UNIVERSITY OF KOTA, KOTA

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

Master of Science

ZOOLOGY

Faculty of Science

SCHEME OF EXAMINATIONS AND SYLLABUS

M. Sc. First and Second Semester Examinations

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	100	36	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 5 hrs.

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 .
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 5 hrs.

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.
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 will also be 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. **Microscopy:** 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.

M.Sc. ZOOLOGY I Semester

Paper-Z-05: 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. Permanent preparations through various parts of Animals mentioned in III (i-iv) anatomy section and study of the structure. 4. 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.

M.Sc. ZOOLOGY I Semester

Scheme of Practical Examination and Distribution of Mark

Max. Marks: 100 Duration - 5 hrs.

(a) Exercise in Cell Biology	05 Marks
(b) Exercise in statistical methods	07Marks
(c) Identification & comments on spots (10x3)	30 Marks
(d) Invertebrate major dissection / demonstration	08 Marks
(e) Invertebrate minor dissection / demonstration	05 Marks
(f) Permanent preparation	05 Marks
(g) Exercise in Biochemistry	05 Marks
(h) Seminar	10Marks
(i) Viva-voce	10 Marks
(j) Class record	10 Marks
(k) Report on field trip	05 Marks
Total	100 Marks

M.Sc. ZOOLOGY II Semester

Z 10: Practical Work Based on Paper Z-05 to Z-09 (Total No. of laboratory hrs. 240)

I. Biotechnology/Immunology

1. To determine the ABO blood groups by slide agglutination.
2. To conduct/demonstrate ELIZA Test
3. Demonstration of Immunological tests WIDAL, VDRL, Pregnancy.
4. To conduct Radio Immuno-diffusion.

II. Invertebrate Taxonomy

1. Identification of Invertebrates using taxonomic keys.

III. Genetics:

1. Culture and identification of male and female *Drosophila* through prepared culture.
2. Identification of wild and mutant forms of *Drosophila.*
3. Problems based on Mendelism and gene interaction.
4. Identification of blood groups in man.
5. Demonstration of sex chromatin (Barr Bodies).

IV. Animal physiology

1. Determination of osmotic potential by tissue weight method.
2. Study of ECG, Heart beat and Blood pressure.
3 Determination of hemoglobin in blood sample by haemoglobinometric/ Photometric (preferably).
4. Demonstration of the following in blood; Clotting time (CT), Bleeding time (BT), erythrocyte sedimentation rate (ESR), haemolysis and crenation, differential count of leucocytes.
5. Determination of blood urea and blood sugar value.
6. Determination of peroxide activity.
7. To carryout differential leukocyte count in human blood sample.
8. Blood film preparation and identification of cells.
9. To conduct serum preparation.
10. Separation of amino acids by Paper chromatography / Thin Layer Chromatography and calculating Rf value.

Scheme of Practical Examination & Distribution of Mark

Duration - 5 hrs.		MM 100
(a)	Exercise based on Biotechnology/Immunology	10 Marks
(b)	Exercise in Genetics	10 Marks
(c)	Exercise in Invertebrate Taxonomy (10 + 10) (Using Taxonomic keys)	20 Marks
(d)	Exercise in physiology	10 Marks
(e)	Seminar	20 Marks
(f)	Field work/Assessment	10 Marks
(g)	Viva-voce -	10 Marks
(h)	Class record -	10 Marks
Total -		**100 Marks**

Syllabus and Course Scheme

Academic year 2020-21

Master of Science- Zoology

III and IV Semester Examination, 2020-21

UNIVERSITY OF KOTA

MBS Marg, Swami Vivekananda Nagar,
Kota - 324 005, Rajasthan, India

Website: ***uok.ac.in***

II YEAR: III SEMESTER

Paper-Z-11 CHORDATA

Paper-Z-12 ANIMAL ECOLOGY

Paper-Z-13 SPECIAL PAPER

Paper-Z-14 SPECIAL PAPER

Paper-Z-15 ZOOLOGY Practical: Duration 10 Hrs; MM 100, Min 50.

Day 1- based on Z-11 &Z-12 ;5 hrs; 50 marks.

Day 2-based on Z-13 &Z-14 ;5 hrs; 50 marks.

Paper-Z-11 CHORDATA

UNIT – I

1. Origin and outline classification ofchordates.

2. Inter-relationships of Hemichordata, Urochordata and Cephalochordata and their relations with other deuterostomes.

3. Life histories of sessile and pelagic tunicates (ascidian), *Pyrosoma, Salpa, Doliolum* and *Oikopleura.*

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.
3. 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-15 ZOOLOGY Practical (Based on Z – 11, Z – 12)

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.

Scheme of M.Sc. III Semester Zoology: Practical (General papers Z – 11, Z – 12)

Examination

Distribution of Marks

Time: 5 hrs	**Max Marks: 50**
SN Exercise	Marks
1. Learning of anatomy*	07 marks
2. Permanent preparation*	05 marks
3. Exercise on Ecology	08 marks
4. Spotting (Museum specimens, bones and slides) 5 spots x 2 marks	10 marks
5. Seminar	05 marks
6. Viva-voce	05 marks
7. Class Record	10 marks
Total	**50 marks**

(* Use of animal for dissection and practical work is subject to the condition that they are not banned under the Wildlife Protection Act)

PAPER Z – 13 (A) SPECIAL PAPER: PAPER- CELL BIOLOGY

Unit-I

1 Concept of cell Theory

1.1 Cell shape, Cell size, Cell Number

1.2 Prokaryotic & eukaryotic cell

2. Cell Types; Detailed structure of different types of cell:

(a) Nerve cell (b) Muscle cell (c) Gland cell (d) Blood cells

3. Cell wall & extra cellular Matrix

3.1 Extra cellular Matrix in Bacteria & plant cells.

3.2 Extra cellular Matrix in animal cells.

4. Cytoskeleton: Microtubules, Actin filaments & Intermediate filaments.

Unit-II

5. Cell Membrane:

Membrane Models.

Membrane Portions- spectrum, glycophorin, Bacteriorhodopsin, porins, cadherins, selectins & integrins Molecular structure of the specialized modifications of the cell membrane cilia, flagella, myelin sheath.

Unit-III

Concept of cell surface: electro kinetic properties of cell surface, their role in intra cellular interaction in cell fusion, cell aggregation etc. Cell adhesions & cell functions.

Cell membrane:- Transport system & permeability, Properties & functions. Membrane excitability (Neurotransmission and ion channels).

Unit-IV

Cytoplasm: Generalized structure & composition of cytoplasm .

Detailed discussion on the following cytoplasmic components with special reference to the biochemical & physiological aspect.

(i) Endoplasmic reticulum (ii) Ribosomes (iii) Golgi Bodies

(ii) (iv) Mitochondria (v) Peroxisomes (vi) Centrosomes

Unit-V

Nucleus:- Structure & function of the nuclear membrane.

Structure & chemical organization of the resting nucleus.

Nucleus & Nucleolus.

Chemistry & biosynthesis of Nucleic acids.

PAPER –Z 13 (B) ENVIRONMENTAL BIOLOGY

UNIT - I

Basic concepts of Environmental planning; Environmental priorities in India; urban planning; Environmental problem of urban planning; Rural Environmental planning; National and State environmental policies. System analysis including models in environmental Biology. Impact of environment at cellular level: Cellular interaction with environment.

