



CMS COLLEGE KOTTAYAM (AUTONOMOUS)

Affiliated to the Mahatma Gandhi University, Kottayam, Kerala

CURRICULUM FOR UNDERGRADUATE PROGRAMME

BACHELOR OF SCIENCE IN ZOOLOGY UNDER CHOICE BASED CREDIT SYSTEM 2016 (With effect from 2016)

SYLLABUS:

B.Sc ZOOLOGY PROGRAMMEMODEL – I

THEORY & PRACTICALS

SEMESTER 1. ZY1711101. CORE COURSE 1.

GENERAL PERSPECTIVES IN SCIENCE & PROTISTAN DIVERSITY

36 Hrs

Credits 2

Objectives:

- To create an awareness on the basic philosophy of science, concepts and scope
- To understand different levels of biological diversity through the systematic classification
- To familiarize taxa level identification of animals
- To make interest in Protistan diversity
- To impart knowledge on parasitic forms of lower invertebrates.

PART I PERSPECTIVES IN SCIENCE

8Hrs

Module I Introduction to Scientific Studies

4Hrs Types of

knowledge: practical, theoretical, and scientific knowledge. What is science, features of science, Deductive and inductive models, scientific temper, empiricism vocabulary of science.

Module II What is Biology?

4 Hrs

Life and its manifestations, History of Biology: Biology in ancient times Landmarks in the progress of Biology. Branches of Zoology, Scope of Zoology

PART II SYSTEMATICS

10 Hrs

Module III–Taxonomical Principles and tools

Systematic, Taxonomy, Phylogeny [Brief account], Approaches to taxonomy, Molecular taxonomy, Bar coding. Zoological nomenclature, International Code of Zoological Nomenclature (ICZN), Law of Priority. Five Kingdom Classification; Linnaean classification, Basis for Animal kingdom classification [Levels of organization, Symmetry, Coelom]

Identification tools

Taxonomic key. Types: Single access key- Dichotomous [linked and nested] and Polytomouskey, Multi access key, Computer aided Interactive Key
Advantages and Disadvantages

PART III: PROTISTAN DIVERSITY

18 Hrs

Module IV – Kingdom Protista Type: *Paramecium*

5 Hrs

Salient features of Kingdom Protista

10 Hrs

Classification of Protista up to phyla

1. Phylum Rhizopoda :Eg. *Amoeba*
2. Phylum Actinopoda : Eg. *Actinophrys*
3. Phylum Dinoflagellata : Eg. *Noctiluca*
4. Phylum Parabasalia : Eg. *Trypanosoma*
5. Phylum Metamonada : Eg. *Giardia*
6. Phylum Kinetoplasta : Eg. *Trypanosoma*
7. Phylum Euglenophyta : Eg. *Euglena*
8. Phylum Cryptophyta : Eg. *Cryptomonas*
9. Phylum Opalinata : Eg. *Opalina*
10. Phylum Bacillariophyta :Eg. Diatoms
11. Phylum Chlorophyta :Eg. *Volvox*
12. Phylum Choanoflagellata :Eg. *Proterospongia*
13. Phylum Ciliophora : Eg. *Balantidium coli*
14. Phylum Sporozoa : Eg. *Plasmodium*
15. Phylum Microsporidia :Eg. *Nosema*
16. Phylum Rhodophyta :Eg. Red Alga

(Mention any five general characters for each phylum. Detailed accounts of examples are not necessary.)

General Topics:

3 Hrs

1. Parasitic protists (diseases mode of transmission and prophylactic measures) - Entamoeba, Trypanosoma, Plasmodium (detailed account of life cycle), Leishmania .

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SEMESTER 1

CORE COURSE PAPER 1

PERSPECTIVES IN SCIENCE & PROTISTAN DIVERSITY

(PRACTICAL)

36 Hrs

2 Credits

1. Taxa, identification techniques
Bird body parts
Butterfly/ dragonfly body parts
2. Identification using keys
Insect, Fish, Snake (Poisonous & Non Poisonous)(Any 3 specimens from each category)
3. General identification - The students are expected to identify any 6 Protistans studied by their generic names and write the general characters of their Phylum.
4. Identification of any 4 economically important protists/parasitic protists(Slides/figures may be used for identification)
5. Identification of two Protistan from pond water

SEMESTER 11. ZY1712102

CORE COURSE 11: ANIMAL DIVERSITY - NON CHORDATA

36 Hrs

Credits 2

Objectives:

- To create appreciation on diversity of life on earth
- To understand different levels of biological diversity through the systematic classification of invertebrate fauna
- To familiarize taxa level identification of animals
- To understand the evolutionary significance of invertebrate fauna

- To instill curiosity on invertebrates around us
- To impart knowledge on parasitic forms of lower invertebrates.

MODULE I Kingdom Animalia

7 Hrs

Outline classification of Kingdom Animalia

Three branches - Mesozoa, parazoa and Eumetazoa

Mesozoa: Phylum Orthonectida - eg. *Rhopalura* (mention 5 salient features)

Parazoa:

1. Phylum Placozoa – Eg. *Trypanoplas adherens*

2. Phylum Porifera – Classification upto classes; Mention gemmules Class I- Calcarea. Eg. *Sycon*.

Class II – Hexactinellida .Eg. *Euplectella*. Class III -

Demospongia Eg. *Cliona*.

General Topics

1. Canal system in sponges.

Phylum Coelenterata -Classification upto classes

Class I - Hydrozoa Eg. *Eg. Obelia* - mention Metagenesis Class II- Scyphozoa

Eg. *Rhizostoma*.

Class III- Anthozoa Eg. *Metridium*.

General Topics:

1. Coral and coral reefs with special reference to conservation of reef fauna.

2. Polymorphism in Coelenterates

Phylum Ctenophora - Eg. *Pleurobrachia*.

MODULE II

Phylum Platyhelminthes Salient features; classification up to classes

3 Hrs

Class I - Turbellaria. Eg. *Planaria*.

Class II –Trematoda Eg. *Fasciola*

Class III- Cestoda Eg. *Taenia saginata*.

General Topics:

1. Life history of *Fasciola hepatica*.

2. Platyhelminth parasites of Man and Dog (*Schistosoma*, *Taenia solium*, *Echinococcus*).

Phylum Nematelminthes(Nematoda)

2 Hrs

Salient features, classification up to classes

Class: Phasmodia Eg. *Enterobius*,
Class: Aphasmodia Eg. *Trichinella*

General Topic

Pathogenic nematodes in man. (*Wuchereria bancrofti*, *Ascaris lubricoides*, *Ancylostomaduodenale*, *Trichinella*).

Phylum Annelida:

2 Hrs

Salient features, Classification upto classes. Class I-	Archiannelida	Eg.
<i>Polygordius</i> Class II -Polychaeta	Eg. <i>Chaetopterus</i>	
ClassIII- Oligochaeta	Eg. <i>Megascolex</i> .	
Class IV- Hirudinea	Eg. <i>Ozobranchus</i> , <i>Hirudinaria</i>	

MODULE III

14 Hrs

Phylum Onychophora

Eg. *Peripatus* (Mention its affinities).

Phylum Arthropoda

Salient features, Classification upto classes

Type: Prawn – *Fenneropenaeus* (*Penaeus*)

1. Sub Phylum - Trilobitomorpha

Class -Trilobita (mention the salient features).Eg.*Triarthrus* – A trilobite (extinct)

2. Subphylum –Chelicerata

Class 1 Merostomata (Xiphosura) (Eg. *Limulus*)

Class 2.Arachnida (Eg., *Palamnaeus*- Scorpion)

Class 3 Pycnogonida (Eg. *Pycnogonum* – Sea spider)

3. Subphylum- Crustacea

Class 1 Branchiopoda Eg. *Daphnia*

Class 2 Ostracoda Eg. *Cypris* -seed shrimp Class 3

Copepoda Eg. *Cyclops*

Class 4 Remipedia Eg. *Speleonectes* (eyeless crustacean seen in caves) Class 5. Branchiura Eg., *Argulus*

(common fish louse)

Class 6 Cirripedia Eg. *Sacculina* (parasitic castrator of crabs) Class 7 Malacostraca

Eg. *Squilla* (spot tail mantis shrimp)

4. Subphylum- Uniramia

Class 1 Chilopoda Eg. *Scolopendra* – (Centipede)

Class 2 Symphyla	Eg. <i>Scutigera</i> – (garden centipedes or pseudocentipedes)	Class 3 Diplopoda	Eg.
<i>Spirostreptus</i> - (Millipede)			
Class 4 Pauropoda	Eg. <i>Pauropus</i>		
Class 5 Hexapoda (Insecta)	Eg. <i>Bombyx mori</i> – (silk moth)		

MODULE IV

Phylum Mollusca 3 Hrs

Salient features, Classification upto classes Class I- Apalcophora Eg. *Neomenia*
Class II- Monoplacophora Eg. *Neopilina*
Class III Amphineura Eg. *Chiton*
Class IV Gastropoda Eg. *Aplysia*
Class V Scaphopoda Eg. *Dentalium*
Class VI Pelecypoda (Bivalvia) Eg. *Pinctada*
Class VII Cephalopoda Eg. *Sepia*

Phylum Echinodermata 3 Hrs

Classification upto classes

Class I- Asteroidea Eg. *Astropecten*
Class II- Ophiuroidea Eg. *Ophiothrix*
Class III- Echinoidea Eg. *Echinus*
Class IV- Holothuroidea Eg. *Holothuria*
Class V – Crinoidea Eg. *Antedon*

Topics

1. Water vascular system in Echinodermata

Phylum Hemichordata: 2 Hrs

Eg. *Balanoglossus*

Minor Phyla

1. Chaetognatha Eg. *Sagitta*
2. Sipunculida Eg. *Sipunculus*

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PRACTICAL

ANIMAL DIVERSITY- NON CHORDATA

36 Hrs.

Credit 1

Scientific Drawing:-

Make scientific drawings of 5 locally available invertebrate specimens belonging to different phyla.

