FACULTY OF SCIENCE

SYLLABI

FOR

M.Sc. (Honours School) Zoology
1st to 4th Semester

Examinations 2014 - 2015

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## M.Sc. (H.S.) 1st year (1st semester)

<table>
<thead>
<tr>
<th>Paper</th>
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<tr>
<td>I</td>
<td>Comparative Animal Physiology &amp; Endocrinology</td>
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<tr>
<td>II</td>
<td>Cytogenetics &amp; Cell Biology</td>
<td>MZO 6102</td>
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<td>III</td>
<td>Biology of Parasites</td>
<td>MZO 6103</td>
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<td>IV</td>
<td>Insect Ecology &amp; Insect Physiology</td>
<td>MZO 6104</td>
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<td>V</td>
<td>Aquaculture &amp; Fisheries</td>
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Total Credits: 28

Total Marks: 700

## M.Sc. (H.S.) 1st year (2nd semester)

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<td>VII</td>
<td>Molecular Biology</td>
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<td>VIII</td>
<td>Biology of Vertebrate Immune System</td>
<td>MZO 6203</td>
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<td>IX</td>
<td>Developmental Biology</td>
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<td>X</td>
<td>Environmental &amp; Quantitative Biology</td>
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Total Credits: 28

Total Marks: 700
### M.Sc. (H.S.) 2nd year (3rd semester)

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**Total Credits: 5.6**

**Total Marks: 140**

### M.Sc. (H.S.) 2nd year (4th semester)

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<td>ii Entomology</td>
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<td>iii Concepts in Parasitology</td>
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<td>iv Genetics &amp; Molecular Cytogenetics</td>
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<td>v Stress &amp; Reproductive Physiology</td>
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**Total Credits: 18.4**

**Total Marks: 460**

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<td><strong>Grand Total</strong></td>
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**Note:** There will be 4 hours theory per paper per week and 3 hours practical per paper per week. The total work load will be 35 hours per week.
FIRST SEMESTER

PAPER I: COMPARATIVE ANIMAL PHYSIOLOGY AND ENDOCRINOLOGY  
(MZO 6101)

Theory hours per week : 4
Practical hours per week : 3

Total Marks : 140
Theory
Sem. Exam. : 80
Int. Ass. : 20
Practical
Practical : 32
Int. Ass. : 8

Objectives
To enable the students know about all the physiological processes going on in the human body. To make the students understand the functions of hormones and their mechanism of action.

UNIT – I

Nutrition: Chemistry, metabolic role, sources and deficiency diseases of vitamins; Biological significance, regulation and deficiency diseases of minerals.

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 effect 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.

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 (microfilaments) and myosin in eukaryotic cells.

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 - amino butyric and glycine
neurotransmitters, acetylcholine receptor channel and their inhibitors; Retinal rod cell excitation and molecular biology of visual cycle, colour vision. Molecular mechanisms of auditory and olfactory responses.

UNIT – III
Reproductive Physiology: Structure and functions of vertebrate testis; spermatogenesis and its hormonal control; structure and functions of leydig cells; steroidogenesis in testis; role of accessory reproductive secretions; structure and functions of vertebrate ovary; folliculogenesis and ovogenesis and their hormonal control; ovulation and luteinization and their regulatory mechanisms; corpus luteum formation, its hormonal and neural maintenance and regression.

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.

Secondary messengers in hormone action, role of cAMP, Ca++, GTP, phosphoinositides, nitric oxide.

UNIT – IV
Autocrine, paracrine and Juxtacrine regulation of hormones.

Pineal-hypothalamo-hypophyseal-gonadal axis.

Pineal gland, its elaborations and circadian rhythms.

Hormonal elaborations of pancreas, adrenals, thyroid, parathyroid and their role in regulation of carbohydrate, lipid, protein, calcium and phosphorus metabolism.

Stress physiology and adaptation.

Hormones of gastro-intestinal tract.

Prostaglandins, their synthesis and biological functions.

Note: In all, nine questions to be set and five to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of ten short answer questions of 2 marks each. For the remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each unit.

Practicals based on theory paper MZO 6101 (MZO 6151)
1. To demonstrate that the optimum activity of salivary amylase is pH dependent.
2. To study the effects of various osmolarities on erythrocytes.
3. To study the effect of exercise on cardiovascular and respiratory system.
4. To perform the tuning fork tests of hearing.
5. To find out the physiological blind spot of human eye.
6. To estimate the glucose level in blood of rat.
7. To study the effect of insulin on blood glucose level of rat.
8. To prepare the vaginal smears of mice and identify the stage of estrous cycle.
9. To locate the endocrine glands in rat.
10. To study the histology of endocrine glands.
BOOKS RECOMMENDED


PAPER II : CYTOGENETICS AND CELL BIOLOGY (MZO 6102)

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<td>Sem. Exam. : 80</td>
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<td>Int. Ass. : 20</td>
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<td>Practical : 32</td>
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<td>Int. Ass. : 8</td>
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Objectives

To enable the students to learn various aspects of cell biology. It will also give an insight into evolution of genetic material, genetic code, regulation of gene, gene therapy and human genome project.

UNIT – I

Evolution: Evolution of biomolecules and pattern of genome evolution.

Cell Division: Molecular basis of cell division. Mitotic apparatus. Forces of cell division (chromosome movement).

Molecular Mutations: Molecular basis of mutations. Site directed mutagenesis. Target theory.


UNIT – II


Genes in Populations: Hardy Weinberg Law and calculation of gene frequencies.

Human Genome Project and gene therapy.
UNIT - III
Fixation : Non-chemical and chemical fixation, fixatives for electron microscopy.

Oogenesis : Pre-meiotic phase, meiotic phase, vegetative growth phase (storage of developmental information), role of oocyte nucleus, other organelles and accessory glands, vitellogenesis and oocyte growth in non-mammalian vertebrates. Ultra structure of mature oocyte of mammal.

