FACULTY OF SCIENCE

SYLLABI

FOR
M.Sc. (TWO YEAR COURSE )

IN

ZOOLOGY
1st & 2nd YEAR( Semester System)

EXAMINATIONS 2013-2014

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# OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR M.SC. (TWO YEAR COURSE) IN ZOOLOGY (SEMESTER SYSTEM)
EXAMINATIONS OF 2013-2014.

## FIRST SEMESTER

<table>
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<th>Paper</th>
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<td>Lower Chordates. Comparative Anatomy of Vertebrates -I</td>
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## SECOND SEMESTER

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<td>Paper VII</td>
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THIRD SEMESTER

Paper XI: Developmental Biology -I  
Practical based on paper XI  
80
20

Paper XII: Biochemistry,  
Practical based on Paper XII  
80
20

Paper XIII: Cell and Molecular Biology  
Practical based on Paper-XIII  
80
20

Paper XIV: Instrumentation and Methodology  
Practical based on Paper XIV  
80
20

Paper XV: Advances in Entomology  
Practical based on Paper XV  
80
20

FOURTH SEMESTER

Paper XVI: Developmental Biology -II  
Practical based on paper XVI  
80
20

Paper XVII: Advances in Parasitology  
Practical based on Paper XVII  
80
20

Paper XVIII: Advances in Fish and Fisheries  
Practical based on Paper XVIII  
80
20

Paper XIX: Environmental Biology & Wild life  
Practical based on Paper XIX  
80
20

Paper XX: Cytogenetics and Molecular Genetics  
Practical based on Paper-XX  
80
20
SEMESTER –I

PAPER-I : STRUCTURE AND FUNCTIONS OF INVERTEBRATES -I

Time : 3 Hours.
Theory hours per week : 4 hours
Total Marks : 100
Theory : 80
Practical hours per week : 3 hours
Internal Assessment: 15
Annual Theory Exam.: 65
Practical : 20
Internal Assessment 05
Final Practical : 15

Objectives of the Course :

To acquaint the students with the classification and general organization of invertebrates. To make the students know about the habitat, habits, morphology and economic importance of various types of invertebrates.

UNIT-I

1. Phylum Protozoa : General organisation of Protozoa with special reference to feeding, locomotory organelles and locomotion, reproduction, parasitism and pathogenic protozoans.
2. Phylum Porifera : General organisation of phylum Porifera with special reference to canal system, skeleton and development.

UNIT-II


Note : Nine questions to be set. First question of 15 marks, covering the whole syllabus will be compulsory and will consist of 10 short answer questions of 1½ marks each. For the remaining 8 questions, 4 to be set from each Unit I and II and 2 to be attempted from each Unit. Each question from Units I and II will carry 12½ marks.

Practicals Based on Theory Paper - I

Classification up to orders and study of the specimens mentioned against each phylum with ecological note.

1. Protozoa.
   a. Permanent stained preparation from the culture of Amoeba, Euglena Paramecium and Vorticella.

2. Porifera
   c. Preparation of permanent slides: gemmules and spicules.

3. Coelenterata
   c. Preparation of permanent slides: *Hydra, Obelia, Sertularia* and *Plumularia*.

4. Platyhelminthes
   a. Specimens: *Planaria*, *Dugesia*, *Fasciola*, *Taenia*, and *Echinococcus*.

5. Aschelminthes
   a. Specimens: *Ascaris* (Male and female)

Books Recommended

PAPER - II : LOWER CHORDATES. COMPARATIVE ANATOMY OF VERTEBRATES - I

Time : 3 Hours

Theory hours per week : 4 hours
Total Marks : 100
Theory : 80

Practical hours per week : 3 hours
Internal Assessment: 15
Annual Theory Exam.: 65
Practical : 20
Internal Assessment 05
Final Practical : 15

Objectives of the Course:

To enable the students know about structure and functions of protochordates.
To draw a comparative account of anatomy of vertebrates and hence to understand the evolution of different systems in vertebrates.

UNIT - I

Introduction to chordates. Organisation and affinities of *Herdmania* and *Amphioxus*.

Comparative account of following systems of the vertebrates with evolutionary trends from Pisces to Mammals.

Integumentary system : Integument and its derivatives.
Skeletal system : Chondrocranium, Spianchnocranium, Dermatocranium, Jaw suspension.

UNIT-II

Digestive system : Alimentary canal and associated glands.
( Types of teeth, dental formulae and functions, Types of stomach, small and large intestines, Glands : Salivary, gastric, Pancreas and liver).
Circulatory system : Evolution of heart & aortic arches.

Note: Nine questions to be set. First question of 15 marks, covering the whole syllabus will be compulsory and will consist of 10 short answer questions of 1½ marks each. For the remaining 8 questions, 4 to be set from each Unit I and II and 2 to be attempted from each Unit. Each question from Units I and II will carry 12½ marks.

Practicals based on theory paper II

1. Classification upto orders, excepting pisces and Aves, where classification upto subclasses is required, Habits, Habitats, external characters and economic importance (if any) of the following animals:

   Chondrichthyes : *Zygaena, Pristis, Narcine, Trygon, Rhinobatus, Chimaera.*

   Actinopterygii : *Polypterus, Acipenser, Lepidosteus, Muraena, Mystus, Catla.*

   *Hippocampus, Sygnathus, Exocoetus, Anabas, Diodon, Tetradon, Echeneis and Solea.*
Dipneusti (Dipnoi) : *Protopterus* (Lung fish)

Reptilia : *Hemidactylus, Calotes, Draco, Varanus, Phrynosoma, Chamaeleon, Typhlops, Python, Eryx, Ptyas, Bungarus, Naja, Hydrus, Vipera, Crocodilus, Gavialis, Chelone and Testudo*.