Anatomy:-

Study of sections. (Any two)

1. Hydra.
2. Ascaris (male and female)
3. Earthworm
4. Fasciola

Dissections

1. Prawn - Nervous system
2. Cockroach - Nervous system

Mounting:-

1. Prawn appendages.
2. Mouth parts - Cockroach/ Plant bug/ House fly / Mosquito. (Any Three)

Identification:-

General identification & classification - The students are expected to identify, classify and describe the following Phylum -wise number of animals by their common names, generic names and 30% of these by their scientific names. Porifera-1, Coelenterata-3, Platyhelminthes-2, Annelida-2, Arthropoda-5, Mollusca-4, Echinodermata-3

Identification of (a) Parasitic protist – any 2 (b) larval forms of *Fasciola*- any 2

(c)

Nematode parasites of man- any 3 (Slides/figures may be used for study)

Taxonomic identification with key:-

Identification of insects up to the level of Order (any Four).

SEMESTER 111, ZY1713103

CORE COURSE 111: ANIMAL DIVERSITY –CHORDATA

54 Hrs

3 Credits

Objectives

- To acquire in depth knowledge on the diversity of chordates and their systematic position.
- To make them aware of the economic importance of some classes.
- To understand the evolutionary importance of selected chordate groups

MODULE I

Introduction

1 Hr

General Characters and outline classification of Chordata up to class, Origin of Chordates –mention theories in brief

Protochordates: General characters and Classification

2 Hrs

1. Sub phylum:

Urochordata

Class I Larvacea

Eg. *Oikopleura*

Class II Ascidiacea Eg: *Ascidia* (Mention Retrogressive

Metamorphosis) Class III

Thaliacea

Eg: *Doliolum*

2. Sub phylum:

Cephalochordata

2 Hrs

Example - *Amphioxus* (Structure and affinities)

MODULE II

3.

Sub phylum: Vertebrata General characters and Classification

2 Hrs

4.

Division 1– Agnatha

Class I Ostracodermi

Eg: *Cephalaspis*

Class II

Cyclostomata

Eg: *Petromyzon*

Division 2 – Gnathostomata

10 Hrs

Super class Pisces General Characters and Classification

Class: Chondrichthyes - General Characters Sub class – Elasmobranchi Eg:

Narcine Sub class - Holocephali

Eg: *Chimaera*

Class: Osteichthyes - General Characters Sub class – Choanichthyes

Order 1 Crossopterygii (Coelocanth)

Eg: *Latimeria* (Evolutionary Significance)

Order 2 Dipnoi

Eg: *Lepidosiren* - Distribution, affinities and systematic position of lung fishes.

Sub class: - Actinopterygii

Super order 1. Chondrostei Eg: *Acipenser*

Super order 2. Holostei

Eg: *Amia*

Super order 3. Teleostei

Eg: Sardine

General topics

1. Accessory respiratory organs in fishes.
2. Parental care in fishes.
3. Scales in fishes.
4. Migration in fishes

MODULE III

Super class: Tetrapoda General characters, Classification up to Orders

11 Hrs

Class Amphibia - Type Frog (*Euphyctis hexadactylus*)

Order I Anura Eg: *Hyla*

Order II Urodela Eg: *Amblystoma* (mention axolotl larva and Paedomorphosis /neotony)

Order III Apoda Eg: *Ichthyophis*.

Class Reptilia

4 Hrs

Sub class I: Anapsida

Order Chelonia

Eg: *Chelone*

Sub class II: Parapsida

Eg: *Ichthyosaurus*

Sub class III: Diapsida

Order I Rhynchocephalia

Eg: *Sphenodon*

Order II Squamata

Eg: *Chamaleon*

Order III. Crocodilia

Eg: *Crocodylus*

Sub class IV: Synapsida

Eg: *Cynognathus*

General topic

Identification of poisonous and non-poisonous snakes

Class Aves

5 Hrs

Sub class I: Archeornithes

Eg: *Archaeopteryx* (Affinities)

Sub class II: Neornithes

Super order I: Palaeognathe

Eg: *Struthio*

Super order II: Neognathe

Eg: Brahminy kite

General topics

1. Migrations in birds
2. Flight adaptations in birds

MODULE IV

Class Mammalia

Type: Rabbit (*Oryctolagus cuniculus*)

17 Hrs

Brief mention of general characters and classification up to order with example. (Mention any five salient features of each order, detailed accounts of examples are not necessary) Sub class I: Prototheria Eg: Echidna, *Ornithorhynchus*

Sub class II: Metatheria Eg: *Macropus*

Sub class III: Eutheria

Order 1 Insectivora	Eg: <i>Talpa</i>
Order 2 Dermoptera	Eg: <i>Galeopithecus</i>
Order 3 Chiroptera	Eg: <i>Pteropus</i>
Order 4 Primates	Eg: <i>Loris</i>
Order 5 Carnivora	Eg: <i>Panthera</i>
Order 6 Edentata	Eg: <i>Armadillo</i>
Order 7 Pholidota	Eg: <i>Manis</i>
Order 8 Proboscidea	Eg: <i>Elephas</i>
Order 9 Hydracoidea	Eg: <i>Procavia</i>
Order 10 Sirenia	Eg: <i>Dugong</i>
Order 11 Perissodactyla	Eg: <i>Rhinoceros</i>
Order 12 Artiodactyla	Eg: <i>Camelus</i> -mention ruminant stomach
	Order 13 Lagomorpha
	Eg: <i>Oryctolagus</i>
Order 14 Rodentia	Eg: <i>Hystrix</i> (Porcupine)
Order 15 Tubulidentata	Eg: <i>Orycteropus</i>
Order 16 Cetacea	Eg: <i>Delphinus</i>

General topics

1. Dentition in Mammals
2. Aquatic Mammals and their adaptations.

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PRACTICAL

ANIMAL DIVERSITY - CHORDATA

36 Hrs

Credit 1

1. Scientific Drawing

Make scientific drawing of 5 locally available vertebrate specimens belonging to different classes

2. Dissections

Frog: Photographs/diagrams/one dissected & preserved specimen each/models may be used for study.

1. Frog Viscera
2. Frog Digestive System
3. Frog Arterial System
4. Frog 9th & 1st Spinal nerve
5. Frog Sciatic Plexus
6. Frog Brain
3. Mounting of placoid scales; study of cycloid and ctenoid scales

4. Osteology

Frog vertebrae - typical, atlas, 8th and 9th Rabbit – Atlas, Axis and typical vertebra

Pectoral and pelvic girdles of Frog and Rabbit
Bird - Keel and Synsacrum
Turtle/Tortoise - plastron and carapace

5. Study of sections.

Amphioxus T. S. through pharynx/T.S. through intestine

6. Identification:- General

identification-

Identify, classify and describe the following animals by their generic names and 30 % of them by their scientific names.

Protochordata-1, Pisces-5, Amphibia-5, Reptilia- 5, Aves-2, Mammalia-2.

Taxonomic identification with key:-

i) Identification of fishes up to the level of order.

ii) Identification of snakes up to family.

SEMESTER IV. ZY1714104

CORE COURSE IV

RESEARCH METHODOLOGY, BIOPHYSICS AND BIOSTATISTICS

54 Hrs

3 Credits

Objectives

1. To familiarise the learner the basic concept of scientific method in research process.
2. To have a knowledge on various research designs.
3. To develop skill in research communication and scientific documentation.
4. To create awareness about the laws and ethical values in biology.
5. To equip the students with the basic techniques of animal rearing collection and preservation
6. To help the student to apply statistical methods in biological studies.

RESEARCH METHODOLOGY

Module I

13 Hrs

Basic concepts of research: Meaning, Objectives, Approaches, Types of research. Research Process: Scientific method in research (eight steps).

Importance of literature reviewing in defining a problem, Identifying gap areas from literature review.

Research Communication and scientific documentation: Project proposal writing,

Research report writing, (Structure of a scientific paper), Thesis, dissertation, research article. Presentation techniques: Oral presentation, Assignment, Seminar, Debate, Workshop, Colloquium, Conference

Sources of Information: Primary and secondary sources. Library- Books, Journals, Periodicals, Reviews, Internet.

Search engines Online libraries, e-Books, e-Encyclopedia, Institutional Websites. Plagiarism

Module II

12 Hrs

Animal Collection – Tools & techniques

Sampling techniques

Quadrat Line

transect

Measurements

Density Abundance

Frequency

Biodiversity indices – concepts Simpson index

Collection methods, techniques and equipments Plankton

Insects Fish

Bird

Preservation techniques – Taxidermy Rearing techniques

Laboratory and field.

Units of measurements- units, SI system, Equivalent weight, normality, molarity

BIOPHYSICS

Module III

14 Hrs

Basic understanding on principle and uses of the following:

Microscopy

(a) Light microscopy, Bright field (Compound Microscope), Phase contrast, Dark field microscopy, Fluorescence, Polarization microscopy, Video microscopy.

