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 Non-chordata.

Objectives Of the course

- To learn the basics of systematics 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 – Sub kingdom Mesozoa, Sub kingdom Parazoa, Sub kingdom Eumetazoa. Levels of organization- cellular. tissue. organ and organ system Divisions of Eumetazoa-Radiata, Bilateria, Acoelomata, Pseudocoelomata, Eucoelomata, Protostomia, Deuterostomia.

Sub kingdom Mesozoa- General characters, eg. *Rhopalura*.

Subkingdom 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 **4 hrs**

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 prophyllaxis], *Caenorhabdites 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**- ***Penaeus***. Mention the classes eg. Cockroach, *Limulus*, *Eupagurus*, *Sacculina*, *Apis indica*, *Daphnia*,

Drosophila. Mosquito-mouth 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: 1. Diversity of Mosquitoes and diseases transmitted by them.

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: Vector born diseases – Dengue fever, Japanese Encephatitis, Malaria, Cutaneous leishmaniasis.

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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 Chordata.

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 in relation to vertebrates

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, Classifitation 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 l Crossopterygii *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.

1. Alien fishes escaped from aquarium tanks and transported to water bodies during flood – impact on indigenous diversity.
2. Edible fishes – Tuna, Sardine, Mackerel, Pearl spot, Ribbon fish

Module III **12 hrs**

Super class Tetrapoda: Salient features; **Class Amphibia** - General characters (self study).

Type study – Frog:

Classification- Oder Urodela eg. *Amblytoma*, Order Anura eg. Rhacophorus, *Bufo*, *Nasikabatachus* ,Order Apoda eg. *Ichthyophis*.

General topic: Parental.care in Amphibia.

Module 1V **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. (Poisonous -snakes) *Naja*, Vipera, *Bungaraus*, *Enhydrina*; (Non poisonous snakes) *Ptyas, Lycodon*, *Dryophis*, *Typhlops* and *Eryx johni* Suborder Crocodilia eg. *Crocodilus-, Javialis, 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: *Archeopreryx*; Subclass Neornithes – Super order Paleognathae eg. *Struthio* and *Emu*: Super order Neognathae eg. Pigeon (External features, Feathers)

General Topic: Migration in birds. Flightless birds, Flight adaptations in birds.

Module VI **12 hrs**

Class Mammalia - General characters (self study) classification of Class Mammalia - Subclass Prototheria eg. *Tachyglossus*. Subclass Metatheria eg.*Macropus.* Subclass Eutheria – Order Insectivora eg. *Paraecinus,* 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 Proboscidia 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, Adaptations of aquatic mammals.

Module VII **5 Hrs**

Comparative account of Brain and Arterial system of Pisces, amphibian, reptiles, aves and human. .

NB:Assignments/Semmar – 1. Zoonotic Diseases – *Bird flux*, Zika virus, West Nile Disease, Nipa virus, Weil's disease, Rubies virus, Kyasanur Forest Disease

2. Diversity of Rodents in our ecosystem (House rat, Mouse, Bardicoot rat, Funanbus Antelope rat)

References

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Semester III

Foundation Course II

Experimental Zoology, Instrumentation

Biostatistics and Bioinformatics

Course Code: ZO. 1341

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 different branches 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

Nature and scope of Zoology: **7 Hrs.**

Branches of Zoology, Opportunities to a 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].

Module - II

Instrumentation (Principle Working and Application) **12 hrs**

Methods in Biological Science and Solutions

Microscopes: 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.

Photometry: Colorimetry and Spectrophotometry, Autoradiography: Principle, mechanism, and significance; Centrifugation: Principle and applications; Chromatography: Principle and uses.

Module - III

Biostatistics and Experimental Science.

16hrs

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, Chi-square test.

BIOINFORMATICS

Module IV **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 V **7hrs**

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 .Diseovery. 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 GENSNIP.

Central Drug Research Institute

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

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Semester IV

Zoology Core course III

ECOLOGY, HABITAT DESTRUCTION & DISASTER MANAGEMENT

Course code – ZO 1441

No. of credits - 3 **Total hours 54**

Course Outcomes

- Students get basic knowledge on ecosystem, food chain, food web and energy flow.
- Students acquire general awareness on pollution and their impacts.
- Imparts basic knowledge on ecosystems and their functioning.
- Students learn about various types of anthropogenic pressures on ecosystem, related degradation and management measures.
- Students get awareness of toxicants, their impacts on human health and environment and remedial measures.
- Create awareness about disasters, prevention and mitigation measures.

ECOLOGY **4 hrs**

Module I

Components of ecosystem: Environmental factors - abiotic factors, light, temperature, soil, air; biotic factors- autotrophs, phagotrophs and saprotrophs; ecosystem interaction and relationship between biotic and abiotic factors, the cybernetic nature and the stability of the system. Pond as an ecosystem (self study)

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 **8 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.

Module IV **5hrs**

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, endosulfan, 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.

Module VII **9 hrs**

Environmental biotechnology: Biotechnological methods of pollution detection, biotechnological methods in pollution management, 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.

Module VIII **5 hrs**

Environment Movements

Environment and health - Environment and development: Environmental Movements (Chipko, Narmada Bachao Andolan). environmental movements in Kerala (Madhav Gadgil/Kasturi Rangan Reports. Ramsar sites Wetland Reclamations and localized anti-reclamation movements) Kerala state Biodiversity Board, Biodiversity Register.

DISASTER MANAGEMENT

Module IX **8 hrs**

Disruption in Ecosystem

Natural-flood, Draught, Earth quaque, Cyclone, Tsunamis, Volcanic eruption. Anthropognic influence on erosion, climate change and pollution. Mining activities Monoclonal plantations, genetically modified plants and their impact in ecosystem. Impact of Developmental projects such as construction of dams, Hydroelectric projects Thermal power station.

Module X **7 hrs**

Disaster Management – Meaning and Definition: Definitions of Disaster, Hazard, Risks. Vulnerability, and Resilience and their relationship: Classification of disasters- Human induced and Natural; Cause of Disasters; Impact of disasters. Factors affecting Vulnerability – Economic, Political, Environmental and Social Counselling.

Assignment/Seminar

Global warming, Green House Effect, Ozone depletion Climate change, Kyoto protocol

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- Chatterjee B. (2003). Environmental Laws: Imple mentation problems

Zoology Core Course IV
Practical I – Instrumentation,
Animal Diversity I and Animal Diversity II
Course Code – ZO 1442

Course Outcomes

- Students learn anatomy by diping through simple dissections and mountings on permitted species.
- Students get familiarized with various organ systems by examining approved animals.
- Emphasize the adage that 'seeing is believing' by observing typical examples and economically important specimens.
- Students learn the working principle of different scientific instruments.
- Students become familiar with economically important species.
- Strengthen what students studied in theory by giving them an opportunity to have first-hand experience in lab as well as outside.

Methodology and Perspectives of Zoology

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. Scales of butterfly wing

4. Cockroach - mouth parts
5. Honey bee - mouth parts / mosquito - mouth parts
6. Prawn - appendages
7. Radula of Sepia

Major Practical - any two

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

Taxonomy

Identification and classification of the following specimens

1. Protista - *Actinophrys, Noctiluca, Pramecium, Opalina*
2. Phylum Porifera - *Euplectella, Spongilla.*
3. Phylum Cnidaria - *Hydra, Obelia, Physalia, Aurelia, Adamsia*
4. Phylum Nematoda - Ascaris male and female (sexual dimorphism)
5. Phylum Platyhelminthes - *Bipalium*, *Fasciola*, *Teania solium*
6. Phylum Annelida - Earthworm, *Nereis*, Leech, *Aphrodite*, *Arenicola*
7. Phylum Onychophora - *Peripatus*
8. Phylum Arthropoda - *Limulus*, *Eupagurus*, *Sacculina*, *Apis indica*, *Lepisma*, Scolopendra, Palamnaeus
9. Phylum Mollusca - *Chiton*, *Pila, Xancus*, *Dentalium, Mytilus, Sepia*, *Octopus*
10. Phylum Echinodermata - Starfish, Brittle star, Sea urchin, Sea cucumber, Sea lily-
11. Larval forms: Nauplius, Tornaria Trochophere, Pluteus

Animal Diversity II

Minor practical

Fishes – 1. placoid scales of *Scoloidon*

2. cycloid and ctenoid scales of *Anabas*

Osteology and Dentition

a. Dention (1) Carnivore (2) Herbivore
b. Pectoral girdle and Synsacram of bird
c. Limb bones, girdles and vertebrae of Frog.
d. carapace and plastron of turtle.