2. Examine and dissect the following animals :
   *Labeo* : Digestive and reproductive systems, Circulatory system: heart, afferent and efferent branchial arteries, Nervous system: cranial nerves and internal ear.

3. Study of the skeleton of *Labeo, Rana* and *Varanus*.

4. Study of histology of different organs of frog.

Books Recommended


PAPER III : ANIMAL PHYSIOLOGY

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Objectives of the Course:

To enable the students to know about all the physiological processes going on in animal/human body.
To make the students understand the functions of hormones and their mode of action at molecular level.
UNIT – I

**Nutrition**: Chemistry, metabolic role and sources of vitamins & deficiency diseases due to them. Biological significance and regulation of minerals and deficiency diseases due to them. Physiology of digestion.

**Circulation**: Chemistry of blood components and their functional significance; origin, formation, molecular regulation and maturation of RBCs and WBCs; biochemistry of haemoglobin and myoglobin; biochemical interconversions during blood coagulation and homeostasis. Cardiac cycle and its regulatory mechanisms. Cardiac output and the factors that affect cardiac output, micro circulation, blood pressure, factors influencing blood pressure and its regulation.

**Respiration**: Concept of respiration, mechanism of breathing; biochemistry of respiratory exchange; Transport of respiratory gases; Regulatory mechanisms (humoral and neural) of respiration. Respiratory acidosis, alkalosis and regulation of pH.

UNIT – II

**Excretion**: Concept of excretion and nitrogenous wastes; functional anatomy of renal unit; biophysical and chemical mechanisms of ultrafiltration, reabsorption and secretion, transport mechanisms, urine formation & regulatory control of sugar, urea, Na⁺ K⁺, and H⁺; Role of kidneys in regulation of acid-base balance and osmoregulation, counter current mechanism.

**Physiology of Muscles**: Types of muscles and their components; Molecular organization of myosin, role of heavy and light meromyosin, molecular organization of actin; interaction of actin and myosin, AT Pase activity of myosin, power-stroke, ATP binding and hydrolysis; Role of troponin and tropomyosin and Ca²⁺ in regulation of muscle contraction. Contraction of smooth muscles, role of phosphorylation, Ca²⁺ and kinases; Role of actin and myosin in eukaryotic cells (microtubules and microfilaments).

**Stress Physiology**: Physiological adaptations in response to high, low ambient temperature, physiological adaptation at high altitude and in deep sea environment.

**Note**: Nine questions to be set. First question of 15 marks, covering the whole syllabus will be compulsory and will consist of 10 short answer questions of 1½ marks each. For the remaining 8 questions, 4 to be set from each Unit I and II and 2 to be attempted from each Unit. Each question from Units I and II will carry 12½ marks.

**Practicals based on theory paper III**
1. To demonstrate that the optimum activity of salivary amylase is pH dependent.
2. Estimation of Haemoglobin.
3. Determination of TLC, DLC & RBC.
4. Determination of bleeding and clotting time.
5. Determination of blood groups.
7. Estimation of ESR.
8. To study the effect of exercise on cardiovascular and respiratory systems.
9. To estimate the glucose level in blood of mammal, Prothrombin test, Haematocrit.
10. To study the effect of insulin on blood glucose level of mammal.

**BOOKS RECOMMENDED**


**PAPER IV : ECOLOGY AND ANIMAL BEHAVIOUR**

Time : 3 Hours  
Total Marks : 100
Theory : 80
Internal Assessment : 15
Annual Theory Exam. : 65
Practical : 20
Internal Assessment : 05
Final Practical : 15

**Objectives of the Course :**

To acquaint the students with the habitat and interactions of diverse animal groups with their environment.
To acquaint the students with characteristic behavioural aspects of animal life.

**UNIT – I : ECOLOGY**

1. **Introduction** : Definition, subdivision & scope of ecology.
2. **Abiotic Factors** : Temperature, light and soil as ecological factors.
3. **Principles of limiting factors** : Liebig’s law of minimum, Shelfords law of tolerance and the combined concept of limiting factors.
4. **Ecosystem** : Definition, components, food chain & food web, energy flow through ecosystem, ecological pyramids, Major ecosystems of the world.
5. **Biogeochemical Cycles** : Definition, different types of gaseous and sedimentary biogeochemical cycles.
6. **Population** : Characteristics, ecological niche
7. **Biotic community** : Characteristics of biotic community, ecological niche.
8. **Ecological succession** : Definition, types of succession, xerarch & Hydrarch concept of climax community, theories of succession.
9. **Ecological Adaptations**: Desert, aerial, fussorial and aquatic adaptations in animals.

**UNIT – II : ANIMAL BEHAVIOUR**

1. Feeding
2. Learning, reasoning, instinctive and motivative behaviour.
3. Social and sexual behavior of animals
4. Circadian rhythms
5. Mimicry and Protective colouration – Definition, types of mimicry with examples.
6. Migration of fishes and birds.
7. Parental care
8. Intra and interspecific relationships.

**Note**: Nine questions to be set. First question of 15 marks, covering the whole syllabus will be compulsory and will consist of 10 short answer questions of 1½ marks each. For the remaining 8 questions, 4 to be set from each Unit I and II and 2 to be attempted from each Unit. Each question from Units I and II will carry 12½ marks.

