M.Sc. – Zoology

Exam.-2017

UNIVERSITY OF KOTA
MBS Marg, Swami Vivekanand Nagar,
Kota - 324 005, Rajasthan, India
Website: uok.ac.in

M.Sc. (Prev.) ZOOLOGY Exam. –2017
Distribution of Marks

			Marks	
1.	Paper I -	Invertebrate & Principles of animal taxonomy	100	Marks
2.	Paper II -	Biological Chemistry, Immunology & Physiology	100	Marks
3.	Paper III -	Cell Biology, Genetics & Biotechnology	100	Marks
4.	Paper IV -	Evolution & Statistical Methods in Biology	100	Marks
5.	Practical based on Paper I to IV in two days + Seminar		200	Marks
		Total	**600**	**Marks**

M.Sc. (Final) ZOOLOGY Exam. –2017

Paper	**Duration**	**Max. Marks**	**Min. Pass Marks**
V	3 Hours	100	25
VI	3 Hours	100	25
VII	3 Hours	100	25
VIII	3 Hours	100	25
Practical (General)	5 Hours	100	36
Practical (Special Paper)	5 Hours	100	36

M.Sc. (Prev.) ZOOLOGY Exam –2017
Distribution of Marks

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1.	Paper I -	Invertebrate & Principles of animal taxonomy	100	Marks
2.	Paper II -	Biological Chemistry, Immunology & Physiology	100	Marks
3.	Paper III -	Cell Biology, Genetics & Biotechnology	100	Marks
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5.	Practical based on Paper I to IV in two days + Seminar		200	Marks
		Total	**600**	**Marks**

Paper -I- Invertebrates and Principles of Animal Taxonomy

Duration : 3 hours Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

UNIT - I

1. A study of the classification of invertebrates with distinguishing features & examples of various subdivisions.

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

4. 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.

5. Excretion : a study of structural and functional organization of excretory systems in various invrertebrate groups and a survey of various excretory products met with in them.

6. Osmoregulation and ionic regulation : a survery of principal mechanisms in fresh water, marine and terrestrial forms.

UNIT - III

7. Structural and functional organization of nervous systems and receptors :

a) Plan of nervous systems in the Cocenferates, 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.

8. Endocrine system : a surey of endocrinal structures and their hormones: role of neurosecretions and hormones in developmental events of insects and crustaceans.

9. 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 and their significance.

UNIT - IV

10. Criteria for phylogenetic interrelationships between Invertebrate phyla.
11. Origin of Parazoa, Mesozoa and Metazoa.
12. Origin or Radiata (Coelenterata and Ctenophora).
13. Origin of Bilateria from Radiata (Importance of Planula larva and Ctenophores)
14. Phylogenetic significance of Rhynchocoela.
15. Interrelationship of important Pesudocelomate groups, Rotifera. Gastrotricha, Kinorhynca, Nematomorpha and Entoprocta.
16. Affinities and evolutionary significance of the unsegmented lesser protostome phyla (Priapulida, Echiuroidea and Sipunculida.
17. Phylogenetic relationship between the coelomate phyla (Annelida, Onychopohra. Arthropoda & Mollusca).
18. Affinities and evolutionaiy significance of the Lophophorate coelomate phyla (Brachiopoda, Phoronida & Ectoprocta).
19. Affinities of the invertebrate deuterostome phyla (Chaetognatha, Echinodermata, Pogonophora & Hemichordata).

UNIT - V

20. Introduction to the science of taxonomy; rules of nomenclature.
21. **Principles of classification :** theories of biological classification & their history; the species category; the polytypic species; population systematic intraspecific categories.
22. **Methods of classification :** taxonomic collection & the processes of identification, taxonomic characters; types of variations (qualitative and quantitative) within a single population, methods of arriving at taxonomic decisions on species level; preparation and use of taxonomic keys.
23. **Cytotaxonomy :** importance of cytology and genetics in taxonomy.

Paper- II- Biological Chemistry, Physiology & Immunology

Duration : 3 hours Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

UNIT - I

1. **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.
3. **Energy considerations :** Biological oxidation & reduction. Fundamental reactions of biological oxidation; redox potential and electron transport system, enzymes and prosthetic groups.
4. Metabolic pathways of protein, carbohydrates, lipids and nucleic acids (including sequence determination).

UNIT - II

5. Physiology of the nervous system :

(a) Nerve impulse : Molecular physiology of nerve impulse.

(b) Synapse physiology and integration of information; coding in the neural information processing. Neuro transmitters.

(c) Reflex action : Various types of central and peripheral reflexes in mammalian nervous system.

6. Physiology of the receptor system :

(a) General mechanism involved in stimulus transduction at receptor sites.

