

**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 systematic and understand the hierarchy of different categories.
- To learn the diagnostic characters of different phyla through brief studies of 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, Taxonomical hierarchy – taxon, category and rank, Linnaean hierarchy, nomenclature, principles of nomenclature. International Code of Zoological Nomenclature (ICZN), rules of nomenclature, requisite – uni, bi and trinomialism. Mention taxonomic aids.

Module II

6 hrs

Kingdom Protista: General characters, structure, zoological importance and systematic position of *Actinophrys*, *Noctiluca*, *Paramecium* 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, Mention the classes of Porifera- Calcispongia, eg. *Sycon*; Hydrospongia, eg. *Euplectella*; Desmospongia, eg. *Spongilla*.

General topic: Canal system in sponges.

Module IV

Subkingdom Eumetazoa

4hrs

Phylum Coelenterata: General characters (self study). Classes- Hydrozoa eg. *Obelia*, *Physalia*; Scyphozoa eg. *Aurelia*; Anthozoa eg. *Madrepora*.

General topic: Polymorphism in coelenterates, Coral and Coral Reef.

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- eg. *Ascaris*, *Ancylostoma*, *Enterobius*, *Wuchereria* [Morphology, life history, pathogenicity and prophylaxis], *Caenorhabditis elegans* (Brief account).

Phylum Annelida: General characters (self study). Classes Polychaeta eg. *Nereis*(mention *heteronereis*), Oligochaeta eg. *Earthworm*, Hirudinea eg. *Leech*.

Module VI

16 hrs

Phylum Arthropoda: General characters (self study), **Type- *Panaeus***. Mention the classes. eg. Cockroach, *Limulus*, *Eeupagurus*, *Sacculina*, Honey bee, *Daphnia*, *Artemia*, *Drosophila*, *Mosquitomouth parts*. Study of crop pests: Pest of paddy-*Leptocorisa*, *Spodoptera*, *Nilapaarvata*; Pest of coconut- *Oryctes*, *Rhynchophorus*, *Eriophyes* .

Phylum Onychophora: General characters, eg. *Peripatus* (Evolutionary significance).
General topic: Sericulture

Module VII

10 hrs

Phylum Mollusca: General characters (self study), Classes- Monoplacophora, eg. *Neopilina*; Amphineura, eg. *Chiton*; Aplecophora, eg. *Neomenia* , Gastropoda eg. *Pila*; Scaphopoda, eg. *Dentalium*; Pelicypoda eg. *Perna* Cephalopoda, eg. *Sepia*, *Octopus*.

General topic- Economic importance of mollusca, Pearl culture, Mussel culture.

Phylum Echinodermata: General characters (self study), Classes- Asteroidea, eg. *Asterias*; Ophiuroidea, eg. *Ophiothrix*; Echinoidea, eg. *Echinus*; Holothuroidea, eg. *Sea cucumber*, Crinoidea, eg. *Sea lily*. General Topic: Water vascular system.

NB: Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

References

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- Barrington E.J.W. (1967). Invertebrate Structure and Function. ELBS and Nelson, London.
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- Kotpal, R.L, Agarwal, S.K. and R.P. Khetarpal. (2002). Modern text book of Zoology Invertebrates.
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- Marshall, A. J. and Williams, W. D. (1972). Text book of zoology vol. 1 Invertebrates. ELBS & MacMillan, London.
- Nigam, S. (1978). Invertebrate Zoology. S. Nigam & Co.
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- Pearse, V., Pearse, J., Buchsbaum, M. and Buchsbaum, R. (1987). Living Invertebrates. Blackwell Scientific Publications, California.
- Ruppert, E.E., Fox, R. and Barnes, R.D., (2004). Invertebrate Zoology. Thomson Books/Cole, U.S.A.
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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

6 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 Crossopterygii 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

9hrs

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. (Poisonous snakes) *Naja*, *Vipera*, *Bungarus*, *Enhydrina*; (Non poisonous snakes) *Ptyas*, *Lycodon*, *Dryophis*, *Typhlops* and *Eryx johni*, Suborder Crocodilia eg. *Crocodylus*, *Alligator*; Subclass Synapsida eg *Cynognathus*.

