UNIVERSITY OF KOTA, KOTA

MBS Marg, Near Kabir Circle, KOTA (Rajasthan)-324 005

SCHEME OF EXAMINATIONS AND

TENTATIVE SYLLABUS

First & Second Semester Examinations

(Effective from the Academic Session 2016-2017)

Master of Science (M. Sc.)

ZOOLOGY

Faculty of Science

This syllabus is only for M. Sc. (Zoology) course running at

University Department of Life Science

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1. The M.Sc. Course in Zoology is a two year full time curriculum offered in the form of Choice-based Credit System organized in four semesters. The number of papers and maximum marks for each theory paper/practical has been shown in the syllabus. It will be necessary for a candidate to pass in the theory part as well as in the practical part (wherever prescribed) separately.
2. The course of study for M.Sc. (Zoology) examination shall be spread over a period of two years with examination at the end of each semester. There shall be **four semesters** in all.
3. Every semester will have four Theory papers and one practical. Syllabus of every theory paper of each semester will be divided into 5 units.
4. Scheme of examination:-

Each Semester	MaxMarks	MinMarks	InterAsse.
Paper I	70	25	30
Paper II	70	25	30
Paper III	70	25	30
Paper IV	70	25	30
Practical	200	72	Nil

I Year : I Semester

Paper-Z-01 INVERTEBRATE: STRUCTURE AND FUNCTIONS
Paper-Z-02 BIOCHEMISTRY
Paper-Z-03 CELL BIOLOGY
Paper-Z-04 EVOLUTION AND BIOSTATISTICS
Paper-Z-05 ZOOLOGY Practical: Duration 10 Hrs; MM 200, Min 100.
Day 1; 5 Hrs. (Z-01 & Z-02) and Day 2; 5 Hrs (Z-03 & Z-04).
Each **theory paper**:-

Teaching hrs	Credit Points	Continuous assessment		Semester assessment		Max marks	Min.Pass marks	Paper Duration
		MM	Pass	MM	Pass			
04	04	30	12	70	28	100	40	3 Hrs.

For **Practical:** Teaching Hrs18, Credit pt: 9; Max. Marks 100, Min. pass marks 50 for each day.
Total (I Semester):- 27 Teaching Hrs 34, Credit pt 25, Continuous assessment (MM 120, Min 48) Semester Assessment (MM 380, Min 162) Total marks 500 Min Pass marks 250.

I Year : II Semester

Paper-Z-06 IMMUNOLOGY AND BIOTECHNOLOGY
Paper-Z-07 ANIMAL TAXONOMY
Paper-Z-08 GENETICS
Paper-Z-09 ANIMAL PHYSIOLOGY
Paper-Z-10 ZOOLOGY Practical: Duration 10 Hrs; MM 200, Min 100.
Day 1; 5 Hrs (Z-06 & Z-07) and Day 2; 5 Hrs (Z-08 & Z-09).
For each **theory paper**:-

Teaching hrs	Credit pt	Continuous assessment		Semester assessment		Max marks	Min.Pass marks	Paper Duration
		MM	Pass	MM	Pass			
04	04	30	12	70	28	100	40	3 Hrs.

For **Practical:** Teaching Hrs18, Credit pt: 9; Max. Marks 100, Min. pass marks 50 for each day.
Total (II Semester):- 27 Teaching Hrs 34, Credit pt 25, Continuous assessment (MM 120, Min 48) Semester Assessment (MM 380, Min 162) Total marks 500 Min Pass marks 250.

Continuous Assessment or Internal or Mid Term Assessment:

(a) The continuous or internal or mid-term assessment (30% weightage of the maximum marks) for each theory paper shall be taken by the faculty members in the Department during each semester. There will be two internal assessment tests (i.e. First Internal Assessment Test or First Mid Term Test and Second Internal Assessment Test or Second Mid Term Test) each of 15% weightage for each theory paper. Each internal assessment test shall be of one hour duration for theory paper and shall be taken according to academic calendar which will be notified by the Department / University.
(b) For practical papers, there will be only one external or semester or end term assessment (100% weightage of maximum marks) and there will be no continuous or internal or midterm assessment.
(c) A student who remains absent (defaulter) or fails or wants to improve the marks in the internal assessment may be permitted to appear in the desired paper(s) (only one time) in the same semester with the permission of the concerned Head of the Department. A defaulter / improvement fee of Rupees 250/- per paper shall be taken from such candidates. Duly forwarded application of such candidates by the teacher concerned shall be submitted to HOD who may permit the candidate to appear in the internal assessment after production of satisfactory evidence about the reason of his/her absence in the test(s) and deposition of the defaulter / improvement fee. A record of such candidates shall be kept in the Department.
(d) Regular attendance of the student shall be considered in the internal assessment. If the attendance / regularity factor is similar for all the students, then it may be merged with the weightage of second internal assessment test (class test / home assignment / quiz, seminar, etc.).
(e) Paper wise consolidated marks for each theory paper and dissertation / seminar (i.e. total marks obtained during various modes of internal assessment) obtained by the students (out of the 30% weightage of the maximum marks of the paper) shall be forwarded by the Head of the Department (in two copies) to the Controller of Examination of the University within a week from the date of last internal assessment test for incorporation in the tabulation register.
(f) The consolidated marks obtained by the students be also made known to them before being communicated by the Head of the Department concerned to the University for final incorporation in the tabulation register. If any discrepancies are discovered or pointed out by the students, the same shall be looked into by the concerned faculty member and corrections made wherever necessary. The decision of

the Head of the Department before the communication of marks to the University shall be final. No corrections shall be made in the internal assessment marks after the declaration of the result by the University.
(g) Consolidated marks communicated to the University shall be in whole number and not in fraction. Marks awarded for the various internal assessments in each paper shall be added up and then round off to the next whole to avoid any fraction.