Unit- II

Ecology- Definition, principles and scope. Abiotic and biotic components, energy flow, food chain, food web and ecological pyramid. Concept of population and community; Ecotones and their importance. Biogeochemical cycles and regulation. Basic cycles; Hydrologic, Carbon, Oxygen, Nitrogen, Phosphorus and Sulphur cycles. Nutrient cycling in forest and aquatic ecosystems.

Unit-III

Ecosystem: structure and function-Terrestrial Ecosystems: Grasslands (including grazing lands), Forests: characteristics of alpines, temperate and tropical forests. Stratification, high altitude (with special reference to Himalayan ecology) Deserts: Types and ecological attributes of desert biota. Aquatic ecosystem; Fresh Water: Lakes (including salt lakes), Ponds, streams, springs, rivers and marshes. Marine: Zonation fauna, Estuarine: Ecological peculiarities and adaptations (including impact on fauna).

Unit- IV

Environmental Physiology: Basic Metabolic rate and body size; Metabolism and climatic adaptations - Hibernation and aestivation; Poikilotherms and Homeotherms; Asphyxic responses. Response to temperature and Pressure. Haematological changes, Thermal properties of water and survival limits. Acclimatization. Aquatic Ecosystems.

Unit- V

Development and evolution of ecosystems: causes and kinds of succession diversity and productivity in relation to succession and development. Urban, rural and other Man-made ecosystems, their impact on animal life. Urbanization and industrialisation. Socio-ecological impacts.

Paper-Z-13 (C) **SPECIAL PAPER**: **- ENTOMOLOGY**

Unit-I

1. Insect integument – structure, composition and functions
2. Moulting & biochemistry of sclerotisation
3. Structure of Head, thorax, abdomen.

Unit-II

4. Appendages of insect- antenna, mouthparts, legs and wings; functions.
5. Wing venation
6. Flight muscles and mechanism of insect flight
7. Modification in the insect appendages.

Unit-III

8. Digestive system- Alimentary canal, Physiology of digestion
9. Circulatory system –Anatomy & Physiology
10. Composition of haemolymph
11. Sound and light producing organs

Unit-IV

12. Respiratory system – structure & physiology. Accessory respiratory organs

13. Respiration in aquatic insects.
14. Excretory system in insects ; excretory products.
15. Neuro – endocrine organs in insect.

Unit-V

16. Classification of insects upto orders and suborders
17. Comparative study of following taxa

(i) Zygoptera and Anisoptera
(ii) Ensifera and caelifera
(iii) Homoptera and Heteroptera
(iv) Adephaga and polyphaga
(v) Symphyta and Apocrita

PAPER- Z -13 (D): FISH BIOLOGY

UNIT- I

1. Geographical distribution: Characters and Classification of fishes, with distinguishing characters of principal subdivisions (Elasmobranchii, Crossopterygii and Actinopterygii). 2. Conservation and Status of fish fauna of India with special reference to Rajasthan.

UNIT-II

3. General account and phylogenetic significance of Ostracoderms and Placoderms. 4. General Characters, classification, affinities and phylogenetic status of cyclostomata, Lamprey and Hagfishes. Petromyzon and Ammocoete larva.

UNIT-III

5. Integument: Structure and Function, fin musculature and eye muscles. 6. Exoskeleton: Scales of fishes (Placoid, Cycloid, Ctenoid, Cosmoid and Ganoid scales), Colouration of fishes (Change in colour, Mechanism of colour change, significance and uses of colouration).

UNIT-IV

7. Structure, modification and functions of median and paired fins, Theories of origin of median and paired fins. 8. Fish Locomotion, Fish Migration: Definition, types, symptoms and significance. 9. Structure and Function of Swim Bladder: Structural modification, Blood supply of the air bladder, Sturcture of bladder wall, Gas secreting complex, connection with the ear, Respiratory function, Sound production, auditory function, sensory function, as a hydrostatic organ, origin of swim bladder.

UNIT-V

10. Endoskeleton: Axial skeleton, Skull, vertebral column, Ribs, fin skeleton. Visceral arches, Pectoral and Pelvic girdles and types of jaw suspension in fishes. 11 . Weberian apparatus and its significance

Paper-Z-13 (E) SPECIAL PAPER: FORESTRY AND WILDLIFE MANAGEMENT

Unit I

Silviculture

General Silvicultural Principles: Ecological and physiological factors influencing vegetation, natural and artificial regeneration of forests; methods of propagation, nursery techniques (layout, preparation of beds, seed sowing, tending, water budgeting, hardening, grading, etc), plantation techniques (planting in pits, direct seed sowing, cutting, planting, etc).

Major Silvicultural systems (clear felling, coppice with standard system, selection system, etc). Management of silviculture systems in temperate, subtropical, humid tropical, dry tropical and coastal tropical forests with special reference to plantations, choice of species, establishment and management of standards, intensive mechanized methods, aerial seeding, thinning.

Unit - II

Forest Types & Forest Services

Principle forest types: Introduction, classification and distribution in relation to other countries, Basis for classification, Major Forest Types of India and their distribution according to Champion and Seth's classification. Major Forest types of Rajasthan. Role of mini-forests and forest trees in overall resource management,

Forest as material and service provider: Environmentally sound forest harvesting practices; logging and extraction techniques and principles, transportation systems, storage and sale; Non-Timber Forest Products (NTFPs) - definition and scope; gums, resins, oleoresins, fibres, oil seeds nuts, rubber, canes, bamboos, medicinal plants, charcoal, lac and shellac, katha and tendu leaves.

Unit- III

Forest Soil and Watershed Management

Forest Soils: Classification, factors affecting soil formation; physical, chemical and biological properties. Causes for soil erosion; types- wind and water erosion; conservation and management of eroded soils/areas, wind breaks, shelter belts; sand dunes; reclamation of saline and alkaline soils, water logged and other wastelands. Role of micro-organisms in ameliorating soils; N and C cycles, Role of VAM (Vesicular arbuscular mycorrhizae); concepts of watershed; forest hydrology, watershed development in respect of torrent control, river channel stabilization, avalanche and landslide controls, rehabilitation of degraded areas.

Unit- IV

Forest Protection

Injuries to forest – abiotic and biotic, destructive agencies, insect-pest and disease, effect of air pollution on forests and forest die back. Susceptibility of forest to damage, nature of damage, cause, prevention and protective measures; benefits due to chemical and biological control. Role of afforestation and forest regeneration in absorption of CO2, concept of carbon sequestration.

Unit- V

Forest Legislation

Indian Forest Policy, 1988 of People's involvement, Joint Forest Management, Involvement of women; Forestry policies and issues related to land use, timber and non-timber products, sustainable forest management; industrialization policies; institutional and structural changes. Forest laws, necessity; general principles, Indian Forest Act 1927; Forest Conservation Act, 1980; Wildlife Protection Act 1972 and their amendments; Application of Indian Penal Code to Forestry. Environmental Impact Assessment (EIA)

Paper-Z-14 (A) SPECIAL PAPER: CELL BIOLOGY

Unit-I

Chromosomes (a) structure, chemical & functional organization of different types of chromosomes (autonomies, giant chromosomes, Sex chromosomes, supernumerary etc).