(b) Functional architecture and stimulus processing in retina, organ of Corti and olfactory epithelium.

UNIT - III

7. a. Physiology of Respiration : Regulation of breathing and transport of O_2 and CO_2. An elementary idea of emplay send asthma accupational disorders and spirometry.

8. Stress Physiology : A general idea of stress physiology with special reference to elastic and plastic strain, stress resistance avoidance and tolerance. Physiological response to oxygen deficient stress and body exercise. Concept of homoeostasis, adaptations and aclimalization.

UNIT - IV

9. Innate and Acquired Immunity; phylogeny and ontogeny of Immune system, organiaztion and structure of lymphoid organs, cells of the immune system and their differentiation.

10. Nature of Immune responses, Nature of antigens and superantigens, factors influencing Immunogenicity, epitopes and haptens.

UNIT - V

11. 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.
12. Organization and expression of Ig genes. T-cell and B-cell generation, activation and differentiation. Cytokines, cell mediated effector functions.
13. Immunological tolerance and Anti-immunity; Hyper sensitivity and immune responses to infection agents especially intracellular parasites.

Paper-III: Cell Biology, Genetics and Biotechnology

Duration : 3 hours Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

UNIT-I
Microscopy, Cytological-techniques and Cell-organelles

1. A general idea of properties of light, lenses and magnification power.
   An elementary knowledge of principles and functioning of light (dissecting and compound), interference, polarising, fluorescence, phase contrast, UV and electron (SEM and TEM) microscopes.
2. Cytological techniques: Centrifugation and ultracentrifugation, intravital and supravital staining, preparation of cell cultures, isolation and fractionation of cell.
3. Plasma membrane and intracellular compartments: Structure and functions of membrane, principles of membrane transport, carrier proteins, ion channels. Structure and functions of endoplasmic reticulum. Signal recognition particles, ER signal peptides; signal transduction.
4. Vesicular traffic organelles: Structure and functions of Golgi complex and lysosomes, transport from Golgi bodies to lysosomes. Endocytosis and exocytosis; structure and functions of microbodies, glyoxysomes, peroxysomes, and spherosomes.
5. Energy transducers and other organelles: Structure, functions and evolution of mitochondria and plastids; their role as energy transducers. Structure and functions of ribosomes; structure of cilia, flagella, vacuoles and cytoskeleton.

UNIT-II
Nucleus, Chromosomes and Cell-division

1. Nucleus: Structure of interphase nucleus, pore compex, nucleoplasm and nucleolus.
2. Chromosomes: Chromatin organisation in dividing and nondividing cells, structure of chromosomes, solenoid model, importance of C-value paradox, centromere and telomere, karyotype, banding techniques, FISH, GISH, Mc FISH, cytometry ; giant and mini chromosomes.
3. Cell cycle and mitosis: Stages of cell cycle (G1, S, G2 and M stage), centriole cycle, mechanism of mitosis, anaphasic movements.
4. Mechanism of meiosis, nondisjunction.
5. Regulation of cell division and abnormalities: Genetic regulation of cell cycle, check points, cyclins, MPF, chalones, mitotic poisons; molecular oigin of cancer; apoptosis.

UNIT-III Genetics-I

1. Basics: Definitions of heredity, variation, gene, allele, autosomes, allosomes, homologous chromosomes, locus, homozygos, heterozygos, hemizygos, dominant, recessive, phenotype, genotype, filial generations, test cross, back cross, reciprocal cross, probable gamete formation for cross, use of symbols.

2. Laws of heredity and their variations: Works of Mendel and Morgan; 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).
4. Genetics of sex: Sex linkage, sex influenced and sex limited traits, sex determination, effects of environment on sex determination.
5. Human genetics: Abnormalities in chromosome structure and number, lnborne errors of metabolism, eugenics, euphenics and euthenics, genetic counselling.

UNIT-IV

Genetics-II Molecular basis of inheritance

1. DNA: Structure and types of DNA; DNA as a genetic material, gene structure, replication of DNA, enzymes and accessory proteins involved in DNA replication,DNA damage and repair, gene mutation and its molecular mechanism.
2. 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.
3. Translation: Mechanism of prokaryotic and eukaryotic translation, protein folding; role of chaperons.
4. Gene regulation: Gene regulation in Prokaryota, positive and negative regulation- Lac operon, tryptophan operon; gene regulatory proteins (motifs); gene regulation in Eukaryota.
5. 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.