Spermatogenesis with examples of insects and mammals. Ultra structure of spermatozoan of mammal

UNIT – IV
Fertilization in sea-urchin and mammals: Capacitation, acrosomal reaction, sperm-egg adhesion, egg activation, blockage of polyspermy, fusion of sperm and egg pronuclei.

Internalization of macromolecules and particles. Sorting and maturation of proteins: Role of endoplasmic reticulum and Golgi apparatus, Membrane dynamics, Synthesis and assembly of collagen.

Mitochondria : Bioenergetics.

Note : In all, nine questions to be set and five to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of ten short answer questions of 2 marks each. For the remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each unit.

Practicals based on theory paper MZO 6102 (MZO 6152)
1. Histochemical study of slides of ovaries of insects, crustaceans, fish, amphibian, bird and mammal.
2. Preparation of permanent histological slides of ovaries of insects, frog, mice/rat.
4. Demonstration of the sites of some enzymes in liver/ovary of rat.
5. Preparation of permanent histological slide of testis of insect.
7. Preparation of smear of testes of insect/rat, Smear of mature spermatozoa of rat and staining with giemsa stain/haematoxylin/eosin.
9. Genic/allelic frequency in population studies.
10. Drosophila eye colour variations.
11. Demonstration of drum sticks in blood smear.
13. Air drying technique for preparing mice chromosomes.
14. Insect chromosome preparations by acetic acid dissociation technique.
15. Preparation of polytene chromosomes from Chironomus larvae.
17. Study of chromosomal slides of different groups of vertebrates/invertebrates (Grasshopper, cockroach, Gryllid, Mosquito, Flies and Fishes).
18. Study of chemical induced chromosomal changes in mice, through slides.
BOOKS RECOMMENDED

PAPER III: BIOLOGY OF PARASITES (MZO 6103)

Total Marks: 140
Theory
Sem. Exam. : 80
Int. Ass. : 20
Practical
Practical : 32
Int. Ass. : 8

Objectives

To enable the students to classify and study the variation in morphology, life cycle and pathogenesis of important parasites causing diseases in animals and human beings.

UNIT – I

Introduction about parasitic protozoa.

General account of medically important parasites in Kinetoplastida, Coccidia, Piroplasemia and Microspora (for example Leishmania, Trypanosoma, Encephalitozoon, Babesia, Theileria, Sarcocystis, Isospora, Cryptosporidium etc.).

Invitro culture of protozoan parasites e.g. Plasmodium, Entamoeba, Giardia, Leishmania, Trypanosoma etc.

UNIT – II

Outline classification of trematodes with general account of important parasites in fasciolidae, paramphistomidae, dicrocoelidae, troglotrematidae, opisthocidae and schistosomatidae.

Ultrastructure of the body wall of digenetic trematodes.

Variation in the life cycle in Digenea.
UNIT - III

Outline classification of cestodes with general account of important parasites in
diphyllolbothridae, taeniidae and anoplocephalidae.

Ultrastructure of the body wall of cestodes.

Variation in the life cycles of cestodes.

UNIT – IV

General organization and Outline classification of nematodes with general account of important parasites in strongylidea, ascaridoidea, oxyuroidea, dracunculoidea, filarioidea and trichinelloidea.

Ultrastructure of nematode sense organs like amphids, phasmids and Papillae.

Variation in life cycle of nematodes.

Note: In all, nine questions to be set and five to be attempted. Q.No.1 is compulsory covering entire syllabus. It will consist of ten short answer questions of 2 marks each. For the remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each unit.

Practicals based on theory paper MZO 6103 (MZO 6153)
1. Study of the cestodes belonging to the family Anoplocephalidae.
2. Study of the trematodes belonging to the family Paramphistomidae.
3. Study of the digenetic trematode larvae from the snails.
4. Study of the nematodes infecting sheep, goat, fowl and cockroaches.
5. Detailed morphological and histological studies of Ascaris.
6. Study of the protozoan parasites infecting cockroaches and mice.
7. Study of invitro culture of Leishmania.

BOOKS RECOMMENDED
PAPER IV : INSECT ECOLOGY & INSECT PHYSIOLOGY (MZO 6104)

Total Marks : 140

Theory
Sem. Exam. : 80
Int. Ass. : 20

Practical
Practical : 32
Int. Ass. : 8

Objectives
To impart knowledge to students on ecological and physiological aspects of Arthropods, which dominate in number among all living organisms. To make the students understand the adaptations of these animals to their environment and the concept of insect societies.

UNIT – I
Salient features of different orders of insects.
Insect and its environment : Interrelations with living and non-living environment, fluctuations in populations of insects.

Extreme environments and insects : Desert insects, cave insects, high altitude insects, insects of torrential streams.

Insects dispersal : Means and limiting factors.
Insect - Plant interaction : Mechanism of host plant selection, receptors systems and sensory perception in phytophagous insects, resistance of host plants to insect attack, Insect-Weed-Crop interactions, insect – pollinator interactions, insect – plant gall interactions.

UNIT – II
Insect Societies : honey bees, termites, ants with reference to general habits including
- caste system
- nest construction
- communication
- brood care
- thermoregulation
- swarming
- feeding and foraging
- defense

UNIT – III
Physiology of digestion in insects including digestion of various types of food.
Gaseous exchange in terrestrial insects.
Physiology of excretion, salt and water metabolism and conservation of water in insects.

UNIT – IV
Neuro-endocrine organs, hormones and their role in development and metamorphosis.
Parthenogenesis and other atypial methods of reproduction in insects viz: paedogenesis, polyembryony, viviparity.
Effect of temperature and photoperiod on the lives of insects, details of onset, termination and significance of diapause.

Note: In all, nine questions to be set and five to be attempted. Q.No.1 is compulsory covering entire syllabus. It will consist of ten short answer questions of 2 marks each. For the
remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each unit.