Bacterial & plasmid genome.

Unit-II

Cell division- meiosis & mitosis; mitotic poisons & their action molecular basis of division cycle.

Unit-III

Chromosomal aberrations :-

Polyploidy, Polysomy

variation & evolution of chromosome number

Mutations and mutagens

Unit-IV

Gametogenesis - Cytological, cytochemical & endocrinological study on the developing male female germ cell, structure & physiology of ovum & spermatozoon.

Unit-V

Physiology of fusion of gametes & acrosome reaction, prevention of polyspermy, egg metabolism during fertilization.

parthenogenesis.

Cell Biology Practical Syllabus based on Paper Z-13, Z-14 (A)

1. Cytological, cytochemical and physiological study on the cells.
2. Study of cell division study of mitotic and meiotic divisions, with special reference to the mechanism of chromosome movement.

3. Chromosomes: study and slide preparation of normal and giant (lamp brush and polytene) chromosomes.

4. Study of various microscopy techniques.

5. Study of various cell organelles.

Scheme of M.Sc. III Semester Zoology: Practical (Cell Biology) Examination

Distribution of Marks

Time : 5 hrs	**Max Marks: 50**
1. Exercise on techniques	05 marks
2. Permanent preparation (cell organelles/cell division)*	05 marks
3. Exercise on Cytochemical/physiological study	08 marks
4. Spotting (Permanent slides, Models, Photo etc.) 5 spots x 2 marks	10 marks
5. Seminar	05 marks
6. Viva-voce	05 marks
7. Class Record	10 marks
Total	**50 marks**

PAPER – Z 14 (B) ENVIRONMENTAL BIOLOGY

UNIT-I

Biodiversity conservation- Definition, classification and importance of Biodiversity; Endangered and Threatened Species (Flora and fauna) of India and Rajasthan, Hotspots of Biodiversity. Role of plants in natural ecosystems and life support system (terrestrial, freshwater and marine); Role of plants in modern and traditional medicine. Role of animals in conservation of natural ecosystems.

UNIT-II

Water Pollution; Types, sources and consequences of water pollution. Physico-chemical and Bacteriological sampling and analysis of water quality. Sewage and waste water treatment and recycling. Water quality standards. Marine: Sources of marine pollution and control. Criteria employed for disposal of pollutants in marine system, coastal management.

UNIT-III

Soil; Physico-chemical and bacteriological sampling and analysis of soil quaIity. Industrial waste/effluents and heavy metals, their interactions with soil components. Soil microorganisms

and their functions, degradation of different insecticides, fungicides and weedicides in soil. Different kinds of synthetic fertilizers (NP & K) and their interactions with different components of soil. Soil Pollution Control.

UNIT-IV

Sources and generation of solid wastes, their characterization, chemical composition and classification. Different methods of disposal and management of solid wastes (Hospital Wastes and Hazardous Wastes); Sources of noise pollution, measurement of noise and Indices, effect of meteorological parameters on noise propagation. Noise exposure levels and standards. Noise control and abatement measures. Impact of noise on human health. Radioactive waste and radioactivity from nuclear reactors; Thermal Pollution. Impacts of large-scale utilization of Solar, Wind, Hydro and Ocean energy.

UNIT-V

Environment legislation: Environmental Management Systems; Provision in Constitution of India regarding Environment (Article 48A and 51A). Environmental (Protection) Act, 1986 and Rules 1986. Air (Prevention and Control of Pollution) Act, 1981 as amended by Amendment Act 1987 and Rule 1982. Water (Prevention and Control of Pollution) Act, 1974 as amended up to 1988 and Rules 1975. Wildlife (Protection) Act, 1972, amended 1991. Indian Forest Act (Revised) 1982. Biodiversity Act, 2002; Bio-Medical Waste (Management and Handing) Rules-1975; Hazardous Waste (Management and Handling) Rules- 1989.

PRACTICAL PAPER –Z 15 (B) ENVIRONMENTAL BIOLOGY based on Z 13 (B) & 14 (B)

1. Identification of wild life and local trees of Rajasthan.

2. Identification of selected endangered wildlife species of India (eg. Asiatic Lion, Tiger, Panther, Sloth bear, Rhinoceros, vulture, black buck, flying squirrel, tree frog etc.).

3. Measurement of climatic factors (atmosphere, water, temperature and relative humidity).

4. 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.

5. Measurement of noise

6. 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

Scheme of M.Sc. (Semester – III) Zoology Examination: Environmental Biology (Special Paper)

Distribution of Marks

Time : 5 hrs.	**Max Marks: 50**
1. Exercise on analysis of water sample	06 marks
2. Exercise on analysis of soil sample	06 marks
3. Noise measurement	04 marks
4. Identification of plankton (Phyto- and Zooplankton)	04 marks
5. Identification and comments on 5 spots	10 marks
6. Viva-voce	05 marks
7. Class Record, Field Trip and Project Report	10 marks
8. Seminar (internal)	05 marks
	Total 50 marks

PAPER-Z – 14 (C) : ENTOMOLOGY

Unit-I

1. Effects of Physical factors, population dynamics.
2. Intraspecific and interspecific relations, host plant insect-interactions.
3. Biochemical adaptation to environmental stress, Pheromonal control of fertility in insects.

Unit-II

4. Embryology : Embryonic and post embryonic development; diapauses.
5. Types of larvae, pupae and metamorphosis
6. Role of endocrine glands in growth and development, viviparity and parthenogenesis.

Unit- III

7. General idea of damage caused by pests.
8. Principal methods of pest control : mechanical, physical, culture, legislative and quarantine.
9. Biological control
10. Integrated pest Management.

Unit-IV

11. Insecticides : classification and types
12. Mode of action and methods of application
13. Drawbacks of chemical control.

Unit-V

14. A general account of chemosterilants, attractants, repellants, pheromones, growth regulators and such other compounds.
15. Development of resistance to pesticides
16. Insecticide synergists and antagonists.

Entomology Practical Z 15 (C) Syllabus based on Paper Z-13 (C) & Z-14 (C)

1. Museum study for identification of insects from various orders (prescribed in theory syllabus).
2. Permanent Preparation: a. Whole mounts of microscopic insects. b. Different types of mouth parts, antennae, legs and wings. c. Sting apparatus and pollen basket of honey bee. d. Tympanum and spiracle of grasshopper.
3. Anatomy a. Cockroach - Digestive, circulatory, reproductive systems . b. Grasshopper - Digestive, circulatory, reproductive systems c. House cricket - Digestive, reproductive and nervous systems. d. Housefly - Digestive and nervous system e. Honey bee - Digestive and nervous systems. f. Wasp - Nervous systems.
4. Study of permanent slides.
5. A tour to visit important centers of entomological / toxicological studies/Field study.