General topic: Identification of poisonous and nonpoisonous snakes; Venom, mode of action and its uses.

Module V**5hrs**

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**19hrs**

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*, Order Carnivora eg. *Panthera leo*, Order Cetacea eg. *Delphinus*, Order Perissodactyla eg. *Equus*, Order Artiodactyla eg. *Camelus*, 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 and Arterial system of pisces, amphibian, reptiles, aves and human.

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

References

- Bhaskaran, K. K. and Biju Kumar, A. (2003). Chordate Zoology. Manjusha Publications. Calicut.
- Ekambaranath Iyer. (2000). A Manual of Zoology. Vol. II S. Viswanathan and Co.
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- Verma, P.S. (2002). A Manual of Practical Zoology-Chordates. S. Chand and Co. Ltd.
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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, Pseudoscience.

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

Data collection and presentation :

14 Hrs

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**12 Hrs****Methods in Biological Science and Solutions:**

Microscopes: Principle, Types of microscopes- Dissection microscope, Light microscope, Dark field microscope, Fluorescent microscope, Phase contrast microscope, Electron microscope (SEM, TEM); Microtome (Different Types), Embedding, sectioning and staining techniques of light microscopy; Preservation of biological specimens: Taxidermy, Fossils, Dead animals (formalin); Photometry: Colorimetry and Spectrophotometry, Principle, Working and uses.

Autoradiography: Principle, mechanism, and significance; Centrifugation: Principle and their applications; Chromatography: Principle and uses.

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, Bioinformatics Centre and Library, Indian Institute of Science, Stem Cell Institute, National Institute of Immunology, Centre for Cellular & Molecular Biology, Centre for DNA Fingerprinting and Diagnostics, Central Drug Research Institute].

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

References

- Aggarwal, S.K. (2008) Foundation course in Biology. Ane Books India, New Delhi.
- Arora PN and PK Malhotra (1996) Biostatistics, Himalaya Publishing House.
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- Veerbala Rastogi. (2008) Fundamentals of biostatistics. Ane books India, Chennai.

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

30 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

8hrs

Cell Division: cell cycle- G₁, S, G₂, and M phases (mention G₀, and D₀ stages and their significances); amitosis (brief account only). Mitosis (self study). Meiosis: description of all stages, synaptonemal complex, significance

Module III

3 hrs

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

Module IV

3 hrs

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

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

References

- Alberts, B. *et al.* Molecular Biology of the Cell. Garland Pubg. Inc., New York
- Beker, W. M. *et. al.* (2004) The World of Cell. Pearson Edn., Singapore
- Bhaskaran, K. K. & Biju Kumar, A. Cell Biology, Genetics & Molecular Biology. Manjusha
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- Watson, J.D. *et al.*, Molecular Biology of the Gene, 4e, Benjamin Cummings

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 – ZO1442

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 and Molar solutions
2. Preparation of Buffers (Acidic, Neutral and Alkaline Buffers)

Study of the following instruments (Any four)

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 (Any Three- Maxillipeds 1,2,3, Chelate leg, First abdominal appendage)

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, Paramecium, 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

1. 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

Identify and write notes of the following bones.

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 (20% of practical CE)

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

Animal Diversity II (20% of practical CE)

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

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

37hrs

Module 1

8hrs

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 (flower colour in 4 'O' clock plant), lethal (yellow coat colour mice) and co-dominance (human ABO blood group system); Non allelic-complementary gene action (flower colour in sweet pea), Co-epistasis (comb pattern in fowl), dominant (feather coat in fowl) and recessive (coat colour in mice), polygenic action (skin colour in human), pleiotropism (sickle cell anaemia in human). Multiple alleles- ABO Blood group system, Rh group and its inheritance.