UNIT-V Biotechnology

1. Basics: Genetic engineering, culture media, culture methods, restriction enzymes, cloning vectors, cell fusion, somatic hybridisation.
2. Recombinant DNA technology: Isolation of genetic materials gel-electrophoresis, amplification by PCR, insertion of r-DNA in host.
3. Bioreactors and downstream processing.
4. Biotechnology in agriculture: BT cotton, pest resistant and virus resistant plants,golden rice, flavr savr transgenic tomato.
5. Biotechnology in medicine: Humulin production, gene therapy, molecular diagnosis (DNA fingerprinting, ELISA), transgenic animals; liposomes (spheroplasts) in biomedical science.

Paper - IV- Evolution and Statistical methods in biologys

Duration : 3 hours Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

UNIT - I

1. Concepts of evolution and theories of organic evolution, Darwinism, Neo-Darwinism.
2. Geological time – scale
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

4. Quantifying genetic variability.
   * Genetic structure of natural populations
   * Phenotypic variation
   * Models explaining changes in genetic structure of populations
5. Molecular population genetics
   * Patterns of change in nucleotide and amino acid sequences
   * Ecological significance of molecular variations
   * Emergence of Non-Darwinism-Neutral Hypothesis
6. Genetics of quantitative traits in populations
   * Genotype-environment interactions
   * Inbreeding depression and heterosis
   * Molecular analysis of quantitative traits
   * Phenotypic plasticity
7. Genetics of speciation.
   * Phylogenetic and biological concept of species
   * Patterns and mechanisms of reproductive isolation
   * Models of speciation (Allopatric, sympatric, parapatric)

UNIT - III

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

UNIT - IV

12. Biostatstics Objective & signifycance : important terms & symbols, graphs (bar diagrams, histograms, frequency polygons, line diagrams)
13. Frequency distributions & centering constants (Mean, Median and Mode).
14. Measures of variation (standard deviation, variance, standard error of the Mean).
15. Rates and ratios
16. Sampling variation of proportions, Significance of difference in proportions
17. Chi-square test.

UNIT - V

18. Correlation and regression

19. Analysis of Variance (ANOVA)
20. Probability distributions : Binomial, Poissans and normal
21. Computer Applications in Zoological study: fundamentals of computer, History and generation of Computer. Computer Paripherals and architecture. Elementary idea, about operating system. DOS and window environment, elementary idea of MS-Office. Software used in biomedical science (image analysis system automation).
22. Bioinformatics : Elementary idea of bioinformatics and proteomics and Genomics

Practical Work Based on Paper I to IV

Total No. of laboratory hrs. 480

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.
4. Study of sections of the arm of a starfish: water vascular system of starfish;

IV. Permanent preparations and their study :

1. Preparation of cultures of Amoeba, Paramaecium and Euglena.Study of these protozoans using vital dyes.
2. Permanent preparations of Amoeba. Paramaecium and Euglena from cultures, vorticella from the pond water; flagellates from the gut of white ant; Rectal ciliates, Trypansomes in the blood of house rat; lifecycle stages of Monocystis from the seminal vesicle of earthworm.
3. Collection, fixation & permanent preparations of trematodes, cestodes & nematodes found in sheep and pig and in the stool of infected persons.
4. Permanent preparations through various parts of Animals mentioned in III (i-iv) anatomy section and study of the structure.
5. Permanent preparations of different materials provided for study using microtome.

V. Biological Chemistry :

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. Physiology

1. Elementary idea of Kymographic recording of muscle twitch, summation of twitches, chronic contractions, tetanus, fatigue & staircase phenomenon from the sciatic nerve muscle preparation of rat.
2. Study of ECG. Heart beat, Blood pressure.
3. Photometric determination of haemoglobin in blood sample.
4. Demonstration of the following in blood; clotting time. Bleeding time, erythrocyte sedimentation rate, haemolysis & crenation, differential count of leucocytes.
5. Determination of blood urea and blood sugar value.

VII. 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.

VIII. 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).

IX. Statistical Methods of Biology :

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.

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

X. Micro-Biology :

1. Demonstration of gram positive and gram negative bacteria.

M.Sc. (Prev.) ZOOLOGY
Scheme of Practical Examination & Distribution of Mark

First Day

Duration - 5 hrs.

(a)	Exercise in Biological Chemistry	-	10	Mark
(b)	Exercise in Cell Biology	-	10	Mark
(c)	Exercise in Invertebrate Taxonomy (Using Taxonomic keys)	-	10	Mark
(d)	Exercise in statistical methods	-	10	Mark
	(i) Diagramatic presentation numericals based on statistical methods	-	10	Marks
(e)	Identification & comments on spots (8)	-	30	Mark
(f)	Viva-voce	-	10	Mark
(g)	Class record	-	10	Mark
	G. Total	**-**	**100**	**Mark**

Second Day

Duration - 5 hrs.