SCHEME OF EXAMINATION

(Semester Assessment)

Duration : 3 hours Max. Marks – 70

Note : The question paper will contain three sections as under –

Section-A : One compulsory question with 10 parts, having 2 parts from each unit, short answer in 20 words for each part. Total marks : 10

Section-B : 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer approximately in 250 words. Total marks : 30

Section-C : 04 questions (question may have sub division) covering all units and one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 30

UNIT WISE DETAILED SYLLABUS

Paper- Z-01 INVERTEBRATE: STRUCTURE AND FUNCTIONS

UNIT I

1. **Introduction:** The concept of "Invertebrate" and "Vertebrate" animal groups, a study of the general body plan of invertebrates. Elementary idea of the animal diversity in marine, estuarine and fresh water environments.
2. **Locomotory mechanisms**: a) Amoeboid movements, ultra structure of cilia and flagella: ciliary and flagellar movements; molecular and physiological mechanisms involved in the three kinds of movements. b) Myonemes and muscle fibers in invertebrate structure and their role in locomotion. c) Locomotion in relation to hydrostatics, coelome, metamerism, arthropodization. d) An outline of flight mechanism in insects.
3. **Feeding mechanisms**: a) Amoeboid feeding. b) Ciliary feeding. c) Filter feeding. d) Parasitic mode of feeding. e) Feeding mechanisms in insect and echinoderms.

UNIT - II

1. **Respiration**: a) Respiration in lower invertebrates (Protozoans to helminthes). b) Gills and Lophophores. c) Gills and lungs in Mollusca. d) Gills, trachea and lung like structures in Arthropods. c) Physiology of respiratory pigments in invertebrates.
2. **Excretion**: a study of structural and functional organization of excretory systems in various invertebrate groups and a survey of various excretory products met with in them.
3. **Osmoregulation and ionic regulation**: a survey of principal mechanisms in fresh water, marine and terrestrial forms.

UNIT – III

1. **Structural and functional organization of nervous systems and receptors:** a) Plan of nervous systems in the Coelenterates, Platyhelminthes, Annelids, Arthropods, Molluscs and Echinoderms: 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 surey of endocrinal structures and their hormones: role of neurosecretions and hormones in developmental events of insects and crustaceans.
3. **Reproduction:** a) Reproduction in Protozoa b) Reproduction in Porifera c) Reproduction in Metazoa : Sexual reproduction; Parthenogenesis. d) Reproduction in Metazoa : Asexual

reproduction in Coelenterata and Polychaeta. e) Larval forms of invertebrates and their significance.

UNIT - IV

1. Criteria for phylogenetic interrelationships between Invertebrate phyla.
2. Origin of Parazoa, Mesozoa and Metazoa. Origin or Radiata (Coelenterata and Ctenophora). Origin of Bilateria from Radiata (Importance of Planula larva and Ctenophores).
3. Phylogenetic significance of Rhynchocoela. Interrelationship of important Pesudocelomate groups, Rotifera. Gastrotricha, Kinorhynca, Nematomorpha and Entoprocta.

UNIT - V

1. **Affinities and evolutionary significance** of the unsegmented lesser protostome phyla (Priapulida, Echiuroidea and Sipunculida.
2. **Phylogenetic relationships** between the coelomate protostome phyla (Annelida, Onychopohra. Arthropoda & Mollusca). Affinities and evolutionaiy significance of the Lophophorate coelomate phyla (Brachiopoda, Phoronida & Ectoprocta).
3. **Affinities** of the invertebrate deuterostome phyla (Chaetognatha, Echinodermata, Pogonophora & Hemichordata).

Paper-Z-02 BIOCHEMISTRY

UNIT I

1. **Introduction:** Basic chemical concepts: a study of the chemical bonds and functional groups.
2. **Biocatalysts** : Classification and nomenclature of the enzymes; nature of enzymes, enzyme specificity; factors affecting enzyme activity; enzymatic and non-enzymatic catalysts; coenzymes and their functions. Enzymes and prosthetic groups.
3. **Energy considerations**: Biological oxidation & reduction. Fundamental reactions of biological oxidation; redox potential and electron transport system.

UNIT II

1. **Carbohydrate** – Classification, structure, general properties and functions of polysaccharides and complex carbohydrates; amino sugars, proteoglycans and glycoproteins.
2. **Lipids** – Classification, structure, properties and functions of fatty acids, essential fatty acids, fats, phospholipids, sphingolipids, cerebrocides, steroids, bile acids, prostaglandins, lipoamino acids, lipoproteins, proteolipids, phosphatidopeptides, lipopolysaccharides.
3. **Nucleic acids –** Classification, structure, properties and functions of nucleic acids. Primary, secondary and tertiary structure of nucleic acids, DNA forms and conformations, Denaturation of DNA.

UNIT III

1**. Proteins** – Peptide synthesis: chemical and Merrifield synthesis. Primary (peptide conformation, N- and C- terminal, peptide cleavage), Secondary (α-helix, sheet, random coil, Ramachandran plot), Tertiary and Quaternary structures of proteins.
2. **Vitamins** – Classification, structure, properties and functions of vitamins.
3. **Hormones** – Classification, structure, properties and functions of Hormones.