Practicals based on theory paper MZO 6104 (MZO 6154)

1. Study of representatives from different insect orders in order to understand the salient features and diversity in insect groups.
2. Dissection of various insects to study the alimentary canal and glands associated with the digestion of different types of food.
3. Dissection of an insect to study tracheation and spiracles.
4. Dissection of various insects to demonstrate number, arrangement and associations of malpighian tubules.
5. Dissection of an insect (cockroach/grasshopper) to expose neuroendocrine organs.
6. To study the effect of temperature and photoperiod on the development of insects.
7. To study nest, castes and life stages of honey-bee.
8. To study nest, castes and life stages of termites.
9. To study nest, castes and life stages of ants.
10. Visit to apiary
11. Project work

BOOKS RECOMMENDED


PAPER V: AQUACULTURE & FISHERIES (MZO 6105)

Theory hours per week : 4
Practical hours per week : 3

Total Marks : 140
Theory
Sem. Exam. : 80
Int. Ass. : 20
Practical
Practical : 32
Int. Ass. : 8

Objectives
To enable the students understand the different fresh water habitats, the classification of water bodies based on various physicochemical and biological parameters and the importance of fishery science.

UNIT - I

Freshwater habitat :
Types of Freshwater habitats – Lotic and Lentic Waters.
Zonation in Lentic habitat
Hydrobiological characteristics – Temperature, penetration of light, turbidity, dissolved gases, pH, biogenic salts etc.
Water problems in aquatic and amphibious situations.

**Ecological classifications of freshwater organisms other than fishes:**
On the basis of trophic status
On the basis of mode of life – Benthos, Periphyton, Plankton, Nekton and Neuston
On the basis of zonation in lentic and lotic habitats.

**Classification of lakes:**
Trophic classification of lakes – Oligotrophic, eutrophic and dystrophic lakes.
Thermal classification of lakes – Forel’s and Yoshimura’s classifications of lakes.
Hutchinson’s classification of lakes – Amictic, cold monomictic, dimictic, warm monomictic, oligomictic and polymictic lakes.

**Ecological succession:**
Definitions and types of ecological succession
Succession of animal communities through Hydrarch

**Productivity:**
Concepts of productivity – Biomass, biotic potential, standing crop, carrying capacity, yield, productivity, primary and secondary productivity.

**UNIT - II**

**Eutrophication:**
Definitions and types - natural and cultural eutrophication.
Causes and impact of eutrophication.
Control of eutrophication – Mechanical, Chemical and Biological control.

**Bioassay** – Terminology, methodology, calculation of LC 50 and EC 50 values and threshold concentrations.
Methods in Field Biology : Methods of estimating population density of animals.

**Estuarine Habitat:**
Characteristics of estuarine habitat.
Classification of estuaries.
Estuarine fauna – Temporary and permanent.
Adaptations of estuarine fauna.

**Special Aquatic Habitats:**
Polar and alpine lakes.
Salt lakes.
Special stream environment.

**UNIT - III**

**Fishery Science** : Its importance and application.

*Morphological variations* in the body form- in deep – sea and hillstream fishes.
General information about the fishes of Punjab, Haryana and Himachal Pradesh:
Brief account of the following orders with ecological notes on the fishes mentioned in brackets:
Clupeiformes (Gadusia chapra) - Notopterus.
Cypriniformes - Schizothorax richardsonii, Hypophthalmichthys molitrix,
Cyprinus carpio, Puntius, Labeo, Catla, Cirrhinus, Tor, Garra, Noemacheilus, Botia.
Siluriformes : (Mystus, Aorichthys, Wallago/Heteropneustes fossiles)
Channiformes : (Channa punctatus)
Perciformes   : Colisa fasciatus
Mastacembeliformes : (Mastacembelus armatus)

UNIT - IV
Age and growth studies using scales, vertebrae, opercular bones. Method of calculating
the back-calculations using Fraser Lee, equation, growth parameters e.g., specific rate of
linear growth, index of species average size, growth characteristic, growth constant,
survival, mortality rate and their application in fishery management.

Exotic fishes: Different fishes introduced in India, history, causes, impacts, usefulness to
fish culture.

Pearl culture in India: species involved, implantation procedure, water quality, economics.

Fish : biodiversity, loss of fish biodiversity, enhancement, role of genetics in aquaculture
and fisheries.

Note : In all, nine questions to be set and five to be attempted. Q.No.I is compulsory
covering entire syllabus. It will consist of ten short answer questions of 2 marks
each. For the remaining eight questions, two to be set from each unit, each
carrying 15 marks. The candidate will be required to attempt one question from
each unit.

Practicals based on theory paper MZO 6105 (MZO 6155)
1. Qualitative study of biotic components of aquatic ecosystem.
2. Quantitative study of biotic components of aquatic ecosystem.
3. Study of different types of Phytoplankton (Bacillariophyceae,
Chlorophyceae,Euglenophycea & Cyanophyceae).
4. Study of different types of Zooplankton (Protozoa, Rotifera, Cladocera, Copepoda).
5. Study of Benthic fauna.
7. Study of Nekton.
8. Study of Macrophytes.
10. Estimation of Phosphates in water.
11. Estimation of dissolved oxygen by modified winklen method in water.
12. Determination of Primary productivity in an aquatic habitat.
13. Study of impact of Heavy metals on productivity.
14. Identification of the following fishes up to species level of Punjab, Haryana and
Himachal Pradesh using already prepared field keys. Noting down their important
characters, making sketches, and economic importance of each fish species along
with ecological notes: Notopterus notopterus, N.chitala, Schizothorax
richardsonii, plagiostomus,Hypophthalmichthys molitrix, Cyprinus carpio,
Ctenopharyngodon idella, Puntius, Labeo rohita, Catla catla, Cirrhinus
mrigala, Tor putitora, Garra gotyla gotyla, Noemechelus botia, Botia berdi, Mystus seenghala, Aorichthys spp., Wallago attu, Heteropneustes fossilis, Channa, Mastacembelus armatus.