(a)	Invertebrate major dissection	-	10	Mark
(b)	Invertabrate minor dissestion	-	07	Mark
(c)	Permanent preparation	-	08	Mark
(d)	Exercise in physiology	-	10	Mark
(e)	Exercise in genetics	-	10	Mark
(f)	Exercise based on microbiology	-	10	Mark
(g)	Viva-voce	-	15	Mark
(h)	Class record	-	10	Mark
(i)	Seminar	-	20	Mark
	Total	**-**	**100**	**Mark**

GRAND TOTAL ***(100+100)*** ***200 Marks***

M.Sc. (Final) ZOOLOGY

(Scheme for Examination) – 2017

Paper	Duration	Max. Marks	Min. Pass Marks
V	3 Hours	100	25
VI	3 Hours	100	25
VII	3 Hours	100	25
VIII	3 Hours	100	25
Practical (General)	5 Hours	100	36
Practical (Special Paper)	5 Hours	100	36

*** Note : Overall 36% marks are required to pass M.Sc. Final examination.**

PAPER-V : CHORDATA AND DEVELOPMENTAL BIOLOGY OF CHORDATES

Duration : 3 hours Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

UNIT - I

1. Origin and outline classification of chordates.
2. Interrelationships of Hemichordata, Urochordata and Cephalochordata and their relations with other deuterostomes.
3. Life histories of sessile and pelagic tunicates (ascidian), *Pyrosoma, Salpa, Doliolum* and *Oikoplpeura*.
4. Origin, evolution and adaptive radiations of vertebrates :
   (a) Geological time scale and fossils.
   (b) Origin, evolution and general characters of Agnatha.(Ostracoderms and Cyclostomes).
   (c) Early gnathostomes (Placoderms).
   (d) A general account of Elasmobranchi, Holocephali, Dipnoi and Teleostomi.
   (e) Adaptive radiation in bony fishes.

UNIT - II

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

6. Origin of flight; flight adaptations.
7. Origin of mammals, primitive mammals (Prototheria & Metatheria)
8. A general survey of main radiations in eutherian mammals, excluding detailed reference to individual orders.
9. Evolution of man; relationships of man with other primates; fossil record of ancestry of man.

UNIT - III

1. Theories of development : Preformation and epigenesis.
2. 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.
4. Early embryonic development.
   (a) Patterns of cleavage, blastulation and gastrulation in chordates (tunicates to mammals).
   (b) Fate maps.
   (c) Morphogenetic movements.
   (d) Mechanics and significance of gastrulation.
5. Causal basis of development and 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 - IV

1. Cell differentiation and differential activity.
2. Organogenesis :
   (a) Morphogenetic processes in epithelia and mesenchyme in organ formation.
   (b) Morphogenesis of brain, neural crest cells and their derivatives.
   (c) Development of the eye, heart, alimentary canal and its accessory organs.
3. Maternal contributions in early embryonic development.
4. Genetic regulations of early embryo development.

UNIT - V

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

3. Types of regeneration, physiological, reparative and compensatory hypertrophy, regenerative ability in chordates.
   (b) Morphological and histological processes in amphibian limb regeneration.
   (c) Origin of cells of regeneration, de-differentiation, redifferentiatoin, pattern formation during amphibian limb generation; reasons for failure of limb generation ability in other chordates and mammals; methods for induction of regenrations.

PAPER-VI : ANIMAL ECOLOGY AND ETHOLOGY

Duration : 3 hours Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

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 :
   (a) The general environment.
   (b) Role of physical factors: temperature, light, water, atmospheric gases, media, substratum, climatology.
   (c) Brief review of important physical factors as limiting factor.
   (d) Nutrients and environment.

UNIT - II

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".
   (d) Patterns in communities : Stratification, zonation, activity, food web, reproductive and social structure.
   (e) Community versus continum.
   (f) Evolution of communities : Palaecology; community structure in past ages.
3. Ecological regulations :

(a) 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.

(b) Fluctuations within community : Irruptive cycle, fluctuation, causes of fluctuation, cycles.

UNIT - III

1. 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.
   f. 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.

UNIT - IV

1. Introduction of animal behaviour.
2. Orientation :
   (a) Classification of various types of taxes and kineses.
   (b) Flight orientation in locust.
3. Methods of studying behaviour : Brain lesions; electrical stimulation, drug administration.
4. Types of behaviour and their regulation :
   (a) Components of feeding behaviour : Hunger drive; directional movement, avoidance, eating, carrying and hoarding.
   (b) Factors influencing choice of food.
   (c) Nervous regulation of food and energy intake :
      i. Motivated behaviour ; drive, satiation and its neurophysiological control.
      ii. Feeding behaviour.
      iii. Learning : Habituation conditioned reflex; trial and error; latent learning; learning and discrimination, imprinting; neural mechanism of learning.
      iv. Instinctive behaviour: Concept, phyletic decent and physiology.
      v. Hormones and behaviour. Mammalian nervous system and involvement of hypothalamus in the regulation of behavioural patterns.