Taxonomy

Prochordates -*Amphioxus (entire)*

Pisces –

a. cartitagenous fishes, 2
b. fishes with accessory respiratory organs, 2
c. Edible fishes - 2
d. Culture fishes-2

Amphibia – *Bufo*, *Rhacophorus Amblystoma*, Axylotl, *Icthyophis*

Reptilia - 2 poisonous and 2 non -poisonous snakes, *Draco*, *Chamaelon*

Aves - Different feathers, Pigeon.

Mammals – Pteropus

Compulsory assignment for practical

Animal Diversity I (5% of practical CE)

Animal Diversity II (5% of practical CE)

Students shall collect any two local fish and prepare a brief note including taxonomy and submit for evaluation.

First Degree Programme

Semester V

Zoology Core course V
Cell and Molecular Biology
Course code – ZO 1541

No. of credits - 4 **Total hours 90**

Course Outcomes

- Students acquire sufficient knowledge on the fundamental structure, function and biochemistry of the cell.
- They understand the principles of molecular biology and gene manipulation.
- Students learn ultra-structure of prokaryotic and eukaryotic cells.
- Students understand the fundamental differences between prokaryotic and eukaryotic cells.
- Students learn the structure, replication and modification of the genetic material of eukaryotes.
- Students understands the mechanism of gene expression and gene regulation.
- Gets an awareness of bacterial recombination.
- Students acquire scientific knowledge on cancer and ageing.

Cell Biology

56 hrs

Module I **38hrs**

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. 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 electron transport chain. Endoplasmic reticulun - 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 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 **6 hrs.**

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

Module III **4 hrs.**

Biology of cancer: characteristics of cancer cells, dedifferentiation of cancer cells, theories of cancer, carcinogenesis, oncogenes and tumor suppressor genes , carcinoma, sarcoma, lymphoma. Treatment and targeted drug delivery.

Module IV **2 hrs**.

Module IV **8 hrs**.

Aging process and problems of elderly: cellular and other changes, apoptosis, causes of aging, mention free radicals and superoxide dismutase (SOD), theories of aging. Hypertension and stroke, Balancing problems and fall in elderly, Urinary incontinence, Senile dementia, Osteoporosis, Senile cataract, Benign prostate hypertrophy (males), Reduced sleep and sleep disturbances, Interstitial long disease and decreased long capacity, Wax deposition and hearing problems, constipation, Hyperacidity and gastric ulcer.

Molecular Biology **34 hrs**

Module V **10 hrs**

Introduction: history, development and scope.

Nature of genetic material: search for the genetic material, Griffith's experiment, transformation, contributions of Avery, Mac Leod and Mc Carty, Conrat & Stern's experiment with TMV, Hershey & Chase's experiment, and 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 VI **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 VII **5 hrs**

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

Module VIII **4 hrs**

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

Suggested topics for assignments / seminars (not for ESE)

1. Basic properties of cells
2. A brief history of studies on plasma membrane structure
3. Role of Ca++ in signal transduction
4. Chemical components of a) Endoplasmicreticulum b) Golgi bodies c) Lysosomes d) Ribosomes
5. Models of ribosome structure
6. Lysosomes and storage diseases

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First Degree Programme

Semester V

Zoology Core Course VI

Genetics and Biotechnology

Course Code – ZO. 1542

No. of credits - 4 **Total hours 72**

Course Outcomes

- Structure of gene is to be learned.
- Students get educated on the underlying genetic mechanism operating in human and state of the art of bio-techniques
- Students develop a proper understanding on the relation between heredity and variation.
- Learn the mechanism of crossing over and inheritance patterns in human.
- Students become aware of different genetic syndromes and the possible ways to reduce its occurrence.
- Students 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, relevance of Mendel's principles in modern genetics (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; Co-epistasis, 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 11 **8 hrs**

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

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

Module III **8 hrs 3**

Sex Determination: Environmental factors on sex determination, mention genic balance theory, chromosome theory of sex determination, chromosomal mechanism of sex determination, (XX-XY, XX-XO, ZZ-ZW), sex determination in human, 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. Gene mutation, molecular basis of mutation, induced mutation- chemical, ionizing and non ionizing radiations

Module V **3 hrs**

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

Module VI **4hrs 3**

Human Genetics: Karyotyping, normal chromosome compliment, 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 human. Disorders Phenylketonuiia, Alkaptonuria, Tyrosinosis and Albinism.

Biotechnology **35 hrs**

Module VII **9 hrs**

Introduction-Scope of biotechnology, emerging branches of biotechnology. Genetic engineering and recombinant DNA technology, techniques in gene cloning, restriction endonucleases, ligases, major steps in cutting and joining of DNA, tools used in recombinant DNA technology, vectors, plasmids, probes, linkers, host cells, transformation and detection of recombinant molecules.

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 stern 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. Biotechnology in future.

Suggested topics for assignments / seminars (not for ESE)

1. Mendel's laws.
2. Human blood groups.
3. Intersexes, hermaphrodites, and gynandromorphs.
4. Genetic counseling
5. Human Genome Project.
6. Applications of DNA fingerprinting.
7. Ethical and social issues of Biotechnology.
8. Complimentary gene action.
9. Incomplete dominance.
10. Chemical mutagens in food.

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First Degree Programme

Semester V

Zoology Core course VII
Immunology and Microbiology
Course code – ZO 1543

No. of credits - 4 **Total hours 72**

Course Outcomes

- Students understand the scope and importance of clinical immunology.
- Students understand the principles and mechanisms of immunology.
- Learn the malfunctioning and disorders of the immune system
- Students acquire knowledge on immunodeficiency diseases.
- Transplantation and mechanism of Graft retention and rejection are learned.
- Students get a brief history of microbiology.
- Students develop a broad understanding of the positive as well as negative aspects of microbes.
- Economic importance (applied aspects) of microbes in industry can be studied.

Immunology **42hrs**

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 **7hrs**

Immune system: organs and tissues of the immune system. Primary (central) - thymus, bone marrow, bursa of Fabricius, 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, lymphokine - activated killer cells;

phagocytes / macrophages; antigen presenting cells - macrophages, B-lymphocytes, dendrite cells, Langerhans cells; follicular dentrite cells, neutrophils, eosinophils, basophils, mast cells. Mitogens - mention only

Module IV **16hrs**

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, induction of CMI, mention cytokines, define immunological memory, immunological tolerance and immune suppression

Module V **14hrs**

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, recombined vaccines, DNA vaccines;

passive immunization- pooled nonnal human Igs, specific Igs (hyper antisera); combined immunization

Microbiology **30hrs**

Module VI **14hrs**

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:- (Fennentative Rods and Vibrios) ex. *Vihrio*, *Pasteurella* (oxidative rods and cocci) eg. *Pseudomonas*, *Azotobacter*, *Rhizohium*; Chemo-lithotrophic 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 **4hrs**

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

Module VIII **12hrs**

Symbiotic and Pathogenic 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

Suggested topics for assignments / seminars (not for ESE)

1. Factors affecting innate immunity
2. Defence mechanisms of the body against infections
3. Factors affecting antibody production
4. Theories of antibody production
5. Organ transplantation
6. Immunization and vaccination
7. Antiseptics and antibiotics
8. Sterilisation and disinfection
9. Inflammation and fever
10. Blood transfusion and safety
11. Timing of vaccination: National Immunization Schedule

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First Degree Programme

Semester VI
Zoology Core Course VIII
Physiology and Biochemistry
Course Code – ZO1641

No. of credits - 4 **Total hours 90**

Course Outcomes

- Students develop a clear understanding of the correlation and coordination between the structure and function of different organs and organ systems of the body.
- Proper study on the physiology help students understand the physiology of different organ systems of the body.
- Students learn the correlation between diseases and the abnormal structure or improper functions of organs.
- Students understand the possible causes of abnormal physiology and the resultant diseases.
- Students understand the structure and functions of bio-molecules and their role in metabolism.
- This course opens new areas of research to students.

Physiology **60 hrs**

Module I **6hrs**

Nutritional Physiology: Structure of digestive system (self study). General 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: Structure of Heart. (self study). 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: Structure of lungs (self study). 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: Structure of Kidney. (self study). Nephron - structure, urine formation, counter-current multiplier system, role of kidney in osmoregulation, composition of urine, abnormal constituents of urine, regulation of kidney functions, renal disorders - nephritis, haematurea, 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: Structure of Brain. (self study). Neurons - structure, types of neuron. 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 **3 hrs**

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

Module IX **8 hrs**

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

Biochemistry **30 hrs**

Module X **8 hrs**

Biomolecules: 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 proteinprimary, secondary tertiary and quaternary structures, haemoglobin as a typical protein, biological functions of proteins.

Module XI **16 hrs**

Metabolism: 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, Ornithire cycle, 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.