UNIT IV

1. **Metabolic pathways** of protein (General reactions of amino acid metabolism - Transamination, decarboxylation, oxidative & non-oxidative deamination of amino acids.)

2. **Metabolic pathways** of carbohydrates (Glycolysis, various forms of fermentations in micro-organisms, citric acid cycle, its function in energy generation and biosynthesis of energy rich bond, pentose phosphate pathway and its regulation. Gluconeogenesis, glycogenesis and glycogenolysis, glyoxylate and Gamma aminobutyrate shunt pathways, Cori cycle, Entner-Doudoroff pathway, glucuronate pathway. Metabolism of disaccharides.)
3. **Metabolic pathways** of lipids (hydrolysis of tri-acylglycerols, α-, β-, ω- oxidation of fatty acids. Oxidation of odd numbered fatty acids – fate of propionate, role of carnitine, degradation of complex lipids. Fatty acid biosynthesis & Lipid biosynthesis) and nucleic acids (Biosynthesis and degradation of purine and pyrimidine nucleotides and its regulation).

UNIT V

1. **Bioanalytical Techniques**: Spectroscopy – Concepts of spectroscopy, Visible and UV spectroscopy, Laws of photometry. Beer-Lambert's law, Principles and applications of colorimetry.
2. **Bioanalytical Techniques:** Chromatography – Principles of partition chromatography, paper, thin layer, ion exchange and affinity chromatography, gel permeation chromatography, HPLC and FPLC. Electrophoretic techniques – Principles of electrophoretic separation: Continuous, zonal and capillary electrophoresis, different types of electrophoresis including paper, cellulose and gel. Electroporation, SDS-PAGE gel electrophoresis.
3. **Bioanalytical Techniques:** Centrifugation – Principles of centrifugation, concepts of RCF, different types of instruments and rotors, preparative, differential and density gradient centrifugation, analytical ultra-centrifugation, sub-cellular fractionation.

Paper-Z-03 CELL BIOLOGY

UNIT I

1. **Microscoy:** A general idea of properties of light, lenses and magnification power. An elementary knowledge about principles and functioning of microscopes: - light (dissecting and compound), interference, polarizing, fluorescence, phase contrast, UV and electron (SEM and TEM).
2. **Cytological techniques**: Centrifugation and ultracentrifugation, intravital and supravital staining, preparation of cell cultures, isolation and fractionation of cell.
3. **The evolution of the Cell**: - From molecules of the First Cell; From Prokaryotes to Eukaryotes; From Single Cell to multi-cellular Organisms.

UNIT II

1. **Plasma membrane** and intracellular compartments: Structure and functions of membrane, Endocytosis and exocytosis; principles of membrane transport, carrier proteins, ion channels.
2. **Structure and functions** of endoplasmic reticulum. Signal recognition particles, ER signal peptides; signal transduction.
3.**Vesicular traffic organelles**: Structure and functions of Golgi complex and lysosomes, transport from Golgi bodies to lysosomes.

UNIT III

1. **Structure and functions** of microbodies, glyoxysomes, peroxysomes, and spherosomes. Structure and functions of ribosomes.
2. **Energy transducer organelles**: Structure, functions and evolution of mitochondria and plastids; their role as energy transducers.
3. **Structure** of cilia, flagella, vacuoles and cytoskeleton – Microtubules, Actins filaments.

UNIT IV

1. **Nucleus**: Structure of interphase nucleus, pore complex, nucleoplasm and nucleolus.
2. **Chromosomes**: Chromatin organization in dividing and non-dividing cells, structure of chromosomes, solenoid model, importance of C-value paradox, centromere and telomere,
3. **Karyotype banding techniques**, FISH, GISH, Mc FISH, cytometry ; giant and mini chromosomes.

UNIT V

1. **Cell cycle** and mitosis: Stages of cell cycle (G1, S, G2 and M stage), centriole cycle,
2. **Mechanism** of mitosis, anaphasic movements. Mechanism of meiosis, nondisjunction.
3**. Regulation** of cell division and abnormalities: Genetic regulation of cell cycle, check points, cyclins, MPF, chalones, mitotic poisons; molecular origin of cancer; apoptosis.

Paper-Z-04 EVOLUTION AND BIOSTATISTICS

UNIT – I

1. Concepts of evolution and theories of organic evolution, Geological time – scale.
2. Lamarckism and Darwinism, New concepts regarding Lamarckism & Darwinism.
3. Hardy-Weinberg law of genetic equilibrium. A detailed account of destabilizing forces: (i) Natural selection (ii) Mutation (iii) Isolation and its role in species formation (iv) Genetic drift (v) Migration (vi) Meiotic drive.

UNIT – II

1. Molecular population genetics, Patterns of change in nucleotide and amino acid sequences, Ecological significance of molecular variations, Emergence of Non-Darwinism Hypothesis.
2. Genetics of quantitative traits in populations, Genotype-environment interactions, Inbreeding depression and heterosis, Molecular analysis of quantitative traits, phenotypic plasticity
3. Genetics of speciation. Phylogenetic and biological concept of species, Patterns and mechanisms of reproductive isolation, Models of speciation (Allopatric, sympatric, parapatric).