UNIT - V

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.
4. Reproductive behaviour in fish (Stickle back or any other fish).
5. Behaviour in insects : Social behaviour, communications, concealment behaviour, role of

pheromones.

6. Behavioural genetics: Single gene effect, multiple gene effect, behavioural variation in an individual; genetics and human behaviour.

PRATICAL SYLLABUS BASED ON PAPER V & VI

Total No. of Lect. Hours : 240 Duration : 5 Hours Max. Marks : 80

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. Developmental biology :
   - (a) Study of development of frog or toad through :
     - (i) Formalin preserved or living material (egg, spawn, embryo, larvae and metamorphic stages).
     - (ii) Permanent microscopic slides of sections through successive embryonic and larval stages.
   - (b) Study of development of chick through :
     - (i) Permanent whole mounts of successive embryonic stages.
     - (ii) Permanent microscopic slides of section through representative regions of successive embryonic stages.

Note : Special emphasis should be laid on organogenesis and morphogenesis.

   - (c) Removal of chick embryos of 18,21,24,33,72 and 92 hours from the egg and their study and identification in the living state; permanent whole mounts of these embryos using living states.
   - (d) Study of (i) formalin preserved foetuses with placenta and (ii) histology of the placenta of any mammal.

3. 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.
4. 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.

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

Scheme of M.Sc. (Final) Zoology : Practical (General) Examination

Distribution of Marks

1.	Dissection - Through photograph / model / chart / CD	10 marks
2.	Permanent preparation	10 marks
3.	Exercise in developmental biology	10 marks
4.	Exercise in Ecology	08 marks
5.	Ethology	08 marks
6.	Identification and comments on 8 spots	24 marks
7.	Viva-voce	10 marks
8.	Class Record	10 marks
9.	Seminar (internal)	10 marks

Duration : 5 Hours		**Total 100 marks**

PAPER-VII (A) : CELL BIOLOGY

Duration : 3 hours Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks :

Unit - I

1. **Concept of Cell Theory**
2. **Cell Types :** Detailed structure of the different types of cells.
   (a) Nerve Cell (b) Muscle Cell (c) Gland Cell (d) Blood Cell
3. **Cell Membrane :**
   a. Study of various models of the molecular structure of the cell membrane as suggested by Devson & Danielli, obertson & Green : Other recent views on the subject.
   b. Molecular structure of the specialized modifications of the cell membrane (Cilia, flagella, myelin, sheath etc.).
   c. Concept of cell surface : Electro kinetic properties of cell surface their role in intercellular, inter-action in cell fusion, Cell aggregation etc.
   d. Properties & functions of the cell membrane, with special reference to permeability.

Unit- II

1. **Cytoplasm :**
   (a) Generalized structure & composition of the cytoplasm.
   (b) Detailed discussion on the following cytoplasmic componets with special reference to the biochemical and physiological aspects.
   (i) Endoplasmic reticulum (ii) ibosomes (iii) Golgi body (iv) mitochondria (v) Lysosomes, peroxisomes & other related particles (xi) Centrosomes.

Unit- III

2. **Nucleus**:
   (a) Structure & functions of the nuclear enyelop .
   (b) Structure and chemical organization of the resting nucleus.
   (c) Nucleus & Nucleolar extrusions.
   (d) Chemistry and biosynthesis of nucleic acids.

1. **Chromosomes :**
   (a) Structural, chemical and functional organization of the different types of chromosomes (autosomes, giant chromosomes, sex chromosomes supernumerary, chromosomes etc.).
   (b) Chromosomal aberration.
   (c) Variation and evolution of chromosome numbers.

Unit- IV

2. **Cell Division :**
   (a) Detailed structural, chemical & physiological study of mitotic and mciotic divisions, with

special reference to the mechanism of chromosome movement and organization o fthe spindle apparatus.

(b) Mitotic poisons and their action.

(c) Polyploidy

(d) Polysomy

Unit- V

3**. Gametogenesis**:

(a) Cytological cytochemical and endocrinological study on the developing male & female germ cells.

(b) Physiology of ovam and spermatozoan.

(c) Physiology o the union of gametes and the acrosome reaction.

PAPER-VII (B) : ENVIRONMENTAL BIOLOGY

Duration : 3 hours Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

UNIT : I

1. System analysis including models in environmental Biology.
2. Impact of environment at callular level : Cellular interaction with environment.

