

# **UNIVERSITY OF KERALA**

## **First Degree Programme in Zoology**

**Choice Based Credit and Semester System**

### **Scheme and Syllabus**

*With effect from 2015 admission*

**Core Courses**

**Foundation Course II**

**And**

**Open Courses**

## First Degree Programme under CBCSS

### Semester I

#### Zoology Core Course I

#### Animal Diversity I Course code – ZO1141

**No. of Credits – 3**

**Total hours 54**

#### **Aim of the course**

To provide the students with an in-depth knowledge of the diversity in form, structure and habits of invertebrates.

#### **Objectives of the course**

- To learn the basics of systematics and understand the hierarchy of different categories.
- To learn the diagnostic characters of each phyla through brief studies of typical examples.
- To obtain an overview of economically important invertebrate fauna

#### **Module I**

**4 hrs**

Introduction to Zoology: taxonomy- definition, history, new trends and importance, mention molecular taxonomy. Components of classification, Taxonomic hierarchy- taxon, category and rank. Linnaean hierarchy, nomenclature, principles of nomenclature. International Code of Zoological Nomenclature (ICZN), rules of nomenclature, requisites – uni, bi and trinomialism. Mention taxonomic aids.

#### **Module II**

**6 hrs**

Kingdom Protista: general characters, structure and zoological importance of *Actinophrys*, *Noctiluca* and *Opalina*. Parasitic protozoans: morphology, life history, pathogenicity and prophylaxis of *Entamoeba histolytica* and *Plasmodium vivax*.

#### **Module III**

**6 hrs**

Kingdom Animalia: Outlines of classification – Subkingdom Mesozoa, Subkingdom Parazoa, Subkingdom Eumetazoa. Levels of organization– cellular, tissue, organ. Divisions of Eumetazoa- Radiata, Bilateria, Acoelomata, Pseudocoelomata, Eucoelomata, Protostomia, Deuterostomia. Sub kingdom Mesozoa- general characters, eg. *Rhopalura*. Sub kingdom Parazoa- general characters and mention the classes of Porifera- Calcispongia, eg. *Sycon*; Hydrospongia, eg. *Euplectella*; Desmospongia, eg. *Spongilla*.

#### **Module IV**

**4hrs**

Phylum Coelenterata: General characters (self study). Classes-Hydrozoa eg. *Obelia*, *Physalia*; Scyphozoa eg. *Aurelia*, *Rhizostoma*; Anthozoa eg. sea anemone, *Madrepora*. Mention coral reefs.

#### **Module V**

**8 hrs**

Phylum Platyhelminthes: General characters (self study). Classes- Turbellaria eg. *Planocera*; Trematoda eg. *Fasciola*; Cestoda, eg. *Taenia solium*.

Phylum Nematoda: general characters (self study), Parasitic nematodes- Morphology, Life history, Pathogenicity and Prophylaxis of *Ascaris*, *Ancylostoma*, *Enterobius*, *Wuchereria*. Phylum Annelida: General characters (self study). Classification: Polychaeta

- eg. Nereis (Mention Heteroneries), Arenicola ; Oligochaeta eg. Earthworm, Hirudinea  
 eg. Leech. General topic - Vermiculture (brief account)

**Module VI****16 hrs**

Phylum Arthropoda: General characters (self study), Type- *Penaeus*. Mention the classes.  
 eg. Cockroach, *Limulus*, *Eupagurus*, *Sacculina*, termite, honey bee, scorpion. Phylum  
 Onychophora: general characters, eg. *Peripatus*. General topic: Apiculture, Sericulture.

**Module VII****10 hrs**

Phylum Mollusca: General characters (self study), Classes- Monoplacophora, eg. *Neopilina*;  
 Amphineura, eg. *Chiton*; Aplacophora, eg. *Neomenia*, Gastropoda eg. *Pila*; Scaphopoda, eg.  
*Dentalium*; Pelicypoda eg. *Perna*; Cephalopoda, eg. *Sepia*. General topic- Economic importance  
 of mollusca - emphasis on pearl culture. Phylum Echinodermata: General characters (self study)  
 Classes- Asterozoa, eg. *Asterias*; Ophiurozoa, eg. *Ophiothrix*; Echinozoa, eg. *Echinus*;  
 Holothurozoa, eg. Sea cucumber, Crinozoa, eg. Sea lily.

**Phylum Echinodermata:** General characters (self study) Classes- Asterozoa, eg. *Asterias*;  
 Ophiurozoa, eg. *Ophiothrix*; Echinozoa, eg. *Echinus*; Holothurozoa, eg. *Sea cucumber*,  
 Crinozoa, eg. Sea lily. General Topic: **Water vascular system.**

**References**

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## First Degree Programme under CBCSS

### Semester II

#### Zoology Core Course II Animal Diversity II Course Code – ZO1241

No. of credits – 3

Total hours 54

#### Aim of the course

To provide the students with an in-depth knowledge of the diversity in form, structure and habits of vertebrates.

#### Objectives of the course

- To learn the general characteristics and classification of different classes of vertebrates.
- To understand the vertebrate evolutionary tree.
- To understand general aspects of applied interest.

#### Module I

5 hrs

**Phylum Chordata:** Chordate characters and their classification into three Sub phyla (self study).  
**Subphylum Urochordata-** General characters, Class Larvacea eg. *Oikopleura* ; Class Ascidiacea eg. *Ascidia* (Mention -Ascidian tadpole larva, Retrogressive metamorphosis) and Class Thaliacea eg. *Salpa*. **Subphylum Cephalochordata-**general characters, eg. *Amphioxus* (Mention feeding behaviour).

#### Module II

8 hrs

**Subphylum Vertebrata:** General characters, **Division 1 Agnatha** -General characters,

Class Cyclostomata eg. *Petromyzon*, Class Ostracodermi; **Division 2 Gnathostomata** - General characters, Classification into Super class Pisces and Tetrapoda.

**Super class Pisces-** General characters and classification, **Class Placodermi**, **Class Chondrichthyes-** Sub class Elasmobranchii eg. *Shark*, Sub class Holocephali eg. *Chimaera*;

**Class Osteichthyes-** Sub class Choanichthyes- Order 1 Crossoptergii eg. *Latimeria*, Order 2 Dipnoi eg. *Protopterus*, Subclass Actinopterygii-Super order Chondrostei eg. *Acipenser*.

Super order Holostei eg *Lepidosteus*, Super order Teleostei eg *Anabas*, *Clarius*, *Saccobranchus*, *Ophiocephalus*, *Echeneis*. General topic: Accessory respiratory organs in fishes, Dipnoians.

### Module III

4 hrs

**Super class Tetrapoda:** Salient features, **Class Amphibia** - General characters (self study). Classification- Order Urodela eg *Amblystoma*, Order Anura eg. *Hyla*, Order Apoda eg. *Ichthyophis*. General topic: Parental care in amphibia.

### Module IV

9 hrs

**Class Reptilia** - General characters (self study). Classification - Subclass Anapsida - Order Chelonia eg. *Chelone*; Subclass Parapsida eg *Ichthyosaurus*; Subclass Diapsida- Order Rhynchocephalia eg. *Sphenodon*, Order Squamata- Suborder Lacertilia eg. *Chamaeleon*, *Draco*, *Hemidactylus*, Suborder Ophidia eg. *Naja naja*, *Vipera*, *Bungarus*, *Enhydrina*, *Ptyas*, *Lycodon*, *Tropidonotus*, *Dryophis*, *Typhlops* and *Eryx johni*, Suborder Crocodilia eg. *Crocodylus*, *Alligator*; Subclass Synapsida eg *Cynognathus*. General topic: Identification of poisonous and nonpoisonous snakes.

### Module V

5 hrs

Class Aves- general characters (self study). Classification- Subclass Archeornithes eg *Archeopteryx*; Subclass Neornithes- Super order Paleognathae eg. *Sruthio* and *Emu* Super order Neognathae eg. Pigeon (External features, Feathers). General topic: Migration in birds. Flightless birds, Flight adaptations in birds.

### Module VI

19 hrs

Class Mammalia – Detailed study: Anatomy of *Homo sapiens*. General characters and classification of Class Mammalia - Subclass Prototheria eg. *Tachyglossus*; Subclass Metatheria eg. *Macropus*; Subclass Eutheria - Order Insectivora eg. *Paraechinus*, Order Dermoptera eg. *Galeopithecus*, Order Chiroptera eg. *Pteropus*, Order Primates eg. *Loris*, Orangutan, Order Carnivora eg. *Panthera leo*, Order Cetacea eg. *Delphinus*, Order Perissodactyla eg. *Equus*, Order Artiodactyla eg. *Camelus*, [*Hippopotamus*], Order Proboscidea eg. *Elephas*. Order Sirenia eg. *Dugong*, Order Hyracoidea eg. *Procavia*, Order Rodentia eg. *Rattus*, Order Lagomorpha eg. *Oryctolagus*, Order Edentata eg. *Dasypus novemcinctus* (Armadillo), Order Pholidota eg. *Manis*, Order Tubilidentata eg. *Orycteropus*. General topic: Dentition in mammals, Egg laying mammals, Aquatic adaptations in mammals.

### Module VII

5 Hrs

Comparative account of Brain, Heart and Arterial system of Vertebrates.

