon, Mabuya, Russel viper, Tree snake, Hydrophis, Krait, Crotalus. Dendrophis, Naja.

Mammal :

Squirrel, Bat (Chiroptera), Pangolin, Rat, Platypus (Model), Echidna (Model).

STUDY OF SLIDES

PROTOCHORDATA :

Hemichordata : Balanoglossus M. L. S. and T. S. passing through various parts of the body. Tornaria Larva W. M.

Urochordata: Herdmania : Nevral Complex, Pharyngeal wall and spicules, Olkoplevra W. M; Pyrosoma, W. M; Botrylus W. M.; Doliolum (Sexual and Asexual Forms) Salpa [Sexual and Asexual Forms].

Cephalochorda : Branchiostoma W. M., L. S. anterior end, oral hood W. M , Branchial Wall, T. S. passing through different parts of the body.

[i] PISCES : Larva W. M., L. S., fish, T. S. Shark embryoeye and T. S. passing through different regions of the body. Different types of scales.

[ii] AMPHIBIA : Complete histology and Embryology.

[iii) REPTILIA : Sections passing through different regions of the body of Lizard/Snake and Scales of Snakes.

(v) AVES : Complete histology and Embryology, W. M. and T. S. of embryos, Different types of feathers, and Pecten.

[v[MAMMAL : Complete histology including placenta.

OSTEOLOGY : Study of articulated and Disarticulated bones of appendicutians and axial skeleton of Frog, Varanus, Fowl and Rabbit.

PRACTICAL

FISH AND FISHERIES

DISSECTIONS :

1. General anatomy and cranial nerves of Mystus; Wallago, Sting-ray and Electric ray.
2. Membranous Labyrinth of Sociodon and Wallago.
3. Weberian Osscles of certain fishes.
4. Accessory respiratory organs and their blood Supply Co. Channa, Clarias, Heteropneustes and Anabas.
5. OSTELOGY of any fresh water fish.

6. EXPERIMENTS ON :

[a] Respiratory rate of a fish.

[b] Study of Physical conditions of freshwater pond including light, temperature, turbidity, transparency, wind velocity. wind direction etc.

(c) Estimation of protein, Glycogen and lipids in Skeletal muscles of fish.

7. Qualitative and Quantitative estimation of Plankton.

8. Determinations of age : growth and length-weight relationships.

9. Qualitative and Quantitative analysis of gut contents of a carnivorous, herbivorous and omnivorous freshwater fish.

10. Chemical analysis of water including measurement of oxygen and carbon-di-oxide cycles and salinity.

11. General survey of local fish fauna.

PRACTICAL

ENTOMOLOGY

1. Detailed study of the external features of grasshopper.

2. Dissections and preparation of the various organ systems of cockroach, grasshopper, Gryllotalpa, Musca, wasp, honeybee, Dysdereus, a coleopteran and a lepidopteran adult and larva.

3. Comparative study of the mouth parts, legs antennae and wings of insects.

4. Study of the life history stages of Butterfly and Mosquito.

5. Mounting of eggs, pupal and larval stages of certain coleopteran and lepidopteran and Dipterous insects.

6. Microtomy of the embryonic stages of an insect.

7. Determination of the pH of insect gut and blood.
8. Demonstration of uric acid in the fat body and malpighian tubules of insects.
9. Study of respiratory-rate of an insect [Cockroach]
10. Insects collection.
11. Insect identification of all the orders given in paper IV (B) and Diptera.
12. Spotting.
13. Practical Record.

PRACTICAL :

CYTOLOGY AND CYTOGENETICS

1. Cytological techniques for the demonstration of nucleus. chromosome mitochondria, Golgi-bodies, ribosomes, fat etc.
2. Squash preparation of onion roots tip and grasshopper testis to demonstrate mitosis and meiosis respectively. Intravital staining of buccal epithelium.
3. Cytochemical demonstration of Proteins, Nucleic acids, and Lipids.
4. Preparation of chromosomes from salivary glands of Chironomus and Drosophila larvae and malpighian tubules and rectal epithelium of dipterous.
5. Demonstration of sex-chromatin in human female using buccal smear and hair root.

PRACTICAL :

ANIMAL PHYSIOLOGY AND BIOCHEMISTRY

1. Identification and separation of sugars amino acids by paper chromatography.
2. Determination of acid phosphatase and alkaline phosphatase in blood serum.
3. Estimation of non protein nitrogen (NPN), Calcium, Magnesium and Inorganic phosphate.
4. Isolation of liver glycogen and its hydrolysis.
5. Isolation and estimation of casein from milk.
6. Determination of total amino acids calorimetrically,
7. Muscles and nerve : Contraction of voluntary and smooth muscles, excitation and conduction.
   Study af action potential through pen orcillograph.
8. Heart and circulation; Capillary circulation, heart beat and contraction of heart muscle, arterial blood pressure.
9. Blood : Differential count, haematocrit, total RBCs and WCBs counts, estimation of haemoglobln percentage. Determination of blood sugars and serum protein, specific gravity and buffering capacity of blood. E. S. R. and blood pressure determination.
10. Respiration Measurement of oxygen consumption of fish by Winkler's method.
11. Digestion : Detection and the effect of various factors i. e. pH, temperature enzyme concentration and substrate concentration on any digestive enzyme.
12. Excretion : Estimation of urea, glucose and physical properties of urine.
13. Endocrine : Microscopic observation of major endocrine glands.
14. Reproductive System : Pregnancy Test.