(b) Electron - Scanning (SEM), Transmission (TEM) and STEM

Micrometry – Stage and Eyepiece micrometers Camera Lucida

Instrumentation

pH Meter

Separation Techniques: Centrifuge, Chromatography, Electrophoresis

Analytical techniques: Colorimeter, Spectrophotometer, X-ray crystallography

BIOETHICS

Module IV

5 Hrs

Bioethics : Introduction, Animal rights and animal laws in India, Prevention of cruelty to animals Act 1960, Biodiversity Act 2003.

Concept of 3 R – conservation (Refined- to minimize suffering, Reduced – to minimize animals, Replaced – modern tools and alternate means),

Animal use in research and education.

Laboratory animal use, care and welfare, Animal protection initiatives- Animal Welfare Board of India, CPCSEA, ethical commitment. Working with human: Consent, harm, risk and benefits.

Module V

Sample & Sampling techniques: Collection of data, classification of data, frequency distribution tables, graphical representation: - Bar diagrams, Histogram, Pie diagram and Frequency curves - Ogives.

Measures of Central Tendency: Mean, Median, Mode (Problem - Direct method only) Measures of dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Standard error. (Merits & demerits and problems on SD).

Correlation: Definition, Types of correlation. (mention in brief)

Test of Hypothesis and Test of Significance: Basic concept, Levels of significance, test of significance, Procedure for testing hypothesis, types of hypothesis- Null hypothesis and Alternate hypothesis.

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22. Taylor D.J. Green N.P.O and Stout G.W. (2008). Biological science (3rd edition- R.S.Oper Ed). Cambridge University press.

CORE COURSE IV

RESEARCH METHODOLOGY, BIOPHYSICS AND BIostatISTICS

(PRACTICAL)

2 creditsPART

A. RESEARCH METHODOLOGY

Animal collection Tools, Techniques & Estimation

1. Quadrate study
2. Transect study
3. Sampling Methods
4. Species area curve
5. Simpson index

PART B - BIOPHYSICS

1. Study of simple and compound light microscopes
2. Micrometry –calibration and measurement of microscopic objects –low power
3. Camera Lucida (draw a few diagrams using Camera Lucida)
4. Paper chromatography (demonstration only)
5. Instrumentation – demonstration (write notes on principle, equipment and its use)pH Meter, Colorimeter/ Spectrophotometer, Centrifuge

PART C BIostatISTICS

1. MS Excel : To create mean and median, Construction of bar diagram, Pie diagram and Linegraphs.
2. MS Access: To create grade of students
3. Internet: Access a web page on any biological topic.
4. Frequency distribution of the given samples to find out arithmetic mean, median, mode.
5. Range and standard deviation for a biological data
6. Correlation using any biological data.

7. Graphical representation of data. Construction of bar diagrams, Histograms, Pie diagram and Linegraphs.

SEMESTER V. ZY1715105 CORE COURSE V

ENVIRONMENTAL BIOLOGY AND HUMAN RIGHTS

54 Hrs

Objectives

To instill the basic concepts of Environmental Sciences, Ecosystems, Natural Resources, Population, Environment and Society

To make the students aware of natural resources, their protection, conservation, the factors polluting the environment, their impacts and control measures.

To teach the basic concepts of toxicology, their impact on human health and remedial measures

To create a consciousness regarding Biodiversity, environmental issues & conservation strategies

To develop the real sense of Human rights – its concepts & manifestations

MODULE 1

ECOSYSTEM

12 Hrs

Basic concepts of ecosystem Components of ecosystem: Abiotic (Sunlight, temperature, soil, water, atmosphere) and Biotic components (Producers, consumers, decomposers), Ecological pyramid- number, biomass, energy, **Functions of ecosystem:** Productivity-Food chain-Food web- Energy flow-Laws of Thermodynamics. Types of Ecosystem: Terrestrial-Forest-Grassland-Desert, Aquatic-Marine-Fresh water, Wetland & Biome **Concept of limiting factors:** Liebig's and Shelford's laws of limiting factors.

Biogeochemical cycles: Concept, gaseous and sedimentary cycles, Carbon cycle, Nitrogen cycle. **Renewable resources** (solar, wind, hydroelectric, biomass and geothermal) and **Non renewable resources** (mineral and metal ore, fossil fuels)

MODULE 2 CONCEPTS OF POPULATION AND COMMUNITY 8 Hrs

Concept of population: Population attributes- Population growth forms, Basic concepts of growth rates, density, natality, mortality, growth curves

Animal interactions: Positive- Commensalism- Mutualism-Protocooperation, Negative-Predation- Parasitism-Competition-Antibiosis

Characteristics of a community: Species diversity- richness, evenness, stratification, dominance, ecological indicators, Ecotone and Edge effect, Keystone species, Concepts of Ecological Niche and Guild, Ecological succession, community evolution- climax.

MODULE 3 BIODIVERSITY AND ENVIRONMENTAL ISSUES 16 Hrs

Introduction to Biodiversity: Types of biodiversity- Alpha, Beta and Gamma diversity. **Concept and importance of Biodiversity:** Levels of Biodiversity-Species diversity, Genetic diversity, Microbial, Ecosystem diversity, India as a mega-diversity nation, Biodiversity hotspots

Global Environmental Issues: Ozone depletion, Greenhouse effect, Global warming, Climate change, Carbon trading, carbon credit; Carbon sequestration, Acid rain, Oil spills, Nuclear accidents, IPCC/UNFCCC.

National Environmental issues: Deforestation, forest fire, pollution (air, water, soil, noise thermal, nuclear- brief account only) solid waste management, sewage, drinking water crisis and water logging,

Toxic products and disaster: Types of toxic substances – degradable, non degradable, Impact on human – case studies: Endosulphan tragedy, Bhopal disaster Flood, drought, cyclone, earthquake and landslide (Management and mitigation)

Local Environmental issues: Landscape alteration, sand mining, quarrying, changing crop pattern, conversion of paddy lands,

Threats to water resources of Kerala: Degrading Mangrove and wetland ecosystems of Kerala,

RAMSAR sites, Marine ecosystem crisis- pollution, overfishing etc.

Impact of tourism on Environment.

MODULE 4

CONSERVATION OF BIODIVERSITY

12 Hrs

Protected area concept – Sanctuary, National Park, Biosphere reserve, Core Zone, Buffer Zone, Corridor concept. Conservation reserves

Concept of threatened fauna – IUCN categories - extinct, extinct in the wild, critically endangered, endangered, vulnerable, near threatened, least concern and data deficient. Red and Green Data Books.

Man–animal conflict (Tiger, Elephant, Dog, Monkey) – causes and concern **Water conservation**- rainwater harvesting, watershed management Environment education

Environmental laws (Brief account only): The Water (Prevention and Control of Pollution) Act, 1974, The Air (Prevention and Control of Pollution) Act, 1981, Indian Forests Act (Revised) 1982. The Environment (Protection) Act, 1986, Hazardous Wastes (Management and Handling) Rules, 1989, The Forest (Conservation) Act, 1980, The Wildlife Protection Act, 1972, Biodiversity Act, 2002.

MODULE 5

HUMAN RIGHTS

6 Hrs

Introduction, main concepts associated with Human Rights, Different types of human rights, Manifestations & phenomena, Role of agencies in promoting human rights, Mechanisms for checking violations of human rights, National human right commission, Constitutional provisions related to Human rights.

References

1. Erach Bharucha 2008 (UGC). Text Book of Environmental Studies of Undergraduate course. University Press.
2. J.B Sharma (2009), Environmental studies' - 3rd Ed. University science Press
3. Misra S.P., Pandey S.N. 2009 Essential Environmental Students, Ane books Pvt. Ltd.
4. P.D Sharma (2012), Ecology and Environment' - 11th Ed. Rastogi Publications

5. R.B Singh & Suresh Mishra PaulamiMaiti (1996), Biodiversity – Perception, Peril and Preservation’ — PHI Learning , Environmental Law in India: Issues and Responses
6. Rajagopalan,R. 2005.*Environmental Studies from Crisis to Cure*. Oxford University Press,New Delhi.
7. Paul R.C., 2000.Situations of Human Rights in India. Efficient offset printers. .
8. Arun kumar Palai(1999) National Human Rights Commission of India, Atlantic publishers
9. Sharma P.D. (2005)Environmental biology and Toxicology, Rastogi publication
10. Meera Asthana and Astana D.K.1990 Environmental pollution and Toxicology Alkaprinters.
11. Odum, E.P. 1971.Fundamentals of Ecology.W.B. Saunders College Publishing,Philadelphia
12. Alan Beeby, 2006 Anne – Maria Brennan First Ecology, Ecological principles and Environmental issues . International students edition Sec. edition Oxford UniversityPress.
13. Robert Ricklefs (2001). The Ecology of Nature. Fifth Edition. W.H. Freeman and Company.
14. Stiling Peter (2002). Ecology: Theories and applications. Prentice Hall of India pvt.Ltd.New Delhi.
15. Landis, Wayne and Hing-hoYu, Baca Raton, 1995. Introduction to Environmental Toxicology: Impacts of chemicals upon Ecological systems: Lewis Publishers.