### References

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## **First Degree Programme under CBCSS**

### **Semester III**

### **Zoology Core Course III**

### **Methodology and Perspectives of Zoology**

### **Course code – ZO1341**

**No. of Credits – 3**

**Total hours 54**

#### **Aim of the course**

To introduce the methodology and perspectives of Science in general so as to enable the students to systematically pursue Zoology in relation to other disciplines that come under the rubric of science.

#### **Objectives of the course**

- To learn the fundamental characteristics of science as a human enterprise
- To understand how science works
- To study to apply scientific methods independently

#### **Module– I:**

**10 Hrs**

#### **Introduction to Science:**

Science- Definition, Major branches (Physical, Life and Earth science) Fields of science in biology, Scientific Methods (observation, prediction, experiment, hypothesis, Consistency, theory) Scientific theory, Scientific Law, Scientific Revolution, Scientific naming, Scientific temper, Empiricism, Hypothetico deductive and inductive models, Simulation and virtual testing, Evidences and Proofs Impact of science in human life - Positive and negative aspects. Types of knowledge: Practical, Theoretical and Scientific knowledge, Information.

#### **Module – II:**

**10 Hrs**

#### **Experimentation in science:**

Design of experiments-observation, data collection, nature and types of data (typical examples), treatment of data, data interpretation, significance of statistical tools in data interpretation. Experimentation: Selection of controls, Observational requirements, Instrumental requirements. Types of experiments: Experiment to test a hypothesis, to measure a variable or to gather data by preliminary and explorative experiments.

**Observations:** Direct and indirect observations, Controlled and uncontrolled observations, Human and machine observations.

**Sampling methods:** Qualitative sample, Quantitative sample, Random sample, Non random samples. Ethics in science: (brief account only), publications and patents, Plagiarism

#### **Module III**

**14 Hrs**

#### **Data collection and presentation:**

**Introduction to Biostatistics:** Variable and attribute; Population vs.sample; Census vs.sample survey; Arrangement of data; Frequency distribution.

**Graphical presentation of data:** Line diagram; Bar diagram; Pie chart; Histogram.

**Measures of central tendency:** Arithmetic mean; Mode; Median.

**Measures of dispersion:** Variance; Standard deviation; Standard error of mean; Standard score. Testing of hypothesis and goodness of fit: Null hypothesis, Level of significance, Probability, Normal distribution, Error of inference, Student's t-test, **Paired t-test**, **Fisher's t-test**, Chi-square test.

**Module – IV:** Methods in Biological Science and Solutions: **12 Hrs**

Microscopes: Principle, Types of microscopes- Dissection microscope, Light microscope, dark field microscope, Fluorescent microscope, Phase contrast microscope, Electron microscope (SEM, TEM, STEM).

Microtome (Different Types), Embedding, sectioning and staining techniques of light and EM. Preservation of biological specimens: Taxidermy, Fossils, Dead animals. Photometry: Colorimetry and Spectrophotometry, Principle, Working and uses. Autoradiography: Principle, mechanism, and significance Centrifugation: Principle, types of centrifuges and their applications Chromatography: Principle, uses : Adsorption chromatography, Partition chromatography, Ion exchange chromatography, Molecular sieving. Types of solutions, Representation of concentrations: Molarity, Normality, Percentage and ppm. Acids and bases: Buffers and pH, Measurement of pH. Preparation and applications of buffers in biological studies.

**Module V:** **8 Hrs**

**Nature and scope of Zoology:**

Branches of Zoology, Opportunities as Zoologist, Institutes of Zoological and Scientific importance in India- Location, major achievements and present activities (academic and scientific) [Zoological Survey of India, Central Marine Fisheries Research Institute, Central Institute of Fisheries Technology, Rajiv Gandhi Centre for Biotechnology, National Institute for Interdisciplinary Science & Technology, Bioinformatics Centre and Library, Indian Institute of Science, Jawaharlal Nehru Centre for Advanced Scientific Research, Stem Cell Institute, Institute of Genomics and Integrative Biology, National Institute of Immunology, Centre for Cellular & Molecular Biology, Centre for DNA Fingerprinting and Diagnostics, Central Drug Research Institute].

### References

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## **First Degree Programme under CBCSS**

### **Semester IV**

### **Zoology Core course IV**

### **Cell Biology**

### **Course code – ZO1441**

**No. of credits – 3**

**Total hours 54**

#### **Aim of the course**

To educate the student on the fundamental structure, biochemistry and function of the cell.

#### **Objectives of the course**

- To study the ultra-structure of prokaryotic and eukaryotic cells

#### **Module I**

**38 hrs**

History, development and scope of cell biology, discovery of cells; cell theory and its modern version (self study).

Cell and its components: Basic types of cells- prokaryotic and eukaryotic, nature and comparison (self study)

Ultra structural organization and functions: Plasma membrane- ultra structure- fluid mosaic model, functions of plasma membrane, trans-membrane transport. Cell communication- cell signaling and signal transduction, basic elements involved.

Mitochondria- structure, functions, mention oxidative phosphorylation and electro transport chain.

Endoplasmic reticulum - morphology, types, functions and formation.

Golgi bodies - morphology, types, functions (role in secretion) and formation.

Lysosomes- morphology, mention major groups of enzymes, classification, polymorphism and functions.

Microbodies - morphology, major enzymes, peroxisomes and glyoxisomes functions.

Ribosomes - different types, subunits, functions.

Proteosomes - structure, ubiquitin - tagged protein degradation.

Centrioles and basal bodies- structure and functions.

Cytoskeleton- microtubules, microfilaments and intermediate filaments- examples and functions.

Interphase nucleus - gross structure and functions; nuclear envelope- pores and pore complexes; nuclear lamina, formation of NE; nucleoplasm- nature and importance.



Nucleolus - structure, nucleolar cycle, nucleolar organizer and functions.

Chromatin - euchromatin and heterochromatin, nucleosomes, unit fibre, solenoid fibre, and higher order of organization, condensation and coiling.

Chromosome - structure of a typical metaphase chromosome; giant chromosomes- polytene chromosomes, lamp brush chromosomes; endomitosis.

## **Module II**

**8 hrs**

Cell Division: cell cycle- G<sub>1</sub>, S, G<sub>2</sub>, and M phases (mention G<sub>0</sub>, and D<sub>0</sub> stages and their significances); amitosis (brief account only). Mitosis (self study). Meiosis: description of all stages, synaptonemal complex, significance

## **Module III**

**2 hrs**

Biology of cancer: characteristics of cancer cells, dedifferentiation of cancer cells, theories of cancer, carcinogenesis, oncogenes and tumor suppressor genes

## **Module IV 2hrs**

Aging: cellular and other changes, apoptosis, causes of aging, mention free radicals and superoxide dismutase (SOD).

# **First Degree Programme under CBCSS**

## **Zoology Core Course V**

### **Practical - I**

#### **Practical I - Methodology and Perspectives of Zoology, Animal Diversity I and II**

**Course Code – ZO1441**

**No. of credits – 4**

### **Aim of the course**

To provide a hands on training experience in anatomy through simple dissection and mountings

### **Objectives of the course**

- To familiarize students with conventional organ system in common, easily available animals.
- To emphasize the adage that 'seeing is believing' typical examples and economically important specimen (preserved) to be studied.

### **Methodology and Perspectives of Zoology**

1. Preparation of Normal, Molar And Molal solutions
2. Preparation of Buffers (Acidic, Neutral And Alkaline Buffers)

### **Study of the following instruments**

1. Compound microscope
2. Centrifuge
3. Colorimeter
4. Microtome
5. pH Meter

## Animal Diversity I

### Minor Practicals - any four.

1. Nereis – parapodium
2. Earthworm – body setae
3. Cockroach – salivary apparatus in situ
4. Cockroach – mouth parts
5. Honey bee – mouth parts / mosquito - mouth parts
6. Prawn – appendages

### Major Practical – (Any Two)

1. Earthworm – nervous system
2. Cockroach – nervous system
3. Prawn – nervous system

### Taxonomy

Identification, Classification up to class and brief note of the following specimens.

1. Protista – *Actinophrys*, *Noctiluca*, *Pramecium*, *Opalina* – any 2
2. Phylum Porifera – *Euplectella*, *Spongilla*- any 1
3. Phylum Cnidaria – *Hydra*, *Obelia*, *Physalia*, *Aurelia*, Sea anemone, *Madrepora* – any 3
4. Phylum Nematoda – *Ascaris* male and female (entire)
5. Phylum Platyhelminthes – *Bipalium*, *Fasciola*, *Teania solium* – any 1
6. Phylum Annelida – Earthworm, *Nereis*, Leech, *Aphrodite*, *Arenicola* – any 1
7. Phylum Onychophora – *Peripatus*
8. Phylum Arthropoda – Cockroach, *Limulus*, *Eupagurus*, *Sacculina*, Honey bee, *Lepisma*, Scorpion – any 3
9. Phylum Mollusca – Chiton, *Pila*, *Xancus*, *Dentalium*, *Perna*, *Mytilus*, *Teredo*, *Sepia*, *Octopus*. – any 2
10. Phylum Echinodermata – Starfish, Brittle star, Sea urchin, Sea cucumber, Sea lily – any 2

## Animal Diversity II

### Minor practical

Fishes - placoid scales of *Scoliodon* and cycloid and ctenoid scales of *Anabas*

2. Fish - Brain [Demonstration only]

### Major practical

1. Fish – Viscera [Demonstration Only] Flag label the parts and write notes.
2. Fish – Alimentary canal [Demonstration Only] Flag label the parts and write notes.