**Practicals based on theory paper IV**

1. To study the phototactic behaviour of an insect.
2. To study the geotactic behaviour of an insect.
3. To study nesting behaviour in birds.
4. To study the soil fauna.
5. To determine the pH of the soil.
6. To determine the moisture content of soil
7. To determine the salinity of the soil.
8. To study desert adaptations in animals.
9. To study aquatic adaptations in animals.
10. To study aerial adaptations in animals.
11. To study inter specific relationships.
12. To study the biotic components of an ecosystem.

**Books recommended**

PAPER V: BIOSTATISTICS & COMPUTER APPLICATIONS

Time: 3 Hours
Theory hours per week: 4 hours
Total Marks: 100
Theory: 80
Practical hours per week: 3 hours
Internal Assessment: 15
Annual Theory Exam.: 65
Practical: 20
Internal Assessment: 05
Final Practical: 15

Objectives of the Course

To acquaint the students of basic statistics applicable in biological studies.

To make the students computer literate to be able to use the vast store of knowledge on the internet and to be able to use computers for studies.

UNIT-I (Biostatistics)

1. Principles and practice of statistical methods in biological research samples and populations.
2. Basic statistics, average statistics of dispersion.
3. Coefficient of variation, standard error, confidence limit.
4. Probability distribution, binomial, Poisson and normal.
5. Tests of statistical significance.

UNIT-II (Computer Applications)

1. General awareness of Computer Hardware i.e., CPU and other peripheral devices.
2. Introduction to MS Office software, covering word processing, spread sheet & presentation software.
3. Introduction to internet and its applications.
4. Introduction to programming in C & its functions.
5. FORTRAN; Preparation of programme.

Note: Nine questions to be set. First question of 15 marks, covering the whole syllabus will be compulsory and will consist of 10 short answer questions of 1½ marks each. For the remaining 8 questions, 4 to be set from each Unit I and II and 2 to be attempted from each Unit. Each question from Units I and II will carry 12½ marks.

Practical based on theory paper V

1. Calculation of dispersion
2. Calculation of measures of central tendency
3. Fitting of Binomial distribution
4. Fitting of Poisson distribution
5. Tests of statistical significance
6. Write programme to demonstrate conditional statements using C language.
7. To perform mail merge.
8. Use of Excel and Power point.
9. Use of E-mail and internet.
Books Recommended
SEMESTER –II

PAPER-VI : STRUCTURE AND FUNCTIONS OF INVERTEBRATES –II

Time : 3 Hours

Theory hours per week : 4 hours

Total Marks : 100

Theory : 80

Practical hours per week : 3 hours

Internal Assessment: 15

Annual Theory Exam.: 65

Practical : 20

Internal Assessment 05

Final Practical : 15

Objectives of the Course :

To acquaint the students with the classification and general organization of invertebrates. To make the students know about the habitat, habits, morphology and economic importance of various types of invertebrates including minor phyla.

UNIT-I

1. Phylum Annelida : General organisation of phylum Annelida with special reference to segmentation, digestive, excretory and reproductive systems.


UNIT-II

3. Phylum Mollusca : General organisation of Mollusca with special reference to feeding, respiration and shell diversity, podium or foot in Mollusca, torsion and detorsion in Gastropoda.

4. Phylum Echinodermata : General organisation of Echinodermata, Comparative account of water vascular system, haemal and perihemal systems, Larval forms in Echinodermata.


Note : Nine questions to be set. First question of 15 marks, covering the whole syllabus will be compulsory and will consist of 10 short answer questions of 1½ marks each. For the remaining 8 questions, 4 to be set from each Unit I and II and 2 to be attempted from each Unit. Each question from Units I and II will carry 12½ marks.

Practicals Based on Theory Paper - VI

1. Annelida
   a. Dissections : Earthworm (digestive, nervous and reproductive systems).
c. Prepared slides: Earthworm (T.S. typhlosolar region, setae, pharyngeal nephridium, septal nephridium, integumentary nephridium). 
   *Nereis* (Parapodium), Leech (T.S. through different regions).

d. Permanent preparations: Setae and nephridia of earthworm, parpodium of *Nereis*.

2. **Arthropoda**
   


3. **Mollusca**
   

   b. Specimens: *Anodonta, Mytilus, Pholas, Pecten, Haliotis, Aplysia, Doris, Limax, Pila, Sepia, Octopus, Nautilus, Chiton* and *Dentalium*.

   c. Prepared Slides: Glochidium larva, radula of *Pila*, gill lamina of *Anodonta*.

   d. Preparation of Permanent mounts: Radula of *Pila*.

4. **Echinodermata**
   
a. Demonstration of anatomy of *Asterias* from a dissected specimen.

   b. Specimens: *Asterias, Echinus, Cucumaria, Antedon, Ophiothrix*.

   c. Prepared slides: T.S. arm of Starfish, tube feet, larval forms of echinodermata.

**Note:** Candidates will be required to submit duly signed note books of practical record.

**BOOKS RECOMMENDED**


OBJECTIVES OF THE COURSE:

To draw a comparative account of anatomy of vertebrates and hence to understand the evolution of different systems in vertebrates.

UNIT-I

Comparative account of the following systems of the vertebrates with evolutionary trends found pisces to mammals:

Respiratory system: Respiratory organs.
Types of respiratory mechanisms (gills, lungs, skin and accessory respiratory organs).

Urinary system: Succession of kidney (archinephros, pronephros, mesonephros, and metanephros), osmoregulation, evolution of gonads and urinary ducts.

UNIT-II

Nervous system: Comparative account and evolution of brain, spinal cord and cranial nerves.