UNIT – III

1. Molecular Evolution: Gene Evolution, Evolution of gene families, Molecular drive, Assessment of molecular variation. Origin of higher categories: Micro-and Macro-evolution
2. Characteristic of evolution Extinction, replacement, irreversibility of specialization etc.
3. Adaptation diversity & nature of adaptation: adaptive radiations, occupation of new environments & niches, mimicry and coloration.

UNIT – IV

1. Biostatistics Objective & significance: important terms & symbols, graphs (bar diagrams, histograms, frequency polygons, line diagrams)
2. Frequency distributions & centering constants (Mean Median and Mode).
3. Measures of variation (standard deviation, variance, standard error of the Mean). Sampling variation of proportions, Significance of difference in proportions

UNIT - V

1. Chi-square test. Rates and ratios
2. Correlation and regression. Analysis of Variance (ANOVA)
3. Probability distributions: Binomial, Poissans and normal.

I Year : II Semester

Paper-Z-06 IMMUNOLOGY AND BIOTECHNOLOGY
Paper-Z-07 ANIMAL TAXONOMY
Paper-Z-08 GENETICS
Paper-Z-09 ANIMAL PHYSIOLOGY

Paper-Z-06 IMMUNOLOGY AND BIOTECHNOLOGY

UNIT - I

1. Innate and Acquired Immunity; phylogeny and ontogeny of Immune system,
2. Organiaztion and structure of lymphoid organs, cells of the immune system and their differentiation.
3. Nature of Immune responses, Nature of antigens and superantigens, factors influencing Immunogenicity, epitopes and haptens.

UNIT - II

1. Structure and functions of Antibodies, Antigen-Antibody interactions in vitro and in vivo, complement system, Major histocompatibility complex in mouse and HLA system in humans.
2. Organization and expression of Ig genes. T-cell and B-cell generation, activation and differentiation. Cytokines, cell mediated effector functions.
3. Immunological tolerance and Anti-immunity; Hyper sensitivity and immune responses to infection agents especially intracellular parasites.

UNIT – III

1. Basics: Definition, Biotechnology – an Interdisciplinary science. It's brief history, scope, significance, and limitations.
2. Genetic engineering, culture media, culture methods, restriction enzymes, cloning vectors, cell fusion, somatic hybridisation.
3. Recombinant DNA technology: Isolation of genetic materials gel-electrophoresis, amplification by PCR, insertion of r-DNA in host. Bioreactors and downstream processing.

UNIT IV

1. Animal tissue culture: Introduction, Primary culture, cell lines and cloning. Tissue and Organ Culture, IVF, embryo- transfers.
2. Brief discussion on the chemical, Physical and metabolic functions of different constituents of culture medium. Basic techniques of mammalian cell cultures in – vitro. Microcarrier culture, cell Synchronization and cell culture.
3. Application of animal cell culture. Hybridoma technology and monoclonal antibodies.

UNIT – V

1. Biotechnology in Industry: Food, dairy, beverages, etc.
2. Biotechnology in agriculture: BT cotton, pest resistant and virus resistant plants.
3. Biotechnology in medicine: Humulin production, gene therapy, molecular diagnosis (DNA fingerprinting, ELISA), transgenic animals; liposomes (spheroplasts) in biomedical science.

Paper-Z-07 ANIMAL TAXONOMY

UNIT - I

1. Introduction to the science of taxonomy; stages in Taxonomy, importance of taxonomy.
2. Rules of nomenclature. Linnaean hierarchy.
3. Principles of classification**:** theories of biological classification & their history.

UNIT - II

1. Concept of species; typological, nominalistic, biological, evolutionary and recognition species concepts. Concepts of superspecies and subspecies.
2. The species category; the polytypic species; population systematic intraspecific categories.
3. Methods of classification: taxonomic collection & the processes of identification.

UNIT - III

1. Taxonomic characters; types and use of taxonomic characters; concept of key characters, types of variations (qualitative and quantitative) within a single population,
2. Methods of arriving on taxonomic decisions at species level; preparation and use of taxonomic keys.
3. Newer trends in taxonomy: Cytotaxonomy - importance of cytology and genetics in taxonomy. Sonotaxonomy - importance of sound, call and sonogram in taxonomy. Molecular taxonomy – importance of macromolecular composition in taxonomy.

UNIT – IV

1. Classification of Invertebrates with salient characteristics and examples of each group.

UNIT – V

1. Classification of Vertebrates with salient characteristics and examples of each group.

Paper-Z-08 GENETICS

UNIT-I

1. Basics: Definitions of heredity, variation, gene, allele, autosomes, allosomes, haploid, diploid.
2. Homologous chromosomes, locus, homozygos, heterozygos, hemizygos, dominant, recessive, phenotype, genotype, filial generations.
3. Types of cross: monohybrid, dihybrid, test cross, back cross, reciprocal cross, probable gamete formation for cross, use of symbols.

UNIT-II

1. Laws of heredity and their variations: Works of Mendel and Morgan.
2. Incomplete dominance, multiple allele, pleotropy, genetic interactions.
3. Linkage and crossing over: Mechanism of crossing over, linkage groups, linkage maps; acessory genetic elements (plasmids, transposons and reteroelements).

UNIT-III

1. Genetics of sex: Sex linkage, sex influenced and sex limited traits, sex determination, effects of environment on sex determination.
2. Human genetics: Abnormalities in chromosome structure and number,
3. Inborne errors of metabolism, eugenics, euphenics and euthenics, genetic counselling.