Module II

8hrs

Linkage and crossing over: Linkage- Linked genes, linkage groups, Views of Sutton, Bateson, Morgan on linkage, Chromosome theory of linkage; Kinds of linkage- Complete (Drosophila bent wing shaven abdomen), Incomplete linkage (Drosophila-purple eye and vestigial wing); significance of linkage: **Crossing over-** Mechanism of meiotic crossing over, kinds of crossing over, factors affecting crossing over, significance crossing over; Chromosome mapping-Cross over value, two point test cross, Three point test cross (brief account only), basic steps of construction of gene map.

Sex Linkage: Characteristics of sex linked inheritance, sex linked inheritance of man (colour blindness and haemophilia), incompletely sex linked genes, holandric genes (hypertrichosis in man), sex limited genes(plumage pattern of birds) and sex influenced genes(baldness in man).

Module III **8hrs**

Sex Determination: Sex determining mechanism-Sex chromosomal mechanism (XX-XY, XX-XO, ZZ-ZW), Genic balance theory, Environmental factors on sex determination, Hormonal control of sex differentiation; Mention Barr bodies, Dosage compensation, Lyon hypothesis, Sex mosaicism, Gynandromorph and Hermaphrodite; Sex determination in man (Role of Y chromosome).

Module IV **6hrs**

Mutation: Chromosomal mutations – structural aberrations, numerical aberrations; Induced mutation (physical, chemical); Significance of mutation.

Module V **3hrs**

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

Module VI **4hrs**

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 **9hrs**

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 **6hrs**

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 **5hrs**

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

Module X **6hrs**

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 **4hrs**

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

5hrs

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

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

References

Genetics

- Benjamin Lewin. (2004). Genes VIII. Oxford University press, N.Y.
- Daniel J Fairbanks and W. Ralph Brooks. (1999) Genetics – principles and analysis. Jones and Bartlett Publishers, Massachusetts.
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Biotechnology

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- Brown, T. A. (1995). Gene cloning. Chapman and Hall, London
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First Degree Programme under CBCSS
Semester V
Zoology Core course VII
Immunology and Microbiology
Course code – ZO1542

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

42 hrs

Module I

2hrs

Introduction: History, development and scope.

Module II

3hrs

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

6hrs

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

14hrs

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

17 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.

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

30 hrs

Module VI

14hrs

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

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; Modern methods classification of Eubacteria - Nonphotosynthetic proteobacteria:- (Fermentative Rods and Vibrios) ex. *Vibrio*, *Pasteurella* (oxidative rods and cocci) eg. *Pseudomonas*, *Azotobacter*, *Rhizobium*; Chemo-lithotrophic bacteria:- eg. nitrifying, sulphur and iron bacteria; Firmicutes (eg. *Staphylococcus*) and Actinobacteria (Coryneform bacteria); Phototrophic bacteria (Cyanobacteria); Algae-(brief study) Protista- different groups- examples: *Plasmodium* ; Fungi- Mention different groups – example *Candida*. Structure of a bacteriophage and a typical bacterium

Module VII

4 hrs

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

Module VIII

12hrs

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

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

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

Physiology

60hrs

Module I

6hrs

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

8hrs

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 **8hrs**

Respiratory Physiology: Gas exchange, respiratory pigments- structure of haemoglobin, transport of O₂- Oxyhaemoglobin curve, Bohr effect, transport of CO₂ -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 **8hrs**

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 encephalogram. 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 **3hrs**

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 **30hrs**

Module X **8hrs**

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 (phosphor 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

16hrs

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

6hrs

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.

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

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Biological chemistry

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First Degree Programme under CBCSS
Semester VI
Zoology Foundation course II
General Informatics, Bioinformatics and Molecular Biology
Course code – ZO1621

No. of Credits - 4

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

4hrs

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

12hrs

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 Intellectual property rights(IPR), copyrights, patents, plagiarism, Use of IT in teaching and learning, Case study of educational softwares. Academic services – INFLIBNET, NICNET, BRNET

Module III

10hrs

Social Informatics : IT and society, Issues and Concerns, Digital divide, Methods to counter digital divide, IT and development, New opportunities and new threats.

Cyber ethics, Cyber crime, Software piracy, Cyber security, Cyber laws, Privacy issues, Cyber addictions, information overload.