Sense organs: Chemoreceptors, photoreceptors and mechanoreceptors.

Note: Nine questions to be set. First question of 15 marks, covering the whole syllabus will be compulsory and will consist of 10 short answer questions of 1½ marks each. For the remaining 8 questions, 4 to be set from each Unit I and II and 2 to be attempted from each Unit. Each question from Units I and II will carry 12½ marks.

PRACTICALS BASED ON THEORY PAPER VII

Aves: Casuarius, Ardea, Anas, Milvus, Pavo, Eudynamis, Tyto and Alcedo.


To study the skeleton of Gallus, Oryctolagus.

Examine and dissect the following animals:

Chick: Digestive, arterial, venous and urinogenital systems.

White rat: Digestive, arterial, venous and urinogenital systems.
Study of the histology of different organs of frog and rat/rabbit through permanent stained preparation.

Study of poison apparatus in snakes through charts.

Books Recommended


PAPER VIII : BIOSYSTEMATICS AND EVOLUTION

Time : 3 Hours
Theory hours per week : 4 hours
Total Marks : 100
Theory : 80
Practical hours per week : 3 hours
Internal Assessment : 15
Annual Theory Exam.: 65
Practical : 20
Internal Assessment : 05
Final Practical : 15

Objectives of the Course :

To enable the students to identify, classify and name the organisms according to international code of Zoological nomenclature.

To acquaint the students with different type of keys. To make the students understand the concept of speciation, origin of life and evolution.

UNIT-I

1. Definitions and perspectives of systematics, classification and taxonomy, goals and importance of taxonomy.
4. Higher taxa and Linnean hierarchy
5. Qualitative and quantitative methods of analysis of variations
6. History and theories of classification
7. International code of Zoological nomenclature-principles, objectives and rules for nomenclature, type system and priority for different taxa.
8. Population structure of species
9. Polytypic species, race, variety, cline, subspecies, semispecies, super species.
10. Speciation.
11. Species concepts - Typological species concept, nominalistic species concept, biological species concept, evolutionary species concept.
12. Difficulties in applying biological species concept.

UNIT- II
1. Mutation theory of evolution: mutations, variations and selection; modern concept and interpretation of evolution and future of evolutionary process.
2. Interrelationship among different phyla of Invertebrates and their evolutionary significance.

Note: Nine questions to be set. First question of 15 marks, covering the whole syllabus will be compulsory and will consist of 10 short answer questions of 1½ marks each. For the remaining 8 questions, 4 to be set from each Unit I and II and 2 to be attempted from each Unit. Each question from Units I and II will carry 12½ marks.

Practicals based on theory paper VIII
1. Use of key to identify the fishes of the region, representing different families.
2. Methods of describing common insects representing different orders, with particular reference to the recording of taxonomic characters.
3. Study of ancestry of man, horse, camel and elephant through charts/models.
4. Visit to a fossil park/Geology and Anthropology museums.
5. Study of origin of invertebrate and vertebrate groups through charts.

Books Recommended
PAPER IX : ENDOCRINOLOGY AND NEURAL PHYSIOLOGY

Objectives of the Course:

To make the students understand the functions of hormones and their mode of action at molecular level.

UNIT- I

Endocrinology: Chemical nature of hormones, steroid hormones, amino acid derived hormones, catecholamines and peptide hormones.
Mechanism of hormone action, steroid hormone-receptor interactions and signal transduction.
Autocrine, paracrine and telocrine regulation of hormones.
Hormonal imbalance.
Pineal-hypothalmo-hypophyseal-gonadal axis.
Hormonal elaborations of pancreas, adrenals, thyroid, parathyroid and their role in regulation of carbohydrate, lipid, protein, calcium and phosphorus metabolism.
Hormones of gastro-intestinal tract.
Prostaglandins, their synthesis and biological functions.
Endocrine control of spermatogenesis and Oogenesis in vertebrates.
Endocrine control of folliculogenesis in mammals.

UNIT-II

Nervous system and sense organs: Neuron as the basic unit of nerve physiology; Methyl-accepting chemotaxis proteins and chemotactic signals of the plasma membrane; Na\(^+\) and K\(^+\) permeability and action potentials, structure of Na\(^+\) and K\(^+\) channels. Neurotransmitters: Molecular mechanism of acetylcholine, catecholamine, serotonin γ-amino butyric and glycine neurotransmitters, acetylcholine receptor channels and their inhibitors; Retinal rod cell excitation and molecular biology of visual cycle, colour vision. Power of accommodation, myopia, hypermetropia, astigmatism, cataract, glaucoma. Mechanisms of auditory and olfactory responses. Gustatory receptors.

Note: Nine questions to be set. First question of 15 marks, covering the whole syllabus will be compulsory and will consist of 10 short answer questions of 1½ marks each. For the remaining 8 questions, 4 to be set from each Unit I and II and 2 to be attempted from each Unit. Each question from Units I and II will carry 12½ marks.
Practicals based on theory paper IX

1. To identify the stage of oestrous cycle.
2. To locate the endocrine glands in rat.
3. To study the histology of endocrine glands.
4. To study the corrective measures for myopia, hypermetropia, astigmatism, cataract.
5. To study the structure of eye, ear and different types of neurons through charts/models.