### Osteology

Human limb bones, girdles, typical vertebra, atlas, axis, thoracic and lumbar vertebrae and lower jaw. Turtle - carapace and plastron.

### Taxonomy

Identification, classification up to order and brief note of the following specimens.

1. Prochordates –*Amphioxus (entire)*
2. Pisces - 2 cartilaginous fishes, 2 fishes with accessory respiratory organs, 2 edible fishes, 2 culture fishes and 2 Cat fishes.
3. Amphibia - any 3 (representing the three orders).
4. Reptilia - 2 poisonous and 2 non -poisonous snakes, *Draco, Chamaelon*
5. Aves - Different feathers, Pigeon.
6. Mammals - Bat

### **Compulsory assignment for practical**

Animal Diversity I (5% of practical CE)

Students shall take photographs of one invertebrate, identify, collect sufficient data regarding the animal and submit a detailed printed report including taxonomy for evaluation.

Animal Diversity II (5% of practical CE)

Students shall take photographs of one vertebrate, identify, collect sufficient data regarding the animal and submit a detailed printed report including taxonomy for evaluation.

## **First Degree Programme under CBCSS**

### **Semester V**

#### **Zoology Core Course VI**

#### **Genetics and Biotechnology**

**Course Code – ZO1541**

**No. of credits – 4**

**Total hours 72**

### **Aim of the course**

To educate the students on the underlying genetic mechanism operating in man and state of the art bio-techniques

### **Objectives of the course**

- To learn the mechanism of crossing over and inheritance patterns in man.
- To understand the principles and techniques involved in DNA technology and get an overview of modern techniques like PCR, Hybridoma technology, gene therapy and human cloning

**Genetics**

**37 hrs**

### **Module 1**

**[8 hrs]**

Introduction, Mendel and his experiments, Correlation between Mendel's theory and chromosome behaviour (self study); genetic terminology-gene, allele, genotype, phenotype, genome; wild type and mutant type, test cross, back cross and reciprocal cross.

Interaction of genes: Allelic, incomplete dominance, lethal and co-dominance, non-allelic, complementary gene action (self study); Co-epistasis (comp pattern in fowl), dominant (feather coat) and recessive (coat colour), polygenic action (skin colour), pleiotropism (one example). Multiple alleles- ABO Blood group system, Rh group and its inheritance.

**Module II** **8 hrs**

Linkage and crossing over: Linked genes, linkage groups, chromosome, theory of linkage, theory of chromosomal crossing over, factors affecting crossing over and its significance. Chromosome mapping (brief account only).

Sex Linkage: Characteristics of sex linked inheritance, sex linked inheritance of man (colour blindness and haemophilia), incompletely sex linked genes, holandric genes, sex limited genes and sex influenced genes.

**Module III** **8 hrs**

Sex Determination: Environmental factors on sex determination, mention genic balance theory, chromosomal mechanism of sex determination, (XX-XY, XX-XO, ZZ-ZW), sex determination in man, role of Y chromosome, Barr bodies, dosage compensation and Lyon hypothesis. Chromosome mosaicism. Mention inter sex, gynandromorph and hermaphrodite.

**Module IV** **6 hrs**

Mutation: Types of mutations - somatic, germinal, spontaneous, induced, autosomal and allosomal, euploidy and aneuploidy. Chromosomal mutation, Gene mutation, molecular basis of mutation, Factors causing mutation.

**Module V** **3 hrs**

Cytoplasmic inheritance: Mitochondrial DNA, kappa particles in paramecium, maternal effects in Drosophila.

**Module VI** **4 hrs**

Human Genetics: Karyotyping, normal chromosome complement, pedigree analysis, chromosomal anomalies in man, autosomal (eg. Down syndrome, Edwards syndrome), allosomal (eg. Klinefelters syndrome, Turner's syndrome)

Biochemical genetics: Human biochemical genetics, biochemical pathway of phenyl alanine, tyrosine metabolism in normal man. Disorders-Phenylketonuria, Alkaptonuria, Tyrosinosis and Albinism.

**Biotechnology** **35 hrs****Module VII** **9 hrs**

Introduction-Scope of biotechnology, Branches of biotechnology.

Genetic engineering and recombinant DNA technology: History, Procedure of genetic engineering, (restriction endonucleases, ligases), major steps in cutting and joining of DNA, Vectors - plasmids, Cosmid, bacteriophage; probes, linkers, host cells, Method of recombinant DNA formation- transformation, transfection and non bacterial transformation.

**Module VIII** **6 hrs**

Genomic library, construction of genomic library and cDNA library, Polymerase Chain Reaction-basic steps and applications of PCR, DNA sequencing (Sanger method, Automated sequencing), patenting DNA sequences.

**Module IX** **5 hrs**

Blotting Techniques: Southern, Northern and Western blotting, DNA fingerprinting.

**Module X** **6 hrs**

Human Genome Project, hybridoma technology and monoclonal antibodies; gene transfer techniques (chemical treatment, electroporation, lipofection, microinjection, retro viral vector method, embryonic stem cell method and shot gun method); transgenic microbes, plants and animals.

**Module XI** **4 hrs**

Gene therapy: somatic gene therapy and germ line gene therapy; gene doping and its implications; DNA vaccines; Human cloning –therapeutic and reproductive cloning.

**Module XII** **5 hrs**

Practical applications of biotechnology-in medicine, agriculture, industry, pollution control, forensics and judiciary. Potential hazards of biotechnology. Bio-ethics - problems and solutions.

**References****Genetics**

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**Biotechnology**

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**First Degree Programme under CBCSS**

**Semester V**

**Zoology Core course VII**

**Immunology and Microbiology**

**Course code – ZO1544**

**No. of credits – 4**

**Total hours 72**

**Aim of the course**

To update the student on the scope and importance of clinical immunology and create an awareness about the inherent dangers of microbes

**Objectives of the course**

- To enable the student to understand the principles and mechanisms of immunology
- To learn the malfunctioning and disorders of the immune system
- To get a broad understanding of microbes and their economic importance with special reference to pathogenic forms.

**Immunology**

**37 hrs**

**Module I**

**2 hrs**

Introduction, history, development and scope.

**Module II**

**3 hrs**

Immunity: definition, classification of immunity. Innate (non-specific)– species, racial and individual IM with examples, acquired (specific)– active IM (natural and artificial) with examples, passive IM (natural and artificial) examples.

**Module III**

**6 hrs**

Immune system: organs and tissues of the immune system. Primary (central) - thymus, bone marrow, bursa of Fabricii; secondary (peripheral)- spleen, lymph nodes, MALT etc. Cells lymphocytes – T cells and B cells – formation, development and maturation; plasma cells and null cells – natural killer cells, killer cells, lymphokine - activated killer cells; phagocytes / macrophages; antigen presenting cells – macrophages, B-lymphocytes, dendrite cells, Langerhans cells; follicular dendrite cells, neutrophils, eosinophils, basophils, mast cells. Mitogens – mention only

**Module IV**

**14 hrs**

Antigens (immunogens) (Ag): definition, complete antigens, haptens, antigenic determinants or epitopes; antibodies (Immoglobulins)- definition, general structure of Ig, Ig determinants, physico-chemical properties of Ig, classes of Ig- G, M, A, D, E; mention abnormal Igs; antigen – antibody reactions- mechanism (mention zone phenomenon), precipitation reactions, agglutination reactions, complement fixation, neutralization, opsonisation (brief accounts only)

Complement system: definition, general features, major histocompatibility complex (MHC) (brief account only). Immune response- definition, types of immune responses- humoral immune response (antigen mediated immunity - AMI) and cellular immune response (cell mediated immunity - CMI)in detail.

**Module V****12 hrs**

Hyper sensitivity / allergy: definitions, classification- types I, II and III (Brief accounts only); immuno deficiency diseases (ID)- definition, primary IDs, disorders of immune mechanism (humoral, cellular and combined IDs), disorders of complements, disorders of phagocytosis, mention one example each, secondary IDs - mention example, an account of Acquired Immune Deficiency Syndrome (AIDS); Auto immunity-definition, mechanism, mention AI diseases; transplantation immunity-definition, classification of transplants, graft versus host reactions; graft rejection, mechanism of graft rejection, factors affecting graft survival; Immunisation and vaccination- definitions, vaccines; types of immunization- active immunization- killed and live attenuated vaccines, microbial extracts, vaccine conjugates, toxoids, recombinant vaccines, DNA vaccines; passive immunization- pooled normal human Igs, specific Igs (hyper antisera); combined immunization

**Microbiology****35 hrs****Module VI****14 hrs**

Introduction: history, development and scope Importance of microbes in various ways- beneficial, harmful, ecological and others.