**PRACTICAL ENVIRONMENTAL BIOLOGY &
TOXICOLOGY**

**36 HRS
CREDIT 1**

1. Estimation of dissolved Oxygen
2. Estimation of carbon di oxide
3. Estimation of soil organic carbon (Demonstration only)
4. Identification of marine/ fresh water planktons
5. Counting of plankton using plankton counting chamber
6. Study of equipments - Sechi disc, Plankton net
7. Study of sandy shore fauna, rocky shore fauna.
8. Study of animal Association
9. Visit to any two important areas of bio diversity: 1. Forest, 2.Sea shore, 3. Mangrove, 3.

Wet lands, 4. Bird sanctuary, 5. Wild life sanctuary, 6. Sacred groves Field study (compulsory)

SEMESTER V. ZY1715106

**CORE COURSE VI
CELL BIOLOGY AND GENETICS**

54 Hrs

Credits 3

Objectives

1. To understand the structure and function of the cell as the fundamentals for understanding the functioning of all living organisms.
2. To make aware of different cell organelles, their structure and role in living organisms.
3. To develop critical thinking, skill and research aptitudes in basic and applied biology 4. To emphasize the central role of genes and their inheritance in the life of all organisms.

CELL BIOLOGY

22 HRS

Module I

6 Hrs

Introduction of cell and Diversity of cells: History, Cell theory, Prokaryotes, Eukaryotes, Mycoplasmas, Virus, Virions and Viroids, Prions.

Cell membrane & Permeability: Molecular models of cell membrane (Sandwich model, Unit membrane model, Fluid mosaic model). Cell properties - permeability, Transport [Diffusion, Osmosis, Passive transport, Active transport, bulk transport], Cell coat and Cell recognition.

Module II

10 Hrs

Cell Organelles : Structure and functions of following cell organelles: Endoplasmic reticulum - Structure and functions. Ribosomes (Prokaryotic and Eukaryotic) Golgi complex

- Structure and functions. Lysosomes - Polymorphism - GERL concept, functions.

Mitochondria - Structure and functions. Nucleus: Structure and functions of interphase nucleus, Nuclear membrane, pore complex, structure and functions of nucleolus

Chromosomes – Structure & organization, Heterochromatin, Euchromatin, Nucleosomes, Polytene chromosomes-Balbiani rings, Endomitosis, Lamp brush chromosomes.

Module III

6 Hrs

Cell Communication: Basic principles of cell communications, Cell signaling (in brief), Types of signaling, Mention signaling molecules (neurotransmitters, hormones, Growth Factors, Cytokines Vitamin A and D derivatives),

Cell Division: Cell cycle - G₁, S, G₂ and M phases, Mitosis and Meiosis. The difference between Mitosis and Meiosis.

References

- 1 Zoological Society of Kerala Study material. 2002. *Cell Biology, Genetics and Biotechnology*
2. Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI Edition.
John Wiley and Sons, Inc.
3. Koshy Thomas & Joe Prasad Mathew (Editors) (2011) *Cell Biology and Molecular Biology*.
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8. Ali, S (2014) *The Cell: Organization Function and Regulatory Mechanisms*, Pearson
9. Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G. P. (2009). *The World of the Cell*. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco. 4

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11. Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
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15. Ariel G Loewy Philip Sickevitz, John R. Menninger and Jonathan A.N. Gallants (1991) cell structure and function. Saunder's College Publication
16. James Darnell. (1998) *Molecular Biology*. Scientific American Books Inc.

GENETICS

32 Hrs

Module I

10 Hrs

Mendelian Genetics: Mendel's experiments- Monohybrid Cross, Dihybrid Cross, Mendel's Laws, Test Cross, Back Cross and Reciprocal Cross. Chromosome Theory of Inheritance

Interaction of genes: Allelic: Incomplete Dominance (Four O Clock Plant). Co- Dominance (Skin colour in Cattle) Lethal Alleles: Dominant lethal gene [Creeper chicken] and recessive lethal gene [cystic fibrosis].

Non Allelic: Complementary (Flower colour in Sweet Pea), Supplementary (Coat colour in mice), Epistasis - dominant (Plumage in poultry) and recessive (Coat colour in mice). Polygenes (Skin colour inheritance in man), Pleiotropism (Vestigial wing gene in *Drosophila*).

Multiple alleles – ABO Blood group system, Rh group and its inheritance. Erythroblastosis foetalis.

Module II

12 Hrs

Sex determination: Chromosome theory of sex determination (Autosome and Sex chromosomes), male heterogamy and female heterogamy, (xx-xy, xx-xo, ZZ-ZW, ZZ-ZO), Genic Balance theory of Bridges. Barr bodies, Lyon's hypothesis, Gynandromorphism, sex

mosaics, intersex (*Drosophila*), Hormonal [free martin in calf] and Environmental (Bonellia) influence on Sex determination

Recombination and Linkage: Linkage and recombination of genes based on Morgan's work in *Drosophila*, Linked genes, Linkage groups, Chromosome theory of Linkage, Types of linkage- complete and incomplete. Recombination, cross over value, chromosome mapping. [Definition]

Sex Linked inheritance : Characteristics of Sex Linked inheritance, X Linked inheritance of man (Hemophilia), Y linked inheritance [Holandric genes] , Incompletely Sex Linked genes or pseudoautosomal genes (Bobbed bristles in *Drosophila*), Sex limited genes (Beard in man) and Sex influenced genes (inheritance of baldness in man).

Module III

10 Hrs

Mutation: Types of mutations - Somatic, germinal, spontaneous, induced, autosomal and allosomal, chromosomal mutations, structural and numerical changes. Gene mutations. [Addition, Deletion and substitution].

Human Genetics: Karyotyping, Normal Human chromosome Complement, Pedigree analysis, Aneuploidy and Non- disjunction. Autosomal abnormalities (Down syndrome, Cry du chat syndrome) Sex chromosomal abnormalities (Klinefelter's syndrome, Turner's syndrome) Single gene disorder (Brief mention) Autosomal single gene disorder [sickle cell anaemia], Inborn errors of metabolism such as phenylketonuria, alkaptonuria, , Albinism. Multifactorial traits – polygenic disorder- cleft lip and cleft palate.

Genetic Counseling, Eugenics and Euthenics -Brief account only

References

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2. Klug, W.S and Cummings,M.R. (2011). *Concepts of Genetics* (7th edn).Pearson Education Inc.India.
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4. Shirley Annie Oommen, Sampath Kumar S., and Jinsu Varghese (Editors) (2012), *GenetoGenome*. Zoological Society of Kerala, Kottayam.
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10. Das, H.K. (2007). *Text Book of Biotechnology*. Willey India Pvt. Ltd. New Delhi.
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12. Primrose, S.B., Twyman, R.M. and Old, R.W. (2001). *Principles of Gene Manipulation* (6th edn.) Blackwell Science Ltd., London.
13. Sobti, R.C. and Pachauri, S.S. (2009). *Essentials of Biotechnology*. Ane's Book Pvt.Ltd. New Delhi.
14. Sinnat Dunn & Dobzhansky 1959. *Principles of Genetics* (T.M.H. New Delhi)

SEMESTER V

CORE COURSE VI

CELL BIOLOGY AND GENETICS(PRACTICAL)

36 Hrs
2 Credits

PART A: CELL BIOLOGY

1. Squash preparation of onion root tip for mitotic stages
2. Mounting of polytene chromosome (*Drosophila*/Chironomous.) Demonstration
3. Tissues (permanent slides of epithelial tissues, striated muscle, smooth muscle, cartilage, bone)
4. Identification of cell organelles
5. Preparation of temporary whole mount.
6. Preparation of permanent whole mount (demonstration)
7. Preparation of human blood smear and identification of Leucocytes

PART B : GENETICS

1. Genetic problems on Monohybrid, Dihybrid Crosses and Blood group inheritance
2. Study of normal male and female human karyotype (use photographs or Xeroxcopies)
3. Abnormal human karyotypes - Down, Edwards, Klinefelter and Turner syndromes

(use photographs or Xerox copies)

4. Sexing of *Drosophila*.

5. Study of Barr body in human buccal epithelium

SEMESTER V. ZY1716604

CORE COURSE - V11: EVOLUTION, ETHOLOGY & ZOOGEOGRAPHY

54 Hrs

Credits 3

Objectives:

- To acquire knowledge about the evolutionary history of earth - living and nonliving
- To acquire basic understanding about evolutionary concepts and theories
- To study the distribution of animals on earth, its pattern, evolution and causative factors
- To impart basic knowledge on animal behavioural patterns and their role

Prerequisite:

- Basic knowledge on principles of inheritance and variation
- Knowledge on molecular basis of inheritance
- Basic understanding on the mechanism and factors affecting evolution
- Knowledge on origin and evolution of man

PART I - EVOLUTION

30 Hrs

Module I - Origin of life

8 Hrs

Theories - Panspermia theory or Cosmozoic theory, Theory of spontaneous generation (Abiogenesis or Autogenesis), Special creation, Biogenesis, Endosymbiosis.

Chemical evolution - Haldane and Oparin theory, Miller-Urey experiment;

Direct evidences of evolution – Recapitulation Theory of Haeckel, Fossilization, Kinds of fossils, fossil dating, Homologous organs and analogous organs.