BOOKS RECOMMENDED


PAPER X : IMMUNOLOGY

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Objectives of the Course:

To acquaint the students with the defense mechanisms of animals/human bodies,

UNIT-I

1. Organs and cells of the immune system and their functions: primary and secondary lymphoid organs, lymphocytes, mononuclear cells and granulocytic cells.
3. Immunoglobulins: Basic and fine structure of Immunoglobulins, biological activities of different classes of Immunoglobulins.
4. Cellular and Humoral immune response - Role of T and B lymphocytes, Primary and secondary immune response.
UNIT-II

5. Major Histocompatibility Complex: MHC molecules and genes, regulation of MHC expression, its relation to immune responsiveness and disease susceptibility.

Note: Nine questions to be set. First question of 15 marks, covering the whole syllabus will be compulsory and will consist of 10 short answer questions of 1½ marks each. For the remaining 8 questions, 4 to be set from each Unit I and II and 2 to be attempted from each Unit. Each question from Units I and II will carry 12½ marks.

Practicals based on theory paper X

1. To study the agglutination reaction by typing of human blood into A,B, AB, O and Rh factor.
2. To study the different types of white cells in a stained blood film of a normal individual and compare with that of a diseased individual (allergy, parasitic infection etc.).
3. To study the sections of different lymphoid organs thymus, spleen, lymph node, intestine etc. from prepared slides.
4. To isolate and check the purity of leukocytes from blood of mice using Histopaque.

Books recommended

THIRD SEMESTER

PAPER X1 : DEVELOPMENTAL BIOLOGY - I

Time : 3 Hours
Theory hours per week : 4 hours
Total Marks : 100
Theory : 80
Practical hours per week : 3 hours
Internal Assessment : 15
Annual Theory Exam. : 65
Practical : 20
Internal Assessment : 05
Final Practical : 15

Objectives of the Course :
To make the students understand the pattern of development at molecular level.
To draw a correlation between evolution of animals and changes in environment.
To acquaint the students with the latest concept of Haemopoetic stem cells and gene therapy.

UNIT - I
1. Gametogenesis in animals.
2. Molecular events during fertilization.
4. Induction, competence, cell-cell interaction.

UNIT – II
1. Molecular basis of differentiation, trans differentiation & dedifferentiation.
2. Differentiation of erythrocytes, ovalbumin.
3. Determination of fate of cells with example of tunicates, Drosophila, amphibians, C. elegans (nematode).
4. Regeneration
5. P-granules in nematode, Caenorhabditis elegans.

Note : Nine questions to be set. First question of 15 marks, covering the whole syllabus will be compulsory and will consist of 10 short answer questions of 1½ marks each. For the remaining 8 questions, 4 to be set from each Unit I and II and 2 to be attempted from each Unit. Each question from Units I and II will carry 12½ marks.

Practicals based on theory paper XI
1. To study the different stages of development in frog and chick.
2. To study the spermatogenesis of rat and grasshopper from smears of testis.
3. Types of eggs from the ovaries of different animals.

Books recommended
PAPER XII : BIOCHEMISTRY

Objectives of the Course:

To enable the students know about structure and functions of various metabolites in animal body. To acquaint the students with various instruments and methodological techniques enable them to pursue scientific research in future.

UNIT-I


Bioenergetics of Carbohydrate metabolism.


UNIT-II


Enzymes: Enzyme kinetics, mode of action of enzyme and biochemical role of coenzymes and isoenzymes, effect of enzyme concentration, effect of substrate concentration and pH on enzyme activity, allosteric enzymes, feed back inhibition, covalent modifications, irreversible and reversible. Ribozyme and Abzyme.

Electron transport chain: Mechanism of oxidative phosphorylation (Mitochondrial), inhibitors of electron transport chain Intibitors and uncouplers of mitochondrial oxidative phosphorylation.

Note: Nine questions to be set. First question of 15 marks, covering the whole syllabus will be compulsory and will consist of 10 short answer questions of 1½ marks each. For the remaining 8 questions, 4 to be set from each Unit I and II and 2 to be attempted from each Unit. Each question from Units I and II will carry 12½ marks.

Practicals based on theory paper XII

1. Estimation of alkaline and acid phosphatases in the liver fraction of rat.
2. Quantitative estimation of glycogen, cholesterol protein in rat tissue.
3. Qualitative estimation of carbohydrates, lipids and protein in rat tissue.
4. To separate a sample of amino acids with the help of paper chromatography, TLC and electrophoresis.
BOOKS RECOMMENDED:

Paper - XIII : CELL AND MOLECULAR BIOLOGY

Time : 3 Hours
Theory hours per week : 4 hours
Total Marks : 100
Theory : 80
Practical hours per week : 3 hours
Internal Assessment: 15
Annual Theory Exam.: 65
Practical : 20
Internal Assessment : 05
Final Practical : 15

Objectives of the Course :
To acquaint the students with various techniques to study histology and histochemistry of various animal tissues and to know about fixation and staining techniques. To enable the students understand the molecular basis of cell-cell signalling, cell division and transport of ions across cell membranes.

To clarify the concept of population genetics to the students through Hardy-Weinberg law.

UNIT- I
1. Fixation and staining techniques : Non-chemical and chemical fixatives, chemistry of staining of acidic and basic dyes.
2. Structure and functions of cell and its organelles (Nucleus, plasma membrane, mitochondria, Golgi bodies, endoplasmic reticulum, ribosomes and lysosomes).

UNIT- II
1. Cell-Cell signalling : Cell surface receptors, Second messenger system, MAP kinase pathways, Signalling from plasma membrane to nucleus.
2. Cytoskeletal elements: Microtubules and microfilaments.
3. Cell division: Cell Cycle, Molecular basis of cell division, mitotic apparatus, modification and abnormalities of cell division, chromosome movement (forces of cell division).

