OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR M.SC. (TWO YEAR COURSE) IN ZOOLOGY (SEMESTER SYSTEM) 2015-2016.

**FIRST SEMESTER**

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

THIRD SEMESTER

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

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

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

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

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

FOUR SEMESTER

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

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

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

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

Paper XX : Cytogenetics and Molecular Genetics 80
Practical based on Paper-XX 20
PAPER-I : STRUCTURE AND FUNCTIONS OF INVERTEBRATES -I

Theory hours per week : 4 hours
Theory : 80
Internal Assessment: 15
Annual Theory Exam.: 65
Practical : 20
Internal Assessment 05
Final Practical : 15

Total Marks : 100

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 upto 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**
   a. Specimens: *Scypha, Grantia, Spongilla, Euplectella, Hyalonema, Euspongia.*
   
   
   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)
   

6. Project based on general information on animals, selecting at least one representative from each phylum.

**BOOKS RECOMMENDED**


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

<table>
<thead>
<tr>
<th>Theory hours per week</th>
<th>Total Marks</th>
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<tr>
<td>4 hours</td>
<td>100</td>
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<tr>
<th>Practical hours per week</th>
<th>Theory</th>
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<tr>
<td>3 hours</td>
<td>80</td>
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**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, Splanchnocranium, 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 in different classes of vertebrates.

**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 (MZL 6052)**

1. Classification upto orders, except 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.
Dipneusti (Dipnoi): Protopterus (Lung fish)

2. Demonstration of dissection of Labeo through video clipping/models/charts:
   Digestive and Reproductive systems
   Circulatory system: heart, afferent and efferent branchial arteries.
   Nervous system: cranial nerves and internal ear.
4. Study of histology of different organs of frog through permanent slides.
5. Study of poison apparatus in snakes through charts.
6. Project based on general information on animals selecting at least one representative from each class/Parental care.

BOOKS RECOMMENDED

PAPER III : ANIMAL PHYSIOLOGY

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

Objectives of the Course:

To enable the students to know about all the physiological processes going on in animal/human body.

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, ATPase 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, Haematocrit.

BOOKS RECOMMENDED
PAPER IV : ECOLOGY AND ANIMAL BEHAVIOUR

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.
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
8. Ecological succession : Definition, types of succession, Xerarch & Hydrarch concept of climax community, theories of succession.
9. Ecological Adaptations : Desert, aerial, fusorial 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 adaptation in animals.
10. To study aerial adaptation in animals.
11. To study inter specific relationships.
12. To study the biotic components of an ecosystem.

BOOKS RECOMMENDED

PAPER V : BIOSTATISTICS & COMPUTER APPLICATIONS

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.
3. Coefficient of variation, standard error, confidence interval.
4. Probability distribution, binomial, poisson and normal.
5. Tests of statistical significance (Chi square - test, Z-test, F-test, Student t-Test).
6. Analysis of variance – one way ANOVA. coefficient of correlation; simple & multiple regression.

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 measure 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

5. *Let us ‘C’* (13th ed.) by Kanetker, Y. B PB Publication; 2013
SECOND SEMESTER

PAPER-VI: STRUCTURE AND FUNCTIONS OF INVERTEBRATES –II

Theory hours per week : 4 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 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. Demonstration of dissection of Earthworm (Digestive, Nervous and Reproductive systems) through video clippings/models/charts
b. Specimens: *Nereis, Heteronereis, Polynoe, Tubifex, Eunice, Aphrodite, Chaetopterus, Arenicola, Pontobdella, Amphitrite* and *Hirudinaria*.


2. Arthropoda
   a. Demonstration of dissection of *Palaemon* (Appendages, Digestive, Nervous and Reproductive systems) through video clippings/models/charts.

3. Mollusca
   a. Demonstration of dissection of *Anodonta* (Digestive and Nervous systems) through video clippings/models/charts.
   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*.

4. Echinodermata
   a. Demonstration of anatomy of *Asterias* through charts/model/video clipping.
   b. Specimens: *Asterias, Echinus, Cucumaria, Antedon, Ophiothrix*.
   c. Prepared slides: T.S. arm of Starfish, tube feet and larval forms of echinodermata

5. Project based on general information on animals selecting at least one representative from each phylum.

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

**BOOKS RECOMMENDED**

PAPER-VII : COMPARATIVE ANATOMY OF VERTEBRATES – II

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 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).