Classification of microbes/particles: broad classification- viruses- different groups, examples; mention viroids and prions, *Mycoplasmas*, *Rickettsiae* and *Chlamydiae*; Bacteria:

1. Archaea – significance of extreme life forms(*Methanoarchaea* , extreme halophiles and thermophiles); Eubacteria (=Bacteria) Major groups of Eubacteria: Bergey's system of classification; modern methods classification of Eubacteria (outline only with familiar examples)- Nonphotosynthetic proteobacteria:- (Fermentative Rods and Vibrios) ex. *Vibrio*, *Pasteurella* (oxidative rods and cocci) eg. *Pseudomonas*, *Azotobacter*, *Rhizobium*; Chemolithotrophic bacteria:- eg. nitrifying, sulphur and iron bacteria; Firmicutes (eg. *Staphylococcus*) and Actinobacteria (Coryneform bacteria); Phototrophic bacteria (Cyanobacteria); Algae-( details not expected) Protista- different groups- examples: *Plasmodium*, *Giardia*; Fungi- Mention different groups – example *Candida*. Structure of a bacteriophage and a typical bacterium

**Module VII****9 hrs**

Applied microbiology: various fields: emphasis on environmental, agricultural, medical, biotechnological, industrial and strategic fields

**Module VIII****12 hrs**

Symbiotic microbes: microbes with other microbes, microbes with plants microbes with animals; microbe – human host interactions, normal human microbiota of various organs- mention any 3 examples, pathogenic microbes – mention any 3 examples, microbial toxins – mention any 2 examples.

Microbial diseases in man (of skin, respiratory system etc.)- viral – chicken pox, measles, cold, herpes, hepatitis, poliomyelitis; bacterial – diphtheria, pneumonia, leprosy, ornithosis; fungal – aspergillosis, candidiasis and others – malaria.

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## First Degree Programme

### Semester V

### Zoology Core Course VIII

### Physiology and Biological chemistry

### Course Code – ZO1543

**No. of credits – 4**

**Total hours 90**

#### **Aim of the course**

To improve the student's perspective of health and biology through in-depth study of human physiology

#### **Objectives of the course**

- To study the different system and the inherent disorders/ deficiencies involved therein.
- To learn the structure and functions of bio-molecules and their role in metabolism

#### **Physiology**

**60 hrs**

#### **Module I**

**6 hrs**

Nutritional Physiology: Introduction, types of nutrition, mechanical and chemical changes of food in the alimentary canal, balanced diet, nutritional disorders – PEM, vitamin deficiency,



deficiency of iron, iodine and calcium, lifestyle diseases, role of fibres, nervous and hormonal control of digestion

**Module II** **8 hrs**

Circulatory Physiology: Blood- Composition and functions of blood plasma and formed elements, blood groups, mechanism of blood clotting, intrinsic and extrinsic pathways, disorders of blood clotting, anticoagulants, heartbeat, conducting system and pace maker, pulse and blood pressure, clinical significance, control of cardiac activity, common cardio vascular diseases – arteriosclerosis, atherosclerosis, Myocardial infarction, electrocardiogram, angiogram, angioplasty. Lymph and lymphatic system (brief account)

**Module III** **8 hrs**

Respiratory Physiology: Gas exchange, respiratory pigments- structure of haemoglobin, transport of O<sub>2</sub>- Oxyhaemoglobin curve, Bohr effect, transport of CO<sub>2</sub> -carbonic acid, carbamino haemoglobin, bicarbonate and chloride shift, regulation of respiration – neural and chemical; respiratory disturbances – apnoea, dyspnoea, hypoxia, hypo and hyper capnia, asphyxia, carbon monoxide poisoning, bronchitis, asthma. Physiological effects of smoking.

**Module IV** **8 hrs**

Renal Physiology: Nephron – Structure, Urine formation, Role of hormone in urine formation and concentration, Counter-current multiplier system, Role of kidney in osmoregulation, composition of urine, abnormal constituents of urine, regulation of kidney functions, renal disorders – nephritis, haematuria, renal calculi, acidosis and alkalosis – Dialysis and kidney transplantation.

**Module V** **8 hrs**

Muscle Physiology: Brief account of types of muscles, fast and slow twitch muscles, red and white muscles. Ultra structure of striated muscle fibre, muscle proteins, simple muscle twitch, summation, tetanus, tonus, All or None law, fatigue, oxygen debt, rigor mortis. Physiological and biochemical events in muscle contraction.

**Module VI** **6 hrs**

Nerve Physiology: Neurons – structure, types of neuron (self study). Synapse and types of synapse, nerve impulse propagation, synaptic transmission. Reflex action, refractory period, neuro transmitters, electro encephalo gram. Nerve disorders – epilepsy, Alzheimer's disease, Parkinson's disease.

**Module VII** **5 hrs**

Sensory Physiology: Structure of eye and ear (self study). Physiology of vision, visual elements and pigments, photo chemistry of vision. Eye defects – myopia, hyperopia, presbyopia, astigmatism, cataract. Structure of ear and mechanism of hearing, hearing impairments – deafness, labyrinthine disease. Olfactory, gustatory and tactile sense organs

**Module VIII** **3 hrs**

Reproductive physiology: Male and female reproductive organs (self study). Reproductive Cycles(role of hormones), puberty, adolescence, pregnancy, parturition, lactation and birth control.

**Module IX 8hrs**

Endocrinology: Endocrine glands in man, hormones and disorders, feed-back mechanism, mechanism of hormonal activity.

**Biological chemistry** **30 hrs****Module X** **8 hrs**

Biomolecules in relation to animals: micromolecules, macromolecules, water, buffer systems and importance; Carbohydrates-structure, classification- monosaccharides (trioses, tetroses, pentoses, hexoses, aldoses, ketoses), disaccharides and polysaccharides (homo and hetero polysaccharides); biological functions of carbohydrates. Lipids- classification- simple lipids, (neutral fats and waxes), conjugated lipids (phospho lipids, sphingo lipids, glyco lipids, lecithins, cephalins, cerebrosides, gangliosides), derived lipids (fatty acids, steroids, prostaglandins), biological functions of lipids. Proteins - classification of proteins, amino acids- basic structure, structure of protein primary, secondary tertiary and quaternary structures, haemoglobin as atypical protein, biological functions of proteins.

**Module XI** **16 hrs**

Metabolism in animals: Carbohydrate metabolism – glycogenesis, glycogenolysis, hexose monophosphate shunt, metabolic pathway of glucose- glycolysis, Kreb's cycle, electron transport series, chemi-osmotic theory, energetic; hormonal control of carbohydrate metabolism.

Lipid metabolism – hydrolysis of lipid, beta oxidation, mention alpha and omega oxidation of fatty acids, hormonal control of lipid metabolism, hormonal control of lipid metabolism.

Protein metabolism – deamination, transamination, formation of urea, hormonal control of protein metabolism.

**Module XII** **6 hrs**

Enzymes: Chemical nature, mechanism of enzyme action, factors affecting enzyme activity, kinetics of enzyme action, Michaelis – Menten equation, iso enzymes, co-enzyme, co-factors, enzyme activation and inhibition.

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## **First Degree Programme under CBCSS**

### **Semester VI**

#### **Zoology Foundation course II**

#### **General Informatics, Bioinformatics and Molecular Biology**

#### **Course code – ZO1221**

**No. of Credits - 3**

**Total hours 90**

#### **Aim of the course**

To expand basic informatics skill and attitudes relevant to the emerging society and also to equip the student to effectively utilize the digital knowledge resources for the study of Zoology

#### **Objectives of the course**

- To review the basic concepts and functional knowledge in the field of informatics
- To create awareness about nature of the emerging digital knowledge society
- To create awareness about social issues and concerns in the use of digital technology
- To learn the nature, application and scope of Bioinformatics

#### **General Informatics**

**34 hrs**

#### **Module I**

**4 hrs**

Overview of Information Technology: features of the modern Personal Computer and Peripherals, computer networks and internet, Introduction to Operating System- DOS/ Windows, Linux. Purchase of technology, license, guarantee, warranty.

**Module II** **12 hrs**

Knowledge skills for Higher Education : data information and knowledge, knowledge management – Internet as a knowledge repository, academic search techniques, creating your cyber presence, open access initiatives, open access publishing models. basic concepts of IPR, copyrights and patents, plagiarism, introduction to use of IT in teaching and learning, case study of educational softwares. Academic services – INFLIBNET, NICNET, BRNET

**Module III** **10 hrs**

Social Informatics : IT and society – Issues and Concerns – digital divide, IT and development, new opportunities and new threats, cyber ethics, cyber crime, security, privacy issues, cyber addictions, information overload; health issues – guide lines for proper usage of computers, internet and mobile phones. Localization issues – IT and regional languages – IT for the disabled, the free software debate.