Note: Nine questions to be set. First question of 15 marks, covering the whole syllabus will be compulsory and will consist of 10 short answer questions of 1½ marks each. For the remaining 8 questions, 4 to be set from each Unit I and II and 2 to be attempted from each Unit. Each question from Units I and II will carry 12½ marks.

Practicals based on theory paper XIII
1. Preparation of permanent histological slides of testis and ovaries of insects/mice/rat.
2. Basis of reaction and demonstration of the sites of proteins, nucleic acids, lipids & carbohydrates in ovaries of insects/rat/mice.
3. Study of stages of mitosis from permanent slides from animal and plant materials.

Books recommended

PAPER XIV: INSTRUMENTATION AND METHODOLOGY

Time: 3 Hours

Theory hours per week: 4 hours
Total Marks: 100
Theory: 80

Practical hours per week: 3 hours
Internal Assessment: 15
Annual Theory Exam.: 65
Practical: 20
Internal Assessment: 05
Final Practical: 15

Objectives of the Course:

To acquaint the students with various instruments and methodological techniques enable them to pursue scientific research in future.
UNIT-I

Microscopy: Principle, structural parts and applications of compound microscope, phase–contrast microscope, fluorescence microscope, interference microscope, polarization microscope, dark field microscope, transmission electron microscope and scanning electron microscope.

Cell fractionation method: Principle of centrifugation and ultracentrifugation, different types of ultracentrifugations (in brief) and their applications, structural parts of an analytical ultracentrifuge, ultracentrifugation and buoyant density.

Spectrophotometry: Principle and structural parts of a colorimeter and a spectrophotometer and their applications.

Chromatography: Principles of chromatography, paper chromatography, thin layer chromatography, gas chromatography, gel permeation chromatography, ion exchange chromatography, high pressure liquid chromatography, affinity chromatography.

UNIT-II

Electrophoresis: Principles of electrophoresis, (Brief introduction to paper electrophoresis, polyacrylamide gel electrophoresis, disc gel electrophoresis,) SDS-PAGE, agarose gel electrophoresis, isoelectric focussing, applications of electrophoresis, Phage DNA, detection of plasmids, separation of DNA molecules, Southern transfer, Northern transfer and Western transfer.

Polymerase chain reaction (PCR) and its application.

Tissue culture techniques: Monolayer suspension, leucocyte cultures, factors affecting cell growth in vitro.

Radioisotopes: Principles and applications of tracer techniques in biology, radiation dosimetry, radioactive isotopes and half life of isotopes, liquid scintillation counter, principles and applications of autoradiography and cerenekov radiation.

Note: Nine questions to be set. First question of 15 marks, covering the whole syllabus will be compulsory and will consist of 10 short answer questions of 1½ marks each. For the remaining 8 questions, 4 to be set from each Unit I and II and 2 to be attempted from each Unit. Each question from Units I and II will carry 12½ marks.

Practicals based on theory paper XIV

1. To study the parts of the compound microscope and phase-contrast microscope and their maintenance.
2. To study the living material under the phase contrast microscope.
3. Finding out the diameter, area and circumference with the help of stage micrometer and oculometer.
4. To sketch the diagram of any tissue with the help of camera lucida and to draw its magnification line.
5. Separation of subcellular fractions from the liver of rat and estimation of any marker enzyme of mitochondria/golgi bodies/plasma membrane/endoplasmic reticulum.
6. Demonstration of section cutting and mounting of sections on the grid for SEM and TEM. Demonstration of SEM & TEM in the CIL lab., P.U., Chandigarh.
7. Demonstration of working of gamma counter, ultracentrifuge, X-ray diffraction apparatus, Deptt. of Zoology, P.U., Chandigarh.
8. Study of DNA amount in the developing stages of spermatogenesis with the help of microdensitometer, Deptt. of Zoology, P.U., Chandigarh.
10. To find out pH with a pH meter and to weigh on with electrical balance.

BOOKS RECOMMENDED:

PAPER : XV  ADVANCES IN ENTOMOLOGY

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Objectives of the Course:

To make the students aware of various pests of food crops and food products and various insect control methods.
To educate the students about economic importance and techniques of Apiculture and sericulture

UNIT-I

1. Salient features with suitable examples of the insect orders - Thysanura, Odonata, Isoptera, Orthoptera, Hemiptera, Coleoptera, Lepidoptera, Hymenoptera and Diptera.
2. Structure and function of the following systems in insects:
   a. Digestive System
   b. Respiratory System
   c. Nervous System
   d. Reproductive System
5. Effect of temperature and photoperiod on the lives of insects, details of onset, termination and significance of diapause.

UNIT-II
1. Systematic position, habits, nature of damage and outlines of the life cycles of following pests of crops, vegetables & fruits.

A. CROPS
   Cotton:
   (i) *Pectinophora gossypiella* (Pink boll worm)
   (ii) *Bemisia tabaci* (Cotton white fly)
   (iii) *Dysdercus cingulatus* (Red cotton bug)

Sugarcane
   (i) *Pyrilla perpusilla* (Sugarcane leaf hopper)
   (ii) *Scirpophaga nivella* (Sugarcane top borer)

Paddy
   (i) *Hieroglyphus banian* (Rice grass hopper)
   (ii) *Leptocorisa varicornis* (Gundhi bug)

Wheat
   (i) *Tanymecus indicus* (Ghujhia weevil)
   (ii) *Sesamia inferens* (Wheat stem borer)

B. VEGETABLES
   (i) *Dacus cucurbitae* (Pumpkin fruit fly)
   (ii) *Raphidopalpa foveicollis* (Red pumpkin beetle)

C. FRUITS
   (i) *Drosicha mangifera* (Mango mealy bug)
   (ii) *Diaphorina citri* (Citrus psylla)

3. Pests of stored food products with particular reference to their systematic position, habits, nature of damage caused by them along with the outlines of their life cycles:
   (i) *Callosobruchus maculatus* (Pulse beetle)
   (ii) *Sitophilus oryzae* (Rice weevil)
   (iii) *Tribolium castaneum* (Rust red floor beetle)
   (iv) *Sitotroga cerealella* (Angoumois grain moth).