Scheme of M.Sc. III Semester Zoology: Practical (Entomology) Examination

Distribution of Marks

Time : 5 hrs	**Max Marks 50**
1. Permanent preparation*.	06 marks
2. Identification of spots (6x2).	12 marks
3. Major Dissection*	08 marks
4. Minor Dissection*	04 marks
5. Record and Report on fieldtrip	10 marks S
6. Seminar (internal)	05 marks
7. Viva-voce	05 marks
Total	**50 marks**

(* Use of animal for dissection and practical work is subject to the condition that they are not banned under the Wildlife Protection Act)

PAPER- Z -14 (D): FISH BIOLOGY

UNIT- I

1. Food, feeding habits of fishes: Carnivorous fishes, Herbivorous fishes, Omnivorous fishes, Plankton feeders. Fishes: Surface, column and bottom feeders. 2. Alimentary canal and its modifications, physiology of digestion and absorption of food, Feeding intensity, methods for food analysis and adaptation for foraging, Artificial food.

UNIT- II

3. Composition of Blood, Structure of heart in Scoliodon and Teleosts, vascular system and circulation of blood, Haemoglobin and its adaptation in fishes. 4. Respiratory organs, accessory Respiratory organs, Air breathing organs, physiology of respiration and its regulation.

UNIT- III

5. Excretory organs: Structure and histology, physiology of excretion, Osmoregulation in marine, fresh water and estuarine fishes, Role of hormone in excretion and osmoregulation 6. Nervous system: Forebrain, Midbrain, Hindbrain, spinal cord and nerves, sense organs: Olfactory, Auditory and photoreceptors and lateral line system.

UNIT- IV

7. Endocrine glands and Neurosecretory system. 8. General study of fish behavior with spwcial reference to chemical communication in fishes. Reproduction in fishes: Reproductive organs (male and female), maturation, spawning and fertilization. Reproductive behavior: courtship and parental care. Gonadosomatic Index, Sexual dimorphism, hormonal control of reproduction, relationship of fecundity with body parameters, Fecundity and its methods.

UNIT- V

9. Embryonic development: Categories in fishes with respect to development, cleavage, fate maps of Blastula, Gastrulation, Larval development, viviparity, hatching and Postembryonic development. 10. Recent trends in fish study and research, fisheries economics and extension: Fishery resources as common property resources, Maximum Sustainability Yield (MSY), Minimum Economic Yield (MEY), Optimum Sustainability Yield (OSY), Fishries extension programmes, Fish Farmer's Development Agencies (FFDAs).

Fish Biology Practical Syllabus Z-15(D) based on Paper Z-13 (D) & Z-14 (D)

1. Complete anatomy of a teleost, represented by *Wallago attu* or any other locally available teleost: External features, general viscera (including urino-genital organs), jaw and lateral musculature, including blood supply, afferent and efferent branchial blood vessels, brain and cranial nerves, eye muscles and their innervations, membranous labyrinth,Weberian ossicle-swim bladder connection.
2. Anatomy through model / photograph / chart / CD. of the head of any cat fish
3. Breathing organs of *Anabas, Clarias, Channa and Heteropneustis* showing the blood supply wherever possible.
4. Permanent preparations and study of pharyngeal denticles, cycloid and other scales.
5. Micro-technical procedures: Preparation and study of serial sections of a larval fish and representative tissues and organs of fish.
6. Local fishes and their identification upto the species level, study of the available museum specimens.

Scheme of M.Sc. III Semester Zoology: Practical (Fish Biology) Examination

Distribution of Marks

Time : 5 hrs **Max Marks: 50**

SN	Exercise	Marks
1.	Learning of fish anatomy*	07 marks
2.	Permanent preparation*	05 marks
3.	Species identification using taxonomic key	08 marks
4.	Microtomy	10 marks
5.	Seminar	05 marks
6.	Viva-voce	05 marks
7.	Class Record	10 marks
Total		**50 marks**

(* Use of animal for dissection and practical work is subject to the condition that they are not banned under the Wildlife Protection Act)

Paper-Z-14 (E) SPECIAL PAPER: FORESTRY AND WILDLIFE MANAGEMENT

Unit- I

Biogeography

Biogeography: Continental drift, bio-geographical realms (8) Afrotropical, Antarctic, Australian, Indomalayan, Nearctic, Neotropical, Oceanic and Palearctic and 14 Biomes. Concept of Biodiversity, level of biodiversity: alpha, beta, gamma diversity, Keystone species, umbrella species, flagship species, indicator species, Indigenous and introduced / exotic species. The Biogeographic classification in India. Zoogeography of Indian Mammals. The origin of Indian fauna and flora, routes of faunal exchange and migration.

Unit- II

Habitat Ecology

Wildlife cover requirement, Edge effect and interspersion, physical and biological features of habitats. Habitat diversity: edge, ecotones, snags, cliffs, talus and caves, interspersion and juxtaposition. Niche, Niche overlap, Niche width, Territory, Home range and cruising radius. Physical and anthropogenic factors influencing terrestrial habitats; drought, flood, grazing, felling, fire.

Carrying capacity: Ecologically based and culturally based. Wildlife habitat analysis and evaluation: Availability, quality, palatability of graze and browse. Animal sign as indicator of habitat use, use of map overlay approach in habitat evaluation, corridors, eco-sensitive zone and critical tiger habitat. Habitat degradation, fragmentation and Successional changes.

Unit- III

Biology of Indian Wildlife

Review of biology of major groups of vertebrates, fish, amphibians, reptiles, birds and mammals with emphasis on importance in wildlife management. Importance of invertebrate conservation. Threats and conservation perspectives of fish biodiversity in India. Batrocology: threats and conservation measures. Role of sex determination in reptiles. Identification of venomous and non-venomous snakes, snake bite, venom and anti-venom. First Aid and Management of snake bite cases. Threats faced by avian community, causes of decline of common birds and their control. Morphological and physiological adaptations in mammals. Mammalian skin and its derivatives.

Unit- IV

Wildlife Management

Management of special habitats: riparian zones, grasslands etc. Management plan for Protected Areas: Forest working plans and wildlife management plans. Need for wildlife management planning. Principle of planning, objectives, resource survey, analysis of surrounding region, management zones, theme plans, communications, staff and visitor amenities and monitoring. Financing protected areas. Population estimation: Meta-population. Census techniques (bird and mammal). Sampling designs for population estimation, population estimation methods: Distance based Sampling Methods, Mark-Recapture for Closed Population.

Unit- V

Wildlife Health Management

Wildlife health management, need for wildlife health management. History of wildlife diseases in India, importance of wildlife health monitoring, problems and solutions, Infectious and non-infectious diseases in fish, amphibian, reptile, birds and mammals. Review of major diseases of Indian wild mammals, birds, amphibians and reptiles. Disease transmission between domestic and wild population. Malnutrition, starvation, dehydration as disease syndrome. Management of waterholes in wildlife disease control. Quarantine and Quarantine Act.

Paper Z-15 (E) - FORESTRY AND WILDLIFE MANAGEMENT PRACTICAL BASED ON Z-13 (E) & Z-14 (E)

1. Review of forest working plan and maps. Study of nearby forest and grassland under various management regimes. (Management practices will also be studied on field courses).

2. Field data collection for estimating population abundance of mammals using line transects, occupancy survey and point counts.

3. Population Estimation, data collection and use of software DISTANCE, MARK and PRESENCE.

4. Analysis of vegetation and habitat characteristics in a specific PA. Forest as material and service provider- utilization and uses.