15. Study of important deep-sea and hills stream fishes with special reference to various adaptations.

16. Study of hard parts e.g., scales, vertebrae, otoliths and opercular bones for age determination. Calculations of back-calculated lengths using Fraser-Lee equation. On the basis of available growth data calculation of various growth parameters e.g., annual increment, specific rate of linear growth, growth characteristic, growth constant, calculation of harvestable size and maximum size to be attained by the fish.

17. Study of various exotic fishes introduced in India and their characteristic features.

18. Study of different bivalves involved in Pearl Culture.

**BOOKS RECOMMENDED**


SECOND SEMESTER

PAPER VI: METHODOLOGY AND INSTRUMENTATION (MZO 6201)

Total Marks : 140
Theory
Sem. Exam. : 80
Int. Ass. : 20
Practical
Practical : 32
Int. Ass. : 8

Objectives
To acquaint the students with various instruments used in scientific laboratories and to make them understand the basic principles involved in the important techniques used in scientific research.

UNIT - I
Microscopy: Principle, structural parts and applications of compound microscope, phase-contrast microscope, Differences of Phase Contrast and interference microscope, fluorescent microscope, transmission electron microscope and its differences with scanning electron microscope.

Cell fractionation method: Different mechanical and chemical procedures. Principle of centrifugation and ultracentrifugation, different methods of ultracentrifugations (in brief) and their applications, structural parts of an analytical ultracentrifuge.

UNIT – II
Spectrophotometry: Principle of Colorimetry and its 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 – III
Electrophoresis: Principle of electrophoresis, paper electrophoresis, polyacrylamide gel electrophoresis, Disc gel electrophoresis, and SDS-PAGE, agarose gel electrophoresis, isoelectric focusing, applications of electrophoresis - distinguishing of Phage DNA, detection of plasmids, separation of DNA molecules, Southern transfer, Northern transfer and Western transfer.


UNIT – IV
Principles and Applications of Flow cytometry, Cell sorting.

Radioisotopes: Radioactive isotopes, half life of isotopes, detection and measurement of radioactivity (Gas ionization, scintillation and autoradiography), applications of radioisotopes in biological sciences.

Immunocytochemistry and Enzyme linked immunosorbent assay.
Note: In all, nine questions to be set and five to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of ten short answer questions of 2 marks each. For the remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each unit.

**Practicals based on theory paper MZO 6201 (MZO 6251)**

1. To study the parts of the compound microscope fluroscent microscope and phase-contrast microscope and their maintenance.
2. To study the living material under the phase contrast microscope.
3. To Find 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.
6. Demonstration of working of ultracentrifuge.
7. To separate a sample of amino acids with the help of paper chromatography and TLC.
8. To find out pH with a pH meter and weight with electrical balance.
9. To do a short term in vitro culture of a parasite.
10. Demonstration of SDS-PAGE and western blotting to students.
11. To demonstrate ELISA to students.

**BOOKS RECOMMENDED:**

OBJECTIVES
To enable the students to understand the molecular basis of cell signalling, cell division and transport of ions across membranes. To acquaint students with various techniques used in molecular biology. To make the students understand the role of different factors causing cancer.

UNIT - I
Structure and function of pro-and eukaryotic membranes, molecular structure of membranes, transport proteins, signalling molecules and cell surface receptors, pathways of intracellular signal transduction.

Cytoskeletal elements and their role in cell shape and cell movements.

UNIT – II
Restriction enzymes, recombinant vectors (plasmid, phage, cosmid, p1, YAC) and their role, genomic and DNA libraries, DNA amplification techniques (PCR and LCR), chromosome walking and DNA sequencing.

Nucleic acid hybridization (Southern and western blotting), DNA finger printing, RFLP markers, RAPD and AFLP, uses of recombinant DNA technology in medicine and health, transgenic animals and knockout mice.

UNIT – III
Extracellular matrix, adhesive proteins: Cell-cell adhesive proteins, cell matrix interaction.

Cell cycle-Eukaryotic cell cycle, regulators and cell cycle progression.

UNIT – IV
Cell proliferation and programmed cell death.

Cancer: Development of cancer, characteristics of cancer cells, causes of cancer: chemicals, viruses and radiations, human tumour viruses. Oncogenes and their proteins (characteristics and classification), tumour suppressor genes (antioncogenes) and the functions of their proteins.

Note: In all, nine questions to be set and five to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of ten short answer questions of 2 marks each. For the remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each unit.

Practicals based on theory paper MZO 6202 (MZO 6252)

1. Introduction to instruments in Biology experiments (i) Oven incubator (ii) Centrifuge (iii) Double distillation plant (water) (iv) Homogenizer (manual & electric)
To stain the bacterial sample provided using gram staining technology.

3. Cell fractionation of rat liver.

4. Estimation of Glucose-6-Phosphatase in various cell fractions compared with homogenate and calculate specific activity.

5. Estimation of Acid phosphatase in various cell fractions compared with homogenate and calculate specific activity of acid phosphatase in various cell fractions.

6. Extraction of nucleic acid from any tissue. Estimation of DNA and RNA.

7. How to culture E. coli in the laboratory.

8. Separation of genomic DNA.


10. Demonstration of the procedure of “Polymerase Chain Reaction” (PCR) for amplification of DNA fragments.

11. Preparation of polytene chromosomes of Chironomus for locating the repetitive DNA sequences in the form of ectopic pairings.


BOOKS RECOMMENDED


PAPER VIII: BIOLOGY OF THE VERTEBRATE IMMUNE SYSTEM (MZO 6203)

Theory hours per week : 4
Practical hours per week : 3

Total Marks : 140

Theory
Sem. Exam. : 80
Int. Ass. : 20

Practical
Practical : 32
Int. Ass. : 8

Objectives
To acquaint the students with the basic concepts of immunology and the immune effector mechanisms. To make the student understand the role of immunity in controlling the pathogenic infection.

UNIT – I

Introduction to immunology.

Immune response and host defense mechanisms, Cell mediated effector responses (CTL’s & NK cells)
Cells and tissues of the immune system: haematopoiesis (Origin and differentiation of the lymphoid cells), blood composition with special reference to globulins and leucocytes, structure and function of primary and secondary lymphoid organs.