Topics for assignments / seminars (not for ESE)

1. Amino Acids
2. Nucleic Acids
3. Enzymes and their Classification
4. Nutrients
5. Vitamin deficiency diseases - symptoms and diagnosis
6. Hormone deficiency diseases - symptoms and diagnosis
7. Body temperature, homeothery and thermoregulation
8. Human brain

9. Instruments used for the diagnosis of circulatory disorders.
10. Kidney related diseases and their diagnostic instruments.
11. Brain related diseases and their diagnostic tools.
12. Description of endocrine glands of mammals (goat, cow, buffalo, pig)
13. Submission of models of diagnostic instruments with description.

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Biochemistry

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First Degree Programme

Semester VI

Zoology Core Course IX

Developmental Biology and Experimental Embryology

Course code ZO - 1642

No. of credits - 4 **Total hours 72**

Course Outcomes

- Students get a brief idea about the history of developmental biology.
- Provide the students a bird's eye view of sophisticated embryological techniques
- Study the various stages involved in the development of organisms.
- Study the initial developmental procedures involved in Amphioxus, Frog and chick
- Procure information on state- of- the art experimental procedures in embryology.
- Different control mechanisms of development including gene action are studied.

Developmental biology **57hrs**

Module I **6 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 envelops; classification of eggs based on different criteria.

Module II **5 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 **7 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, pleuripotency 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 **28 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. **Human** - implantation, pregnancy, parturition. Placentation in mammals - different types of placenta, functions.

Module VII **3hrs**

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

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 human 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.

Suggested topics for assignments / seminars (not for ESE).

1. Human male and female reproductive organs.
2. Larval forms of invertebrates.
3. Metamorphosis in insects.
4. Regeneration in animals
5. Cloning experiments in animals.
6. Transgenic animals.
7. Stem cell research.
8. Comparative account on cleavage, blastulation, gastrulation in different animals.
9. Embryonic development of an invertebrate.

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First Degree Programme
Semester VI
Zoology Core Course X
Ethology, Evolution and Zoogeography
Course Code - Z01643

No. of credits - 3 **Total hours 72**

Aim of the course : To enhance the student's concept on organic evolution and appreciate the different modes of energy efficient communication systems existing in the animal world.

Objectives of the course :

1. To study the physiological basis of behavior.
2. Study the different types of communication system among animals.
3. To get a concept on organic evolution.
4. To get knowledge on the distribution of animals in the biosphere.

Ethology **32 hrs**

Module I **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.

Perception of Senses and Communication Systems in Animals

Module II : Sounds as communication system in the Animal world **6 hrs**

Vibrations of Insect Wings, Stridulation in Insects, Sound production in Cicada, Ultrasonic sounds of animals, Communication by Infrasonic sounds, Echo location, Evasion of insects to ultrasonic sounds, Sounds of Deep sea animals, Sounds for maintenance of territory, sounds and courtship behaviour.

Module III : Light as a device for Animal Communication **6 hrs**

Light of Visible spectrum, Colour vision, Black and white vision, UV vision, Infra red vision Phosphorescence, Flourescence, Bioluminesce-in Insects, Mollusca, Deep Sea

fish, Energy efficiency of Bioluminescent organs. Physiology of Bioluminescence, Bioelectricity.

Module IV: Transmission of Information through Chemicals 8 hrs

Pheromones, Signalling pheromones in rodents and population control, Scent markings of Carnivores, Civet, Musk, Musth in elephants, Urine markings of dogs, Jacobsons organ. Insect pheromones Aggression pheromones, Trail pheromones, Sex attractants, Bombykol, Gypsilure, Pheromones for pest management, Pheromones for colony maintenance in honeybees, Dufours gland secretion, Allomones, Kairomones.

Evolution 30 Hrs

Module V

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 VI 4 hrs

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

Module VII 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 VIII 4 hrs

Evolution above species level: Adaptive radiation, Micro-evolution, Macroevolution,Mega evolution, Co-evolution**.**

Module IX **6 hrs**

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

Zoogeography **10 hrs**

Module X **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 XI **6 hrs**

Zoogeographical Realms: (Brief account of each realm mention the areas included, physical features and fauna) Palaearctic- region; Australian region, Ethiopian region, Nearctic region, Oriental region and Neotropical region. Biogeographial Classification of India. Western -Ghats, Easter Ghats and Himalayas. Insular Fauna: Brief account of oceanic islands and continental islands (with one example each)

References

1. Stebbins. G.L. (1977) Process of organic Evolution.
2. Volpe.E.P. (1985) Understanding Evolution. India Repr. Universal Book stall, Delhi.

3. Ahluwalia, V. K. and Malhotra. S. (2006). Environmental science. Ane Books Pvt. Ltd.
4. Andrews M.I. and Joy K.P. (1989). Ecology Evolution and Zoogeography RobersK, Kerieyer Pubo, New York.
5. Brace, C.L. (1967). The stages of Human Evolution, Prentice Hall International Cambridge University Press.33.
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9. Dobzhansky T. (1964). Genetics and the origin of species Oxford and IBH Pub. New Delhi
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12. John Alock. (2001). Animal Behavior, an evolutionary approach. Sinauer
13. Lull R.S. (1947). Organic Evolution Macmillan Pub. Co. New York.
14. Manning Aubrey. (1995). Introduction to Animal Behaviour.
15. Edward Arnold Marvel and Hamilton. Mechanism of Behavior. McGraw-Hill New Delhi.
16. Moody P.A. (1978) Introduction to Evolution, Ind. Ed. Kalyani Pub., New Delhi
17. Oparin A.I. (1957). The Origin of Life on Earth, Oliver & Boyd, London. Private Ltd, New Delhi
18. Rajagopalan R. (2006). Environmental studies. From crisis to cure. Oxford
19. Savage .J.M. (1969). Evolution. Hold. Rinehart and Winston Inc. New Delhi.

Perception of Senses and Communication system in Animals.

Alcock. J (2001) Animal Behaviour, an Evolutionary approach, 7th Edition, Sinano Associates, Inc, ISBN-10-0878930116.

Bradbury. J.W and Vehren camp S.L. (1998) Principles of Animal communication (2nd Edn) Sinauer Associates, Inc, Sunderland, U.S.A.

Champman. R.F. (1998). The insects, structure and function (Forth Education) Cambridge University Press. London.

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Olle Hastrad. (2014) A vision physiological estimation of UV lights visibility in birds, NCBI Resources.

Richard. D. Goris (2011) Infrared organ of snakes, Arisona State University Press.

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First Degree Programme

Zoology Core course XI

Practical II - Cell Biology, Genetics, Bioformatics

Biotechnology, Immunology and Microbiology
Course Code — ZO1644

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 broad knowledge on conventional biotechnological- procedures
4. To perform routine blood analysis.

Cell Biology [Any six]

1. Staining of prokaryotic cells: (a) *Lactobacillus* from curd (I) 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 (*Allitum 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)
8. Localisation of mitochordia in Yeast cells using Janus green

Genetics [Any five]

1. Study of monohybrid cross using coloured beads.
2. Study of normal chromosome compliment and karyotypc of human.
3. Study of genetic syndromes and abnormal karyotypes of human (Klinefelter's syndrome. Turner's syndrome. Down syndrome and Edward syndrome

4. Recording the dermatoglyphic patterns (Human finger prints) significance, comment.
5. Study of Barr body and its significance (in stained buccal epithelial cells
6. Construction of Pedigree chart.
7. Identification of male and female Drosophila.

Biotechnology and Bioinformatics (Any two)

1. Polymerase chain reaction (PCR)
2. Southern Blotting and Northern Blotting
3. Gene cloning

(Schematic arrangement in orderly sequence, the steps involved in the above three methods and make comments) C D display or visit to any Research Institute.

4. Sequence comparison using software (BLAST/FASTA)

Immunology and Microbiology (Two)

1) Effect of anticoagulant in human blood.
2) Total leucocyte count (Demonstration)
3) Human blood groups and Rh Factors.
4) Identification of bacterial types (Permanent slides)

(Coccus, Vibrio, Bacillus Spirulla) any two.

Practical III - Physiology and Biological Chemistry, Molecular Biology and Biostatistics

Course Code ZO1645

No. of credits - 3

Aim of the course

To demonstrate basic principle 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: [1-9 ,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) Detection of abnormal constituents (glucose and albumin) in urine[two test each].
8) Detection of excretory products - ammonia (Nessler's test). urea (Ammonia generation/ Biuret test) and uric acid (Phosphotungstic acid test)
9) Preparation of blood smear and study of blood cells of human.
10) Isolation of casein from milk 12-13.[Any one]
11) Effect of temperature on the opercular activity of fish.

Biostatistics 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 and DNA replication)

Practical IV - Developmental Biology , Ecology, Ethology, Evolution and Zoogeography
Course Code — ZO1646

No. of credits - 3

Developmental Biology and Experimental Embryology

[Any six]

1. Study of different types of eggs-Amphioxus, frog, chick, human 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 onel
5. Study of placenta(model/specimen) - any two types.
6. Stained preparation of grass hopper sperm (demonstration)
7. Mount few eggs of Culex from the egg raft and record the life cycle of Mosquito
8. Mount the egg of yellow crazy ant (an alien invasive ant) *Anoplolepis* and describe the type of egg.