5. Quantification of flora using vegetation sampling methods (Estimation of species dominance, frequency, density using quadrate / plot methods).

6. Zoogeography of mammals of Indian sub-continent; Distribution of (i) Primates: Rhesus macaque (ii) Carnivores: Tiger, panther, hyena, sloth bear (iii) Ungulates: Sambar, chital, wild boar. Study and identification of fish and insects commonly found in any study area. Horn/ Antler identification. Identification of poisonous and non-poisonous snakes, venom types.

7. Bird watching and identification of resident and migratory birds (minimum 100), bird census techniques.

8. Field Visit to Zoo/Biological Park/Protected Area.

9. Field report writing.

Scheme of M.Sc. III Semester Zoology: Practical (Forestry and Wildlife Management) Examination

Distribution of Marks

Time: 5 hrs.	**Max Marks: 50**
1. Exercise on zoogeography/wildlife techniques	**05 marks**
2. Exercise on vegetation sampling methods	**05 marks**
3. Exercise on Forest Services (plant & animal)	**05 marks**
4. Spotting (Pugmarks, Models, Photo etc.) 5 spots x 2 marks	**10 marks**
5. Field report	**10 marks**
7. Viva-voce	**05 marks**
7. Class Record	**10 marks**
	Total 50 marks

II YEAR: IV SEMESTER

Paper-Z-16 ANIMAL BEHAVIOUR

Paper-Z-17 DEVELOPMENTAL BIOLOGY OF CHORDATES

Paper-Z-18 SPECIAL PAPER

Paper-Z- 19 SPECIAL PAPER

Paper-Z-20 ZOOLOGY Practical

Day 1; 5 Hrs (Z-16 & Z-17)

Day 2; 5 Hrs (Z-18 & Z19).

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 behavior: 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 DEVELOPMENTAL BIOLOGY OF CHORDATES

UNIT – I

1. Theories of development: Preformation and epigenesis.
2. Gametogenesis (i). Spermatogenesis: Growth of spermatocyte and acrosome formation; spermeogenesis. (ii). Oogenesis: (a) Growth of oocyte and vitellogenesis. (b) Organization of egg cytoplasm; role of the egg cortex. (c) Morphogenetic determination in egg cytoplasm.
3. 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.

UNIT – IV

1. Genetic regulations of early embryo development.

2. 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.

3. 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, re-differentiation, (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-20 ZOOLOGY Practical (General)

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.

2. **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 mount 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.

Scheme of M.Sc. IV Semester Zoology: Practical (General papers Z – 16 & Z – 17)

Examination

Distribution of Marks

Time : 5 hrs **Max Marks: 50**

SN Exercise	Marks
1. Exercise on Ethology *	07 marks
2. Permanent preparation*	05 marks
3. Exercise on Development Biology	08 marks
4. Spotting (Permanent slides, Models, Photo etc.) 5 spots x2 marks	10 marks
5. Seminar	05 marks
6. Viva-voce	05 marks
7. Class Record	10 marks
Total	**50 marks**

(* Use of animal for dissection and practical work is subject to the condition that they are not banned under the Wildlife Protection Act)

PAPER-SPECIAL PAPER Z – 18 (A) CELL BIOLOGY

Unit-I

Specialized function of S components in a cell with special reference to the molecular mechanism (contractibility, secretion, phagocytosis & pinocytosis).

Vesicular Transport & membrane fusion.

Unit-II

Cell & Tissue Culture:-

(a) Behaviour of cells in culture

(b) Primary & established cell lines kinetics of cell growth.

Unit-III

Natural & defined media for culture.

Importance of cell & tissue culture.

Generalized account of the mechanism of cell aggregation during development in vitro studies.

Unit-IV

Study of fixation & staining & discussion on the following techniques:-

(a) Freeze substitution

(b) Freeze drying

(c) Fresh & fixed frozen section.

(d) PAS

(e) Metachromasia, feulgen, lipid & protein staining techniques.

Unit-V

Centrifugation & ultra-centrifugation single two dimensional & column chromatography.

Intravital & supravital staining. Paper, gel SDS-PAGE & disc electrophoresis.

PAPER –Z 18 (B) ENVIRONMENTAL BIOLOGY

UNIT: I

History and scope of toxicology. Toxicology of aquatic and terrestrial environme nts. Acute and chronic toxicity. Toxicity testing in field and enclosure. Toxic dose: Approximate acute LD50 /LC50 of some representative chemical agents. The use of biomarkers in assessing the impact of environmental contaminants. Biossay. Trophic level transfer of contaminants. Bioindicators of environmental quality.

UNIT- II

Toxic Chemicals in the environment--Air, Water: Pesticides in water. Bio-chemical aspects of Arsenic, Cadmium, Lead, Mercury, Carbon monoxide, O3 and PAN Pesticides, Insecticides, MIC, carcinogens in the air.

UNIT-III

Occupational Health: Definition, Occupational Health Hazards, Common hazards: Pneumoconiosis. Silicosis, Anthracosis, Byssinosis, Bagassosis, Asbestosis, Farmers's Lung, Lead poisoning, Occupational Cancer, Occupational Dermatitis, and Radiation Hazards. Measures for health protection of workers and Role of WHO in Occupational Health. Occupational Health in India.

UNIT IV

Impact of human activities on environment. Management of Environmental Natural resources: their conservation and development. Classification of pollutants: Physical treatment principles, Chemical treatment principles, Biological treatment principles and Sludge treatment and disposal Systems analysis for Environmental problems. Environmental monitoring for Air, Water, Soil, Radiation and Microbiology: Common parameters, sampling procedures and analytical techniques

UNIT- V

Population growth, variation among nations, global population growth, population explosion, Urbanization , Population Ecology: Factors determining population. Factors leading to the commonness, rarity and vulnerability of extinction of a species. Environmental and human health, Environmental health , Climate and health, human rights, Equity , Nutrition, health and human rights, Intellectual Property Rights and Community Biodiversity Registers , Human heritage, Equitable use of Resources, Common Property Resources, Ecological degradation.

PAPER- Z-18 (C) : ENTOMOLOGY

Unit-I

1. Nervous system - structure of central, peripheral and autonomous nervous system.
2. Sense organs – chemoreceptors, mechanoreceptors photoreceptors
3. Physiology of nervous system and sense organs.

4. Reproduction system –made female reproductive organs.

Unit-II

(i) Detailed classification of following orders emphasizing selected super and families and families –order Thysanura, odonata, orthoptera, Isoptera and Hemiptera.

(ii) Economic In these orders.

Unit-III

(i) Detail of following orders emphasizing selected subfamilies and families-order coleopteran, Lepidoptera, Diptera and Hymenoptera

(ii) Economic importance of these orders.

Unit-IV

1. Causes of success of Insects.
2. Fossils Insects
3. Ancestary and origin of Insects
4. Evolution of Insects

Unit-V

(i) Social life in termites

(ii) Social life in honey bee

(iii) Social life in Ants

(iv) Social life in wasps

(v) Caste determination in Social Insects.