Urinogenital system : Succession of kidney (archinephros, pronephros, mesonephros, and metanephros), osmoregulation, evolution of gonads and urinogenital 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

1. Aves : Casuarius, Ardea, Anas, Milvus, Pavo, Eudynamis, Tyto and Alcedo.
3. To study the skeleton of Gallus, Oryctolagus.
4. Demonstration of dissection of chick and white rat through video clipping/models/charts.
   Chick : Digestive, arterial, venous and urinogenital systems.
   White rat : Digestive, arterial, venous and urinogenital systems.
5. Study of the histology of different organs of frog and rat/rabbit through permanent stained slides.
6. Project based on general information on animals selecting at least one representative from each class/Bird migration.
BOOKS RECOMMENDED

PAPER VIII : BIOSYSTEMATICS AND EVOLUTION

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.
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

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 (MZL 7001)

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

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 chemotoxis proteins and chemotactic signals of the plasma membrane; $\text{Na}^+$ and $\text{K}^+$ permeability and action potentials, structure of $\text{Na}^+$ and $\text{K}^+$ channels.
Neurotransmitters : Molecular mechanism of acetylcholine, catecholamine, serotonin, $\gamma$-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 show the endocrine glands in rat through charts/models/video clipping.
3. To study the histology of endocrine glands through permanent stained slides.
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

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 defense mechanisms of animals/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 demonstrate Ouchterlony diffusion assay through Kit.
BOOKS RECOMMENDED

PAPER XI: DEVELOPMENTAL BIOLOGY - I

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.

UNIT - I
1. Basic concepts of Development: Potency, commitment, specification, induction, instructive and permissive interactions, competence, determination and differentiation.

UNIT – II
1. Gametogenesis in animals.
2. Molecular events during fertilization.
3. Zygote formation, blastula formation and embryonic fields. Gastrulation and formation of germ layers in animals.
4. Regeneration.

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 through permanent slides.
2. To study the spermatogenesis of rat and grasshopper through slides/charts/photographs.
3. Types of eggs in animals through charts/photographs/models.
BOOKS RECOMMENDED

1. *An Introduction to Embryology* by Balinsky, B. I., Saunders, Philadelphia;1981.
PAPER XII : BIOCHEMISTRY

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 various metabolite in animal body.

UNIT-I


UNIT-II


Enzymes: Enzyme kinetics, mode of action of enzyme and biochemical role of coenzymes and isoenzymes, effect of substrate concentration, effect of enzyme concentration, effect of 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 Inhibitors 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 procured from local market.
2. Quantitative estimation of glycogen, cholesterol protein in tissue procured from local market.
3. Qualitative estimation of carbohydrates, lipids and protein in tissue procured from local market.
BOOKS RECOMMENDED

Paper - XIII : CELL AND MOLECULAR BIOLOGY

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.

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).
4. Protein sorting in ER, golgi and targeting of proteins to Mitochondria, secretory and endocytotic pathway.

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. Study 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 through slides and photographs.
3. Study of stages of mitosis and meiosis from permanent slides from animal and plant materials through slides/charts/photographs.
BOOKS RECOMMENDED

Paper XIV: INSTRUMENTATION AND METHODOLOGY

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 focusing, applications of electrophoresis, Phage DNA, detection of plasmids, separation of DNA molecules.

Polymerase chain reaction (PCR) and its application.

Tissue culture techniques: Introduction to basic culture technique in cell culture, organ culture, Aseptic techniques, sterilization technique, specialized culture technique, Monolayer culture, suspension culture, 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 cerenkov 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. 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.
6. Demonstration of working of ultracentrifuge.
7. Demonstration of the working of PCR and Western blotting, Deptt. of Zoology, P.U., Chandigarh.
8. To separate a sample of amino acid with the help of paper chromatography.

**BOOKS RECOMMENDED**

PAPER : XV ADVANCES IN ENTOMOLOGY

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 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 various 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. Plant host-insect interaction.
2. Practices of Sericulture, Apiculture & Lac culture
3. 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 flour 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).

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. Study of insect biodiversity in natural environment and preparation of project based on observation.
2. Identification marks and taxonomic status of insect pests of crops vegetables, fruits and stored products mentioned in theory syllabus.
3. Demonstration of dissection of insects for the study of following systems through charts/models/video clippings:
   a. Digestive System
   b. Nervous System
   c. Reproductive System.
4. Systematic position up to family and ecology of the following medical and veterinary pests:
5. Introduction to apiculture practices and handling of Beehives.
6. Study of male and female external genitalia of insects through permanent slides.
7. Study of different types of larvae and pupae with the help of charts/photographs/diagrams.