**Module IV** **8 hrs**

IT @ Service of society: e-governance application and state level, overview of IT application in medicine, healthcare, business, commerce, industry, defense, law, crime detection, publishing, communication, resource management, weather forecasting, education, film and media, futuristic IT – artificial Intelligence, virtual Reality

**Bioinformatics** **16 hrs****Module V** **8 hrs**

Definition, Nature & Scope of Bioinformatics - Contrast between Bioinformatics and Computational Biology; Key Bio-sequences in Molecular Biology - DNA, RNA and Aminoacid sequences -Popular Databases in Bioinformatics - NCBI, DDJB, PDB, OMIM; BLAST & FASTA sequence file formats, Approach of Comparative Biology based on sequence comparison - The basic idea of sequence comparison (algorithms not required) - idea of scoring matrices

**Module VI** **8 hrs**

The Blast search engine - important features - Idea of Multiple sequence alignment – Proteomics: Basic ideas of Protein Structure prediction- Concept of Homology Modeling- Idea of Molecular Phylogenetics - advantages and computational procedure (only description of use of a package such as Phylip)- Basic concepts of computer Aided Drug Discovery- General description of drug discovery pipeline- concept of Personalized medicine; Bioinformatics tools: (i)Molecular Visualization Software - Rasmol (Basic features only) - (ii) ORF finding (iii) gene finding, (iii) BLAST (iv) Hydrophobicity Prediction (v) Single Nucleotide Polymorphism (SNP) prediction using GENSNIIP

**Molecular Biology** **40 hrs****Module VI** **16 hrs**

Introduction: history, development and scope. Nature of genetic material: search for the genetic material, Griffith's experiment, transformation, contributions of Avery, MacLeod and McCarty, Conrat & Stern's experiment with TMV, Hershey & Chase's experiment, transduction. Composition and structure of nucleic acids - Watson - Crick model of DNA, clover leaf model of tRNA, different types of DNA and RNA; DNA replication in prokaryotes and eukaryotes - Semi-conservative method, Messelson & Stahl experiment, replication machinery and mechanism; modification and repair of DNA.

**Module VII****15 hrs**

Gene Expression: contributions of Garrod, one gene – one enzyme hypothesis, one gene one polypeptide hypothesis, central dogma of Molecular Biology, central dogma reverse, colinearity of genes and gene products. Genetic code - deciphering / cracking the GC, characteristics of GC, codon assignment and wobble hypothesis. Mention contributions of Nirenberg and his associates, Khorana and his associates. Transcription of RNAs - RNA polymerases, transcription factors, mechanism of transcription, post-transcriptional modifications of mRNA, rRNA and tRNA, reverse transcription, translation –machinery and mechanism; post translational modification of proteins; role of chaperones in protein normal folding and protection

**Module VIII****5 hrs**

Gene regulation: in prokaryotes (inducible and repressive systems); operon concept – Lac operon and Trp operon

**Module IX****4 hrs**

Bacterial Recombination: transformation, conjugation and transduction (general and specialized transduction)

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## First Degree Programme

### Zoology Core course VIII

#### Practical II - Cell Biology, Molecular Biology, Genetics,

#### Biotechnology, Immunology and Microbiology

#### Course Code – ZO1641

**No. of credits – 4**

#### Aim of the course

To expertise the student to carry out routine hematological and microbiological techniques

#### Objectives of the course

- 1) To prepare and observe chromosomal arrangements during cell division
- 2) To study chromosomal aberrations in man
- 3) To gain of broad knowledge of conventional biotechnological procedures
- 4) To perform routine blood analysis.

**Cell Biology and Molecular Biology[ Any six]**

1. Staining of prokaryotic cells: (a) *Lactobacillus* from curd (b) Nitrogen fixing bacteria (*Rhizobium*) from root nodules of legumes
2. Staining of eukaryotic cells: buccal epithelial cells (observe Barr body)
3. Study of cell organelles
4. Mitosis: stages in onion (*Allium cepa*) root meristem (squash preparation)
5. Calculation of mitotic index and metaphase index in root meristem of *Allium cepa*
6. Meiosis: stages in testis of grass hopper (demonstration only)
7. Giant chromosomes in Diptera: (*Drosophila Chironomus* larvae) salivary gland cells (demonstration only)

**Genetics[Any five]**

1. Study of monohybrid cross using coloured beads.
2. Study of normal chromosome complement and karyotype of man.
3. Study of genetic syndromes and abnormal karyotypes of man (Klinefelter's syndrome, Turner's syndrome, Down syndrome and Edward syndrome).
4. Study of Barr body and its significance (in stained buccal epithelial cells).
5. Construction of Pedigree chart.
6. Study of phenotypic characters of male and female *Drosophila*.

**Biotechnology[ Any two]**

1. Estimation of DNA by diphenylamine method.
2. Polymerase Chain Reaction
3. Southern blotting and Northern blotting
4. Gene cloning (Demonstration in the Department / Visit to research institute / CD display)

**Immunology[Any two] and Microbiology[Two]**

1. Collection of blood, and study of the effect of anticoagulant.
2. Total and differential count of blood cells.
3. ABO and Rh systems of blood grouping.
4. Microscopic observation and study of stained preparations of any two microbes

**First Degree Programme****Semester VI****Zoology Core Course X****Developmental Biology and Experimental Embryology****Course code – ZO1642****No. of credits – 4****Total hours 72****Aim of the course**

To familiarize the student with the principle of developmental biology and provide him a bird's eye view of sophisticated embryological techniques

**Objectives of the course**

- To study the various stages involved in the developing embryo
- To study the initial developmental procedures involved in *Amphioxus*, Frog and chick
- To procure information on state-of-the-art experimental procedures in embryology.

**Developmental biology** **57 hrs**

**Module I** **4 hrs**

Introduction, historical perspective (brief account), theories- Preformation, Epigenesis, Recapitulation and Germplasm. Subdivisions of Developmental biology.

Spermatogenesis and oogenesis, structure of Graafian follicle, typical egg and sperm. Polarity of egg, egg envelopes; classification of eggs based on different criteria.

**Module II** **8 hrs**

Fertilization: Agglutination, sperm penetration, activation of egg, amphimixis; physiological and biochemical changes during and after fertilization. Parthenogenesis- introduction, natural and artificial parthenogenesis, arrhenotoky and thelytoky, obligatory and facultative, significance of parthenogenesis.

**Module III** **9 hrs**

Cleavage: types of cleavage - holoblastic and meroblastic; patterns of cleavage – radial, bilateral, spiral, rotational; cell lineage in Planocera (brief account only). Morula formation in microlecithal, mesolecithal, macrolecithal eggs; blastulation - introduction, different types of blastula – stereo blastula, coeloblastula, discoblastula, periblastula, blastocyst. Presumptive organ forming areas and fate maps, eg. amphioxus, frog, construction of fate maps.

**Module IV** **3 hrs**

Gastrulation: introduction, brief account of morphogenetic movements – epiboly and emboly (invagination, involution, infiltration, ingression, delamination, convergence, divergence) concept of germ layers, derivatives of germ layers.

**Module V** **5 hrs**

Cell differentiation : totipotency, pluripotency and unipotency of embryonic cells. Determination and differentiation in embryonic development. Gene action, drosophila as a model organism (brief account only), Homeotic genes and Hox genes.

**Module VI** **25 hrs**

Development: Amphioxus - cleavage, blastulation, gastrulation, neurogenesis, notogenesis, mesoderm and coelom formation. Frog -cleavage, blastulation, gastrulation, organogeny – development of brain, eye, heart; metamorphosis - ecological, morphological and physiological changes and hormonal control. Chick - cleavage, blastulation, gastrulation, study of 24 hrs chick embryo; development of extra- embryonic membranes in chick. Man - implantation, pregnancy, parturition. Placentation in mammals – different types of placenta, functions.

**Module VII** **3 hrs**

Teratology: definition, causes, infections, drugs and chemicals, metabolic imbalance, ionizing radiation, malnutrition, autoimmunization.



**Experimental embryology****Module VIII****15 hrs**

Spemann's constriction experiments, organizers and embryonic induction, transplantation experiments involving optic cup, nuclear transplantation experiments in amphibians. In vitro fertilization and embryo transfer experiments in farm animals, In vitro fertilization and embryo transfer experiments in man and test tube babies; cloning experiments in animals mammals; prenatal diagnosis and sex determination methods – amniocentesis chorionic villus sampling, ultra sound scanning. Embryonic and adult stem cell research and stem cell therapy.

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- Werner. A. Muller. (2008). Developmental Biology. Springer.
- Wolpert, L. (1998). Principles of Development. Oxford University Press, N. Y.

**First Degree Programme****Semester VI****Zoology Core Course XI****Ecology, Ethology, Evolution and Zoogeography****Course Code – ZO1643****No. of credits – 3****Total hours 72****Aim of the course**

To enhance the student's concept of nature and her resources and appreciating the process and product of organic evolution

**Objectives of the course**

- To learn the principles, applications and management of environmental science.

- To study the inherent morphological and physiological bases of behavioural pattern exhibited by vertebrates.
- To get an exhaustive knowledge of organic evolution with special reference to man.

**Ecology** **24 hrs**

**Module I**

Components of ecosystem: Environmental factors - abiotic factors, light, temperature, soil, water, air; biotic factors- autotrophs, phagotrophs and saprotrophs; ecosystem interaction and inter-relationship between biotic and abiotic factors.

**Module II** **5 hrs**

Biogeochemical cycles: Basic types of biogeochemical cycles - gaseous cycle-carbon and nitrogen cycles, mention sedimentary cycles (P and S), recycling pathways and recycle index. Limiting Factors- basic concepts- Leibig's law of minimum, Shelford's law of tolerance, combined concept of limiting factors, Light and temperature as limiting factors.