UNIT-IV

1. Molecular basis of inheritance. DNA: Structure and types of DNA; DNA as a genetic material, gene structure,
2. Replication of DNA, enzymes and accessory proteins involved in DNA replication,DNA damage and repair, gene mutation and its molecular mechanism.
3. RNA: Structure and types of RNA (r-RNA, m-RNA, t-RNA, Hn-RNA, Sn-RNA, antisense-RNA); types of RNA polymerase, transcription, step initiation, chain elongation and termination; post transcriptional modification, cap and tail formation, RNA splicing.

UNIT-V

1. Translation: Mechanism of prokaryotic and eukaryotic translation, protein folding; role of chaperons.
2. Gene regulation: Gene regulation in Prokaryota, positive and negative regulation- Lac operon, tryptophan operon; gene regulatory proteins (motifs); gene regulation in Eukaryota.
3. Applied Molecular Biology: RNA interference, molecular mechanism of antisense molecules, ribozymes, molecular mapping- RFLP analysis and its application in forensic, disease diagnosis and generic counselling.

Paper-Z-09 ANIMAL PHYSIOLOGY

UNIT I

1. Digestion and Absorption of food in gastrointestinal tract.
2. Regulation of gastrointestinal processes.
3. Obesity and Starvation.
4. Common disorders of digestive tract.

UNIT II

1. Physiology and regulation of respiration.
2. Homeostasis, prevention of blood loss.
3. Cardiac cycle.
4. Blood pressure and common cardiovascular diseases.

UNIT III

1. Structure and mechanism of Kidney function.
2. Ionic and Osmotic balance.
3. Osmoregulation in aquatic and terrestrial environments.
4. Homeostasis.

UNIT IV

1. Structure and function of muscle fibers in vertebrates.
2. Molecular theory of contraction.
3. Muscle fatigue
4. Skeletal muscle disorder- Tetany, Cramps, Muscular dystrophy.

UNIT V

1. Electrochemical potential and membrane excitation.
2. Impulse conduction via myelinated , non-myelinated fibres and synaptic junctions.
3. Neurotransmitters and Neuromodulators.
4. Sense organs: eye and ear.

Paper-Z-10 ZOOLOGY Practicals: Practical Work Based on Paper Z-01 to Z-04

Total No. of laboratory hrs. 240

1. Invertebrates : I. Identification, classification & study of distinguishing features of important representatives (Protozoa to Hemichordata).
II. Study of permanent prepared slides (Protozoa to Hemichordata). III. Anatomy*: 1. Reproductive, excretory, nervous & heamocoelomic systems of leech. 2. Nervous system and general anatomy: Patella, lamellidens, Mytilus and Aplysia. 3. General Anatomy, reproductive and nervous system of Cockroach, Grasshopper.
IV. Permanent preparations and their study: 1. Preparation of cultures of Amoeba, Paramaecium and Euglena.Study of these protozoans using vital dyes. 2. Permanent preparations of Amoeba. Paramaecium and Euglena from cultures, vorticella from the pond water; flagellates from the gut of white ant; Rectal ciliates, Trypansomes in the blood of house rat; lifecycle stages of Monocystis from the seminal vesicle of earthworm. 3. Collection, fixation & permanent preparations of trematodes, cestodes & nematodes found in sheep and pig and in the stool of infected persons. 4. Permanent preparations through various parts of Animals mentioned in III (i-

iv) anatomy section and study of the structure. 5. Permanent preparations of different materials provided for study using microtome.
V. Biochemistry : 1. Identification of protein, carbohydrates and Lipid in various tissues. 2. Identification of different kinds of mono, di and poly saccharides in biological and chemical materials. 3. Quantitative estimation of the following by spectrophotometric / semiautoanalyser method 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. 4. Paper chromatography and Thin Layer Chromatography: Unidimensional chromatography using amino acids from purified samples and biological materials. 5. Study of digestive enzymes in different parts of alimentary canal.
VI. Cell biology: 1. Squash & smear preparations of testis of cockroach / grasshopper : Acetocarmine & Feulgen staining of these preparations. 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 or Drosophila larva. 4. 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. 5. Chromosome counts in cells of the testis of an insect or mammal or cells of the bone marrow of a mammal, micrometry and image analysis. 6. Study of prepared microscopic slides of various cell types, mitosis, meiosis and giant Chromosomes.
VII. Biostatistics: 1. Preparation of frequency tables and graphs (Computer based exercise). 2. Calculation of standard deviation, variance and standard error of the mean. 3. Correlation and rank of correlation. 4. Calculation of probability & significance between mean using t-test. 5. Calculation of significance using Chi-square test. 6. Plotting the slope of a line on a graph: calculations of the slope of a line, coefficient and regression. 7. Preparation of histogram, bar diagram and line graph preferably using computer
VIII. Field Trip: 1. Study of animals in their natural habitats.
Note: Use of animal for dissection and practical work is subject to the conditions that there are not banned under the wildlife protections act.