Ecology (1-14 Compulsory)

1. Estimation of dissolved oxygen of water sample.
2. Estimation of CO2 in water sample.
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. Pheromones for pest management

11(a) Mango fruit fly trap (*Dacus dorsalis*) by Methyl eugenol

11(b) Melon fly trap (*Bactrocera cucurbitae*) by cue lure trap

Environment Movements

12**.** Photo of Rachel Carlson, Sunderlal Bahuguna, Medha Patkar. (Photo of Eminent persons, Identify and comment on their contributions)

Evolution

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

Zoogeography

14. Study different zoogeographical realms with fauna.

First Degree Programme
Semester VI
Zoology Project and Field study

Course Code - ZO1647

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 group not exceeding 10 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 Departinent 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, shal1 not be repeated by any later batches of students. List.of projects submitted year wise is to. be maintained in a register and subrnitted before the examiners if requested. Supervising teachers are not suppose to guide topics involving biological samples and measurements on humans, unless there is clearence from the University level Ethical Committee.

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 (I hour/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. Study tour can be conducted seperately during the period of three years (such as one day visit to an ecologically important habitat or in a Research Institution) or continuously for four to six days.

PATTERN OF UNIVERSITY QUESTIONS

(from 2019 Admission)

Duration : 3 hours

Max marks: 80

10 x 1	= 10 marks	No option
10 x 2	= 20 marks	15 questions
6 x 5	= 30 marks	10 questions
2 x 10	= 20 makrs	4 question
Total 28	**80 marks**	**39 questions**

(The pattern of question was approved in Annual meeting of Board of studies in Zoology (pass), held at 11 am on 11/12/2017 in the Dept. of Zoology, Kariavattom)

Semester V

Zoology Open Course I

Public Health and Hygiene

Course Code - Z01551.1

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 personal hygiene and sanitation.

Module I **6hrs**

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 **4hrs**

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 **18hrs**

Health Hazards: Health dynamicity - definition, factors influencing health. health as medium of socio-economic development. Diseases - Common food borne and water born be diseases (gastroenteritis, jaundice,-cholera; salmonellosis, travellers' diarrhoea and *Escherichia coli* infection, typhoid) – mode of transmission, causative agents, symptoms,

prevention and control. Sexually mode. of transmission, (STD) 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, Weil's disease (general methods of mosquito control and the need; to prevent mosquito breeding in and around our homes).

Life style 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 **6hrs**

Health Education: Definition, objectives, principles and methods of health education, ill effects 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 **12hrs**

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 **8hrs**

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.

NB:-**Assignments/ Seminar** - Topics-related to syllabus- can he given to students as assignment/seminar.

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.

Zoology Open Course Il

Human Health and Sex Education

Course Code - Z01551.2

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 1 **14hrs**

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 and lifestyle diseases. Community health- health centres, role of health centres. Spiritual health. yoga and meditation.

Module II **8hrs**

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, hysterectorny and menopause.

Module III **7hrs**

Events of human reproduction: Gametogenesis- spermatogenesis and oogenesis. ovulation, fertilization, embryonic –development pregnancy, morning sicknes, parturition

Module IV **12hrs**

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, SUZ1 (sub-zonal insemination), MIST (micro insemination sperm transfer)

Module V **6hrs**

Sexually transmitted diseases (STD): Syphilis, genital warts, chlamydia, chancroid, gonorrhea, genital herpes, AIDS

Module V **7hrs**

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

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

References

- Common sexual problems and solutions by Dr. Prakash Kothari, UBS Publishers and Distributors Ltd.
- Mac E. Hadley. Endocrinology. Pearson Education, Singapore.
- Taylor, D.J., Green, N.P.O.. Stout G. W. Biological Science. (Editor R. Soper) 3rd Edition, Cambridge University Press.
- The Complete Manual of Fitness and Well-being. The Reader's Digest Association, Inc. Pleasantville,. New York / Montreal.
- Guyton & Hall.Textbook of Medical Physiology.

Semester V

Zoology Open Course III

Human diseases and their management

Course Code - Z01551.3

No. of credits - 2 **Total hours 54**

Aim of the course

To instruct 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 **6 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 **6 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 III **6 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 IV **6 hrs**

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

Module V **6 hrs**

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

Module VI **6 hrs**

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

Module VII **6 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)

ModuleVIII **10 hrs**

Basic viewing techniques- endoscopy: Examination techniques: Blood- total count, differential count, ESR, blood clotting test, routine blood chemistry, blood cholesterol test, hormone tests; urine-routine, urine chemistry: cell and tissue test. pap test, biopsy, histopathology;. prenatal diagnosis tests-amniocentosis, chorionic villi sampling: imaging techniques- X - ray. ultrasound scanning, CT scan, MRI scanning:

Module IX **2 hrs**

Role of yoga in management of common diseases.

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

References

- Abraham Verghese. (1996). Introduction to Psychiatry. 131 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. Mentaf Hygiene. - A Science of Adujustment.. 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.

Semester VI

Zoology Elective Subject – I

Economic Zoology – Vermiculture and Apiculture

Course Code – ZO1651.1

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 **24hrs**

Module I **6 hrs**

Introduction: definition and scope of vermiculture. Nature and species of earthworrms: habit categories - epigeic, endogeic and anecic, indigenous and exotic species *(Eudrillus eugeniae/Eisenia .foetidae/Perionyx excavatus/ Lampito mouritii)*. 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**

Vermi compost profile and applied aspects: physical, chemical and biological parameters of vermicast,. vermin . enrichment, economic uses of vermiculture (biofertilizer, waste disposal, vermiwash, 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.

NB:**Assignments/ Seminar** - Topics 'related to syllabus, can be given to students as assignment/ seminar.

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.

Semester VI

Zoology Elective Subject II

Ornamental Fresh water fish production

Course Code – ZO 1651.2

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 I **7 hrs**

Importance and history of aquarium fish keeping. Design and consruction 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 dissolve carbon dioxide, ammonia, hardness, turbidity and ozone in aquarium.

Module III **3 hrs**

Aqarium plants: Uses of aquarium plants - different varieties of plants like submerged plants (tubers, rooted plants. cutting plants) and emerged plants.

Module IV **12hrs**

Fresh water ornamental fishes- : Common ornamental fishes indigenous and exotic species; Identification and biology of the common ornamental fishes. *Cyprinius carpio* (koi carp).*Molliensia sphenops* (black molly lyre tail), *Poecilia reticulata* (guppy). *Poecilia latipinna*, *Xiphophorous* helleri (red sword tail) *Xiphophorous maculates* (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 **8 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 **8 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 **12Hrs**

Indigenous ornamental fishes - Common indigenous ornamental fishes. Identification and biology of the common ornamental fishes. Cyprinids.:*Puntius denisonii* (red line torpedo fish), *Punaus 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: *Etroplus maculatus* (yellow :.and orange chromides), *E . suratensis* (pearl spot),

Anabantids: *Anabas* testudineus (climbing-'perch) and Catfishes: *Horabagrus brachysoma* (Yellowish catfish). H . *nigricollaris* (White collared imperial catfish).

Assignment:

Students are to visit ornamental fish hatchery/ pet shop and submit a report with photos.

References

- Arumugam. N. (2008). Aqua culture, Saras publications, Tamil Nadu, India.
- Axelord, H.R. (1967). Breeding aquarium fishes, T F H Publications.
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- Gerhard Brunner, (1973). Aquarium plants, T F H Publications. Inc. Ltd.. Hongkong.
- Harishankari. A & A..Bij Kumar, (1997). Aquarium Fishes, B. R. publishing Corporiition, 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.
- Tom Lovell (1998). Nutrition and feeding of fish second Ed. Kluwer Academic publishers.
- Talwar.P.K., and Thingran.A.G..(1991). Inland fishes Oxford and IBH Publishing Co PVT LTD, New Delhi.

First Degree Programme
Semester VI
Zoology – Elective Subject – III
Human Nutrition
Course Code - ZO1651.3

No. of credits - 2 Total hrs 54

Aim of the course

To make aware the students about the importance of nutrition in maintaining health.

Objectives of the course

- To cultivate proper feeding habits.
- To learn the proper and scientific value of different food items.

Module 1 **15 hrs**

Introduction and scope. Carbohydrates, Proteins and Lipids - **Carbohydrates** : Functions, classification, food sources. storage in body, biomedical importance. Brief outline of metabolism : glycogenesis & glycogenolysis (in brief), glycolysis, citric acid cycle. Clinical significance.