PAPER- Z-18(D): FISH BIOLOGY

UNIT-I

1. Survey of principal fisheries of India (Indian major carps, Mackeral, Sardine, Bombay Duck fisheries). 2. Biology of Indian major carps, catfishes, Hilsa, sardine mackerel, sharks, mahaseer, prawns and oysters.

UNIT-II

3. Exotic fishes: Cyprinus carpio, Hypophthalmichthys molitrix, Ctenopharyngodon idella, Tinca tinca, Tilapia mossambica, Osphronemus Goramy, Carassius carassius, Trout, Mosquito fish. larvivorous fishes, predatory fishes and weed fishes. 4. Fish Marketing, Domestic fish marketing in India, Price policy and fish marketing system in India. 5. Aquaculture and its importance with special reference to India. Role of aquaculture in rural development. Giant freshwater Prawn Culture and Oyester Culture, Different types of fish culture: Composite fish culture, Cage culture and integrated culture, factors affecting fish culture. 6. Biota of pond water, carrying capacity of a pond, carrying capacity of a pond,Types of pond for culture, Growing or stocking pond, Kinds of fish farm, Extensive fish culture, Intensive fish culture, cultivable species.

Unit III

7. A detailed study of methods of fishing: Fishing crafts and Fishing gears in India (Spear and Harpoon, Fish traps, Nets, Types of Nets, Use of electric Current, Modernization of fishing methods). 8. Pond management, fish seed resources and their transport, induced breeding by hormones.

UNIT-IV

9. Fish preservation and processing (Spoilage of fish, Rigor Mortis, Causes of spoilage of fish, Preservation of fish, Chilling, Freezing, Deep freezing and freeze drying, Salting, Brinning, Smoking, Canning. Food poisoning by fish. 10. Fishery resources and Economic value: Bio-chemical composition of fish, fish as food. 11. Fish and mankind, byproducts of fishing industry.

UNIT-V

12. Inland fisheries resources: Reverine fisheries, The Ganga River System, The Brahmaputra River System, The East coast River System, The Indus River System, Reverine resources of cold water fishery and Reservoir fisheries, cold water Fishries of lake. 13. Estuarine fisheries: Open eastuaries, Embanked estuary, Principal fisheries of brakish water. 14. marine fisheries: Fishery resources, coastal fisheries, factors influencing fish production.

Paper-Z-18 (E) SPECIAL PAPER: FORESTRY AND WILDLIFE MANAGEMENT

Unit I

Wildlife Conservation & Captive Breeding

Conservation Ethics and Values of Wildlife in India: Importance of Wildlife; Values of Wildlife- Positive and Negative Values. Captive breeding and Propagation: Founder population, rehabilitation, education, utilization, gene banks, Ex-situ and in-situ linkages. Conservation breeding management plans, Role of scientific institution and NGOs in Conservation Breeding Programmes. Case studies on Conservation Breeding Program of endangered wild animals in India (Asiatic Lion, Tiger, Rhino, Indian Bustard, Gharial).

Important conservation projects undertaken in India: Project Tiger, Project Elephant, Project Indian Bustard, Rhino-reintroduction and Tiger-reintroduction Program.

Unit II

Wildlife Behaviour

Animal habitat interactions, pattern of habitat utilization, feeding ecology of herbivores, carnivores, insectivores and omnivores, temporal and spatial variation in food resources, animal body conditions, reproductive ecology, dispersion, pattern of growth, study of signs and symptoms of wildlife presence, role of minerals in animal health, adaptation with respect to temperature and water. Wildlife behavior – Instinct and learning Behavioral ecology, study method and significance for conservation, Group living in animals, Territory in animals, Social organization.

Unit III

Wildlife Toxicology

Exposure of wildlife to toxicants in natural habitats and manmade habitats; Metals and their exposure. Toxicity testing of wildlife exposure to toxicants; Effect of Radiations on wildlife. Various toxicological testing methods; Biological indicators of pollution exposures; Biomagnification of pesticides and heavy metals, consequences of biomagnifications.

Unit IV

Illegal trading

About TRAFFIC and Wildlife trade, Key agencies contributing to wildlife crime enforcement. Some methods of poaching in India, Illegal wildlife trade of important species and products. Convention on International Trade in Endangered species (CITES). Important Medicinal Plants of Arid and Semi-arid zone, CITES listed species of Medicinal Plant Conservation Areas (MPCA) in Rajasthan.

Unit V

Wildlife Forensics

Wildlife Forensics: Principles of crime scene investigation and collection of physical and biological evidences (samples) from crime scene; use of different techniques in wildlife forensics with special emphasis on identification of species from different parts of reptiles, birds, mammals and plants. Molecular markers used in wildlife forensics; Wildlife forensics based on DNA analysis and morphometry.

Macro Histological: Introduction, hair types, classification of hair characteristics, Techniques to study hair structures. Protocols and setting up of infrastructure for identifying species from hair.

Paper-Z- 19 (A) CELL BIOLOGY

Unit-I

Elementary concept of the principle & theory of microscopy as exemplified by the foll:

(a) Phase contrast microcopy
(b) Interface microscopy
(c) Polarizing microscopy
(d) Fluorescence microscopy
(e) Electron violet microscopy

Unit-II

A general account of the effect of ionizing radiation at the celluler level.

Mechanism of action of the foll. Enzymes at cellular level.

(a) ATP ase
(b) Suceinic dehydrogenase
(c) Acid & Alkaline phosphatas
(d) Hyalnronidase

Unit-III

Cellular aspects of the process of aging.

Cellular aspects of immunity and virus-cell interaction.

Elementary idea of the origin of foll diseases (a) Glycogen storage disease (b) AIDS

Unit-IV

Cancer – Carcinogens & viruses.

Proto- Oncoglenes.

Oncogenes & Timor Suppressor Genes.

Omcoproteins, Activation, Translocations & Amplification.

Unit-V

Apoptosis : Cell death

Apoptosis in Coenorhabditis

Cell death in Manuals

Apoptosis in Drosophila

Purpose of cell death

Mechanism of cell death

Apoptosis targeted therapies.

M.Sc. IV Semester - Zoology Cell Biology Practical Z-18 (A)&19A

1. Study of "fixation" and "staining" techniques.
2. Study of microscopy techniques.
3. Single two dimensional & column chromatography.
4. Paper, gel, SDS-PAGE and disc electrophoresis.
5. Permanent slide preparation (Cell organelles etc.)
6. Elementary ideas of the origin of diseases: AIDS, Cancer and aging.