Unit- II

1. Environmental Physiologhy:
   Basic Metabolic rate and body size
   Metabolism and climatic adaptions -
   Hibernation and aestivation
   Poikilotherms and Homeotherms Asphyxic responses.
2. Response to temperature and Pressure.
   Haematological changes
   Thermal properties of water and servival limits. Acclimatization.

Unit-III

1. A detailed study of different ecosystems. (Study with includiabitic and biotic components and their interrelationship, productivity and adaptations of animals).
2. Terrestrial Ecosystems :
   1. Grasslands (including grazing lands)
   2. Forests : characteristics of alpins, temperate and tropical forests. Stratification, high altitude (with special reference to Himalayanecology)
   3. Deserts : Types and ecological attributes of desert biota.
   4. Toiga : Extent and ecological peculiarities
   5. Tundre : Extent and ecological peculiarities

Unit- IV

1. Aquatic Ecosystems :

1. Fresh Water : Lakes (including salt lakes) Ponds streams, springs, rivers and marshes.
2. Marine : Zonation fauna
3. Esturine : Ecological peculiarities and adaptions (including impact on fauna)

2. A general knowledge of Biogeography

Unit- V

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

PAPER-VII (C) : ENTOMOLOGY

(Morphology, Physiology and Systematics)

Duration : 3 hours Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

UNIT : I

1. Insect integument : Structure, composition and functions.
2. Biochemistry of sclerotisation.
3. Functional morphology : Head, thorax, abdomen and appendages, head segmentation, wing venation.
4. Muscular system and its functions.

UNIT : II

1. Digestive system : Alimentary canal and physiology of digestion.
2. Circulatory system : Anatomy, physiology; composition of haemolymph.
3. Respiratory system : Structure and physiology.
4. Excretory system : Functional architecture.

UNIT : III

1. Nervous system : Structure and physiology.
2. Neuro endocrine system.
3. Sense organs : Chemoreceptors, mechanoreceptors, photoreceptors, sound and light producing organs, visual organs and physiology of vision.
4. Reproductive system : Structure and physiology.

UNIT : IV

1. Classification of insects upto order and suborders.
2. Comparative study of wing venation in Orthoptera, Hymenoptera (*Apis*), Diptera (mosquito) and Homoptera (Aphid).
3. Introduction to primitive insects and fossil insects, cause of success of insects.

4. Orgin and evolution of insects.

UNIT : V

1. Detailed classification of the following orders emphasizing selected superfamilies and families : Orthoptera, Isoptera, Coleoptera, Homoptera, Hemiptera, Lepidoptera, Diptera and Hymenoptera.
2. Economic importance of these orders.
3. Social life in Isoptera and Hymenoptera.
4. Caste determination in social insects.

PAPER-VII(D) : FISH BIOLOGY

Duration : 3 hours Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

UNIT- I

1. Geographical distribution: Classification of fishes, with distinguishing characters of principal subdivisions.
2. Status and conservation of fish fauna of India with special reference to Rajasthan.
3. General account and phylogenetic significance of Ostracoderms and Placoderms.
4. Origin and adaptive radiation of various groups.
5. Body form and locomotion.

UNIT-II

6. Integument, exoskeleton and colouration of fishes.
7. Structure, modification and functions of median and paired fins.
8. Theories of origin of median and paired fins.
9. Musculature: Lateral musculature, jaw and respiratory musculature, fin musculature and eye muscles.

UNIT-III

10. Endoskeleton: Neurocranium and visceral arches, vertebral column, fin skeleton and girdles, types of jaw suspension in fishes.
11. Food, feeding habits, alimentary canal and physiology of digestion.
12. Blood, heart, vascular system and circulation of blood. Haemoglobin and its adaptation in fishes.
13. Respiratory organs, physiology of respiration and its regulation. Air breathing organs.

UNIT-IV

14. Excretory organs and physiology of excretion. Osmoregulation in marine, fresh water and estuarine fishes.
15. Structure, function and physiology of swim-bladder.
16. Weberian apparatus and its significance.
17. Nervous system and sense organs, lateral line system.

UNIT-V

18. Endocrine glands and their hormones.
19. Reproduction in fishes: Reproductive organs (male and female), reproductive behaviour, courtship and parental care, general study of fish behaviour, hormonal control of reproduction.
20. Embryogenesis: Ontogenic development in fishes, categories of fishes with respect to development; viviparity; molecular aspect of yolk formation.
21. Recent trends in fish study and research, recombinant DNA technology in fish research.

PAPER-VIII (A) : CELL BIOLOGY

Duration : 3 hours Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

Unit- I

1. Specialized function of cytoplasmic components in a cell with special references to the molecular mechanism (Contractibility, secretion, phagocytosis and pinocytosis).
2. Cell and tissue culture :
   (a) Behaviour of cells in culture.
   (b) Primary and established cell lines; kinetics of cell growth.
   (c) Natural and defined media for culture.
   (d) Importance of cell and tissue culture.
3. Generalized account of the mechanism of cell aggregation during development; in vitro studies.