Module II - Theories of organic evolution

9 Hrs Lamarckism and its

Criticism, Weismann's Germplasm theory, Darwinism and its Criticism, Neo-Darwinism, Theory of De Vries,

Population genetics and evolution: Hardy-Weinberg Equilibrium, gene pool, gene frequency. Factors that upset Hardy-Weinberg Equilibrium, Effects of genetic drift on population: Bottleneck effect and founder effect

Module III – Nature of evolution **13 Hrs** Species and

Speciation: Species concept, subdivisions of species (sub species, sibling species, cline and deme), Speciation: Types of speciation, Phyletic speciation (autogenous and allopathic speciation), True speciation, Instantaneous and gradual speciation, allopatric and sympatric speciation

Isolation: Types of isolating mechanisms-Geographic isolation (mention examples) and Reproductive isolation. Role of isolating mechanisms in evolution

Microevolution, Macroevolution (Adaptive radiation -Darwin finches) Mega evolution, Punctuated equilibrium, Geological time scale, and Mass extinction (brief account only). Evolution of Horse

PART II- ETHOLOGY **14 Hrs**

Module IV – Introduction **1 Hr**

Definition, History and scope of ethology

Module V – Learning, imprinting and behaviour **9 Hrs**

Types of learning with examples; patterns of behaviors – types of rhythms, navigation, homing instinct, hibernation, aestivation; pheromones- types and their effect on behavior, hormones and their action on behavior (aggressive and parental behavior)

Module VI – Social organization **4 Hrs** Social

organization in insects (ants) and mammals (monkey), Courtship behaviour and reproductive strategies

PART III- ZOOGEOGRAPHY **10 Hrs**

Module VII – General Topics **4 Hrs**

Continental drift theory, Types and means of animal distribution, Factors affecting animal distribution; insular fauna – oceanic islands and continental islands,

Module VIII - Zoogeographical realms **6 Hrs** Palaearctic

region, Nearctic region, Neotropical region, Ethiopian region, Oriental region, Australian region (brief account with physical features and fauna, Wallace's line, Weber's line, Biogeography of India with special reference to Western Ghats)

References:

EVOLUTION

1. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). *Evolution*. Cold Spring, Harbour Laboratory Press.
2. Barnes, C.W. (1988). *Earth, Time and Life*. John Wiley & Sons, New York
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10. Coyne J.A. and Allen Orr H. (2004). *Speciation*, Sinauer Associates
11. Ridley, M. (2004), *Evolution* 3rd Edition. Blackwell Publishing
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13. Strickberger, M.W. 2000. *Evolution*. Jones and Bartlett, Boston.

ETHOLOGY

1. Agarwal. V. K. (2009). *Animal Behaviour*. S.Chand and Company Pvt. Ltd., New Delhi.
2. Bonner, J.T. (1980). *The Evolution of Culture in Animals*. Princeton University Press. NJ, USA.
3. David McFarland. (1999). *Animal Behaviour*. Pearson Education Ltd. Essex, England.
4. Dawkins, M.S. (1995). *Unravelling Animal Behaviour*. Harlow: Longman.
5. Dunbar, R. (1988). *Primate Social Systems*. Croom Helm, London.
6. Gundevia J.S. and Singh H.G. (1996), *A Text Book of Animal Behaviour*. S. Chand and Company Pvt. Ltd., New Delhi.
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8. Sherman P.W and Alcock J., (2001) *Exploring Animal Behaviour- Readings from*

9. Wilson, E.O. (1975). Sociobiology. Harvard University Press, Cambridge, Mass. USA. (Module 9).

ZOOGEOGRAPHY

1. Briggs, J.C. (1996). Global Biogeography. Elsevier Publishers. (Module VI and VII).
2. Chandran Subash M.D. (1997). On the ecological history of the Western Ghats. Current Science, Vol.73, No.2.146-155.
3. Chundamannil Mammen. 1993, History of Forest management in Kerala. Report No.89. Kerala Forest Research Institute, Peechi, India.
4. Daniels, R.J.R and Vencatesan J. (2008), Western Ghats Biodiversity. People Conservation; Rupa & Co. New Delhi. India.
5. Mani, M.S. (1974). Ecology and Biogeography of India; The Hague: Dr. W. Junk b.v. Publishers,
6. Nair, C.S. (1991). The Southern Western Ghats: A Biodiversity Conservation Plan. INTACH, New Delhi.
7. Ramesh, B.R and R Gurukkal (2007), Forest Landscapes of the Southern Western Ghats, India- Biodiversity, Human Ecology and management Strategies. (French Institute of Pondicherry) India.
8. Tiwari, S. (1985), Readings in Indian Zoogeography (vol.1). Today & Tomorrow Printers & Publishers

PRACTICAL

EVOLUTION, ETHOLOGY AND ZOOGEOGRAPHY

36 Hrs

Credit 1

1. Identification of Zoogeographical realms using map
2. Study on endemic species of each realm
3. Show the discontinuous distribution of (lung fishes, camel, elephant)
4. Providing a map trace the route of HMS Beagle
5. Providing a map mark any two continental/oceanic islands.: Greenland, Madagascar, New Zealand, New Guinea, Maldives, Iceland, Hawaii – any two
6. Contributions of scientists (showing photos) - Any four
7. Identification of different stages of horse evolution
8. Study on Homology and Analogy
9. Study on connecting links (*Peripatus*, *Archaeopteryx*, *Protopterus*, *Echidna*)

10. Pheromone traps
11. Skinner box & T Maze
12. Experiment to demonstrate phototaxis and chemotaxis using *Drosophila*/House fly
13. Identification of behaviour (Grooming/courtship dance of flamingos/stickle back fish/Tail wagging dance/ Aggressive behaviour/ Auto/Allo grooming, Flehmen response) showing pictures (Any five)

SEMESTER V. ZY1715108

CORE COURSE VIII

HUMAN PHYSIOLOGY, BIOCHEMISTRY, AND ENDOCRINOLOGY

54 Hrs

Credits 3

Objectives:

1. This course will provide students with a deep knowledge in biochemistry, physiology and endocrinology.
2. Defining and explaining the basic principles of biochemistry useful for biological studies for illustrating different kinds of food, their structure, function and metabolism.
3. Explaining various aspects of physiological activities of animals with special reference to humans.
4. Students will acquire a broad understanding of the hormonal regulation of physiological processes in invertebrates and vertebrates.
5. By the end of the course, students should be familiar with hormonal regulation of physiological systems in several invertebrate and vertebrate systems.
6. This also will provide a basic understanding of the experimental methods and designs that can be used for further study and research.

7. The achievement of above objectives along with periodic class discussions of current events in science, will benefit students in their further studies in the biological/physiological sciences and health-related fields, and will contribute to the critical societal goal of a scientifically literate citizenry.

HUMAN PHYSIOLOGY

31 Hrs

Module I

8 Hrs

Nutrition: Nutritional requirements – carbohydrates, proteins, lipids, minerals (Ca, P, Fe, I), vitamins (sources and deficiency disorders). Importance of dietary fibre and antioxidants. Balanced diet, Recommended Dietary Allowance (RDA). Nutrition during pregnancy and lactation, Infant nutrition, Malnutrition (PEM).

Digestion: Anatomy and histology of digestive glands (liver, pancreas, salivary, gastric and intestinal). Digestion and absorption of carbohydrates, proteins and fats. Nervous and hormonal control of digestion.

Module II

8 Hrs

Respiration: Phases of respiration (external respiration, gas transport and internal respiration). Respiratory pigments: Haemoglobin, Myoglobin (Structure and Function). Transport of respiratory gases - transport of oxygen, oxyhaemoglobin curve, factors affecting oxyhaemoglobin curve, transport of carbon dioxide, (chloride shift). Control of respiration. Respiratory disturbances (Hypoxia, Hypercapnia, Asphyxia). Physiological effect of smoking, carbon monoxide poisoning, Oxygen therapy and artificial respiration.

Circulation: ESR, Haemopoiesis, blood pressure, ECG. Haemostasis (blood coagulation) – clotting factors, intrinsic and extrinsic pathways, anticoagulants and its mechanism of action. Cardiovascular diseases (Jaundice, Atherosclerosis, Myocardial infarction, Thrombus, Stroke). Angiogram and angioplasty.

Module III

5 Hrs

Excretion: Histology of Bowman's capsule and tubular part. Urine formation – glomerular filtration, tubular reabsorption, tubular secretion. Urine concentration – counter current mechanism. Acid – base balance, hormonal regulation of kidney function. Renal disorders (kidney stone, acute and chronic renal failure, and dialysis). Homeostasis: Definition,

concept and importance in biological system. Thermal regulation and thermal adaptation in homeotherms.

Module IV

10 Hrs

Nerve physiology: Ultra structure of neuron. Nerve impulse production (resting membrane potential, action potential), transmission of impulse along the nerve fiber, interneuron (synaptic) transmission, neuromuscular junction and transmission of impulses. Neurotransmitters (acetyl choline, adrenalin, dopamine). EEG. Memory, Neural disorders (brief account on Dyslexia, Parkinson's disease, Alzheimer's disease, Epilepsy).

Muscle physiology: Ultra structure of striated muscle, muscle proteins (myosin, actin, tropomyosin, troponin), Muscle contraction and relaxation-Sliding Filament Theory, cross bridge cycle, biochemical changes and ATP production in muscle, Cori cycle. Kymograph, Simple muscle twitch, muscle fatigue, tetanus, rigor mortis.

BIOCHEMISTRY

15 Hrs

Module V

5 Hrs

Carbohydrates: Basic structure, biological importance and classification of monosaccharides, oligosaccharides, polysaccharides with examples.

Proteins: Basic structure and classification of amino acids; structure, biological importance and classification of proteins with examples.