**Module III** **5 hrs**

Habitat Ecology: Biosphere classification- lithosphere, hydrosphere and atmosphere - physical features, fauna and their adaptations of aquatic, terrestrial and marine habitats (self study) Population ecology: Properties of population- density, natality, mortality, age distribution, biotic potential, environmental resistance and carrying capacity, population growth forms, J and S shaped curves, emigration, immigration and migration, population fluctuation. Community ecology: Definition and characters, species diversity; stratification; dominance; ecotone and edge effect; ecological indicators; community periodicity, succession (self study)

**Module IV** **5 hrs**

Anthropogenic impact on ecosystem: Ionizing radiation and radioisotopes, ionizing radiation and human health, radiation accidents and other exposures, disposal of radioactive wastes, pesticides like DDT, endosulphan, furadan, insect repellants, e-wastes. Monitoring of pollutants – physical, chemical and biological.

**Module V**

Wild life conservation and management: Significance, causes of extinction, concepts of threatened species, red data book, IUCN, WWF, CITES, Green Environment and Green peace; protected areas, biosphere reserves, national parks and sanctuaries in India, forests in India, desertification, deforestation, carbon trading; importance of mangroves in coastal ecosystems- conservation and management (self study)

**Module VI** **9 hrs**

Environmental biotechnology: Biotechnological methods of pollution detection, bioremediation, biotechnology and biodegradation, genetically engineered microbes in bio-treatment of waste, eco-friendly bioproducts for environmental health, bio-piracy, bio-pesticides and bio-fertilizers, organic farming and its merits. Green chemistry – designing a Green synthesis, basic principles of Green chemistry.

**Ethology** **12 hrs**

**Module VII** **12 hrs**

History and scope of ethology: Motivation- models of motivation (Lorenz's psychohydraulic model and Deutsch's model); learning- types of learning (imprinting, habituation, conditioned

reflex, unconditioned reflex, latent learning); neural mechanisms in behaviour role of hypothalamus and other brain centers, hormones and behavior; sociobiology- social groups – merits and demerits, properties of organized societies, social groups in mammals, social stress. Pheromones and chemical communications, human pheromones.

**Evolution** **26 hrs**

**Module VIII** **4 Hrs**

Theories of organic evolution: Lamarck's theory, its criticism (Weisman's germplasm theory) Darwin's theory of natural selection (mention the contributions of Wallace). Mutation theory (self study)

**Module IX** **4 hrs**

Geological timescale, fossils, fossilization, paleontological evidences of evolution, fossil dating and significance of fossils.

**Module X** **12 hrs**

Modern concept of organic evolution: (Neo Darwinism) - genetic basis of evolution- gene pool, gene frequency, mutation, role of mutation in evolution, neutral mutation (Kimura), genetic drift, genetic equilibrium; factors affecting genetic equilibrium and Hardy –Weinberg law. Natural selection: types of selection (brief account of the observation in *Biston betularia*), isolation and isolating mechanisms; speciation- sympatric speciation and allopatric speciation. Hybridization- adaptive radiation with special reference to Darwin's finches.

**Module XI** **6 hrs**

Evolution of man: Organic and cultural, examples of trends in human evolution, fossil men brief accounts of Parapithecus, Propliopithecus, Dryopithecus, Ramapithecus, Australopithecus, Neanderthal, Cromagnon and Modern man.

**Zoogeography** **10 hrs**

**Module XII** **4 hrs**

Animal Distribution: Geographic distribution of animals-cosmopolitan distribution, discontinuous distribution, bipolar distribution and isolated distribution, factors affecting animal distribution, barriers to animal distribution- physical and biological barriers.

**Module XIII** **6 hrs**

Zoogeographical Realms: (brief account of each realm mention the areas included, physical features and fauna) Palaeartic region, Australian region, Ethiopian region, Nearctic region, Oriental region and Neotropical region. Biogeographical classification of India- Western Ghats, Eastern Ghats and Himalayas. Insular Fauna: Brief account of oceanic islands and continental islands (with one example each)

## References

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### **First Degree Programme**

#### **Zoology Core Course XII**

#### **Practical III - Physiology and Biological Chemistry and Bioinformatics.**

#### **Course Code - ZO1644**

**No. of credits – 3**

#### **Aim of the course**

To demonstrate basic principles in physiology

#### **Objectives of the course**

- To learn clinical procedures for blood & urine analysis
- To make the student skillful in simple biochemical laboratory procedures.

#### **Physiology and Biological Chemistry Practicals: [Compulsory]**

1. Kymograph apparatus and explanation of simple muscle twitch.[Demonstration]
2. Measurement of oxygen consumption of cockroach using Fen's respirometer.[Experiment set up]
3. Study of tonicity of blood cells
4. Paper chromatographic separation of amino acids
5. Estimation of haemoglobin of blood using Haemoglobinometer.
6. Effect of temperature / pH on salivary amylase activity
7. Qualitative tests of sugars.
8. Qualitative tests of proteins.
9. Detection of abnormal constituents (glucose and albumin) in urine[two test each].
10. Detection of excretory products – ammonia (Nessler's test), urea (Ammonia generation/ Biuret test) and uric acid (Phosphotungstic acid test)
11. Preparation of blood smear and study of blood cells of man.
- 12-14 [ Any one]
12. Isolation of casein from milk.
13. Estimation of protein by Lowry's method
14. Digestion of starch and separation of maltose by dialysis.

#### **Bioinformatics:**

1. Finding statistical significance of a given data using t test
2. Graphical representation of data (Histograms, frequency polygon, Pie diagram)
3. Calculation of Mean, median, mode and standard deviation of given data.

## First Degree Programme

### Zoology Core Course XIII

#### Practical IV - Developmental Biology, Ecology, Ethology, Evolution and Zoogeography

Course Code – ZO1645

**No. of credits - 3**

#### **Developmental Biology and Experimental Embryology**

1. Study of different types of eggs-Amphioxus, frog, chick, man- based on models/charts [Any three].
2. Study of blastula- Amphioxus, frog- slide / model [Any one]
3. Study of gastrula – Amphioxus/frog-yolk plug stage - slide / model.[Any one]
4. Mounting, sketch and label of 24hrs/48hrs chick blastoderm.[Any one]
5. Study of placenta(model/ specimen) – any two types.
6. Sperm motility in a fish /zebra fish
7. Embryonic development of the egg of zebra fish (demonstration only)

#### **Ecology**

1. Estimation of dissolved oxygen
2. Estimation of CO<sub>2</sub>
3. Primary productivity using dark and light bottle
4. Turbidity using Secchi disc
5. Estimation of hardness of three different water samples.
6. Extraction of soil organisms- Berlese funnel, Baerman's funnel[Any one]
7. Construction of food web
8. Study of ecological adaptations – any three
9. Study of marine plankton – any three
10. Measurement of pH of different water samples using pH meter, pH paper and indicator solution.

#### **Ethology**

11. Alarm pheromones in ants.

#### **Evolution**

12. Photo of Darwin and Lamark - Identify the scientist and mention the contribution .

#### **Zoogeography**

13. Study different zoogeographical realms with fauna.

**First Degree Programme****Semester V****Zoology Open Course I****Public Health and Hygiene****Course Code – ZO1551.1****No. of credits – 2****Total hours 54****Aim of the course**

To make the student aware of the essentials of public health and sanitation thereby warding off diseases and uplifting the living standards of the community

**Objectives of the course**

- To learn the principles of nutrition and dietetics
- To understand the ill effects of modern lifestyle
- To study the advantages of being hygienic

**Module I****6 hrs**

Introduction: Scope and importance of the study; balanced diet, diet control for diabetics, cholesterol etc., concept of energy, calories, daily food intake as per occupation, pregnancy and lactation. Dietary requirements of infants, pre-school, children, school children, adults and geriatric care. Malnutrition and over nutrition – obesity and weight control; defects of modern food habits – fast food, soft drinks, ice-creams and broiler chicken.

**Module II****4 hrs**

Adulteration of food: food hygiene – hygiene of milk, meat, fish, eggs, fruits and vegetables, common food adulterants – harmful effects and their detection, food additives, fortification of food; Food Adulteration Act and its stringent implementation

**Module III****18 hrs**

Health Hazards: Health dynamicity – definition, factors influencing health, health as a medium of socio-economic development. Diseases – Common food borne and water borne diseases (gastroenteritis, jaundice, cholera, salmonellosis, travellers' diarrhoea and *Escherichia coli* infection, typhoid) – mode of transmission, causative agents, symptoms, prevention and control. Sexually transmitted infections – AIDS, genital herpes, hepatitis B, syphilis, gonorrhoea – causative agents, symptoms, modes of transmission and prevention.

Dengue, chikunguniya, rat fever (general methods of mosquito control and the need to prevent mosquito breeding in and around our homes). Lifestyle habits – excessive usage of T.V., computer, mobile phones, two wheelers, and their impacts on health. Lack of physical exercise and its deleterious effects on the body and mind

**Module IV****6 hrs**

Health Education: Definition, objectives, principles and methods of health education, illeffects of smoking, alcoholism and drug abuse (emphasis should be given to pan masala, amphetamines, hashish, opium, brown sugar, pethedine). Population control and family welfare, use of contraceptives. Blood donation – basics of ABO, blood grouping including Rh factor. Genetic incompatibility and consanguineous marriages.