Practical Work Based on Paper Z-05 to Z-10 (Total No. of laboratory hrs. 240)
1. First Day
1. Chordates : (a) Taxonomy : Study of museum specimens or representative animals from all chordate groups (Protochordata to Mammalia).
(b) Anatomy : (i) General anatomy and neural gland of Herdmania using charts and computer software. (ii) Afferent and efferent arteries, cranial nerves, membranous labyrinth, eye muscles and their innervation ,brain of any fish. (iii) Study of fish anatomy through serial section of fry and fingerling stages. (iv) Limb musculature, cranial nerves and eye muscles and their innervation in frog dissection using computer software. (v) General anatomy, major blood vessels and cranial nerves of any nonpoisonous snake through charts / models / computer software. Study of differences between poisonous and non-poisonous snakes. (vi) Flight muscles, perching mechanism, air sacs and anatomy of the neck region in pigeon through charts / models / computer software. (vii) Reproductive system and anatomy of the neck region in rat.
(c) Osteology : Comparative study of the axial and appendicular skeleton from fish to mammals, with particular reference to important skull types in amphibians, reptiles, birds and mammals.
(d) Permanent preparations: Whole mounts of pelagic tunicates, cycloid scales, pecten and columella in pigeon, ear ossicles of rat or squirrel or any other mammal.

(e) Histology: A detailed study of the histology of all mammalian tissues and organs through prepared slides.

2. Second Day

1. Immunology

1. To determine the ABO blood group by slide agglutination.
2. To conduct ELISA.
3. To conduct radio immuno diffusion.
4. Demonstration of Widal, VDRL, pregnancy.

2. Physiology:

1. Determination of osmotic potential by tissue weight method.
2. Separation of amino acids by TLC/paper chromatography and calculating the Rf value.
3. To estimate hemoglobin contents of human blood by hemoglobinometer.
4. To conduct serum preparation.
5. To detect clotting time of human blood sample.
6. To detect bleeding time human blood sample.
7. Blood film preparation and identification of cells.
8. To carry out differential leukocyte of human blood sample.
9. Determination of peroxidase activity.

3. Field Trip: 1. Study of animals in their natural habitats.

Note: Use of animal for dissection and practical work is subject to the conditions that there are not banned under the wildlife protections act.

M.Sc. ZOOLOGY I Semester

Scheme of Practical Examination & Distribution of Mark

Max. Marks 100 **First Day** Duration - 5 hrs.

(a) Exercise in Cell Biology	10 Marks
(b) Exercise in Invertebrate Taxonomy (Using Taxonomic keys)	10 Marks
(c) Exercise in statistical methods	
(i) Diagrammatic presentation	10 marks
(ii) Numerical based on statistical methods	10 Marks
(d) Identification & comments on spots (10x3)	30 Marks
(e) Viva-voce	10 Marks
(f) Class record	10 Marks
(g) Regularity, Participation in Departmental activities, Laboratory skills, Cleaning of Work place, etc.	10 Marks
Total	100 Marks

M.Sc. ZOOLOGY I Semester

Scheme of Practical Examination & Distribution of Marks

Max. Marks 100 **Second Day** Duration - 5 hrs.

(a) Invertebrate major dissection / demonstration	10 Marks
(b) Invertebrate minor dissection / demonstration	05 Marks
(c) Permanent preparation	10 Marks
(d) Exercise in Biochemistry	10 Marks
(e) Report of Field Trip	10 Marks
(f) Viva-voce	20 Marks
(g) Class record	10 Marks
(h) Seminar	25 Marks
Total	100 Marks
GRAND TOTAL (100+100)	200 Marks

M.Sc. ZOOLOGY II Semester

Scheme of Practical Examination & Distribution of Marks

Max. Marks 100 **First Day** Duration - 5 hrs.

(a) Exercise in Cell Biology	10 Marks
(b) Exercise in Invertebrate Taxonomy (Using Taxonomic keys)	10 Marks
(c) Exercise in statistical methods	
(i) Diagrammatic presentation	10 marks
(ii) Numerical based on statistical methods	10 Marks
(d) Identification & comments on spots (10x3)	30 Marks
(e) Viva-voce	10 Marks
(f) Class record	10 Marks
(g) Regularity, Participation in Departmental activities, Laboratory skills, Cleaning of Work place, etc.	10 Marks
Total	100 Marks

M.Sc. ZOOLOGY II Semester

Scheme of Practical Examination & Distribution of Marks

Max. Marks 100 **Second Day** Duration - 5 hrs.

(a) Vertebrate major dissection / demonstration	10 Marks
(b) Vertebrate minor dissection / demonstration	05 Marks
(c) Permanent preparation	06Marks
(d) Exercise in Physiology	07 Marks
(e) Exercise in Immunology	07 Marks
(e) Report of Field Trip	10 Marks
(f) Viva-voce	20 Marks
(g) Class record	10 Marks
(h) Seminar	25 Marks
Total	100 Marks
GRAND TOTAL (100+100)	200 Marks

II Year : III Semester

Paper-Z-11 CHORDATA
Paper-Z-12 ANIMAL ECOLOGY
Paper-Z-13 DEVELOPMENTAL BIOLOGY OF CHORDATES
Paper-Z-14 SPECIAL PAPER
Paper-Z-15 ZOOLOGY Practical: Duration 10 Hrs; MM 200, Min 100.
Day 1; 5 Hrs (Z-06 & Z-07) and Day 2; 5 Hrs (Z-08 & Z-09).

Paper-Z-11 CHORDATA

UNIT – I

1. Origin and outline classification of chordates.
2. Interrelationships of Hemichordata, Urochordata and Cephalochordata and their relations with other deuterostomes.
3. Life histories of sessile and pelagic tunicates (ascidian), Pyrosoma, Salpa, Doliolum and Oikoplpeura.

UNIT - II

1. Geological time scale and fossils.
2. Origin, evolution and adaptive radiations of vertebrates :Agnatha.(Ostracoderms and Cyclostomes).
3. Early gnathostomes (Placoderms).

