

M.Sc. (Prev.) ZOOLOGY - 2013

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

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 invrtebrate 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 Cocciferates, 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 survey 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 of 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 Pseudocoelomate 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, Onychophora, Arthropoda & Mollusca).
18. Affinities and evolutionary 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

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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 O₂ and CO₂. An elementary idea of employ 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 complex, 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 origin of cancer; apoptosis.

UNIT-III Genetics-I

1. Basics: Definitions of heredity, variation, gene, allele, autosomes, allosomes, homologous chromosomes, locus, homozygous, heterozygous, hemizygous, 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, pleiotropy, genetic interactions.
3. Linkage and crossing over: Mechanism of crossing over, linkage groups, linkage maps; accessory genetic elements (plasmids, transposons and reterolements).
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, Inborne 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. 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

3. Quantifying genetic variability.
 - * Genetic structure of natural populations
 - * Phenotypic variation
 - * Models explaining changes in genetic structure of populations
 - * Factors affecting human disease frequency
4. Molecular population genetics
 - * Patterns of change in nucleotide and amino acid sequences
 - * Ecological significance of molecular variations
 - * Emergence of Non-Darwinism-Neutral Hypothesis
5. Genetics of quantitative traits in populations
 - * Genotype-environment interactions
 - * Inbreeding depression and heterosis
 - * Molecular analysis of quantitative traits
 - * Phenotypic plasticity

UNIT - III

6. Genetics of speciation.
 - * Phylogenetic and biological concept of species
 - * Patterns and mechanisms of reproductive isolation
 - * Models of speciation (Allopatric, sympatric, parapatric)
7. Molecular Evolution
 - * Gene Evolution
 - * Evolution of gene families, Molecular drive
 - * Assessment of molecular variation
8. Origin of higher categories
 - * Micro-and Macro-evolution

UNIT - IV

9. Characteristic of evolution
Extinction, replacement, irreversibility of specialization etc.
10. Adaptation diversity & nature of adaptation : adaptive radiations & occupation of new environments & niches : mimicry and coloration.
11. Biostatistics Objective & significance : important terms & symbols, graphs (bar diagrams, histograms, frequency polygons, line diagrams)
12. Frequency distributions & centering constants (Mean, Median and Mode).
13. Measures of variation (standard deviation, variance, standard error of the Mean).

UNIT - V

14. Rates and ratios
15. Sampling variation of proportions, Significance of difference in proportions
16. Chi-square test.

17. Correlation and regression
18. Analysis of Variance (ANOVA)
19. Probability distributions : Binomial, Poissons and normal
20. 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).
21. Bioinformatics : Elementary idea of bioinformatics and proteomics and Genomics

Practical Work Based on Paper I to IV

Total No. of laboratory hrs. 480

I. 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 Sepia 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; general anatomy of a holothurian: Aristotle's lantern of seurchin; complete and disarticulated; arrangement of disarticulated parts of the Aristotle's lantern.

IV. Permanent preperations and their study :

1. Preparation of cultures of Amoeba, Paramecium and Euglena. Study of these protozoans using vital dyes.
2. Permanent preparations of Amoeba. Paramecium and Euglena from cultures, vorticella from the pond water; flagellates from the gut of white ant; Rectal ciliates, Trypanosomes 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. ECG & its interpretation. 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. Monohybrid & Dihybrid inheritance in Drosophila.
4. Problems based on Mendelism and gene interaction.
5. Identification of blood groups in man.
6. 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. Calculation of probability & significance between mean using t-test.
4. Calculation of significance using Chi-square test.
5. Plotting the slope of a line on a graph: calculations of the slope of a line, coefficient and regression.
6. 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. Molecular Biology :

1. Electrophoresis : Paper and Gel (SDS) (PAGE) and agarose electrophoresis.
2. Determination of Serum Protein through paper and Gel electrophoresis.

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

Duration - 5 hrs.

(a) Exercise in Biological Chemistry	-	14	Mark
(b) Exercise in Cell Biology	-	12	Mark
(c) Exercise in Invertebrate Taxonomy (Using Taxonomic keys)	-	08	Mark
(d) Exercise in statistical methods	-	12	Mark
(e) Identification & comments on spots (8)	-	24	Mark
(f) Viva-voce	-	10	Mark
(g) Class record	-	10	Mark
G. Total	-	90	Mark

Second Day

Duration - 5 hrs.

(a) Invertebrate major dissection	-	20	Mark
(b) Invertebrate minor dissection	-	08	Mark
(c) Permanent preparation using microtome	-	12	Mark
(d) Exercise in physiology	-	10	Mark
(e) Exercise in genetics	-	10	Mark
(f) Exercise based on molecular biology/microbiology	-	10	Mark
(g) Viva-voce	-	10	Mark
(h) Class record	-	10	Mark
(i) Seminar	-	20	Mark
Total	-	110	Mark

GRAND TOTAL **(90+110)** **200 Marks**