Antigens: definitions, properties of immunogens, adjuvants. Antigen-antibody interaction: Serodiagnostic assays.

UNIT – II
Immunoglobulins: Basic structure, Fine structure, Immunoglobulin Classes their structure and functions, Effector functions of Immunoglobulins, B cell receptor.

Complement system: Complement pathways, deficiencies

Hypersensitivity: Mechanisms and causes of anaphylactic shock, Arthus-type and cell mediated delayed hypersensitivity.

UNIT - III
Monoclonal antibodies: Basic steps involved is the production of monoclonal antibodies characterization and uses of monoclonal antibodies.

Immunity to parasites: Brief account of immunity to protozoan (Plasmodium, Leishmania, Trypanosoma) and helminth parasites of man.
Cytokines: Properties, Structure, Receptors, Antagonists.

UNIT – IV
The Major Histocompatibility complex: Distinguishing features of MHC, H2 complex, HLA complex, transplantation, T cell receptor.

Autoimmunity: Immunological tolerance and autoimmunity, major autoimmune diseases and immunosurveillance.

Vaccines: Active and passive immunisation, types of vaccines.

Note: In all, nine questions to be set and five to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of ten short answer questions of 2 marks each. For the remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each unit.

Practicals based on theory paper MZO 6203 (MZO 6253)

1. To study the histology of lymphoid organs.
2. Preparation of blood film and identification of white blood cells from normal and infected animals.
3. To perform agglutination reaction by using blood group typing kit.
4. To perform antigen – antibody interaction by Ouchterlony method.
5. To isolate W.B.C. from blood using density gradient centrifugation.
7. To perform indirect fluorescent antibody test.
8. To demonstrate antigen-antibody reaction by ELISA to students.
9. To perform DOT- ELISA by using kit.
BOOKS RECOMMENDED


PAPER IX: DEVELOPMENTAL BIOLOGY (MZO 6204)

Total Marks : 140

Theory
Sem. Exam. : 80
Int. Ass. : 20

Practical
Practical : 32
Int. Ass. : 8

Objectives
To enable the students understand the process of development in various animals and the phenomena associated with that. It also includes the genetic involvement and the role of maternal environment on fetal development. It will enable the students understand the environmental influences on development and factors responsible for ageing.

UNIT – I
Cytoplasmic determinants and autonomous cell specification – Cell commitment and differentiation, cell specification in nematodes, germ cell determinants, germ cell migration. Progressive cell-cell Interaction and cell specification fate.

Induction : Cell-cell interactions, primary embryonic induction, role of endoderm in mesodermal specificity, mesodermal inducers, neural induction, secondary induction, instructive and permissive interactions, chemical nature of evocators, concept of competence, epitheliomesenchymal interaction.

UNIT – II
Molecular basis of differentiation, transdifferentiation and dedifferentiation.

Eukaryotic regulatory proteins and their interaction, transcription regulators in tissue and stage specific gene expression, DNA methylation, tissue specific enhancers, regulation of transcription by vertebrate steroid hormones.
Globin gene switching.

UNIT – III
Hormones as mediators of development. Amphibian metamorphosis, Insect metamorphosis, Ovarian luteinization and mammary gland differentiation.

Limb development and pattern formation - limb generation and position effect, role of mesoderm and ectoderm in development of limb, changes in the polarity of limb, Regeneration.
UNIT – IV
Teratogenesis - Critical period, dose, classes of cytotoxic teratogens, human teratogenesis.

Gene regulation in development - Maternal genes, maternal and zygotic control during initiation of development.

Ageing : Consequences, causes, control by genes, ageing of cells in vitro.

Note : In all, nine questions to be set and five to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of ten short answer questions of 2 marks each. For the remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each unit.

Practicals based on theory paper MZO 6204 (MZO 6254)

1. To study the different larvae in the invertebrates.
2. To study the different stages of development in frog and chick.
3. To prepare permanent stained slides of developing stage from fertilized egg of hen.
4. To study the RNA activity in the polytene chromosomes in dipterans.
5. To prepare permanent slides of larvae of invertebrates.

BOOKS RECOMMENDED
5. Rastogi, V. B. and Jayaraj M. S., Developmental Biology, Kedar Nath Ram Nath, Meerut (2009)

PAPER X : ENVIRONMENTAL & QUANTITATIVE BIOLOGY (MZO 6205)

Total Marks : 140

Theory
Sem. Exam. : 80
Int. Ass. : 20

Practical
Practical : 32
Int. Ass. : 8

Objectives
To impart environmental education to students on the important environmental issues such as pollution, global warming, ozone depletion and management of solid waste. To enable the students to understand the importance of epidemiology and biostatistics in scientific research.

UNIT I
Environmental education : Objectives, guiding principles, major areas and scope of environmental education.

20
Environmental challenges in India: Population explosion and poverty, land degradation, human settlement, increase in agricultural growth, energy crises, biodiversity, environmental pollution, water management etc.

Biomonitoring of Environment: Microbial system, lower plants, higher plants, animal systems, human system, cell biology & genetics, aeroallergins etc.

Control of Environmental Pollution through Law: Environmental Protection Act 1986 and amendments in Air and Water Acts.

Atmospheric Pollution: Sources, hazards of air pollutants on plants, animals, human beings and climate.

Water Pollution: Impact of pollution due to sewage, industries, thermal power plants, silt, pesticides, fertilizers, detergents, etc.

Management of Solid municipal wastes – composting, incineration, sanitary landfills,

Management of Hazardous wastes – deep well injection, land application, secure land fill, source reduction, treatment, incineration etc.

Recycling and reclamation of wastes – anaerobic bacterial digestion, pyrolysis, as fuel, composting, recycling, etc.

Environment and Global issues:

Global Warming – Green house effect, changes in green house gases, impact of green house.