UNIT - III

1. A general account of Elasmobranchi, Holocephali, Dipnoi and Teleostomi.
2. Adaptive radiation in bony fishes.
3. Origin, evolution and adaptive radiation of Amphibia.

UNIT - IV

1. Origin and evolution of reptiles; the conquest of land Seymouria and related forms; Cotylosauria; basic skull types and outline classification of reptiles.
2. Dinosaurs : Types and evolutionary significance.
3. Livinig reptiles : a brief account of Rhynchocephalia, Chelonia, Squamata & Crocodilia.

UNIT - V

1. Origin and evolution of birds; Origin of flight; flight adaptations.
2. Origin of mammals, primitive mammals (Prototheria & Metatheria). A general survey of main radiations in eutherian mammals, excluding detailed reference to individual orders.
3. Evolution of man; relationships of man with other primates; fossil record of ancestry of man.

PAPER Z -12: ANIMAL ECOLOGY

UNIT - I

1. Concepts of modern ecology.
2. Limiting factors : Leibig's law of minimum, Shelford's law of tolerance; combined concept of limiting factors, conditions of existence as regulatory factors.
3. Analysis of environment : The general Methods.

UNIT – II

1. Role of physical factors: temperature, light, water, atmospheric gases, media, substratum, climatology.
2. Brief review of important physical factors as limiting factor; Nutrients and environment.

UNIT – III

1. Organization at the population level : (a) General properties of population. (b) Population growth form and forces shaping the population growth. (c) Measurement of population; simple numerical problems on population measurement. (d) Animal aggregation and social life.
2. Organization at the community level : (a) Biotic community concept. (b) Community structure and concept of community dominance. (c) Ecotone and concept of "edge effect".
3. Patterns in communities : Stratification, zonation, activity, food web, reproductive and social structure. (e) Community versus continuum. (f) Evolution of communities.

UNIT – IV

1. Succession in community : Basic types of succession; convergence and divergence in succession; modifications in succession; concept of climax, monoclimax versus polyclimax theory; barriers and ecesis in succession; biome.
2. Fluctuations within community : Irruptive cycle, fluctuation, causes of fluctuation, cycles.
3. Environment and animals in ecosystem : (a) Nature and constituents of ecosystem. (b) Fundamental operation of ecosystem. (c) Flow of matter and energy in ecosystem. (d) Homeostasis in the ecosystem. (e) Cycling of chemical elements in ecosystem (bio-geo-chemical cycles).

UNIT – V

1. Concept of productivity : Productivity of land and water, measurement of productivity.
2. Organization and dynamics of ecological communities : The habitat approach : A detailed knowledge of extent, zonation, environment, biota, adaptations and communities of fresh water, marine, terrestrial and estuarine ecosystems.
3. The ecological outlook : Space ecology, nuclear radiations, human population explosion, resources; applied human ecology.

PAPER Z – 13 DEVELOPMENTAL BIOLOGY OF CHORDATES

UNIT – I

1. Theories of development : Preformation and epigenesis. 2. Spermatogenesis: Growth of spermatocyte and acrosome formation; spermeogenesis. 3. Oogenesis: (a) Growth of oocyte and vitellogenesis. (b) Organization of egg cytoplasm; role of the egg cortex. (c) Morphogenetic determination in egg cytoplasm. 4. Fertilization : Significance of fertilization in development and the essence of activation of the egg.

UNIT – II

1. Early embryonic development. Patterns of cleavage: morulation and blastulation.
2. Gastrulation in chordates (tunicates to mammals). (a) Fate maps. (b) Mechanics of gastrulation(c) Morphogenetic movements. (d) and significance of gastrulation.
3. Primary embryonic induction: (a) Concepts of potencies; prospective fates; progressive determination, totipotency and pleuripotency, nuclear transfer experiment. (b) Induction of the primitive nervous system (Spemann's primary organizer) (c) Nature & regionally specific properties of inductor. (d) Competence. (e) Abnormal (hetrogeneous) inductors. (f) Chemistry and mechanism of action of inducing substances.

UNIT – III

1. Cell differentiation and differential activity. 2. Organogenesis : (a) Morphogenetic processes in epithelia and mesenchyme in organ formation. (b) Morphogenesis of brain, neural crest cells and their derivatives. (c) Development of the eye, heart, alimentary canal and its accessory

organs. 3. Maternal contributions in early embryonic development. 4. Genetic regulations of early embryo development.

UNIT – IV

1. Embryonic adaptations: (a) Evolution of cleidoic egg and its structural and physiological adaptations. (b) Development and physiology of extra-embryonic membranes in amniotes. (c) Evolution of viviparity. (d) Development, types and physiology of mammalian placenta. 2. Metamorphosis in amphibia : (a) Structural and physiological changes during metamorphosis. (b) Endocrine control of metamorphosis.

UNIT – V

1. Types of regeneration, physiological, reparative and compensatory hypertrophy, regenerative ability in chordates. (b) Morphological and histological processes in amphibian limb regeneration. (c) Origin of cells of regeneration, de-differentiation, redifferentiatoin, (d) pattern formation during amphibian limb generation;
2. Reasons for failure of limb generation ability in other chordates and mammals; methods for induction of regenerations. 3. Abnormalities of Embryonic development: teratology.