4. Insect control:
   (a) Chemical control: Categories of pesticides, important examples, their application and mode of action; Insect repellents and attractants.
(b) Biological Control: Principles, History, use of parasites, predators and pathogens.

(c) Integrated Pest Management (IPM).

5. Principle and practices of Apiculture.

Note: Nine questions to be set. First question of 15 marks, covering the whole syllabus will be compulsory and will consist of 10 short answer questions of 1½ marks each. For the remaining 8 questions, 4 to be set from each Unit I and II and 2 to be attempted from each Unit. Each question from Units I and II will carry 12½ marks.

Practicals based on theory paper XV

1. Collection and their identification up to family level of at least three different species from the pterygote orders prescribed in theory.

2. Identification marks and taxonomic status of insect pests of crops, vegetables, fruits and stored products.

3. Dissection of suitable insects for the study of following systems:
   a. Digestive System
   b. Nervous System
   c. Reproductive System

4. Systematic position up to family and ecology of the following medical and veterinary pests:
   a. Anopheles
   b. Culex
   c. Aedes
   D. Blowfly
   e. Bot fly
   f. Horse fly
   g. Flesh fly.

5. Introduction to apiculture practices and handling of Beehives.

6. Permanent stained preparation of male and female external genitalia.

7. Study of different types of larvae and pupae with the help of preserved material.

Books recommended


6. Insects and Mites of Crops in India by MRGK. Nair, ICAR, N. Delhi, 1975.


FOURTH SEMESTER

PAPER XVI : DEVELOPMENTAL BIOLOGY - II

Time : 3 Hours
Theory hours per week : 4 hours
Total Marks : 100
Theory : 80
Practical hours per week : 3 hours
Internal Assessment: 15
Annual Theory Exam : 65
Practical : 20
Internal Assessment : 05
Final Practical : 15

Objectives of the Course :

To draw a correlation between evolution of animals and changes in environment.
To acquaint the students with the latest concept of Haemopoetic stem cells and gene therapy.

UNIT – I

1. Role of endoderm in mesodermal specificity, mesodermal inducers.
   Instructive and permissive interactions, epitheliomesenchymal interactions, neural induction, secondary induction, chemical nature of evocators.
2. Teratogenesis critical period dose, classes of cytotoxic teratogens, human teratogenesis.

UNIT – II

1. Totipotency & nuclear transfer experiment.
4. Environmental evolution and animal development: Environmental cues and effects, Malformations and disruptions, Changing evolution through development modularity, Developmental constraints, Creating new cell types - basic evolutionary mystery.
5. Hemopoetic stem cells : Stem cell disorders, Blood cells formation, Bone marrow transplants, Gene therapy.

Note: Nine questions to be set. First question of 15 marks, covering the whole syllabus will be compulsory and will consist of 10 short answer questions of 1½ marks each. For the remaining 8 questions, 4 to be set from each Unit I and II and 2 to be attempted from each Unit. Each question from Units I and II will carry 12½ marks.

Practicals based on theory paper XVI

1. To prepare the permanent stained slides of developing stages from fertilized egg of hen.
2. To study different larvae in invertebrates from permanent slides.
3. To prepare the permanent slides of larvae of invertebrates (Redia, Cercaria, Arthropod larvae, Glochidium larva).
Books Recommended


PAPER XVII : ADVANCES IN PARASITOLOGY

Time : 3 Hours
Theory hours per week : 4 hours Total Marks : 100
Theory : 80
Practical hours per week : 3 hours Internal Assessment 15
Annual Theory Exam: 65
Practical : 20
Internal Assessment : 05
Final Practical 15

Objectives of the Course:

To introduce the students to various pathogens causing diseases and the reactions of the body against them.

UNIT-I

1. Introduction to Parasitology
2. Parasite Host Specificity : Kinds of parasite host specificity, specificity factors related to infection and growth.

UNIT-II

1. Immunity to Parasites : Brief account of immunity to malaria, leishmaniasis, trypanosomiasis, schistosomiasis and ascariasis.
2. Vectors - Brief account of various insect vectors of human parasitic infections.

Note: Nine questions to be set. First question of 15 marks, covering the whole syllabus will be compulsory and will consist of 10 short answer questions of 1½ marks each. For the remaining 8 questions, 4 to be set from each Unit I and II and 2 to be attempted from each Unit. Each question from Units I and II will carry 12½ marks.
Practicals based on theory paper XVII
1. To study the protozoans and helminth parasites infecting common frog, toad and common household insects.
2. To study the helminth parasites infecting gut of the sheep and goat.
3. To study the parasites from blood smears - *Leishmania, Plasmodium* and *Trypanosoma*.
4. To study the vectors of different parasitic infections (Mosquito, ticks, sandfly etc.).

**Books Recommended**

**PAPER : XVIII : ADVANCES IN FISH AND FISHERIES**

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**Objectives of the Course :**
To acquaint the students with aquatic animal life and its economic importance.