BOOKS RECOMMENDED

FOURTH SEMESTER

PAPER XVI : DEVELOPMENTAL BIOLOGY - II

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
2. Primary and secondary embryonic induction, chemical nature of evocators.
3. Introduction to stem cells, stem cell related disorders, gene therapy.
4. Metamorphosis.

UNIT – II
1. Teratogenesis : Critical period dose, classes of cytotoxic teratogens, human teratogenesis.
2. Totipotency & nuclear transfer experiment.
4. Environmental evolution and animal development: Environmental cues and effects, malformations and disruptions, changing evolution through development modularity, developmental constraints.
5. Sex determination.

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 study through PS of larvae of invertebrates (Redia, Cercaria, Arthropod larvae, Glochidium larva).
BOOKS RECOMMENDED

1. *An Introduction to Embryology* by Balinsky, B.I., Saunders, Philadelphia; 1981.
PAPER XVII : ADVANCES IN PARASITOLOGY

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, different types of animal associations : definitions; Parasitism, Mutualism, Hyperparasitism
2. Parasite Host Specificity : Kinds of parasite host specificity, specificity factors related to infection and growth.
3. Molecular, Cellular and Physiological basis of Host Parasite Relationship in Protozoans, trematode, cestode and nematode parasites.

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.
4. Ecology of parasites : Ecological niche, host size, and parasite nubus, biological control, role of metazoan parasites in transmission of microbial infection.

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 frog, toad and common household insects through slides/charts.
2. To study the helminth parasites infecting gut of the sheep and goat obtained from slaughter house.
3. To study the parasites from stained 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

Objectives of the Course:

To acquaint the students with aquatic animal life and its economic importance.

UNIT-I

1. Introduction: History and scope of aquaculture, Different kinds of aquaculture- traditional, extensive, intensive, semi-intensive, flow through and re-circulatory.
3. Principle of composite fish culture, Composite fish culture of endemic and exotic fishes in India.
4. Limnological parameters: influence of the environmental parameters on fish abundance and distribution, aquaculture and other anthropogenic activities on fish populations.
5. Induced breeding: History, technique, different kinds of hatcheries and advantages of induced breeding in fishes. Use of synthetic chemicals for induced breeding.
6. Ecological classification of aquatic organisms other than fishes.
7. Characteristics of lotic environment (river/stream) as per zonation, major abiotic and biotic factors in a stream/river affecting the body form in hillstream fishes, Body form in hillstream fishes.
8. Productivity: Concept of productivity, estimation of primary productivity by different methods and classification of water bodies on the basis of productivity.

UNIT-II

1. Major and minor constituents of fish including minerals and trace elements in fish. Post mortem changes in fish- rigor mortis, autolysis, auto-oxidation and their significance, biochemical and microbial spoilage of fish.
2. Fish diseases: Fungal, bacterial, protozoan, worm and crustacean diseases of fishes.
3. Principles of fish preservation, Preservation of fish by curing (drying, salting and smoking), Chilling and freezing of fish, canning of fish and fish products. Fish transportation and marketing
4. Biological pollution-algal blooms and their affect on fish production, Biological and chemical control of algal blooms.
5. Concept of Transgenic organisms, GMO’s and bio-safety regulations.
6. Concept of stock, DNA markers in stock identification: Allozymes, RFLP, RAPD, AFLP, Microsatellites, EST’s, SNPs, Type I and Type II markers, mtDNA and nuclear DNA markers.
7. Age and growth determination in fishes using hard parts such as scales, opercular bones etc.
**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

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 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.
4. **Environmental education**: Goals, objectives, and methods of teaching of environmental education.
5. **Ecosystem dynamics and management**: Stability and complexity of ecosystems. Speciation and extinctions, environmental impact assessment, sustainable development.

UNIT-II

1. **Zoogeography**: Zoogeographical regions and their fauna.
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

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 understand the genetic code, structure of chromosome, molecular basis of gene expression and regulation, mutation and genetic engineering.

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 for mitosis by squash method.
4. Study of sex-chromatin Bars body from human buccal mucosa.
5. Demonstration of monohybrid and dihybrid cross, Co-dominance, Incomplete dominance and Epistasis with the help of beads and photographs.
6. Study of genetic disorders with the help of photographs.
7. Study of structural and numerical alteration of chromosomes: deletion, duplication, inversion, translocation and ploidy with the help of photographs.

BOOKS RECOMMENDED