Paper-Z-14 SPECIAL PAPER

Paper-Z-15 ZOOLOGY Practical

1. Chordates : (a) Taxonomy : Study of museum specimens or representative animals from all chordate groups (Protochordata to Mammalia). (b) Anatomy : (i) General anatomy and neural gland of Herdmania using charts and computer software. (ii) Afferent and efferent arteries, cranial nerves, membranous labyrinth, eye muscles and their innervation ,brain of any fish. (iii) Study of fish anatomy through serial section of fry and fingerling stages. (iv) Limb musculature, cranial nerves and eye muscles and their innervation in frog dissection using computer software. (v) General anatomy, major blood vessels and cranial nerves of any nonpoisonous snake through charts / models / computer software. Study of differences between poisonous and non-poisonous snakes. (vi) Flight muscles, perching mechanism, air sacs and anatomy of the neck region in pigeon through charts / models / computer software. (vii) Reproductive system and anatomy of the neck region in rat. (c) Osteology : Comparative study of the axial and appendicular skeleton from fish to mammals, with particular reference to important skull types in amphibians, reptiles, birds and mammals. (d) Permanent preparations : Whole mounts of pelagic tunicates, cycloid scales, pecten and columella in pigeon, ear ossicles of rat or squirrel or any other mammal. (e) Histology : A detailed study of the histology of all mammalian tissues and organs through prepared slides.
2. Ecology : (a) Measurement of climatic factors (atmosphere, water, temperature and relative humidity). (b) Measurement of water and soil pH, edaphic factors of soil; preparation of soil extract, determination of humidity in microhabitat; pH, alkalinity of water, dissolved oxygen, free carbondioxide, chloride, salinity, temporary and permanent hardness of water, turbidity, velocity of current. (c) Measurement of population density. Numerical problems of population determination to be done. (d) A field study of any one of the following habitats to be assigned to an individual or to a group of students : (i) Pond habitat. (ii) Marine habitat. (iii) Terrestrial habitat.
3. Developmental biology : (a) Study of development of frog or toad through : (i) Formalin preserved or living material (egg, spawn, embryo, larvae and metamorphic stages). (ii) Permanent microscopic slides of sections through successive embryonic and larval stages. (b) Study of development of chick through : (i) Permanent whole mounts of successive embryonic

stages. (ii) Permanent microscopic slides of section through representative regions of successive embryonic stages. (Note: Special emphasis should be laid on organogenesis and morphogenesis). (c) Removal of chick embryos of 18,21,24,33,72 and 92 hours from the egg and their study and identification in the living state; permanent whole mounts of these embryos using living states. (d) Study of (i) formalin preserved fetuses with placenta and (ii) histology of the placenta of any mammal.
4. Special Paper:

II Year : IV Semester
Paper-Z-16 ANIMAL BEHAVIOUR
Paper-Z-17 SECIAL PAPER
Paper-Z-18 SPECIAL PAPER
Paper-Z- 19 DISSERTATION
Paper-Z-20 ZOOLOGY Practical: Duration 10 Hrs; MM 200, Min 100.
Day 1; 5 Hrs (Z-06 & Z-07) and Day 2; 5 Hrs (Z-08 & Z-09).

Paper-Z-16 ANIMAL BEHAVIOUR

UNIT – I

1. Introduction of animal behaviour: definition, concept of ethology, scope and limitations.
2. Orientation : Classification of various types of taxes and kineses.
3. Methods of studying behaviour : Brain lesions; electrical stimulation, drug administration.

UNIT – II

1. Types of behaviour and their regulation : Components of feeding behaviour : Hunger drive; directional movement, avoidance, eating, carrying and hoarding.
2. Factors influencing choice of food. Nervous regulation of food and energy intake.
3. Motivated behaviour ; drive, satiation and its neurophysiological control.

UNIT – III

1. Learning : Habituation conditioned reflex; trial and error; latent learning; learning and discrimination, imprinting; neural mechanism of learning.
2. Instinctive behaviour: Concept, phyletic decent and physiology.
3. Hormones and behaviour. Mammalian nervous system and involvement of hypothalamus in the regulation of behavioural patterns.

UNIT - IV

1. Social behaviour in primates : (a) Primate societies. (b) Social signals, olfactory, tactile, visual, vocal and acoustic. (c) Status : Dominance and hierarchy, territorial behaviour, courtship and mating, aggression.
2. Behaviour of domestic and zoo animals.
3. Behaviour in birds: Behaviour of Streptopelia (ring dove); homing and migration.

UNIT - V

1. Reproductive behaviour in fish (Stickle back or any other fish).
2. Behaviour in insects: Social behaviour, communications, concealment behaviour, role of pheromones.
3. Behavioural genetics: Single gene effect, multiple gene effect, behavioural variation in an individual; genetics and human behaviour.

Paper-Z-17 SECIAL PAPER
Paper-Z-18 SPECIAL PAPER
Paper-Z- 19 DISSERTATION
Paper-Z-20 ZOOLOGY Practical:
1. Ethology : (a) Study of the process of learning in rat with the help of animal maize; analysis of the results with simple experiments. (b) Study of the shock and avoidance behaviour in rat. (c) Imprinting in precotial birds. (d) Chemical communication in the earthworms. (e) Study of the food preferences and feeding behaviour of an insect pest. (f) Study of the phototactic response in Triboleum/housefly. (g) Study of habituation in chicks.
3. Special Paper:

4. Special Paper:
5. Dissertation:

Note : Use of animals for practical work is subject to the condition that they are not banned under the wild life protection act.