Ozone depletion – Ozone depletion and CFC, Global efforts and management issues.

Biodiversity – Concept, human activity as a major threat to biodiversity.

UNIT II

Epidemiology: Definition, meaning, history, concept and scope. Descriptive epidemiology: Factors: Physical factors (Geological, geographical, climatic), Biological factors (Flora and fauna, nutrition, allergins etc.) socio-economic factors (population distribution, social and political structure). Epidemiological procedures – Investigations with reference to time (fluctuations, types of epidemics), place (national and international variations), person (sex, age, profession).

Demographic Studies: fertility, mortality, population size. Methods: tables, comparative tables, city maps, graphs etc., Periodic monitoring through maps.

Detection of epidemics: Verification, confirmation, identification of cases, data analysis & Hypothesis.

UNIT III

Quantitative Biology - Study of the following Statistical methods with special reference to biological problems (Only application part is included derivations excluded).

Measures of central tendency: Mean, mode and median.

Measures of dispersion: Standard deviation.

Correlation analysis: Karl Pearson, ranking and concurrent methods.

Regression analysis: Construction of regression equation on the basis of biological data and calculation of X value when Y is given.
UNIT IV

Graph: Construction of graph when different types of biological data is given.

Normal distribution: Normal distribution curve and its properties, Z-score.

Test of significance: t-test, F-test, chi-square test.

Note: In all, nine questions to be set and five to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of ten short answer questions of 2 marks each. For the remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each unit.

Practicals based on theory paper MZO 6205 (MZO 6255)

1. Estimation of percentage saturation of dissolved oxygen by modified Winkler’s method.
2. Estimation of free carbon dioxide content in a water sample.
3. Determination of total hardness and % age of temporary hardness in given polluted water sample.
4. Determination of % age of different ions imparting alkalinity in a water sample.
5. Determination of organic pollution load in a water sample.
7. Determination of dissolved solids.
8. Determination of pH of water sample.
10. Study of the following with the help of atlas/maps/charts:
    a) Hydroelectric projects
    b) Nuclear Power Projects
    c) Thermal Power Projects.
11. Study of the following with the help of atlas/maps/charts:
    a) Coal fields
    b) Oil wells
    c) Oil refineries
13. Study of different types of forests in India with the help of atlas/maps/charts.
14. Recording of data by using any material such as fish or mollusks or insect.
15. Calculation of standard deviation on the basis of recorded data.
16. Calculation of correlation coefficient (between X & Y variables) on the basis of material provided.
17. Setting up of regression equation and the calculation of the value of Y of unknown X on the basis of equation Y = a+bX.

BOOKS RECOMMENDED

SEMMESTER - III

PAPER XI: ANIMAL BIOCHEMISTRY (MZO 7101)

Time : 3 hrs.
Total Marks : 140

Theory
Sem. Exam. : 80
Int. Ass. : 20

Practical
Practical : 32
Int. Ass. : 8

Objectives
To acquaint the students with the biochemical events that occur at the molecular level including structure, chemical properties and biological significance of macromolecules of physiological importance.

UNIT - I
Introduction : Importance of Biochemistry in Animal Sciences

Carbohydrates : General structure, classification and chemical properties of carbohydrates.


Lipids: Simple lipids, general structure and chemical properties of simple lipids.

Compound lipids: Structure of phospholipids like lecithins, lysolecitihins, cephalins, phosphatidyl serine, phosphatidyl inositol, plasmalogens, cardiolipins, sphingomyelins, glycolipids, cerebrosides, gangliosides, properties and functions of phospholipids.

Derived lipids: Cholesterol and steroid hormones (chemistry), biological functions of lipids.

Proteins : Amino acids as monomers of proteins and their properties, types of proteins and their classification, levels of protein structure and forces stabilizing protein structure and shape, the conformation of proteins, subcellular assemblies of protein, functions and their denaturation.

UNIT – II
Conjugated proteins: Lipoproteins, glycoproteins, nucleoproteins, metalloproteins and chromoproteins, biological functions of proteins.

Nucleic acids : Molecular structure and biological functions of DNA & RNA molecules, Z-DNA and its biological significance, physical properties of nucleic acid - denaturation of DNA, hydrolysis of nucleic acids, nucleic acids and protein interaction.

Porphyrins: Porphyrins and their classification, important metalloporphyrins occurring in nature, bile pigments - chemical nature and their physiological significance.

UNIT - III
Enzymes: Enzyme kinetics, mode of action of enzymes and biochemical role of coenzymes and isoenzymes, effect of enzyme concentration, substrate concentration and pH on enzyme activity, mechanism of enzyme action - a brief description, allosteric enzymes, concentration
of effector, feedback inhibition - various mechanisms, covalent modifications Irreversible and Reversible.
Metabolism: ATP - cycle, energy rich phosphate compounds, major pathways of catabolism of carbohydrates, glycolysis, tricarboxylic acid cycle, phosphogluconate pathway, glycogenolysis.

UNIT - IV

Oxidation of fatty acids: Oxidation, biosynthesis of saturated and unsaturated fatty acids.

Mitochondrial-electron transport chain, mechanism of mitochondrial oxidative phosphorylation, inhibitors of electron transport chain, inhibitors and uncouplers of mitochondrial oxidative phosphorylation.

Note: In all, nine questions to be set and five to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of ten short answer questions of 2 marks each. For the remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each Unit.