Proteins - Functions, classification. food sources, composition, essential & non-essential amino acids, protein deficiency. biomedical importance. Metabolism: Transformation, Decarboxylation, Ammonia formation & transport, Urea cycle. Clinical significance

Fats & oils: Function of fats. classification, food sources, composition. saturated and unsaturated fatty acids. biomedical importance, essential fatty acids. Brief out line of metabolism : Beta oxidation of fatty acids. Ketosis. Cholesterol. Clinical significance.

Module 11 **15 hrs**

Vitamins and minerals - sources and functions, deficiency status. Minerals - macro & micronutrients - functions, sources. Bioavailability and deficiency of Calcium, Iron, Iodine, Sodium & Potassium (very brief account). Water - as a nutrient, function, sources, requirement, water balance & effect of deficiency.

Module 111 **5 hrs**

Calorific values of food - Basal metabolic rate, energy requirements of man, women infants and children.

Module IV **15 hrs**

Nutritional value of foods- cereals, fruits, milk, egg, meat, fish. Balanced diet. Nutrition in pregnancy - Physiological stages of pregnancy, nutritional requirements, food selection, complication of pregnancy.

Nutrition during lactation - Physiology of lactation, nutritional requirements. Nutrition during infancy -growth & development. nutritional requirements, breast feeding, infant formula. introduction of supplementary foods. 'Nutrition during early childhood (Toddler/Preschool)- Growth & nutrient need, nutrition related problems, feeding patterns. Nutrition of school children- Nutritional requirement. importance of snacks. school lunch. Nutrition during adolescence - Growth & nutrient:tieeds, food. choices, eating habits, factors influencing nutritional need. Nutrition during adulthood Nutritional requirements.-feeding pattern. Geriatric nutrition: Factors affecting- food-intake and nutrient-Use, nutrient needs. nutrition related problems.

Nutritional value of foods-cereals, fruits, milk, egg; meat.-fish. Balanced diet, Malnutrition.

Module V **5 hrs**

Interrelationship between nutrition & health : - Visible symptoms of goodshealth; Use of food in body -Digestion, Absorption. transport & utilization; Role of fibres in human nutrition; Effect of cooking & heat processing on the nutritive value of foods; Processed supplementary foods; Food sanitation in hygiene.

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

Reference:

- Gopalan.C, BS. Ramasastri & SC balasubramanian: 1971, Nutritive value of Indian foods. National Institute of Nutrition.Hyderabad.
- Gopalan.D & K. Vijaya raghavan 1971. Nutrition atlas of India, ICMR, New Delhi.
- Ghosh. S 1981, The feeding care of infants and young children, UNICEF, New Delhi. _
- Mudambi.SR ,1995. Fudementals of food and nutrition. New age international, New Delhi.
- Swaminathan.K 1989. Handbook of food and nutrition: Bappco, Bangalore.
- Swaminathan.M, 1974. Essentials of food and nutrition. Vol I & II, Ganesh and Co. Madras.

Zoology Complementary Course
FIRST DEGREE PROGRAMME
SCHEME OF INSTRUCTION OF ZOOLOGY COMPLEMENTARY COURSE

Course code	Course Title	Sem I			Sem II			Sem III			Sem IV			Total Credit	Duration of Examination	Evaluation	
		Hour Contact		Credit	Hour Contact		Credit	Hour Contact		Credit	Hour Contact		Credit			CE	ESE
		T	P		T	P		T	P		T	P					
ZO1131	ANIMAL DIVERSITY I	2		2										2	3 Hrs	20%	80%
ZO1231	ANIMAL DIVERSITY II				2		2							2	3 Hrs	20%	80%
ZO1331	FUNCTIONAL ZOOLOGY							3		3				3	3 Hrs	20%	80%
ZO1431	APPLIED ZOOLOGY										3		3	3	3 Hrs	20%	80%
ZO1432	PRACTICAL OF ZO 1131, 1231, 1331&1431		2			2			2			2		4	3 Hrs	20%	80%

Semester I
Zoology Complementary Course I
Animal Diversity I

Course Code - ZO1131 **Total hours: 36**

No. of credits - 2

Aim of the Course

To inculcate in the student a love and understanding of the fascinating world of invertebrates

Objectives of the course

- Impart to the student a concrete idea of the evolution, hierarchy and classification of invertebrate phyla
- Understanding the basics of systematics by learning of the diagnostic and general characters of various groups
- Getting an overview of typical examples in each phyla.
- To study.the economic importance of invertebrates with the special reference to insect pests

Module I **5 hrs**

Introduction: Classification of organisms- two kingdom system, three kingdom system, four kingdom system and five kingdom system.

Kingdom- Protista- General features and classification: Phylum Dinoflagellata eg:: *Noctiluca*: Phylum Parabasalia eg: *Trichonympha*; Phylum Ciliophora eg. *Paramecium*: Phylum Rhizopoda eg. *Entamoeba* - life history.

Module II **5' hrs**

Kingdom Animalia : Salient features. levels of organization- cellular. tissue,: organ and organsystem. Branches- Mesozoa, Parazoa and Eumetazoa-radiata and bilateria-

Protostomia. and Deuterostomia; acoelomata, pseudo coelomata and eucoelomata-schizocoela and enterocoela: body segmentation- metamerism and pseudometamerism.

Phylum Porifera: General characters (self study) classification up to classes- Class Calcarea eg. Sycon, Class Hexactinellida eg. *Euplectella*, Class. Desmospongiae eg. *Spongilla*

Phylum Cnidaria: General characters (self study), classification up to clases. Class Hydrozoa. eg. Obelia, Physalia mention polymorphism, Class seyphozoa eg. *Aurelia* mention larval stages, Class Anthozoa – Sea *Adamsia*.

Module III **10 hrs**

Phylum Platyhelminthes: General characters (self study), classification up to classes- Class Turbellaria eg. *Bipalium*, Class Cestoda eg. *Taema solium*, Class Trematoda e.g *Fasciola*.

Phylum Nematoda: General characters (self study), classification up to classes- Class Secernentea (Phasmida);eg. *Ascaris*, Class Adenophorea (Aphasmida); eg. *Trichinella*. Human nematode parasites.

Phylum Annelida : General . characters (self study), classification up to class. Class _ Polychaeta eg. *Nereis* (mention parapodium, heteronereis.); Class Oligochaeta eg. Earthworm (mention vermiculture); Class Hirudinea eg. *Hirudinaria*.

Phylum Mollusca: General characters (self study), classification up to cfasses:Class Aplacohophora - eg. *Neomenia*; Class Monoplacophora e.g. *Neopilina*; Class Bivalvia eg. Pearl oyster; Class Gastropoda eg. *Pila*; Class Cephalopoda eg. *Sepia*; class Scaphopoda eg.*Dentalium*. Economic importance of molluscs.

Phylum Onychophora: General characters, eg. Peripatus- evolutionary significance.

Module IV **13 hrs**

Phylum Arthropoda: General characters (self study), classification up to classes- Suphylum Trilobitomorpha- Class Merostomata eg. *Limulus*; Class Arachnida eg. Scorpion; Class Pycnogonida eg. Nymphon; Subphylum Mandibulata- Class Crustacea

eg. Prawn (detailed study); *Sacculina*; Class Chilopoda eg. *Scolopendra*; Class Symphyla e.g.*Scutigeralla*; Class Diplopoda eg.*Spirostreptus*; Class Pauropoda Class Insecta eg. Cockroach (self study- external characters mouth parts, digestive system); Mosquitoes-Anopheles, *Culex* and *Aedes*. pathogenicity of mosquitoes. Pest of paddy - *Leptocorisa* and *Spodoptera*, Coconut palm *Oryctes rhinoceros* and Eriophid mite, stored food grains -*Sitophylus oryzae* and *Tribolium*.

Module V **3 hrs**

Phylum Echinodermata: General characters (self study), classification- Class Asteroidea eg. sea star, Class Ophiuroidea eg. brittle star, Class Echinoidea eg. sea urchin. Class. Holothuroidea eg. Sea cucumber, Class Crinoidea eg.-sea lily (mention larval stages)

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

References

- Brusca R.C. and Brusca G.J. (1990) Invertebrates. Sinauer Associates. Sunderland.M.A
- Chandler, A.C. and Read. Parasitology.
- Hickman C.P. and Roberts L.S. (1994) Animal Diversity. Wm. C. Brown, Dubuque,IA
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- Ruppert E.E., Fox R and Barnes R.D. (2004) Invertebrate Zoology. Thomson Books.Cole. USA.

First Degree Programme
Semester II
Zoology Complementary Course II
Animal Diversity II

Course Code - ZO1231 **Total hours 36**
No. of credits - 2
Aim of the course

To inculcate in the student a fascination for nature and learn the bionomics of vertebrates.