Unit-II

1. Chemical basis of "fixation" and "staining" and a discussion on the following techniques.
   a. Freeze substitution b. Freeze drying
   c. Fresh and fixed frozen sections
   d. PAS, Metachromasia, Feulgen, lipid and protein staining techniques.
   e. Centrifugation and ultra-centrifugation.
   f. Single two dimensional & column chromatorgraphy.
   g. Intra-vital and supra-vital staining.
   h. Paper, gel and disc electrophoresis.

Unit- III

2. Elementary concept of the principle & theory of microscopy as exemplified by the following :
   (a) Phase contrast microscopy (b) Interface microscopy
   (c) Polarizing microscopy. (d) Fluorescence microscoy
   (e) Electron microscopy (f) Ultra violet microscopy

Unit- IV

1. A general account of the effect of ionizing radiation at the cellular level.
2. Ole and mechanism of action of the following enzymes at the cellular level
   (a) AT Pase (b) Succinic dehydrogenase
   (c) Acad and alkaling phosphatases (d) Hyaluronidase.

Unit-V

3. Elementary ideas of the origin of following diseases :
   (a) Cancer (b) Glycogen storage disease (c) AIDS
4. Cellular aspects of the process of aging
5. Cellular aspects of immunity and virus – cell interaction .

PAPER-VIII (B) : ENVIRONMENTAL BIOLOGY

Duration : 3 hours Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

UNIT : I

1. History of man and his cultural evolution in relation to impact on environment.
2. Management of Environment Natural resources : their conservation and development.

UNIT- II

1. Management of -
   1. agriculture and forestry including best management
   2. wild life resources
   3. mineral resource s
   4. aquaculture (Fresh water and marine)
   5. energy resources
   6. river basin
2. Pollution - monitoring, sources effect and control

UNIT-III

1. Water pollution, Air pollution and land pollution
2. Thermal, noise and radiation pollution

UNIT-IV

1. Environment and Health -
   Urban health problems, impact of urbanization stress, Health status and health problems. Rural health problems
2. Socio- pollution impact of weather, natural disasters, pollution, water availability, food resources in relation to human health.

UNIT- V

1. Environmental Toxicology : Natural and man-made toxicants accuring in the environment and their impact on animal life in different ecosystems. safely measures.
2. Methodology for environmental analysis :
   a. monitoring
   b. analysis of physical and chemical factors
   c. statistical analysis
   d. bioassay techniques.

PAPER-VIII (C) : ENTOMOLOGY

(Ecology and Applied Entomology/Toxicology)

Duration : 3 hours Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

UNIT : I

1. Effects of physical factors ; population dynamics.
2. Intraspecific and interspecific relations ; host plant insect - interactions.
3. Biochemical adaptation to environmental stress. Pheremonal control of fertility in insects.
4. Embryology : Embryonic and post embryonic development ; diapause, types of larvae, pupae and metamorphosis. Role of endocrine glands in growth and development, viviparity and parthenogenesis.

UNIT : II

1. General idea of damage caused by pests.
2. Principal methods of pest control.
3. Insecticides : Types, mode of action and methods of application.
4. General idea of appliances used in the insecticide treatment and their safe handling.

UNIT : III

1. A general account of chemosterilants, attractants, repellents, pheromones, growth regulators and such other compounds.
2. Development of resistance to pesticides.
3. Insecticide synergists and antagonists.

UNIT : IV

1. Life history, damage caused and control of three major pests of each of the following crops : Wheat, paddy, maize, jowar, millet, sugarcane, cotton, mustard and soyabean.
2. Stored grain and milled product pests :
   Sitophilus, *Callosobruchus*, *Rhizopertha*, *Triboleum*, *Trogoderma*, *Oryzaephilus*.
   An elementary idea of storage.
3. Pests of veterinary and medical importance; priliminary idea of insect borne diseases.

4. Life cycle of aphid and locust and their control.

UNIT : V

1. A general idea of plant protection organisations in India; forensic entomology with special reference to human and wild life.
2. Beneficial insects : Silk worm, honey bee, lac insect; their economic importance and industries related to them.
3. Role of genetics in insect vector control.
4. An elementary idea of IPM.