Books Recommended


Practicals based on Paper – XI MZO 7101 (MZO 7151)

1. Qualitative estimation of Carbohydrates.
2. Quantitative estimation of Glucose in RBCs
4. Qualitative estimation of proteins
7. Qualitative estimation of fats.
9. Quantitative estimation of DNA.
10. Quantitative estimation of RNA.
12. Effect of different substrate concentration on enzyme activity.
SEMESTER IV

Special Paper (either of these)  Total Marks : 460
Paper XII  Marks
i. Limnology & Fisheries (MZO 7201)  100
ii. Entomology (MZO 7202)  
iii. Concepts in Parasitology (MZO 7203)  250
iv. Genetics & Molecular Cytogenetics (MZO 7204)  
v. Stress & Reproductive Physiology (MZO 7205)  
Dissertation  
Seminar  50
Viva-voce test  60

(i) LIMNOLOGY & FISHERIES (MZO 7201)

Time : 3 hrs.
Total Marks : 100

Theory hours per week : 4
Sem. Exam. : 80
Int. Ass. : 20

UNIT - I ( LIMNOLOGY )

Physico-chemical characteristics of water in relation to biota: temperature, light and turbidity, dissolved oxygen, carbon dioxide, pH, nitrogen, phosphorus.

Plankton: classification, distribution, diurnal movements of plankton.

Benthos: zonation, phyto and zoo-benthos.

Lotic Waters: characteristics and adaptations of organisms.

Thermal stratification in lakes.

UNIT - II

Aquatic ecosystem: components, food chain, ecological energetics.


Bog Lakes: physico-chemical conditions, biotic conditions - nature and quantity of plankton, faunal characteristics.

Aquatic pollution: aquatic pollution in relation to biota, thermal pollution, treatment of waste waters - primary, secondary and tertiary, BOD and saprotric classification of waters, bioindicators of water pollution.

Role of limnology in the management of fish ponds.

UNIT - III ( FISHERIES )

History of Indian fisheries.

Morphology of the following category of fishes: carp, cat-fish, perch, eel.
Riverine fisheries of the following major river systems of India, their physico-chemical characteristics and important fishes: Indus river system, Ganga river system.

Fishery, location, physico-chemical characteristics, management and present status of the following reservoirs: Gobindsagar, Pong.

Fish culture in freshwater ponds: kinds of ponds (contour, barrage, paddy), parts of ponds (walls, pond inlet, pond outlet, overflow, shape, size & depth), soil type, water quality, nursery pond, rearing pond, stocking pond, feeding pits, hatching pits, marketable tanks, hospital tanks.

Culturable fishes: Indian major carps, salt-water fishes, exotic fishes, air-breathing fishes.

Fish breeding: types of breeding (natural and bundh breeding), fish seed collection from natural resources.

UNIT - IV

Types of fish culture: composite-culture (fish-cum-paddy, fish- cum-duck, fish-cum-dairy), monoculture, sewage fish farming.

Induced breeding: history, technique, P.G. injection, use of synthetic chemicals for induced breeding.

Fish diseases and their control: protozoan, viral, bacterial, fungal, crustacean, helminthes, nematodes, environmental stress (temperature, light, DO, pH, ammonia, bicarbonates, acidity, nutritional deficiency diseases).

Note: In all, nine questions to be set and five to be attempted. Q.No.1 is compulsory covering entire syllabus. It will consist of ten short answer questions of 2 marks each. For the remaining eight questions, four to be set from Unit I and four from Unit II, each carrying 15 marks. The candidate will be required to attempt two questions from each Unit.

BOOKS RECOMMENDED

(ii) ENTOMOLOGY (MZO 7202)

Theory hours per week : 4
Sem. Exam. : 80
Int. Ass. : 20

Objectives:
The paper will provide the students, the much needed information about insect pests related to food crops and human health. It will inform them about the suitable methods of control.

UNIT - I

Systematic position, host plants, nature of damage and outlines of the life cycle of the following pests of crops, vegetables and fruits:

A. Crops:
   - **Cotton**: Pectinophora gossypiella (Pink bollworm), Empoasca devastans (cotton jassid), Bemisia tabaci (cotton white fly), Dysdercus cingulatus (Red cotton bug), Myllocerus maculosus (Cotton grey weevil).
   - **Sugarcane**: Pyrilla perpusilla (Sugarcane leaf hopper), Aleurolobus barodensis (Sugarcane white fly), Scirpophaga nivella (Sugarcane top borer), Chilo infuscatellus (Sugarcane shoot borer).
   - **Paddy**: Hieroglyphus banian (Rice grass hopper), Dicladispa armigera (Rice Hispa), Leptocorisa varicornis (Gundhi bug).
   - **Wheat**: Tanymecus indicus (Ghujia weevil), Mythimna separata (Army worm), Sesamia inferens (Wheat stem borer).

B. Vegetables:
   - **Pieris brassicae**: (Cabbage caterpillar), Plutella xylostella (Diamond-black moth), Urentius sentis (Brinjal lace wing bug), Epilachna vigintioctopunctata (Hadda beetle), Raphidopalpa foveicollis (Red Pumpkin beetle).

C. Fruits:
   - Drosicha mangiferae (Mango mealy bug), Dacus dorsalis (Mango fruit fly), Diaphorina citri (Citrus psylla).

UNIT-II

D. Pests of stored food products with particular reference to their habits, nature of damage caused by them and outlines of their life cycles:
   - Callosobruchus maculatus (Pulse beetle), Sitophilus oryzae (Rice weevil), Rhizopertha dominica (Lesser grain borer), Trogoderma granarium (Khapra beetle), Tribolium castaneum (Rust-red flour beetle), Sitotroga cerealella (Angoumois grain moth).

E. Insects of medical and veterinary importance: (Mosquito, house fly, tsetse fly, sand fly, horse fly, blow fly, bot fly, warble fly, poultry louse, sucking louse, fleas, with
particular reference to their systematic position, mode of infection and diseases caused by them.

UNIT - III
History of insect pest control, simple devices such as mechanical and cultural control.

Biological control of insect pests with reference to principles, strategies, use of parasites, predators and pathogens.
Integrated pest management (IPM).

UNIT - IV
Chemical control of insect pests including classification of insecticides: stomach poisons, contact poisons, botanicals, systemics, fumigants, common examples from each class and their mode of action, synergistic substances, resistance to pesticides.

Physical methods of pest control: use of radiations and chemosterilants, history and principle of sterile insect release method (SIRM).