Lipids: Structure of fatty acid, saturated and unsaturated fatty acid, biological importance and classification of lipids with examples.

Vitamins and minerals: Major fat soluble and water soluble vitamins. Important minerals and trace elements required for living organisms. Biological importance of vitamins and minerals.

Enzymes: Chemical nature of enzymes, enzyme activation, enzyme inhibition, allosteric enzymes, isoenzymes, co-enzymes. Michaelis-Menten enzyme kinetics.

Module VI

10 Hrs

Carbohydrate metabolism: Glycogenesis, Glycogenolysis, Gluconeogenesis, Hexose monophosphate Shunt, Glycolysis, Citric Acid Cycle, Electron Transport Chain and ATP synthesis. Ethanol metabolism.

Protein metabolism: Deamination, Transamination, Transmethylation, Decarboxylation, Ornithine cycle.

Lipid metabolism: Biosynthesis of fatty acids, Beta oxidation, physiologically important compounds synthesized from cholesterol.

ENDOCRINOLOGY

Endocrinology and reproduction

8 Hrs

Module VII

8 Hrs

Endocrine physiology: Hormones – classification and mechanism of hormone action. Major endocrine glands (Histology is not included) their hormones, functions and disorders (hypothalamus, pituitary gland, pineal gland, thyroid gland, parathyroid gland, islets of Langerhans, adrenal gland). Homeostasis and feedback mechanism.

References

Albert L. Lehninger, Michael Cox and David L. Nelson; 2004; Biochemistry Lehninger.

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Barrington, E. J. W.; 1975; General and Comparative Endocrinology, Oxford, Clarendon Press.

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Melmed, Shlomo, Williams, Robert Hardin; 2011; Textbook of Endocrinology: Elsevier,

12th edition

Prosser and Brown,; 1962; Comparative Animal Physiology; W. B. Saunders Co., West Washington Square, Philadelphia 5.

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Satyanarayana U. and Chakrapani, U.; 2013. Biochemistry Elsevier; 4 edition

PRACTICAL

HUMAN PHYSIOLOGY, BIOCHEMISTRY, AND ENDOCRINOLOGY

36 Hrs

Credit 1

HUMAN PHYSIOLOGY

1). Determination of haemoglobin content of blood 2). Total RBC count using

Haemocytometer

3). Total WBC count using Haemocytometer 4). Estimation of

microhaematocrit

5). Effect of hypertonic, hypotonic and isotonic solutions on the diameter of RBC.

6). Instruments: Kymograph, Sphygmomanometer and Stethoscope (principle and use) 7). Measurement of blood pressure using sphygmomanometer (demonstration only) **BIOCHEMISTRY**

1. Qualitative analysis of protein, glucose, starch and lipids.

2. Chromatography – Determination of R_f value of amino acids and identification of amino acids (Identify the Amino Acids using different solvent front and solute front)

ENDOCRINOLOGY

1. Cockroach – Corpora cardiaca & Corpora allata (Demonstration)
2. Effect of adrenalin on heart beat of Cockroach (Demonstration)

SEMESTER VI. ZY1716109

CORE COURSE IX

DEVELOPMENTAL BIOLOGY

54 Hrs

3 Credits

Objectives:

1. To achieve a basic understanding of the experimental methods and designs that can be used for future studies and research.
2. To provide the students with the periodic class discussions of current events in science which will benefit them in their future studies in the biological/physiological sciences and health-related fields
3. To contribute to critical societal goal of a scientifically literate citizenry.

Module 1

10 Hrs

Introduction: Definition, Scope of developmental biology, sub-divisions (descriptive, comparative, experimental and chemical), historical perspectives, basic concepts and theories.

Reproductive Physiology: Gonads- anatomy of testis and ovary, spermatogenesis, oogenesis, gonadal hormones and their functions. Hormonal control of human reproduction - Female reproductive cycles (Estrous cycle, Menstrual cycle). Structure of mammalian sperm and egg, Pregnancy, parturition and lactation. Reproductive health and importance of sex education.

Egg types: Classification of eggs based on the amount, distribution and position of yolk. Mosaic and regulative, cleidoic and noncleidoic eggs. Polarity and symmetry of egg.

Fertilization: Mechanism of fertilization-(Encounter of spermatozoa and Ova, Approach of the Spermatozoon to the Egg, Acrosome Reaction and Contact of Sperm and Ovum, Activation of Ovum, Migration of Pronuclei and Amphimixis,), Significance of fertilization, Polyspermy, Parthenogenesis- Different types and significance.

Module II

14 Hrs

Cleavage: Types, planes and patterns of cleavage, Cell lineage of Planaria. Influence of yolk on cleavage.

Blastulation: Morula, blastula formation, types of blastula with examples.

Fate maps: Concept of fate maps, construction of fate maps (artificial and natural), structure of a typical chordate fate map. Significance of fate map.

Gastrulation: Major events in gastrulation. Morphogenetic cell movements. Influence of yolk on gastrulation. Exogastrulation. Concept of germ layers and derivatives.

Cell differentiation and gene action: Potency of embryonic cells (Totipotency, Pluripotency, Unipotency of embryonic cells). Determination and differentiation in embryonic development, Gene action during development with reference to Drosophila (maternal effect genes), Zygotic genes.

Module III

20Hrs

Embryology of Frog: Gametes, fertilization, cleavage, blastulation, fate map, gastrulation, neurulation, notogenesis. Differentiation of Mesoderm and Endoderm, Development of eye. Metamorphosis of frog, Hormonal and environmental control.

Embryology of chick: Structure of egg, fertilization, cleavage, blastulation, fate map, gastrulation. Development and role of Primitive streak, Salient features of 18 hour, 24 hour, 33 hour & 48 hour chick embryo. Extra embryonic membranes in chick.

Human development: Fertilisation, cleavage, blastocyst, implantation, placenta. Gestation, parturition and lactation. Human intervention in reproduction, contraception and birth control. Infertility, In vitro fertilization (test tube baby)

Module IV

5Hrs

Experimental embryology: Spemann's constriction experiments, Organizers and embryonic induction. Embryo transfer technology, cloning, stem cell research. Ethical issues.

Teratology / Dysmorphology, Developmental defects: Teratogenesis, important teratogenic agents.(Radiations, chemicals and drugs, infectious diseases) genetic teratogenesis in human beings,
Developmental defects: Prenatal death (miscarriage and still birth). Intrauterine Growth Retardation (IUGR).

Module V

5 Hrs

General topics: Classification and functions of placenta in mammals. Prenatal diagnosis (Amniocentesis, Chorionic villi sampling, Ultra sound scanning, Foetoscopy, Maternal serum alpha-fetoprotein, Maternal serum beta-HCG).Regeneration in animals.

References

- Anthony S. Fauci, Eugene Braunwald, Dennis L. Kasper, Stephen L. Hauser, Dan L. Longo,
J. Larry Jameson and Joseph Loscalzo; 2008; Harrison's Principles of Internal Medicine; Churchill Livingstone 17th Ed.
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biology, McGraw Hills Dutta 2007 Obstetrics, Church Livingstone 17 Ed
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Melissa A & Gibbs, 2006; A practical Guide to Developmental Biology, Oxford university press (Int. student edition)
Scott F. Gilbert; 2003; Developmental biology; Sinauer Associates Inc., U.S.; 7th Revised edition.
Vijayakumarn Nair, K. & George, P. V. 2002. A manual of developmental biology, Continental publications, Trivandrum
Taylor D J, Green NPO & G W Stout. (2008) Biological Science third edition. Cambridge

PRACTICAL DEVELOPMENTAL

BIOLOGY

36 Hrs

Credit 1

Model/Chart/ Slide may be used

1. Embryological studies- Blastula (frog, chick)
2. Embryo transfer, cloning, gastrula (frog, chick)
3. Amniocentesis
4. Embryotransfer technology, cloning
5. Study of placenta- pig and man
6. 18 hour, 24 hour, 33 hour and 48 hour chick embryo.
7. Candling method.
8. Vital staining- demonstration.
9. Male and female reproductive organs in cockroach
10. Calculate the fecundity of fish.
11. Calculate the gonado-somatic index of given fish.

SEMESTER VI. ZY1716110

CORE COURSE X. MICROBIOLOGY AND IMMUNOLOGY

54 Hrs

3 Credits

MICROBIOLOGY

Module I

10 Hrs

Introduction: History and scope of microbiology. Outline classification of Microbes.(bacteria, fungus & virus)

Methods in Microbiology: Sterilization and disinfection - physical and chemical methods.

Culture media – selective media, enrichment media, differential media. Plating techniques and isolation of pure colony. Culture preservation techniques: refrigeration, deep freezing,

freezing under liquid nitrogen, lyophilization.

Module II

15 Hrs

Morphology and fine structure of bacteria: Size, shape, cilia, pili, flagella, capsule, cell wall and its composition. Cytoplasmic membrane, protoplast, spheroplast, intracellular membrane systems, cytoplasm, vacuoles, genetic material, cell inclusions, bacterial spores. Bacterial growth Curve, Staining techniques – gram staining.

Bacterial Reproduction Sexual – (conjugation, transduction) and Asexual (budding, fragmentation). Virology: Structure of virus; Human, animal, and bacterial virus. Viral replication, cultivation of animal viruses.