Scheme of M.Sc. IV Semester Zoology: Practical (Cell Biology) Examination

Distribution of Marks

Time : 5 hrs **Max Marks: 50**

1. Exercise on techniques	05 marks
2. Permanent preparation (cell organelles/cell division)*	05 marks
3. Exercise on Cell and tissue culture	08 marks
4. Spotting (Permanent slides, Models, Photo etc.) 5 spots x 2 marks	10 marks

5. Seminar	05 marks
6. Viva-voce	05 marks
7. Class Record	10 marks
Total	**50 marks**

PAPER –Z 19 (B) ENVIRONMENTAL BIOLOGY

UNIT-I

Definitions and concept, reclamation, remediation, restoration and rehabilitation. Disturbance: causes and impact on the structure and functioning of terrestrial and aquatic ecosystems. Aims and strategies: Passive and active; habitat, species and ecosystem restoration; single vs. multiple end-points. Ecosystem reconstruction: Acceleration of ecological succession, physical, chemical, biological and biotechnological tools. Restoration of biological diversity: Augmentation, reintroduction and introduction of species. Degradation and restoration of natural ecosystems: Forests, grassland/savanna, wetlands and other aquatic ecosystems. Restoration of degraded soils: Restoration of contaminated soils and soil fertility, mine spoil restoration

UNIT-II

Blast fishing, Illegal, unreported and unregulated fishing, Environmental effects of over fishing, Deforestation, Invasive species, Pollinator decline, Species extinction, Poaching, Wildlife trade, Intensive farming, Overgrazing, Environmental education and awareness, role of governmental and non-governmental organizations. Current Environmental issue in Indian Context: Narmada Dam, Tehri Dam, Almetti Dam, Soil Erosion. Formation and reclamation of Usar, Waste lands and their reclamation, Floods and Drought.

UNIT - III

Environmental priorities in India and sustainable development. Environmental issues with War, Genetically modified food controversies, Overpopulation and Gender Imbalance. Epidemiological issues (e.g., Goitre, Fluorosis, Arsenic). Environmental Appraisal with particular reference to: Mining Projects Industrial Projects, Thermal Power Projects, River Valley, Multipurpose, Irrigation and H.E. Projects. Infrastructure Development and Miscellaneous Projects. Nuclear Power Projects

UNIT-IV

Social perspectives of environment: Global and Indian issues. Sustainable development: Concept, components and strategies. Social impacts of growing human population and affluence, food security, hunger, poverty, malnutrition, famine. Social impacts of water crisis, global climate change, O3 depletion, nuclear accidents, acid rain, consumerism and waste products. Problems related to major dams and other developmental projects, resettlement and rehabilitation. Environment and human health: epidemiological issues, women and child welfare, family welfare programme. Environmental education, Environmental ethics, public awareness, people participation in resource conservation and environmental protection.

UNIT-V

Introduction to environmental impact analysis. Environmental impact Statement and Environmental Management Plan. EIA guidelines 2006, Notifications of Government of India. Impact Assessment Methodologies, their strengths and weaknesses. Generalized approach to impact analysis. Procedure for reviewing Environmental impact analysis and statement. Guidelines and basic principles of Environmental auditing -Definition, functions, benefits and costs of Environmental Auditing. Introduction to Environmental planning. Base line information and predictions (land, water, atmosphere, energy, etc.). Landuse policy for India. Urban planning for India. Rural planning and landuse pattern. Concept and strategies of sustainable development. Cost-Benefit analysis

PRACTICAL PAPER –Z 20 (B) ENVIRONMENTAL BIOLOGY based on 18 (B) & 19 (B)

1. Bioassay using LD 50 and LC 50
2. Estimation of Biological Oxygen Demand and Chemical Oxygen Demand
3. Estimation of total inorganic and organic carbon
4. Designing of waste water treatment plant
5. Estimation of Biodiversity.
6. Determination of particle size using Respirable Dust Sampler.
7. Estimation of Respirable Suspended Particulate Matter by RSPM sampler.
8. Site visit of degraded landscape or habitat as terrestrial and aquatic
9. GPS: Application in field
10. Advanced instrumental technique: (i) Flame photometry

(ii) UV- visible spectrophotometry

11. Visit to single or multipurpose project of state or national level importance.

12. Social perspectives of environment: Case study of food security, hunger, poverty, malnutrition, famine and water crisis. (Area should be selected according state prescribed for social welfare schemes)

13. Case study related to pollution monitoring, treatment and control

14. Case study of EIA

Scheme of M.Sc. (Semester – IV) Zoology Examination: Environmental Biology (Special Paper)

Distribution of Marks

Time: 5 hrs.	**Max Marks: 50**
1. Experimental bioassay	06 marks
2. Exercise on pollutant effect	04 marks
3. Determination of particle size	06 marks
5. Exercise on instrumentation	04 marks
6. Estimation of Microbial diversity	04 marks
7. Viva-voce	08 marks
8. Class Record, Field Trip and Project Report	10 marks
9. Seminar (internal)	08 marks
	Total 50 marks

PAPER- Z-19 (C) : ENTOMOLOGY

Unit-I

1. Life history, damage caused and control of three major pests of each of the following crops:

(i) Wheat, paddy, maze, jowar, millet

(ii) Sugarcane, cotton, mustard and soyabean.

Unit-II

2. Life history damage caused and control of two major pests of each of vegetables and fruits.

3. Life history, damage and control of stored grain/milled product pests: Sitophilus, callosobruchus, Rhizopertha, Tribolium, Trogoderma, oryzaephilus.

Unit-III

4. Pests of veterinary and medical importance.
5. Preliminary idea of insect borne diseases.
6. Role of genetics in insect vector control.

Unit-Iv

7. Life cycle of aphid and locust and their control.
8. A general idea of plant protection organization in India.
9. Forensic entomology with special reference to human and wild life.

Unit-V

10. Beneficial insects and their economic importance.
11. Importance and related industries of silkworm, honeybee and lac insect.

Entomology Practical Syllabus based on Paper Z-18 (C) & Z-19 (C)

1. a. Knowledge and use of equipments for rearing, collection and preservation of insects; insect net, lulling bottle, spreading board, insect-box; devices for inflating larva; light trap etc. b. Maintenance of insectaria.

2. Collection and preservation of insects and their different stages.

3. Collection of seasonal, nocturnal, aquatic insects, crop pests, stored grain pests, household pests and insects of veterinary and medical importance.

4. Familiarity with techniques and appliances used for insecticide treatment.

5. Bioassay experiments for testing the insecticides.

6. Study of food preference in stored grain pests.

7. Micro-technical procedures (microtomy).

8. Insect identification up to family level using taxonomic key.

Scheme of M.Sc. IV Semester Zoology: Practical (Entomology) Examination

Distribution of Marks

Time : 5 hrs **Max Marks: 50**

1. Study and use of insecticides and insecticides appliances	05 marks
2. Toxicological exercise/Bioassay methods /Microtomy	05 marks
3. Insect behavior/Insect collection and preservation Techniques*	05 marks
4. Insect taxonomic Key and Identification (5)*	15 marks
5. Record and Insect collection*	10 marks
6. Seminar	05 marks
7. Viva-voce	05 marks
Total	**50 marks**

(* Use of animal for dissection and practical work is subject to the condition that they are not banned under the Wildlife Protection Act)

PAPER- Z -19 (D): FISH BIOLOGY

UNIT-I

1. Estimation of population number and mortality rates in fresh waters. 2. Age and growth studies: Factors influencing growth of fish, Regulation of Growth, Growth Periodicity, Methods for determining Age and Growth, Practical utility of determining Age and Growth. Length-Weight relationship and indices of condition and growth.

UNIT-II

3. Limnology: Definition, types of lakes/ponds, their significance, Plankton: Definition, types, diurnal variations; planktons and their significance in fisheries. 4. Fishries management and conservation: Conservation of genetic and ecological diversity. Measures for fish conservation, In situ conservation, Ex situ conservation, cryopreservation of gametes, applications of cryopreserved sperm.