Note: In all, nine questions to be set and five to be attempted. Q.No.1 is compulsory covering entire syllabus. It will consist of ten short answer questions of 2 marks each. For the remaining eight questions, four to be set from Unit I and four from Unit II, each carrying 15 marks. The candidate will be required to attempt two questions from each Unit.

BOOKS RECOMMENDED

(iii) CONCEPTS IN PARASITOLOGY (MZO 7203)

Time : 3 hrs.
Total Marks : 100
Theory hours per week : 4
Sem. Exam. : 80
Int. Ass. : 20

Objectives:
To enable the students to understand the basic concepts in parasitology and acquaint them with the different types of host parasite interactions, immune response generated during parasitic infections, ecological adaptations and transmission of the parasites. It will enable the students to understand the different vectors involved in transmission of parasitic diseases and various aspects involved in their diagnosis.
UNIT - I
Different types of animal associations: Definitions; Phoresis, Commensalism, Parasitism, mutualism, Hyperparasitism.

Evolution of parasites: Origin of parasitism, possible evolutionary pathways, adaptation to multiple hosts, some evolutionary patterns.

UNIT - II
Parasite host specificity: Kinds of parasite - host specificity, specificity factors related to infection and growth: host specificity of protozoa and helminth parasites.

Diagnosis of parasitic infections: Protozoans parasites, helminthic parasites.

UNIT - III
Hot parasite interactions: Immunity to protozoans and helminthes.

Pathogenesis of parasitic infections.

Vectors: Brief account of various insect vectors of human parasitic infections.

UNIT - IV
Parasite transmission: Introduction, mechanism for location of host mechanism for penetrating the host, circadian rhythm associated with transmission.

Ecology of parasites: Ecological niche, host size, age and parasite numbers, biologic control, role of metazoan parasites in transmission of microbial infections.

Note: In all, nine questions to be set and five to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of ten short answer questions of 2 marks each. For the remaining eight questions, four to be set from Unit I and four from Unit II, each carrying 15 marks. The candidate will be required to attempt two questions from each Unit.

Books Recommended
(iv) GENETICS & MOLECULAR CYTOGENETICS (MZO 7204)

Time : 3 hrs.
Total Marks : 100
Theory hours per week : 4
Sem. Exam. : 80
Int. Ass. : 20

Objectives:
To acquaint students with organization of genome and specialized chromosomes. To understand basic principles of genetics and its applications.

UNIT - I

1. Organization of the genetic material:
   Fine structure of eukaryotic chromosomes, chromosome models, chromosomal proteins, nucleosome concept, various types of DNAs-Satellite DNA, Pallindromic DNA, Promiscuous DNA, Mitochondrial DNA.
2. Split genes, Overlapping genes, Plasmids, IS Elements, Transposons and Retroposons.
3. Specialized chromosomes:
   Lampbrush chromosomes - Methods of preparation, distribution of lampbrush chromosomes, structure in detail of the chromosomes in amphibians, in Drosophila spermatocytes and other organisms, significance of the studies of the lampbrush chromosomes.

UNIT - II

4. Polyten chromosomes - Distribution of the polytene chromosomes, organization and structure, relationship between the bands and genes, the puffing mechanism, DNA replication in polytene chromosomes, polytene chromosomes in the hypotrichous ciliates.
5. Mechanism of chromosome pairing:
   Synapsis and synaptonemal complex-Structure and composition, attachment, biochemical process of pairing and synapsis. Synaptonemal complex in achiasmate meiosis, synaptonemal complex in non-homologous pairing, recombination nodules and their role in meiotic pairing, polycomplexes.

UNIT - III

6. Chromosome banding:
   Chromosome bands - What do they represent, techniques and their mechanisms, classification of bands, importance of banding, differences between banding of metaphase chromosomes and polytene chromosomes.
7. Gene expression:
   Transcription - In prokaryotes-RNA polymerase in E.coli, initiation, elongation and termination of RNA synthesis in prokaryotes. In eukaryotes : RNA polymerases in eukaryotes, transcription factors and initiation of RNA synthesis, transcription factors for elongation of RNA chain, termination of RNA synthesis. RNA processing - capping, polyadenylation, splicing, introns and exons.

Unit-IV

8. Translation - Activation of amino acids, transfer of amino acids to tRNA, initiation of synthesis, elongation of the polypeptide chain and chain termination. Genetics of prokaryotes.
10. **Applied genetics:**
Recombinant DNA, molecular probes, gene libraries and PCR.

Note: In all, **nine** questions to be set and **five** to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of **ten** short answer questions of 2 marks each. For the remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each Unit.

**BOOKS RECOMMENDED**

(v) : **STRESS & REPRODUCTIVE PHYSIOLOGY (MZO 7205)**

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**Theory hours per week: 4**

**Objectives:**
To make the students aware about the physiological process and the influence of stress in causing changes particularly with respect to reproduction.

**UNIT – I**

Introduction: Physical and biological concept of stress and strain, stress tolerance (conformity) and avoidance, (retaliation), type of strain, injuries and homeostasis.

Thermal Stress: Ranges of environmental temperatures, heat exchange between organisms and environment. Body temperature in aquatic amphibious and terrestrial animals to high and low temperature.

**UNIT - II**


UNIT - III

Aviation and Space Stress; Effects of centrifugal and linear acceleratory forces, perception of equilibrium and turning in blind flying, radiation at high altitude and in space, weightlessness in space.

Structure and physiology of mammalian ovary, folliculogenesis, corpus luteum and its functions.

Vertebrate reproductive cycles and factors regulating them.

UNIT - IV

Physiology of mammalian testis, Sertoli cell-germ cell interaction, functions of Leydig cells, Sperm maturation and capacitation.
Hypothalamic-pituitary-gonadal interaction.
Fertilization in mammals, and in vitro fertilization. Parturition, lactation.

Note: In all, nine questions to be set and five to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of ten short answer questions of 2 marks each. For the remaining eight questions, two to be set from each Unit, each carrying 15 marks. The candidate will be required to attempt one question from each Unit.

Books Recommended

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