Module III

8 Hrs

Infections & Diseases: Types of infections – primary, secondary and nosocomial infections. (Brief Account only) Contagious diseases – epidemic, endemic and pandemic, mode of Transmission – food, water, air, vectors and carriers.

Diseases: Epidemiology, symptomology, diagnosis and treatment. Bacterial - Clostridium tetani (tetanus), Viral – HIV virus (AIDS), fungal – *Candida albicans* (candidiasis).

IMMUNOLOGY

Module IV

9 Hrs

Introduction to Immunology: Innate and acquired immunity, passive (natural and artificial) and active immunity (Natural and Artificial). Mechanisms of innate immunity - barriers, inflammation, phagocytosis.

Lymphoid organs: Primary (Thymus, Bone marrow) and secondary lymphoid organs (lymph nodes, spleen).

Lymphocytes: T and B cells, Natural killer cells, memory cells, macrophages.

Module V**9 Hrs**

Antigens, Types of antigens, haptens, adjuvants, immunoglobulin structure, classes and functions of immunoglobulins.

Types of Immunity - , humoral & cell mediated immunity Monoclonal & polyclonal antibodies

Antigen – antibody reactions, Precipitation test, Agglutination test, VDRL WIDAL, ELISA. Auto immune diseases: Pernicious Anemia, Rheumatoid Arthritis. Immunodeficiency -

AIDS. Hyper sensitivity- Type I, (E.g. Anaphylaxis) II (Transfusion reaction) , III (Arthus reaction) and IV (Mantoux Test) (in brief).

Vaccines**3 Hrs**

Introduction Types of vaccines, Current Vaccines, Recent trends in vaccine preparation

References

1. Ananthanarayan R & Jayaram Paniker C K. (2009) Text Book of Microbiology Orient Longman Private Ltd.
2. Gladys Francis & Mini K.D., (Editors) (2012), Microbiology, Zoological Society of Kerala, Kottayam.
3. Kuby J, Kindt T., Goldsby R. and Osborne B. (2007). Kuby immunology
4. Sharma K. (2005) Manual of Microbiology: Tools and Techniques, Ane books
5. Susan Panicker & George Abraham (Editors) (2008), Micro Biology and Immunology, Zoological Society of Kerala, Kottayam.
6. Coleman: (2002). Fundamentals of Immunology
7. Darla J. Wise & Gordon R. Carter: (2004): Immunology A Comprehensive Review Iowa State University Press. A Blackwell science company,
8. Hans G. Sch, Legal General Microbiology, Seventh Ed. Cambridge Low Price Ed.

9. Helen Hapel, Maused Harney Siraj Misbah and Next Snowden: (2006) Essentials of Clinical Immunology Fifth Ed. Blackwell Publishing Company,

10. Heritage, J, E.G.V. Evaus and R.A.Killungten (2007): Introductory Microbiology Cambridge University Press 6. Ivan Roitt I (2002) Essentials of Immunology ELBS.

PRACTICAL MICROBIOLOGY AND **IMMUNOLOGY**

72 Hrs2
Credits

1. Instruments –Autoclave, Hot air oven, Bacteriological incubator – Laminar air flow
2. Preparation of solid and liquid media for microbial cultures. (Ingredients, pH and method of preparation)
(Demonstration)
(a) Solid media (1) Nutrient agar (2) Mac Conkey's agar
(b) Liquid Media (1) Nutrient broth (2) Peptone water.
3. Culture methods (Demonstration)
(a) Streak plate technique and isolation of pure colonies.
(b) Lawn culture (c) Pour plate culture (d) Liquid culture
4. Examination of microbes in living condition
Hanging drop method for demonstrating motility of bacteria.
5. Gram staining – preparation, procedure, identification of Gram + ve and Gram –ve bacteria.
6. Antibiotic sensitivity test (demonstration only)
7. Streak plating (individual performance)
8. Preparation of a fungal smear – Lactophenol cotton blue staining and mounting
9. Determination of ABO blood groups and Rh factor (Antigen – antibody Reaction)
10. Study through photographs/ illustration, the primary immune (Bone marrow and thymus) and secondary immune (spleen and lymph nodes) organs in Rat/Man

SEMESTER VI. ZY1716606 CORE COURSE

XI.

BIOTECHNOLOGY, BIOINFORMATICS AND MOLECULAR BIOLOGY BIOTECHNOLOGY

20 Hrs

Module I

11Hrs

Introduction: Scope, Brief History, Scope and Importance

Tools and Techniques in Biotechnology: Enzymes (restriction endonucleases, ligases, linkers & adapters), Vectors-[Plasmids, Phage vectors, Cosmids, Artificial Chromosomes] Host cells. Basic steps & techniques in rDNA technology

Gene Libraries, Construction of genomic library and cDNA Library. PCR technique and DNA amplification, Brief description of screening methods – Probes, Nucleic Acid hybridization, In situ Hybridization, Fluorescence in situ Hybridization (FISH), Colony hybridization. Methods of transfer of desired gene into target cell. Blotting Techniques- Southern, Northern, Western blotting. DNA Finger printing (DNA Profiling) and its application. Molecular markers - RFLP

Module II

9 Hrs

Animal Cell Culture: Brief account on methods, substrates, media and procedure of animal cell culture, Stem Cells, types and potential use, Organismal Cloning- reproductive & therapeutic- brief account only.

Applications of Biotechnology: Applications in Medicine (insulin, growth hormone, gene therapy), Agriculture (GM plants and biopesticides), Environment (bioremediation), Industry (Single Cell Protein) and applications of Fermentation Technology- lactic acid, vitamins, food and beverages.

Potential Hazards of Biotechnological Inventions: Risks related to genetically modified organisms (GMO) and biologically active products, Biological warfare & Biopiracy. Protection of biotechnological inventions. Intellectual Property Rights, Patenting and patent protection.

References

1. Singh B.D Biotechnology 2002. Kalyan Publishers New Delhi.
2. Brown C.H., Campbell I & Priest F, G. 1987. Introduction of Biotechnology (Blackwellscientific publishers Oxford).
3. Colin Ratledge Bjorn Kristiansesn, 2008. Basic Biotechnology 3 rd ed. CambridgeUniversity.
4. Janarathanan S & Vincent S. 2007. Practical Biotechnology, Method of Protocols.University Press.
5. John E. Smith. Biotechnology Cambridge Low priced ed. (Third Ed) 2005 Madingan,Martinko and Parker 2002, Biology of Microorganisms, Brock Eighth Ed. Prentice Hall.
6. Singh B.D. Biotechnolgy 2002, Kalyan Publishers New Delhi.
7. Sudha Gangal 2007. Biotechnology Principles and & practice of Animal Tissue culture,Universities Press.

BIOINFORMATICS

14 Hrs

Module III

8 Hrs

Introduction: Definition, importance and role of bioinformatics in life sciences. Computational Biology.

Biological databases: Nucleotide sequence databases (NCBI- GENBANK, DDBJ and EMBL). Protein databases - structure and sequence databases (PDB, SWISSPROT and UNIPROT). Introduction to Sequences alignments: Local alignment and Global alignment, Pair wise alignment (BLAST and FASTA] and multiple sequence alignment. Phylogenetic Tree construction and Analysis

Module IV

6 Hrs

Molecular visualization software - RASMOL. Basic concepts of Drug discovery pipe line, computer aided drug discovery and its applications. Human Genome Project.

MOLECULAR BIOLOGY

20 Hrs

Module V

8 Hrs

Nature of Genetic Materials: Discovery of DNA as genetic material – Griffith's transformation experiments. Avery Macarty and Macleod, Hershey Chase Experiment of Bacteriophage infection, Prokaryotic genome; Eukaryotic genome. Structure and types of DNA & RNA. DNA replication. Modern concept of gene (Cistron, muton, recon, viral genes)., Brief account of the following-- Split genes (introns and exons), Junk genes, Pseudogenes, Overlapping genes, Transposons.

Module VI

12 Hrs

Gene Expressions: Central Dogma of molecular biology and central dogma reverse, one gene-one enzyme hypothesis, One gene-one polypeptide hypothesis Characteristics of genetic code, Contributions of Hargobind Khorana.

Protein synthesis [prokaryotic]: Transcription of mRNA, Reverse transcription, post transcriptional modifications, Translation, Post translational modifications.

Gene regulations: Prokaryotic(inducible & repressible systems) Operon concept -Lac operon and Tryptophan operon, Brief account of Eukaryotic gene regulation.

References

1. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James
(2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Gupta, P. K (2002) Cell and Molecular Biology, (2ed), , Rastogi Publications., Meerut
4. James Darnell. (1998) Molecular Biology. Scientific American Books Inc
5. Thomas AP(Editor). 2011 Cell & Molecular Biology The Fundamentals. Green leaf publications .TIES Kottayam
6. Zoological Society of Kerala Study material. (2011) Cell and Molecular Biology

PRACTICAL .

BIOTECHNOLOGY, BIOINFORMATICS & MOLECULAR BIOLOGY

BIOTECHNOLOGY

1. Identify and comment on the item provided: (Western blotting / Southern blotting /Northern blotting / PCR)
2. Write down the procedure involved in DNA isolation

BIOINFORMATICS

1. Download/use print out/pictures of genome sequences of any 2 organisms. Identify and mention the characteristic features of both.
2. Download/ use print out/pictures of a protein sequence , identify it & comment on its amino acid composition
3. Download / use print out/pictures of a macromolecule. Write a brief note on the bioinformatics tool used to visualize its structure.