Objectives of the course

- Learn the evolution. hierarchy and classification of different classes of chordates
- To get an overview of the morphology and physiology of typical examples.
- To study the adaptations and economic importance of specific vertebrates.

Module I **10 hrs**

Phylum Chordata: Salient features of the phylum Chordata (self study), classification up to classes- Subphylum Urochordata eg. *Ascidia*- general characters. external features and retrogressive metamorphosis; Subphylum Cephalochordata- General characters, eg. *Amphioxus*.

Module II **10 hrs**

Subphylum Vertebrata: General characters (self study), classification- Super class Agnatha eg. *Petromyzon*: Super class Pisces eg. Scoliodon, Narcine, Anguilla. Echeneis. *Hippocampus*. *Etroplus*. *Mackerel Sardine, Pomfret; Super class Tetrapoda- Class Amphibia- General characters and eg. lchthyophis*, *Rhacophorus*, *Amblystoma*-axolotl larva.

Module III **9 hrs**

Class Reptilia: General characters (self study), eg. *Calotes, Draco, Chameleon*, *Chelone.* snakes-general features, non poisonous snakes eg. *Lycodon, Ptyas* (external features and peculiarities of examples), poisonous snakes eg. *Naja*, *Viper*, *Bungarus*, *Enhydrina*

(characteristic features), identification of poisonous and non poisonous snakes, different types of venom. mode of action.

Module 1V **7 hrs**

Class Ayes: General characters (self study), flightless birds- eg. Ostrich and Kiwi, flying birds eg.Pigeon- mention different types of feathers and pea fowl. Flight adaptations of birds. **Class Mammalia**- General characters (self study), eg. Echidna, Kangaroo, Bat. Loris, Tiger and Whale.

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

References

- Dhami. P.S and Dhami, J:K..Vertebrate Zoology. R. Chand and Co.
- Ekambaranatha Ayyar, M. and Ananthakrishnan, T.N. A Manual of Zoology. Vol II
- Green N.P.O., et al (2000) Biological Science. Cambridge University Press.
- Jordan, E.L. and Verma, P.S. Vertebrate Zoology. S. Chand and Co.
- Kotpal, R.L. (2002) Modern Text Book of Zoology: Vertebrates. Rastogi Publishers
- Mayer E. (1980) Principles of Systematic Zoology. Tat Mc Grow Hill Publishing New Delhi.
- The New Encyclopedia Britannica, Macropedia, (1998). Encyclopedia Britannica

Semester III
Zoology Complementary Course III
Functional Zoology

Course Code - ZO1331 **Total hours 54**

No. of credits - 3

Aim of the course

To familiarize students on the physiology of their own body and urge them to take precautionary measures to safeguard their health.

Objectives of the course

- To study the structure and function of each system in the human body.
- To study the etiology of common physiological disorders, syndromes and diseases.

Module I **4 hrs**

Nutrition: Types of nutrition - autotrophy and heterotrophy. Outline classification of food components. Brief mention of malnutrition disorders. Vitamins - physiological role and disorders (deficiency diseases).

Module H **6 Hrs**

Respiration: Respiratory pigments and their functions with special emphasis on haemoglobin transport of oxygen and carbon dioxide.

Respiratory • disturbances - brief mention of Apnoea, Dyspnoea, Hypoxia, Hypo and Hypercapnia. Asphyxia and Carbon monoxide poisoning. Physiological effects of smoking.

Module III **8 hrs**

Circulation : Blood-composition and functions, blood groups, mechanism of blood clotting (intrinsic and extrinsic pathways), anticoagulants, disorders of blood clotting -haemophilia and thrombosis. Heart - neurogenic and myogenic, peculiarities of cardiac muscle. Heart beat, pace maker. Blood pressure. ECG. cardiovascular disorders- arteriosclerosis, myocardial infarction and hypertension; angiogram and angioplasty.

Module IV **6 hrs**

Excretion and osmoregulation:- Classification of animals based on excretory wastes. Human nephron - structure and urine formation ultrafiltration, selective reabsorption, tubular secretion and countercurrent mechanism; hormonal control of renal function: composition of urine. Kidney diseases - proteinuria, uremia. acidosis and alkalosis; dialysis.

Module V **6 hrs**

Neurophysiology: Neurone-structure, nerve impulse -resting potential action potential and latent period; synapse and synaptic transmission- All or none law, refractory period, neurotransmitters. Saltatory transmission and EEG.

Module. VI **8 hrs**

Muscle Physiology: Ultra-structure of a striated muscle fibre, mechanism.of muscle contraction, brief mention of muscle twitch, summation, tetanus and tonus, all or none law, fatigue, oxygen debt and rigor mortis.

Module VII **8 hrs**

Endocrinology: List the various endocrine glands and their corresponding hormones, brief description of hormonal influence. action and hormonal disorders- goitre, cretinism exophthalnic goitre diabetes mellitus diabetes insipidus, dwarfism, gigantism and acromegaly. Role of Hormones in reproductive cycle.

Module VIII **8 hrs**

Immunology: Types of immunity-innate, acquired, active, passive, humoral and cell mediated. Cells, tissues and organs of immune system- lymphocytes, lymphoid tissue and organs (Lymph nodes, spleen, hone marrow, thymus and mucosa associated lymphoid tissue). Antigens. Antibodies- structure and function of immunoglobulin, classes of immunoglobulins. Hypersensitivity and allergy; immunization-passive and active; vaccination. AIDS and its etiology.

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

References

- Eckert R and Randall D (1987) Animal physiology, CBS Publishers and Distributors,
- Ganong, W.F. (2002) Lange Review of Medical Physiology. Mc G H.
- Ganong, W.F. (2003) Review of medical physiology. Mc Graw-Hill, New Delhi.
- Goyal, K.A. & Sastrv. K.V. :Animal Physiology. 6e 2002, Rastogi Publishers.
- Guyton A.C. (1998) Text book of Medical Physiology. W.B. Sanders Co.
- Hoar W.S. (1975) General and Comparative Physiology. Prentice Hall.
- Joshi, K.R. (2003) Immunology. Agro.
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- Nagabhushanan R. Kohardar M.S. and Sarojini R (1983) A textbook of animal physiology. Oxford IBH publishing, Co. New Delhi.
- Roitt J (2000) Immunology. W. Freeman, Oxford.
- Schimdt-Niclson K (2002) Animal Physiology. Prentice Hall India Ltd. Sebastian KM.- (1990). Animal Physiology. Madona Books. Kottayam.
- Withers P.X. (1992) Comparative animal physiology. Saunders College Publishing. New Delhi.

Semester IV

Zoology Complementary Course IV

Applied Zoology

Course code - ZO1431 **Total hours 54**

No. of credits - 3

Aim of the course

To introduce the methodology and perspectives of applied branches of zoology with a view of educating youngsters on the possibilities of self employment.

Objectives of the course

- To learn the basic principles involved in the culture and breeding of common, edible and ornamental fishes of Kerala and the art of aquarium keeping.
- To get a basic understanding of human genomics and reproductive biology including stern cell research and prenatal diagnostic techniques

Module I **17 hrs**

Aquaculture: Traditional methods of aquaculture, fishing crafts and gears, common fishes used for culture in Kerala, *Catla, Etroplus, Tilapia and Mugil;* capture fishes- *Sardine*, *Mackerel*.

Pond culture: Construction, maintenance and management; carp culture, shrimp culture, shellfish culture, composite fish culture and pearl culture

Ornamental fish culture: Fresh water ornamental fishes - biology, breeding habits; spawning, hatching and rearing techniques.

Construction and maintenance of aquarium: Construction of home aquarium, materials used, setting up of freshwater aquaria, aquarium plants, ornamental objects, cleaning the aquarium, maintenance of water quality. control of snail and algal growth.

Module II **10 hrs**

Sericulture: Brief account of morphology and life history of silkworm, varieties of silkworm, rearing technique, mulberry cultivation, diseases and pests of silkworm. Processing. of cocoon, reeling and marketing of silk.

Apiculture: Species of honey bees, social organization of honey bees, apiary management and maintenance, bee keeping equipments, bee pasturage, honey and bees wax and their uses.

Module III **8 hrs**

Live Stock Management: Poultry farming, poultry breeds: mention American, Asiatic, Mediterranean, English and indigenous breeds. Poultry breeding and poultry products; rearing of chicks, growers, layers, broilers, ducks. turkeys and quails; diseases of poultry:

Dairy farming: Types, loose housing system and conventional barn system; advantages and limitations of dairy farming: establishment of dairy farm and choosing suitable dairy animals, feed, diseases of dairy animals.