**Module V****12 hrs**

Mental Health: Definition by WHO and necessity of mental well being, major depressive disorders, substance abuse, schizophrenia, obsessive compulsive disorders, domestic violence, causes for lost years of healthy life, strategies for prevention and possible interventions, childhood mental disorders and illnesses, gulf widow syndrome, stress reduction and management (importance of yoga)

**Module VI****8 hrs**

Hygiene: Definition, personal hygiene- body odour, oral hygiene, grooming, feminine hygiene, sleep hygiene, hand washing, toiletry. Social hygiene – clean living movements, occupational hygiene, food and cooking hygiene, medical hygiene, excessive hygiene.

**References**

- Jatin V. Modi and Renjith S. Chawan. Essentials of Public Health and Sanitation - Part I- IV
- Murray, C. J. L. and A.D. Lopez. (1996). The Global Burden Of Disease. World Health Organization.
- Park, J.E. and Park, K. Textbook of Community Health for Nurses.
- Swaminathan S. Principles of Nutrition and Dietetics.

**First Degree Programme****Semester V****Zoology Open Course I****Human Health and Sex Education****Course Code – ZO1551.2****No. of credits – 2****Total hours 54****Aim of the course**

To redress problem associated with health and sex thereby promoting fitness and well being.

**Objectives of the course**

- To make the student understand the importance of good health.
- To educate the student on clean sexual habits thereby warding off sexually transmitted diseases.

**Module I****14 hrs**

Introduction to health, health as a state of wellbeing, health awareness, Immunity immunization and vaccination, factors affecting health- food, balanced diet, food supplements, pathogens, pollution, sleep, exercise and stress. Physical health, reproductive health, adolescence, senescence. Mental health- mental illness and disabilities, symptoms and prevention of mental illness; alcoholism, tobacco addiction, de-addiction, lifestyle diseases. Community health- health centres, role of health centres. Spiritual health, yoga and meditation.

**Module II****8 hrs**

Human reproductive system: Male reproductive system- structural details of testis and accessory structures, functions of testis, semen, hormonal control. Female reproductive system- structure of ovary, accessory structures, puberty, reproductive cycles and hormonal control, menstrual cycle, gestation period, hysterectomy, menopause.



**Module III** **7 hrs**

Events of human reproduction: Gametogenesis- spermatogenesis and oogenesis, ovulation, fertilization, embryonic development, parturition

**Module IV** **12 hrs**

Human intervention in reproduction: Contraception and birth control-barrier method, hormonal methods, natural methods, sterilization, termination of pregnancy. Infertility-male and female infertility, causes and treatment for infertility. Assisted Reproductive Techniques- IVF, GIFT, ZIFT, Donor Insemination (DI). Artificial Insemination by Donor (AID), Artificial Insemination by Husband or partner (AIH). Surrogacy, SUZI (sub-zonal insemination), MIST (micro insemination sperm transfer)

**Module V** **6 hrs**

Sexually transmitted diseases: Syphilis, genital warts, chlamydia, chancroid, trichomoniasis, gonorrhoea, genital herpes, AIDS

**Module VI** **7 hrs**

Sex education: Adolescent sexual activity, teenage pregnancy, sexual harassment, sexual awareness and policies (legal aspects), lesbian and gay sex, bisexual, transgender youth, adolescent stress management

**References**

- Common sexual problems and solutions by Dr. Prakash Kothari, UBS Publishers and Distributors Ltd.
- Mac E. Hadley. Endocrinology. Pearson Education, Singapore.
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- The Complete Manual of Fitness and Well-being. The Reader's Digest Association, Inc. Pleasantville, New York / Montreal.
- Guyton & Hall. Textbook of Medical Physiology.

**First Degree Programme****Semester V****Zoology Open Course I****Human diseases and their management****Course Code – ZO1551.3****No. of credits – 2****Total hours 54****Aim of the course**

To instill in the students the need to manage communicable diseases thereby creating a healthy society.

**Objectives of the course**

- To learn the various modes and agents of disease transmission
- To learn the causative factors of non communicable diseases

**Module I** **5 hrs**

Introduction- Health – WHO definition, important of individual health. Lifestyle choice for healthier life: Diet and health, exercise and health, alcohol, tobacco and drugs, sex and health, computers and health, mobile phone and health, psychological health

**Module II** **4 hrs**

Communicable diseases: Classification of communicable diseases. Defense mechanism – immunity (natural, acquired)

**Module III** **5 hrs**

Viral Infections: Brief account of virus, chickenpox, poliomyelitis, rabies, yellow fever, dengue fever, mumps, influenza, measles, encephalitis, hepatitis ,HIV infection and AIDS – causes ,symptoms, prevention and cure.

**Module IV** **5 hrs**

Bacterial Infections: Brief account of bacteria, dysentery, cholera, tuberculosis, tetanus, diphtheria, septicemia, scarlet fever, typhoid, plague; STD and leprosy – causes, symptoms, prevention and cure.

**Module V** **5 hrs**

Protozoan Infections: Brief account of protozoans - amoebiasis, leishmaniasis, trichomoniasis, malaria - causes, symptoms, prevention and cure.

**Module VI** **5 hrs**

Worm Infections: Brief account of platyhelminthes and nematods, cysticercosis, taeniasis, ascariasis, ancylostomiasis, encephalitis, enterobiasis and dracunculosis – causes, symptoms, prevention and cure.

**Module VII** **4 hrs**

Vector borne diseases: Vector – identification of vectors – dengue, filaria, kala azar, Japanese encephalitis, chikungunya- causes, symptoms, prevention and cure.

**Module VIII** **5 hrs**

Non-communicable diseases: Hereditary and congenital diseases – haemophilia, diabetes mellitus, hypertension, muscular dystrophia, some types of cancer. Immunological diseases – allergy, autoimmune diseases. Deficiency diseases – scurvy, pellagra, beriberi, xerophthalmia, rickets. Cardiovascular diseases-causes, symptoms, prevention and treatment.

**Module IX** **5 hrs**

Mental health: Meaning, definition, history, characteristics of a mentally healthy person. Types of mental illness – causes, symptoms and prevention – major mental illness (schizophrenia, paranoia), minor mental illnesses (anxiety, phobia, obsessive compulsive neuroses)

**Module X** **9 hrs**

Basic viewing techniques- endoscopy examination techniques: Blood- total count, differential count, ESR, immune function tests, blood clotting test, routine blood chemistry, blood cholesterol test, hormone tests; urine- routine urine chemistry; cell and tissue test- pap test, sputum test, biopsy, histopathology; genetic tests- amniocentesis, chorionic villi sampling; imaging techniques- X – ray, ultrasound scannig, CT scan, MRI scan, SPECT scanning, PET scanning;

**Module XI****2 hrs**

Role of yoga in management of common diseases.

**Suggested topics for assignments/ seminars**

Epidemiological study of the above diseases. Questionnaire has to be prepared . Students has to be grouped in 10. Each student will have to visit 25 houses and record the observations. The data of 10 students (250 Houses) has to be tabulated, studied and interpreted. Every year the study, if possible, has to carry out in the same houses or to the same locality. This follow up survey will be very useful

**References**

- Abraham Verghese. (1996). Introduction to Psychiatry. BI Publication Pvt. Ltd.
- Anderson, G. M. Communicable Disease Control,. Macmillan, New York.
- Bajpee. (1995). Textbook of Preventive and Social Medicine. Jaypee Brothers Medical publishers, New Delhi.
- Chauhan, S. S. Mental Hygiene – A Science of Adjustment, Allied Publishers.
- Carol.D.Tamparo. Diseases of Human body
- Deepak Kumar. (2001). Diseases and Medicines in India: A historical Overview.
- Mangal, S., K. (2004). Introduction to Abnormal Psychology. Sterling Publishers.
- Mary L M, Mark Zelman, Paul Holdway; Human Diseases – A Systematic Approach.
- Park, K. (2005). Textbook of Prevention and Social Medicine, Jebelpur, Banarids.
- Park, J., E., and Park, K. Textbook of Preventive and Social Medicine.
- Swami Styananda Saraswathi, Swami Karam: Yogic Management of Common Diseases.

**First Degree Programme****Semester VI****Zoology Open Course II****Economic Zoology - Vermiculture and Apiculture****Course Code – ZOI651.1****No. of credit – 2****Total hours 54****Aim of the course**

To promote self employment and self reliance among educated youth

**Objectives of the course**

- To learn the basic procedure and methodology of vermiculture
- To learn the scope and methodology of apiculture.

**Vermiculture****24 hrs****Module I****6 hrs**

Introduction: definition and scope of vermiculture. Nature and species of earthworms: habit categories – epigeic, endogeic and anecic, indigenous and exotic species (*Eudrillus eugeniae/ Eisenia foetidae/Perionyx excavatus/ Lampito mauritii*), identification of the above four species based on morphological characters.

**Module II** **10 hrs**

Methodology of vermicomposting: step by step methodology – containers for culturing, raw materials required, preparation of bed, environmental pre-requisites, feeding, harvesting, and storage of vermicompost. Advantages of composting, precautions to be taken to prevent attack by pests and pathogens.

**Module III** **8 hrs**

Vermicompost profile and applied aspects: physical, chemical and biological parameters of vermicast, vermin enrichment, economic uses of vermiculture (biofertilizer, waste disposal, vermivash, poultry feed, vermi-remediation etc.

**Apiculture** **30 hrs****Module IV** **8 hrs**

Introduction and Scope: Definition and significance of the study. Caste system and Social behavior; common species of honeybees used, organization of bee colony, social life and adaptations of honeybees.