Entomology Practical Syllabus based on Paper VII (C) and VIII (C)

Duration : 5 Hours **Maximum Marks : 100**

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. 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 insectary.
4. Collection and preservation of insects and their different stages.
5. Collection of seasonal, nocturnal, aquatic insects, crop pests, stored grain pests, household pests and insects of veterinary and medical importance.
6. Anatomy
   a. Cockroach - Digestive, circulatory, reproductive systems and neuroendocrine complex.
   b. Grasshopper - Digestive, circulatory, reproductive systems and neuroendocrine complex.
   c. House cricket - Digestive, reproductive and nervous systems.
   d. Bug - Digestive and nervous systems.
   e. Butterfly - Digestive and nervous systems.
   f. Housefly - Digestive and nervous systems.
   g. Honey bee - Digestive and nervous systems.
   h. Wasp - Nervous systems.
   i. Beetle - Nervous systems.
7. Familiarity with techniques and appliances used for insecticide treatment.
8. Bioassay experiments for testing the insecticides.
9. Microtechnical procedures (microtomy).
10. Study of food preference in stored grain pests.
11. A tour to visit important centres of entomological / toxicological studies.

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

Distribution of Marks

1.	Learning of insect anatomy	12 marks
2.	Permanent preparation	05 marks
3.	Identification of 4 insects using taxonomic keys	12 marks
4.	Microtomy	10 marks
5.	Exercise in Applied Entomology (Toxicology)	05 marks
6.	Identification and comments on 8 spots	16 marks
7.	Viva-voce	10 marks
8.	Class Record	10 marks
9.	Field Trip and Project Report	10 marks
10.	Seminar (internal)	10 marks

	Total	**100 marks**

PAPER-VIII(D): FISH BIOLOGY

Duration : 3 hours Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

UNIT-I

1. A general survey of world's fisheries, survey of principal fisheries of India (riverine, reservoir, estuarine and marine fisheries).
2. Biology of Indian major carps, catfishes, *Hilsa*, sardine mackerel, sharks, mahaseer, prawns and oysters.
3. Exotic fishes, larvivorous fishes, predatory and weed fishes.
4. Prawn culture in lakes and ponds of fresh and brackish water of Rajasthan.

UNIT-II

5. Pisciculture and its importance with special reference to India.
6. Different types of fish cultures viz. composite fish culture, paddy culture, sea food fish culture, cage culture, air breathing fish culture, carnivorous fish culture and ornamental fish culture.
7. A detailed study of methods of fishing (crafts and gears) in fresh water of India.
8. Fisheries: Management, growth, productivity and expansion.
9. Management of fish marketing and impact of fisheries on state economy.

UNIT-III

10. Fish preservation and processing.
11. Bio-chemical composition of fish, fish as food.
12. Fish and mankind, byproducts of fishing industry.
13. Ecological factors affecting the life of fishes in various ecosystems.
14. Estimation of population number and mortality rates in fresh waters.

15. Age and growth studies.

UNIT-IV

16. Limnology: Definition, types of lakes/ponds, their significance in fishery practice.
17. Plankton in relation to fisheries.
18. Water pollution and fisheries with special reference to India.
19. Aquatic weeds and their control.
20. Aquaria and their uses, setting up and maintenance of aquaria.

UNIT-V

21. Diseases of fishes: Symptoms, etiology and treatment.
22. Specialized organs: Bioluminescent organs, electric organs, sound producing organs, poisonous and venomous glands.
23. Fish migration, its causes and significance.
24. Adaptations to special conditions of life: Hill stream fishes, deep sea fishes, cave dwelling fishes, arctic and antarctic fishes.
25. Fish culture and cytogenetics. General diversity of fishes of India, transgenic fishes and fish genomics.

M.Sc. (FINAL) - ZOOLOGY
FISH BIOLOGY PRACTICAL
BASED ON PAPER VII(D) AND VIII(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 scales.
5. Micro-technical pocedures: Preparation and study of serial sections of a larval fish and represetative tissues and organs of fish.
6. Local fishes and their identification upto the species level, study of the available museum specimens.
7. 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.
8. 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): eggs, cleavage, blastula, gastrula, external gill, mature larva, fry and fingerlings.

9. (a) Periodical visits to a local fishing farm to gain a first hand knowledge of its psciculture pactices 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.
10. 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 7 and 10 has to be submitted compulsorily by each candidate.

Scheme of M.Sc. (Final) Zoology : Practical (Fish Biology) Examination
Distribution of Marks

1.	Learning of fish anatomy	10 marks
2.	Permanent preparation	06 marks
3.	Species identification using taxonomic key	06 marks
4.	Microtomy	10 marks
5.	Hydrobiological exercise	06 marks
6.	Biochemical / Physiological exercise	06 marks
7.	Identification and comments on 8 spots	16 marks
8.	Viva-voce	10 marks
9.	Class Record	10 marks
10.	Field Trip and Project Report	10 marks
11.	Seminar (internal)	10 marks

	Total	**100 marks**