Module IV **7 hrs**

Human Genetics: Normal chromosome complements: karyotype study, pedigree analysis. Syndromes- autosomal syndromes (Down's syndrome and Edwards syndromes), sex chromosomal syndromes (Turners syndrome and Klinefelter's syndrome), genetic disorders single gene disorders (sickle- cell- anemia and phenyl ketonuria), multifactorial disorders (cleft lip, and cleft palate), genetic counseling

Module V **12 hrs**

Developmental Biology and Biotechnology .:Types of egg; fertilization; types and pattern of cleavages, blastulation - different types of blastula, gastrulation- morphogenetic movements (epiboly and emboly); brief description of organizers and embryonic induction. Cloning experiments in animals and man. Embryonic stem cell research.

Prenatal diagnostic techniques-amniocentesis, chorionic villus sampling, ultrasound scanning. Test tube babies, gene cloning, human genome project, human gene therapy.

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

References

- Bard. J (1986). Handbook of Tropical Aquaculture.
- Gardner, E.J (1983). Human heredity, John Wiley and Sons, New York
- Hawkins, A.D (1981). Aquarium Systems, Academic Press
- Lewin, B (1983). Genes, John Wiley and Sons, New York.
- Mishra, R.0 (2002). Perspectives in Indian Apiculture, Agro
- Philips, E.F(2003). Bee Keeping. Agro
- Santhanam, R. A. Manual of Aquaculture.
- Shukla and Upadyay (2002). Economic Entomology.
- Tembhare, D.B (1997). Modern Entomology, Himalaya Publishing House.
- Zuka. R.1 and Hamiyn (1971). Aquarium fishes and plants

First Degree Programme

Zoology Complementary Course V

Practical I -Animal Diversity I & II Functional Zoology and Applied Zoology

Course Code – ZO1432

No. of credits - 4

Aim of the course

To provide hands on training experience in anatomy through simple dissections 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.

To study and carry out row ine clinical analysis of blood and urine

Animal Diversity I & II

Study specimens

1. Protista : *Noctiluca*, *Paramecium*, *Entamoeba*, *Trichonympha* [any 3]
2. Porifera : *Sycon*
3. Cnidaria : *Obelia*, *Aurelia*, Sea anemone (*Adamsia*)
4. Platyhelminthes : *Bipalium, Fasciola, Taenia solium*
5. Nematoda : *Ascaris*, *Ancylostoma*
6. Annelida : *Nereis, Hirudinaria*
7. Arthropoda : *Limulus*, Scorpion, *Scolopendra*, *Sacculina*, *Leptocorisa Oryctes*, Larval stages of prawn [any 5]
8. Mollusca : Freshwater mussel, *Sepia*, *Pila*
9. Echinodermata : Starfish, Sea urchin, Brittle star, Sea cucumber, sea lily [any 3]

10. Chordates : *Branchiostoma* (*entire*), *Ascidia, Petromyzon*

    Scoliodon, Narcine, Echeneis, Hippocampus, Anguilla [any 3]

    Icthyophis, Amblystoma, Rhacophorus [any 2]

    Chamaeleon, Bungarus, Naja, Vipera, Chelone [any 4]

    Pigeon - different. types of feathers

    Pteropus

Minor Practicals (Mounting) - any three

1. Earthworm : Setae
2. *Penaeus* : Appendages (Maxillipeds, Chelate, First abdominal- any three)
3. Cockroach :Mouth parts
4. Nereis : Parapodium
5. Shark : Placoid scales

Major Practicals (Dissection) - any two

1. Earthworm : Alimentary canal and associated glands (Demonstration, Flag labeling of parts.
2. *Penaeus:* Nervous system
3. Cockroach : Alimentary canal

Osteology

Study of the skeleton of frog

1. Vertebrae (typical, 8th, 9th and urostyle)
2. Limb girdles: pectoral girdle with sternum, pelvic girdle.

Functional and Applied Zoology

Functional Zoology [1-4, Compulsory]

1. Preparation of human blood smear to study the different types of WBCs.
2. Human blood grouping: ABO and Rh Systems.
3. Urine analysis for abnormal constituents: albumin and glucose.

4. Study of slides/models of different types of eggs (frog. chick), blastula of frog and gastrula of frog.

Applied Zoology [1-2, Compulsory]

1. Study of beneficial insects *Apis* (worker, drone and queen). Bombyx (life cycle, silks
2. Study of the following items of economic importance: *Perna*, *Pinctada, Penaeus*, *Sardinella*.

Human Genetics [1-2, Compulsory]

Study of the following using charts/photographs

1. Study of normal human karyotype.
2. Study of abnormal human karyotypes. [Klinefelter's, Turner's, Down.and Edward’s syndrome]

COMPLEMENTARY ZOOLOGY

(FOR B.Sc PSYCHOLOGY COURSE)

From 2019 admission onwards

Semester 1	ZO. 1131	Complementary Course I BRAIN AND BEHAVIOUR
Semester 2	ZO 1231	Complementary Course III SENSORY PHYSIOLOGY
Semester 3	ZO 1331	Complementary Course V PHYSIOLOGY OF MOTIVATION
Semester 4	ZO 1431	Complementary Course VII PHYSIOLOGY OF EMOTION AND COGNITION

Semester I : Complementary Course I **Total hours: 54**

(Credits 2, Weekly hours 3)

Course Code ZO1131

BRAIN AND BEHAVIOUR

1. **Neurophysiology** **(12 hrs)**

1.1. Neuron-structure and function

1.2. Types of neurons – myelinated and unmyelinated; unipolar, bipolar and multipolar; sensory, motor and interneurons

1.3. Glial Cells-different types and functions

1.4. Nerve impulse generation and transmission-Resting membrane potential, action potential, hyperpolarization, saltatory conduction, threshold stimulus and potential, latent period, All or none law, Refractory period

1.5. Synaptic transmission-chemical transmission across synapse, electrical transmission, synaptic delay, synaptic fatigue

1.6. Neurotransmitters – types (brief mention about acetyl choline, aspartic acid, glutamic acid, serotonin, histamine, adrenalin, glycine, GABA, dopamine), synthesis, transport, storage, release and diffusion, activation of receptors of the postsynaptic cell, inactivation and reuptake, negative feedback from postsynaptic cell. Role of neurotransmitters in psychotic behavior

2. **Techniques in Physiological Psychology (Components, Principle and application)**

(8 hrs)

2.1 CT Scan
2.2. PET Scan
2.3. MRI and functional MRI
2.4. NMR
2.5. rCBF
2.6. Brain lesioning and Deep brain stimulation (mention stereotactic surgery)
2.7. Transcranial magnetic stimulation

2.8. EEG (mention different types of brain waves

3. **Nervous System and behavioural functions** **(18 hrs)**

3.1. Overview of human Central nervous system

3.2. Structural overview of the brain – forebrain, midbrain and hind brain

3.3. Limbic system and hypothalamus – functional anatomy, behavioural and motivational functions of the hypothalamus and associated limbic structures, functions of hippocampus, amygdala and limbic cortex

3.4. Motor functions of Cerebellum, basal ganglia and spinal cord; spinal cord reflexes – monsynaptic and multisynaptic

3.5. Non- neural material in the CNS – non-neural cells (Schwann cells, neuroglia, microglia, ependymal cells, oligodendrocytes and astrocytes), meninges, cerebral blood flow, ventricles of the brain and cerebrospinal fluid, blood brain barrier

3.6. Neuroplasticity of brain

3.7. Peripheral nervous system, Autonomic nervous system; The brain in action: sensory and motor processing.

4. **Cerebral cortex and language functions** **(16 hrs)**

4.1. Physiologic anatomy of cerebral cortex – cortical neurons- stellate and pyramidal cells; cortical areas sensory and motor areas and their classification; sensory and motor homunculus; functions of specific cortical areas

4.2. Brief mention about Cerebral lateralization and handedness, interhemispheric differences and sex differences in cerebral function

4.3. Language functions of cerebral cortex - Wernicke's area, Broca's area, Motor cortex, Arcuate fasciculus, Wernicke- Geshwind model of language perception and production; Brain damage and language - Wernicke's aphasia, Broca's aphasia; Conduction aphasia, Global aphasia, Transcortical aphasia

Reference:

1. S. Marc Breedlove, Neil Verne Watson and Mark R. Rosenzweig (2010) Biological Psychology: An introduction to behavioural, cognitive and clinical neuroscience, 6th Edition, Sinauer Associates, Incorporated Publishers.
2. Arthur C. Guyton and C.E. Hall (2010) Text Book of Medical Physiology, Elsevier Publishers.
3. Sabyasachi Sircar, (2008) Principles of Medical Physiology, 2nd Edition, Thieme Publishers.
4. James W. Kalat (2009) Biological Psychology, 10th Edition, Wadsworth
5. John P.J. Pinel, Biopsychology, Pearson International Edition

Semester II : Complementary Course III **Total hours: 54**

(Credits 3, Weekly hours 3)