Computer- Ergonomics and Health issues, Guide lines for proper usage of computers, Internet and mobile phones. IT and regional languages, IT for the disabled, Free software debate, E-Waste and Green computing.

Module IV**8hrs**

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

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**8hrs**

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 GENSNP

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

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**15hrs**

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**5hrs**

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

Module IX**4hrs**

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

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

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- George Beekman, Eugene Rathswohl, Computer Confluence, Pearson Education, ISBN 0-13-066185-6
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- Jean M. Clavierie and Notredam. Bioinformatics, a beginners Guide, John Wiley, India.
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First Degree Programme
Semester VI
Zoology Core Course IX
Developmental Biology and Experimental Embryology
Course code – ZO1641

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

57hrs

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

8hrs

Fertilization: Capacitation, 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

9hrs

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

3hrs

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 **25hrs**
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, Lactation. Placentation in mammals – placenta, functions, classification based on type of foetal membrane, mode of implantation, nature of contact, distribution of chorionic villi and histological intimacy.

Module VII **3hrs**
Teratology: Definition, causes, infections, drugs and chemicals, metabolic imbalance, ionizing radiation, malnutrition, autoimmunization.

Module VIII **15hrs**
Experimental embryology: Spemann's constriction experiments, organizers and embryonic induction – kinds of embryonic induction, primary, secondary and tertiary organizers; transplantation experiments in amphibian- involving optic cup, nuclear transplantation . 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 mammals (Sheep); prenatal diagnosis and sex determination methods – amniocentesis, alpha-foeto protein (AFP) estimation, chorionic villus sampling, ultrasound scanning. Embryonic and adult stem cell, significance and applications, stem cell therapy.

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

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First Degree Programme
Semester VI
Zoology Core Course X
Ecology, Ethology, Evolution and Zoogeography
Course Code – ZO1642

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

24hrs

Module I

3 hrs

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

4 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

5hrs

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

4 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 **3 hrs**

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 **5 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 **12hrs**

Module VII **12hrs**

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 **26hrs**

Module VIII **4 Hrs**

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

Module IX **4hrs**

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

Module X **12hrs**

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

4hrs

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

6hrs

Zoogeographical Realms: (Brief account of each realm mention the areas included, physical features and fauna) Palearctic 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)

NB:Assignments/ Seminar – Topics related to syllabus can be given to students as assignment/ seminar.

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First Degree Programme
Zoology Core course XI
Practical II - Cell Biology, Genetics,
Biotechnology, Immunology and Microbiology
Course Code – ZO1643

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 [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
Zoology Core Course XII
Practical III - Physiology and Biological Chemistry, Molecular Biology
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: [1-11,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 and Molecular Biology:

1. Graphical representation of data (Histograms, Frequency polygon, Pie diagram)
2. Calculation of Mean, median, mode and standard deviation of given data by discrete series-Direct method.
3. Molecular Biology: Spotters(Watson - Crick model of DNA, clover leaf model of tRNA, DNA replication)

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 (1-13 Compulsory)

1. Estimation of dissolved oxygen
2. Estimation of CO₂
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 Lamarck - Identify the scientist and mention the contribution.

Zoogeography

13. Study different zoogeographical realms with fauna.

First Degree Programme Semester VI
Zoology Project and Field study

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 5 students. Every student should submit typed (A4 paper, 12 Font, 1.5 Space), spirally bind project report duly attested by

the supervising teacher and the Head of the Department on the day of practical examination before a board of two Examiners for ESE. The viva-voce based on the project is conducted individually. Project topic once chosen shall not be repeated by any later batches of students. List of projects submitted year wise is to be maintained in a register and submitted before the examiners if requested.

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 and Study tour

A total of eighteen hours (1hour/week) has to be allotted to field study in the fifth semester. Study tour of minimum 4 days is compulsory. Students are directed to visit one research institute and one wild life sanctuary / museum / zoo, preferably within the state of Kerala. Scientifically prepared hand written study tour report along with photographs of candidate at the places of visit must be submitted by each student for ESE on the day of the examination of project evaluation.