UNIT-III

5. Water pollution and fisheries: causes of water pollution,Domestic sewage, Industrial wastes and effluents, Soil erosion and Sedimentation, Fertilizers, Pesticides and Insecticides, Radioactive Waste, Thermal Waste, Oil Pollution, Acidification, Mining Wastes, effect of 6. Pollutents on fish, precautions. Aquatic weeds: types, habitat and their control. 7. Aquaria: setting up and maintenance.

UNIT-IV

8. Diseases of fishes: Causes, etiology, Symptoms and treatments, fish parasite and their control.

9. Specialized organs: Bioluminescent organs, electric organs, sound producing organs, poisonous and venomous organs.

UNIT-V

10. Adaptations to special conditions of life: Hill stream fishes, deep sea fishes, cave dwelling fishes. 11. Application of genetics and biotechnology in fishes, transgenic fishes and fish genomics 12. Aspects of fish genetics: Chromosomes, Gene and Chromosomes Mutation, Sex chromosomes, Sex determination, Polyploidy, hybridization.

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M.Sc. - Zoology Fish Biology Practical based on paper Z -18(D) & Z -19(D)

1. Hydro-biological exercise: (a) Analysis of water: Determination of pH, free Carbon-di-oxide, dissolved Oxygen, chlorides, Calcium, total alkalinity, total salinity, BOD, COD. (b) Collection: Qualitative and quantitative analysis of planktons.

2. Biochemical/Physiological/Embryological exercise: (a) Estimation of glycogen in liver. (b) Determination of free amino acids of muscles or blood plasma through chromatogaphy. (c) Induced spawning. (d) Study of development of teleost fish through preserved material (whole

embryo or sections) or models/charts: eggs, cleavage, blastula, gastrula, external gill, mature larva, fry and fingerlings.

3. (a) Periodical visits to a local fishing farm to gain a firsthand knowledge of its pisciculture practices and fisheries activities. (b) A week's tour of an inland fisheries research station. (c) A week's tour of an important marine biological or fishery centre in the country.

4. Preparation and maintenance of fresh water aquarium housed with local and exotic fishes, in your department.

Note: A record of the work done under item 03 and 04 has to be submitted compulsorily by each candidate.

Scheme of M.Sc. IV Semester Zoology: Practical (Fish Biology) Examination

Distribution of Marks

Time: 5 hrs **Max Marks: 50**

SN Exercise	Marks
1. Hydrobiological exercise	07marks
2. Exercise on Biochemistry/Physiology/Embryology	05 marks
3. Identification and comments on 8 spots	16 marks
3. Assignment work	06 marks
4. Viva-voce	05 marks
5. Field Trip and Project Report	06 marks
6. Seminar (internal)	05 marks
Total	**50 marks**

Paper-Z-19 (E) SPECIAL PAPER: FORESTRY AND WILDLIFE MANAGEMENT

Unit I

Remote Sensing & Geographical Information System (GIS)

Application of Remote sensing in wildlife management: Principals and practical application of remote sensing techniques, including aerial photography and satellite imagery.

Introduction to GIS, Spatial and non-spatial database for GIS analysis. Use of global positioning system, Data entry and processing system, Data analysis and visualization. Geographical Information Systems (GIS): Open source ArcGIS software, use of GPS and Mobile Apps.

Unit II

Wildlife Telemetry & Sono-Taxonomy

Introduction to Wildlife telemetry: Transmitters (Antenna, Power source) Transmitter attachments (General protocol, collars etc.), Radio tagging, Receivers, Relocating wildlife, Study review of Habitat Utilization by species groups; Amphibians, Reptiles, Small mammals, Large Carnivores. Review of radio-telemetry studies in India.

Sono taxonomy- sound based identification of species with particular reference to wild life, principles of bio-acoustics and vocalization; types of calls, sound spectrum and analysis, Sound based monitoring of species. Advantage of sound based identification and monitoring of species.

Unit III

Capture & Handling of Wild Animals

Capture and handling of animals : Restraints, Capture and Animals Barriers : Purpose, live traps, snares, pits, nets, canon (rocket) nets, net gun, mist nets, corrals, stockade, spotlighting. Animal barriers: Reasons for use; trenches, walls, stockades, mechanical fences, electric, repellents. Drug immobilization: Jabstick, blowpipe, pistol, rifle, crossbow, dart design; radio darts. Drug action, dosages, responses, side effects, effects, safety measures, complications & blind folding. Central Zoo Authority (CZA) protocol of Handling and Transport of wild animals, designing sledge, crate and holding enclosures. Ecological restoration, Reintroduction/ Translocation of Tiger.

Unit IV

Human Wildlife Conflict

Human- Wildlife Conflicts, types of conflict, causes & prevention; Identifying the problem and possible solutions. Negative Impacts of HWC; Conflict Resolution or Management; Management Techniques. Reducing HWC and enhancing Coexistence. Human Elephant conflict, Human- Tiger and leopard conflict, Human –Sloth bear conflict.

Unit V

Wildlife Tourism

Tourism in protected areas. Development of Interpretative facilities, visitor characteristics, expectations and motivations, sustainability in Wildlife Tourism. Wildlife based Tourism-objectives, planning and economics. Ecotourism in India, positive negative aspects of Eco-tourism. Physical carrying capacity of a park and percent disturbance to wildlife.

Forestry and Wildlife Management Practical Z-20 (E): based on Paper Z-18 (E) & 19 (E)

1. Methods of behavioral observation; Instantaneous scan, focal animal, all occurrence and one-zero sampling, collection and analysis of behavioral data of some common availability species, preparation of ethograms, time-activity budgets and social interaction matrices.

2. Scat analysis and Identifying species from hair. Photomicrographs and descriptions of hair characteristics of different classes of wild and domestic mammals.

3. Study on tiger reintroduction program and monitoring of tiger in Rajasthan.

4. Use of different techniques in identification of different parts and products of flora and fauna reported in wildlife trade. Biological Sampling, preservation and transport of samples. Identification of fake skin/wildlife materials. Identification of weapons.

5. Demonstration of equipment traps, net, dart gun etc. Mist netting and trapping on campus. Participation in capture operations as appropriate. Examination of various types of barrier in the field. Field identification by natural markings. Equipment and its use tags, collars, radio tracking equipment. Bird ringing.

6. Modern methods of identification of species by sono-taxanomy.

7. Drug immobilization and dosage: Jabstick, blowpipe, pistol, rifle, crossbow, dart design; radio darts and drug action.

8. Exposure to post-mortem sites.

9. Visit to GIS Laboratory.

10. Field reportwriting.

Scheme of M.Sc. IV Semester Zoology: Practical (Forestry and Wildlife Management) Examination

Distribution of Marks

Time: 5 hrs.	**Max Marks: 50**
1. Exercise on Behaviour	**05 marks**
2. Exercise on Radio Telemetry/ Drug immobilization	**05 marks**

3. Exercise on scat analysis/Forensic	**05 marks**
4. Spotting (Pugmarks, Models, Photo etc.) 5 spots x 2 marks	**10 marks**
6. Field report	**10 marks**
7. Viva-voce	**05 marks**
7. Class Record	**10 marks**
	Total 50 marks