Course Code ZO1231

SENSORY PHYSIOLOGY

1. **Vision** **(14 hrs)**

1.1. Structure of eye – anatomy and function of the structural elements of the retina

1.2. Photochemistry of vision – visual receptors, rhodopsin-retinal visual cycle, light and dark adaptation

1.3. Colour vision – theories, tricolour mechanism of colour detection, colour blindness

1.4. Neural function of the retina – neural circuitry, ganglion cells

1.5. Neurophysiology of vision -Visual pathways, visual cortex, binocular vision and accommodation, neuronal patterns for analysis of visual image, detection of colour, motion and depth, control of eye movements, control of accommodation and pupillary aperture

1.6. Visual defects

2. **Audition** **(10 hrs)**

2.1. Structure of ear – anatomy and functions of the structural components

2.2. Process of hearing, determination of sound frequency – place theory and volley theory; determination of loudness

2.3. Auditory pathways

2.4. Localization of sound - brain systems that analyze binaural cues

2.5. Hearing defects

3. **Chemical senses – Taste and Smell** **(8 hrs)**

3.1. Gustation - Taste receptors and their mechanisms – perception of salty, sour, sweet, bitter and umami tastes; Transmission of taste information to brain;

Taste preference

3.2. Olfaction - Olfactory membrane and receptors, transmission of smell signals to the brain, mechanism of olfactory coding and perception, categorizing odours; olfactory disorders

3.3. Interaction of taste and smell

4. **Cutaneous senses and proprioceptive senses** **(12 hrs)**

4.1. Touch and Pressure receptors: -Meissner's corpuscle, Markel's discs, Pacinian corpuscle, Ruffini's ending

4.2. Thermoreceptors: -warm and cold receptors, A-delta fibres, C-fibres, Mention Transient Receptor Potential (TRP) receptors

4.3. Position Senses: -Muscle spindle and Golgi Tendon Organ

4.4. Vestibular Senses (Labyrinthine Sense): -Otolith organs in inner ear (Utricle and Saccule- Structure and function), Semi-circular Canals-crista ampullaris (structure and function)

4.5. Mention Labelled Line principle

5. **Pain** **(10 hrs)**

5.1. Nociceptor-Different types, mention TRP channel, hyperalgesia

5.2. Different Types of Pain-Acute pain and chronic Pain, Neuropathic pain, Phantom Limb pain and mirror box, Psychogenic pain, pain asymbolia, mention referred pain and visceral pain; Headache – intracranial and extracranial; clinical abnormalities of pain and other somatic sensations – hyperalgesia, thalamic syndrome, Herpes Zoster, Tic Douloureux, Brown-

Sequard Syndrome

5.3. Pain Suppression system in the brain and spinal cord-Analgesia system in brain and spinal cord (periaqueductal gray , periventricular areas, raphe magnus nucleus, dorsal horn etc), Ascending and descending pathway of pain suppression, mention brain opiate system (endorphins and enkephalins), Gate control theory-Melzack and Wall

5.4. Pain Treatment and management: -Opioid and non-opioid analgesics, Anti-inflammatory drugs, cannabinoids, muscle relaxants, Acupuncture, Placebo effect, TENS

Reference

1. Frederick Toates (2011) Biological Psychology, 3rd edition, Pearson Education Ltd.
2. S. Marc Breedlove, Neil Verne Watson and Mark R. Rosenzweig (2010) Biological Psychology: An introduction to behavioural, cognitive and clinical neuroscience, 6th Edition, Sinauer Associates, Incorporated Publishers.
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Semester III : Complementary Course V **Total hours: 54**

ZO1331 **(Credits 3, Weekly hours 3)**

PHYSIOLOGY OF MOTIVATION

1. Physiological basis of wakefulness and sleep (14 hrs)

1.1. Physiological activity during sleep

1.2. Mechanism of sleep-waking rhythm - circadian rhythm – Suprachiasmatic nuclei, biochemistry of circadian rhythm

1.3. Functions of sleep

1.4. Characterizing sleep – NREM sleep and REM sleep

1.5. Neural control of sleep – ARAS, brain stem nuclei, noradrenergic systems, serotonergic systems, cholinergic systems, reciprocal interaction model of sleep, role of hypothalamus, sleep factor

1.6. Endocrine manifestations of sleep and wake

1.7. Biological perspectives on dreaming

1.8. Disruption of sleep and rhythms – insomnia, SADS, narcolepsy, Slow wave sleep disorders, REM sleep disorders, disruption of circadian rhythm, jet lag

2. Physiological basis of eating (12 hrs)

2.1. Feeding centres in the brain – hypothalamus

2.2. Internal cues for feeding – glucose based signal, fat based signal

2.3. Satiety – determinants of satiety

2.4. Neural and hormonal mechanisms of eating – hypothalamus, role of arcuate nucleus, orbitofrontal cortex and chemical factors – NPY, ghrelin, insulin, α-MSH, leptin; Palatability – role of opioids, GABA, taste aversion learning

2.5. Abnormalities of feeding – excessive food craving, obesity, anorexia nervosa,

cancer-associated anorexia

3. Physiological basis of drinking (12 hrs)

3.1. Hypothalamic control of thirst – osmotic and volemic thirst
3.2. Thirst receptors – signalling the brain
3.3. Regulating drinking behaviour – off signal – the lateral hypothalamic syndrome
3.4. Thirst satiety
3.5. Normal drinking – neuroscience of drinking, the cellular stimulus, extracellular stimulus, food related drinking, spontaneous drinking

4. Physiological basis of sexual behavior (16 hrs)

Define sex; dynamics of sexual behavior- mating patterns based on number of mates & breeding period- estrus, frequency of sexual behavior; external control of sexual behavior-Coolidge effect; external cues, brain and sexual behavior- performance circuit- nervous system during sexual intercourse; hormones and sexual behavior- role of hypothalamus, pituitary and gonads- Control of the secretion of sex hormones in male and female; Role of pheromones; Chemical interventions and sexual behaviour – chemicals that target dopamine, serotonin; Sexual orientation

Reference

1. Frederick Toates (2011) Biological Psychology, 3rd edition, Pearson Education Ltd.

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6. John P.J. Pinel, Biopsychology, Pearson International Edition
7. Levinthal, C.F. Introduction to Physiological Psychology. New Delhi Prentic –Hall
8. Schneider, A.M. and Tarshis, B. An Introduction to Physiological Psychology. New York: Random House.

Semester IV : Complementary Course VII **Total hours: 54**
(Credits 3, Weekly hours 3)

Course Code ZO 1431

PHYSIOLOGY OF EMOTION AND COGNITION

1. Neural basis of emotion **(14 hrs)**

1.1. Theories of emotion – physiological theories, biological theories, evolutionary theories

1.2. Neural mechanisms in emotion expression and emotion recognition - Limbic system – hypothalamus – amygdala – orbitofrontal cortex – cingulated cortex, hemispheric lateralization and emotion

1.3. Aggression – nature of aggression, hormones and aggression, neural mechanisms of aggression

1.4. Neural basis of pleasure

2. Clinical aspects of emotion **(10 hrs)**

2.1. Clinical Aspects of Emotion - Stress - Eustress and Distress - Stressors and Health effects - Coping mechanisms - Physiological aspects of stress - Psychological aspects of stress - Stress related disorders - Emotional breakdown - Cognitive breakdown.

3. Physiology of learning **(16 hrs)**

3.1. Learning – definition and types of learning - Motor, Verbal, Concept, Discrimination

3.2. Principles of learning - Problem solving, Attitude learning

3.3. Early learning discoveries- Pavlov’s experiments, contributions of Thorndike, Kohler and Skinner

3.4. Learning and nervous system- pseudolearning, role of cortex in learning- Lashley’s work, role of hippocampus in learning- Thompson’s work, learning outside hippocampus, synaptic basis of learning- Hebbian theory, Kendel’s findings

3.5. Neural mechanisms of sensitization & habituation

4. Physiology of memory **(14 hrs)**

4.1. Criteria of memory

4.2 Brain structures involved in memory – spinal memory, cerebellum, diencephalic structures, hippocampus, limbic system

4.3. Types of memory – declarative/explicit, non-declarative/implicit, semantic and episodic memories, long term and short term memories, engram, working memory

4.4. Neural basis of memory – cortical areas of memory storage, long term potentiation (LTP), Human amnesic syndrome, Korsakoff's syndrome

4.5. Cellular mechanisms of memory – changes in neuronal activity, structural changes, Hebb synapse

Reference

1. Frederick Toates (2011) Biological Psychology, 3rd edition, Pearson Education Ltd.
2. S. Marc Breedlove, Neil Verne Watson and Mark R. Rosenzweig (2010) Biological Psychology: An introduction to behavioural, cognitive and clinical neuroscience, 6th Edition, Sinauer Associates, Incorporated Publishers.
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