**Module V** **12 hrs**

Bee keeping methods and equipments: indigenous methods, extraction appliances, extraction of honey from the comb and processing, management and maintenance of an apiary, bee pastures

**Module VI** **10 hrs**

Diseases and economics: diseases (bacterial, fungal, protozoan, acarine, brood diseases), preventive and curative measures. Use of honey, bees wax, bee venom, nutrient profile of honey, marketing strategies.

**Suggested topics for assignments / seminars****Vermiculture**

1. Report of field visits to commercial/professional units
2. Feasibility of maintaining a vermicomposting plant in the College maybe worked out
3. Awareness programmes on waste management through vermicomposting may be conducted for the local residence associations

**Apiculture**

1. Report of field visits

**References**

1. Cherian & Ramachandran Bee keeping in *South Indian* Govt. Press, Madras.
2. Gupta, K.C. Romance of bee keeping. Khadi Paristhan, Calicut.
3. Mary Appelhof. Worms eat my Garbage.
4. Mishra R.C. Perspectives in Indian Apiculture
5. Sathe, T.V. Vermiculture and Organic farming.

**First Degree Programme**  
**Semester VI**  
**Zoology Open Course II**  
**Ornamental Fresh water fish production**  
**Course Code – ZO1651.2**

**No. of credits - 2**

**Total hours 54**

**Aim of the course**

To make the student aware of the vast potentials involved in ornamental fish farming and trading

**Objectives of the course**

- To learn the scientific method of setting an aquarium
- To learn the culture breeding and marketing techniques of common indigenous ornamental fishes

**Module 1**

**7 hrs**

Importance and history of aquarium fish keeping. Design and construction of aquaria: aquarium fabrication- shape, size, volume, type of glass tank, cutting of glass, preparation of glass tank, strengthening and supporting of tank, fitting of tanks into room settings; aquarium floor setting – type and size of pebbles, gravels, granites used for bed setting and its advantages. Filters- biological, chemical and mechanical. Aquarium accessories like aerators, decorative, lighting, heating and feeding trays.

**Module II**

**4 hrs**

Water quality management in aquarium systems – sources of water, containers, storage, temperature, pH, dissolved carbon dioxide, ammonia, hardness, turbidity and ozone in aquarium.

**Module III**

**6 hrs**

Aquarium plants: Uses of aquarium plants, different varieties of plants like submerged plants (tubers, rooted plants, cutting plants) and emerged plants, indoor plants and outdoor plants, selection of plants, planting techniques, propagation and maintenance of aquarium plants. Advantages of natural plants over artificial plants.

**Module IV**

**11 hrs**

Fresh water ornamental fishes : Common ornamental fishes- indigenous and exotic species; Identification and biology of the common ornamental fishes. *Cyprinus carpio* (koi carp), *Molliesia sphenops* (black molly lyre tail), *Poecilia reticulata* (guppy), *Poecilia latipinna*, *Xiphophorus helleri* (red sword tail) *Xiphophorus maculatus* (red platy) *Pterophyllum scalare altum* (angel fish) *Carassius auratus* (red oranda) *Betta splendens* (Siamese fighting fish) *Trichogaster leeri* (pearl gourami). Live bearers and egg layers. Sexual dimorphism in ornamental fishes.

**Module V**

**7 hrs**

Breeding and rearing of common ornamental fishes. Conditions for breeding- pH, temperature and sex ratio. Brood stock management- selection of brooders, maintenance and management of brood stocks. Selective breeding and hybridization techniques. Induced breeding. Colour enhancement techniques.

**Module VI****7 hrs**

Aquarium maintenance- Setting up of a freshwater community tank and its maintenance. Food and feeding - live feed and formulated feed. Preparation and culture of live feed ( Artemia, Infusoria, Spirulina). Control of algal growth, snails and other predators. Common disease of ornamental aquarium fishes - their causative agents - virus, bacteria, fungi, protozoa and nematode; symptoms, treatment and prophylactic measures.

**Module VII****12 hrs**

Indigenous ornamental fishes - Common indigenous ornamental fishes. Identification and biology of the common ornamental fishes. Cyprinids :*Puntius denisonii* (red line torpedo fish),*Puntius fasciatus* (melan barb), *Puntius filamentosus* (Indian tiger barb), *Puntius curmuca* (red tailed silver shark) , *Danio malabaricus* (Malabar danio) ;Loaches ( *Nemacheilus triangularis*(Zodiac loach), *Lepidocephalus thermalis* (Malabar loach) ; Cichlids: *Etoplus maculatus* (yellow and orange chromides), *E . suratensis* (pearl spot), Anabantids: *Anabas testudineus* (climbing perch) and Catfishes : *Horabagrus brachysoma* (Yellowish catfish), *H . nigricollaris* (White)

**References**

- Arumugam. N. (2008). Aqua culture, Saras publications, Tamil Nadu, India.
- Axelord, H.R. (1967). Breeding aquarium fishes, T F H Publications.
- Dick Mills (1981). Aquarium Fishes, Arco publishing.
- Dick Mills and Gwynne Vevers, (1982). The Practical encyclopedia of fresh water Tropical Aquarium fishes, Salamander Books limited, London.
- Gahlawat, S.K., et.al. (2007). Manual of experimental Ichthyology, Daya publishing House, Delhi.
- Gerhard Brunner, (1973). Aquarium plants, T F H Publications, Inc. Ltd., Hongkong.
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- Harishankar J. A & A. Biju Kumar, (1997). Aquarium Fishes, B. R. publishing Corporation, Delhi.
- Jorgen Hansen, (1979). Making your own aquarium, Bell and Hyman Ltd., London.
- Ramachandran. A., (2002). Breeding, Farming and management of ornamental fishes. School of Industrial Fisheries, Cochin University of Science and Technology, Cochin-16.
- Saroj. K. Swain, (2003). Aquarium cave and maintenance, Publ. CIFA, ICAR, Orissa, India.
- Stephen Spotte, (1970). Fish and invertebrate culture, Wiley Inter Science, John Wiley & Sons, Inc., New York.
- Tom Lovell (1998). Nutrition and feeding of fish second Ed. Kluwer Academic publishers.
- Talwar.P.K., and Jhingran.A.G.,(1991). Inland fishes Oxford and IBH Publishing Co. PVT LTD, New Delhi.
- Web site: [www. Ornamentalfish.org](http://www.Ornamentalfish.org)

**First Degree Programme****Semester VI****Zoology Open Course II****HUMAN NUTRITION****Course Code – ZOI651.3****UNIT – I**

Introduction and scope. Carbohydrates, proteins and lipids – classification – sources – digestion and absorption – daily requirements – essential amino acids – essential fatty acids. - 15 Hrs.

**UNIT – II**

Vitamins and Minerals – sources and functions – deficiency status. Water as a nutrient – regulation of water balance. - 15 Hrs.

**UNIT – III**

Calorific values of food – Basal metabolic rate – Energy requirements of man, woman, infants and children. - 10 Hrs.

**UNIT – IV**

Nutritional value of foods: Cereals, fruits, milk, egg, meat, fish. Balanced diet. Nutritional requirements: infants, school children, pregnant and lactating mothers and the aged – Health education – Malnutrition. - 20 Hrs.

**Reference:**

1. Gopalan C., B.S.Ramasastri, and S.C.Balasubramanian. 1971. Nutritive value of Indian foods. National Institute of Nutrition, Hyderabad.
2. Gopalan, D. and K.Vijayaragavan. 1971, Nutrition atlas of India. ICMR., New Delhi.
3. Ghosh,S. 1981. The feeding care of infants and young children. UNICEF, New Delhi.
4. Mudambi, S.R. 1995. Fundamentals of Food and nutrition. New age International, New Delhi.
5. Swaminathan, M., 1989. Handbook of food and nutrition. Bappco., Bangalore.
6. Swaminathan, M., 1974. Essentials of food and nutrition. Vol. I and II. Ganesh and company, Madras.

**First Degree Programme****Semester VI****Zoology Project and Field study****Course Code – ZOI646****No. of credit – 4****Project****Aim of the course**

To develop an aptitude for research in Zoology

**Objective of the course**

To inculcate proficiency to identify appropriate research topic and presentation

**Specifications**

Topics of biological interest can be selected for the project.

Project is to be done by a group not exceeding 10 students.

Every student should submit typed (A4 paper, 12 Font, 1.5 Space), spirally bind project report in duplicate to the department on the day of the examination of Practical II.

A copy duly attested by the supervising teacher and the Head of the Department must be placed for ESE before a board of two Examiners.

The viva-voce based on the Project is conducted individually.

Project topic once chosen shall not be repeated by any later batches of students.

The project report may contain the following sections

1. Preliminary (Title page, declaration, Certificate of the supervising teacher, content etc.)
2. Introduction with relevant literature review and objective
3. Materials and Methods
4. Result
5. Discussion
6. Conclusion / Summary
7. References.

**Field study**

A total of eighteen hours (1hour/week) are allotted to field study in the fifth semester. Field study of 4 days is compulsory. Students are directed to visit one research institute and one wild life sanctuary / ecosystem / museum / zoo, preferably within the state of Kerala. Scientifically prepared hand written study tour report must be submitted by each student for ESE on the day of the examination of Practical II.