**UNIT-I**
1. Introduction : History and scope of Fishery Science in India.
3. Aquatic ecosystem : Components, food chain & food web, flow of energy through a aquatic ecosystem.
4. Ecological classification of aquatic organisms other than fishes.
6. Productivity : Concept of productivity, estimation of primary productivity by different methods, classification of water bodies on the basis of productivity.
7. Role of limnology in the management of a fish pond.
8. Various types of body forms in fishes.

**UNIT-II**
1. Fish Farming : Composite fish culture of Indian and exotic fishes in India.
2. Induced breeding : History, technique and advantages of induced breeding in fishes. Use of synthetic chemicals for induced breeding.
3. Study of Local fishing gears.
4. Fish diseases : Fungal, bacterial, protozoan, worm and crustacean diseases of fishes.
5. Preservation, transportation and marketing of fishes.
7. Bioluminiscence

**Note:** Nine questions to be set. First question of 15 marks, covering the whole syllabus will be compulsory and will consist of 10 short answer questions of 1½ marks each. For the remaining 8 questions, 4 to be set from each Unit I and II and 2 to be attempted from each Unit. Each question from Units I and II will carry 12½ marks.

**Practicals based on theory paper XVIII**
1. To estimate the dissolved oxygen in water.
2. To estimate the pH of water.
3. To estimate the phosphate of water.
4. To determine the BOD of water.
5. To study the benthic organisms.
6. To study the different types of fishing gears.
7. To study the Indian culturable fishes.
8. To study the Exotic culturable fishes.

**Books Recommended**
PAPER XIX : ENVIRONMENTAL BIOLOGY AND WILD LIFE

Objectives of the Course:

To educate the students about the basic environmental phenomena like pollution, ecosystem, biogeochemical cycles, etc.

To educate the students about the importance of wild life conservation.

UNIT-I

1. Environmental Pollution: Causes, impact and control measures of air, water and noise pollution, management of wastes, Environment Protection Act 1986.
2. Natural resources: Natural resources and their conservation.
3. Energy resources: Study of renewable and non-renewable energy resources. Non conventional energy resources.
5. Ecosystem Dynamics and Management: Stability and complexity of ecosystems. Speciation and extinctions, environmental impact assessment, sustainable development.

UNIT-II

2. Wildlife of India: Different types with references to animals, causes of depletion, significance and conservation of wildlife.
3. Sanctuaries and National Parks: Location and Important fauna of the sanctuaries and national parks of India.
4. Wildlife Projects: Tiger Project, Crocodile Breeding Project, Hangul project, Gir lion Sanctuary project.

Note: Nine questions to be set. First question of 15 marks, covering the whole syllabus will be compulsory and will consist of 10 short answer questions of 1½ marks each. For the remaining 8 questions, 4 to be set from each Unit I and II and 2 to be attempted from each Unit. Each question from Units I and II will carry 12½ marks.

Practicals based on theory paper XIX

1. To study the distribution of animals through zoogeographical maps.
2. A visit to a zoological park to study different wild animals and make a report.
3. To estimate the alkalinity of water.
4. To estimate the chlorides of water.
5. To estimate the nitrates of water.
6. To study the different types of phytoplankton.
7. To study the different types of zooplankton.
Books recommended

Paper XX : CYTOGENETICS AND MOLECULAR GENETICS
Time : 3 Hours
Theory hours per week : 4 hours
Total Marks : 100
Theory : 80
Practical hours per week : 3 hours
Internal Assessment: 15
Annual Theory Exam.: 65
Practical : 20
Internal Assessment : 05
Final Practical : 15

Objectives of the Course:
To acquaint the students with various techniques to study histology and histochemistry of various animal tissues and to know about fixation and staining techniques. To enable the students understand the molecular basis of cell-cell signalling, cell division and transport of ions across cell membranes.

To clarify the concept of population of genetics to the students through Hardy-weinberg law.

UNIT-I
2. Molecular mutation: Molecular basis of mutation, physical and chemical mutagens, radiation mutagenesis, site directed mutagenesis, target theory.
3. Regulation of gene function: Operon hypothesis; Pro and eukaryotic operons; Induction and repression; Complex gene clusters.

UNIT-II
1. Linkage and Genetic maps.
2. Dosage compensation.
4. Fine structure of gene, Eukaryotic genome organization (structure of chromatin, coding and non-coding sequences, and satellite DNA); DNA damage and repair, DNA replication, amplification and rearrangements.
5. Organization of transcriptional units; Mechanism of transcription of prokaryotes and eukaryotes; RNA processing (capping, polyadenylation, splicing, introns and exons); Ribonucleoproteins, structure of mRNA.
6. Protein Synthesis.
7. Principles and methods of genetic engineering and Gene targeting; Applications in agriculture, health and industry.
Note: Nine questions to be set. First question of 15 marks, covering the whole syllabus will be compulsory and will consist of 10 short answer questions of 1½ marks each. For the remaining 8 questions, 4 to be set from each Unit I and II and 2 to be attempted from each Unit. Each question from Units I and II will carry 12½ marks.

Practicals based on theory paper XX
1. Preparation of chromosomes from onion root tip and grasshopper for mitosis and meiosis by squash method.
2. Temporary squash preparation of salivary gland chromosomes for the study of polytene chromosomes of larvae of *Chironomus/Drosophila*.
3. Study and preparation of metaphase karyotypes from photographs and permanent slides of *Drosophila*, grasshopper and man/rat.
4. Study of sex-chromatin Bar body from human buccal mucosa.
5. Demonstration of monohybrid and dihybrid cross with the help of beads.
6. Study of genetic disorders with the help of photographs.

Books recommended