MOLECULAR BIOLOGY

1. Identify and comment on its molecular composition / structural orientation / functional significance (Any tissue / Cell organelles/ DNA, DNA replication, RNA different types using models or diagrams)

V1 SEMESTER. ZY1716112 CORE COURSE XII

OCCUPATIONAL ZOOLOGY .

(APICULTURE, VERMICULTURE, QUAIL FARMING & AQUACULTURE)

54 Hrs

Credits 3

Objectives:

1. To equip the students with self employment capabilities.
2. To provide scientific knowledge of profitable farming.

3. To make the students aware of cottage industries.

Module 1. APICULTURE

18 Hrs

Definition, Different species of honey bees, Organization of honey bee colony, Social life and adaptation of honey bees. Communication among honey bees. Bee keeping methods and equipments, Management and maintenance of an apiary, Growth period, honey flow period and dearth period Division of the colony, uniting two colonies, replacing old queen with new queen, swarming management, monsoon management. Enemies of bees. Diseases of bees, Bee pasturage. Uses of honey bees, By-products of honey bees, Honey and wax composition. Testing the quality of honey. Extraction of wax, Uses of honey and wax. Royal jelly, Propolis. Apitherapy, Agencies supporting apiculture.

Activity : Visit to an apiculture unit.

Field visit and report submission - 10 Hrs

Field visit and report submission on any two items are taken for internal evaluation.

MODULE: 2. VERMICULTURE

8 Hrs

Introduction, Ecological classification of earth worms. Species of earth worms used for vermiculture, Reproduction & life cycle, Role of earth worm in solid waste management, in agriculture, in medicine etc. Preparation of vermibed, Maintenance & monitoring, Preparation of vermicompost, Preparation of vermish. Vermiwash.

Activity : Submission of a report after preparing a vermiculture unit or visiting a vermicomposting unit.

MODULE: 3. QUAIL FARMING (*Coturnix coturnix*)

4 Hrs

Introduction, care of quail chicks, care of adult quails, care of breeding quails, ration for quail, care of hatching eggs, health care, use of quail egg and meat. Sources of quality chicks.

MODULE: 4. AQUACULTURE.

24 Hrs

Advantages and salient features of aquaculture, Types of Aquaculture, Biotic and abiotic features of water, Importance of algae in aquaculture, Common cultivable fishes of Kerala, Fish diseases, Composite fish culture, Integrated fish culture, Carp culture, Prawn culture Mussel culture Pearl culture. Processing & Preservation.

Aquarium management - Setting up of an aquarium, Biological filter & Aeration, Breeding of gold fish, gourami (*Osphronemus*), fighter and Guppy (live bearer). Nutrition and types of feed for aquarium fishes, Establishment of commercial ornamental fish culture unit. Fish Transportation - Live fish packing and transport Common diseases of aquarium fishes and their management. Aquaponics (a brief introduction only).

Activity – Setting up of an Aquarium Field visit – Visiting an

Aquaculture farm

References

NPCS Board, The complete book on Bee keeping and honey processing, NIIR Projectconsultancy services, 106E, Kamala nagar, Delhi- 110007.

Shukla G.S, & Updhyay V.B, Economic zoology ,Rastogi Publ. Meerut.Pradip.V.Jabde , Text book of applied zoology, 2005

Applied Zoology, Study Material Zoological Society of Kerala , CMS college Campus Clive. A Edwards, Norman. Q. & Rhonda. 2011.

Vermitechnology: earthworms, organicwaste & environmental management.

Chauhan, H.V.S. Poultry, Disease, diagnosis and treatment, Wiley eastern Ltd Delhi.Otieno.F.O 2014. Quail farming: markets & market strategies

Pillai T.V.R., Aquaculture, principles and practices.

Ronald j. Roberts (1978) Fish pathology , Cassel Ltd London.

Cowey C. B. *et. al.* (1985) Nutrition and feeding in fishes, academy press.Farm made aquafeeds. FAO fisheries Technical paper, 343.

Harisankar J. Alappat& A. Bijukumar, Aquarium Fishes. B. R. Publ. Corporation, Delhi.MPEDA, A hand Book on AquafarmingOrnamentalfishes, MPEDA, Kochi.

Amber Richards. 2014. Aquaponics at home. Pradip.V.Jabde. 1993. Text book of applied zoology

Venkitaraman, P.R,1983, Text book of Economic zoology(SudharsanaPuubl. Kochi)Addison Webb, Bee Keepingfor profit and pleasure, Agrobios Ltd.

Edwards.C.A.&Lafty, J.R.1972 Biology of earthworms(Chapman & Hall Led.London)Applied Zoology, Study Material Zoological Society of Kerala , CMS college Campus

George cust& Peter Bird, Tropical Fresh water Aquaria, Hamlyn London. Verreth J. Fish larval nutrition, Chapman & Hall Publ.
 Bone Packer. 2014. Aquaponic system

**PRACTICAL OCCUPATIONAL
 ZOOLOGY**

**36 Hrs
 Credit 1**

1. General Identification, Economic importance, Morphology, scientific names and common names of the following
 - a) Economic important and morphology of culturable fishes (Catla, Rohu, Grass carp, Common carp, Silver carp, *Etroplus suratensis*, *Oreochromis /Tilapia*, *Mugil cephalus* and *Anabas Testudineus*)
 - b) Identification and morphology of ornamental fishes (gold fish, fighter, Gourami, Angel fish, Guppy)
 - c) Two species of earthworms used in Vermiculture
 - d) Four species of honey bees
 - e) Economic importance and morphology of shell fishes (Any three species of prawn, two marine mussels, two oysters one rock oyster - *Crasostrea* and pearl oyster - *Pinctada fucata* and freshwater mussel - *Lamellidens marginalis*).
2. Castes of bees
3. Principle & uses of - Aquarium filters, Aquarium aerator, Aquarium plants, Oven, Pelletiser, Screw Press, die plate
4. Identification and study of fish parasites and diseases (five numbers each) using slides/pictures
5. Bee keeping equipments, Beehive, Smoker, honey extractor, Queen Cage,
6. Bees wax, Honey, Vermicompost (Identification-Uses)
7. Formulation of artificial feed for aquarium fishes – demonstration
8. Tests for determining the adulteration in honey.

9. Mounting of pollen basket
10. Mounting of mouth parts of honey bee
11. Separation of cocoon from worm castings.

SEMESTER V. OPEN COURSES (FOR OTHER STREAMS)ZY5OPT01

1. VOCATIONAL ZOOLOGY

72 Hrs

4 Hrs/Week, Credits 3

Objectives of the Course

- To develop critical thinking skill and research aptitude among students, by introducing the frontier areas of the biological science.
- To emphasize the central role that biological sciences plays in the life of all organisms.
- To introduce the student to some of the present and future applications of bio-sciences
- To acquire basic knowledge and skills in aquarium management, Quail farming, vermicomposting and apiculture for self-employment
- To learn the different resources available and to develop an attitude towards sustainability
- Give awareness to society about need for waste management and organic farming

Module 1 Aquarium management

12 Hrs General

introduction to Aquarium, Aims and types of aquarium (material, size and shape). Requirements of an aquarium - filtration of waste, physical, chemical and biological; Setting an aquarium (self-sustainable with biological filters), Major indigenous aquarium fishes of Kerala.

Activity: Setting up of a freshwater aquarium and rearing of aquarium fishes

Module 2 Ornamental Fish Culture

20 Hrs

Introduction to ornamental fishes: Present status of ornamental fish culture in India with special reference to Kerala, Breeding of Gold fish, Fighter, Gourami (*Osphronemus*), and Guppy (live bearer). Nutrition and types feed for aquarium fishes, Use of live fish feed

organisms in Ornamental fish culture. Methods and techniques involved in the formulation of fish feed. Fish Transportation: Live fish packing and transport, Common diseases of aquarium fishes and their management. Establishment of commercial ornamental fish culture unit,

Activity: field visit to an ornamental fish breeding Centre to understand breeding practices of various aquarium fishes.

Module 3 Quail farming (*Coturnix coturnix*)

10 Hrs

Introduction, care of quail chicks, care of adult quails, care of breeding quails, ration for quail, care of hatching eggs, health care, use of quail egg and meat, Sources of quality chicks. **Activity:** Visit to a quail farm or viewing a quail documentary to familiarize the quail farming practices

Module 5 Vermiculture and composting

12 Hrs

Introduction, ecological classification of earth worms, Life history, Species of earth worms used for vermiculture, Preparation of vermicompost; Preparation of vermicompost, Preparation of vermifish, Maintenance and management of vermicomposting unit, Role of vermiculture in solid waste management.

Activity: - Preparation of a vermiculture unit or visit to a vermicomposting unit.

Module 6 Apiculture

18 Hrs

Definition, Uses of bees, species of bees cultured, organization of honey bee colony, bee keeping methods (modern method only) and equipments, management and maintenance of an apiary-growth period, dividing the colony, uniting two colonies, replacing old queen with new queen, honey flow period, Bee pasturage, Death period, Enemies of bees, Bee diseases, uses of honey and wax, Apitherapy, Propolis, Royal jelly, Agencies supporting apiculture.

Activity: Identify different types of honey bees and rearing equipments

Field visit and report Submission

Field visit and report writing on any two items are taken for internal evaluation, instead of assignment and seminar. Conduct a workshop on various cultural practices and the preparation of byproducts.

References

1. Applied Zoology, Study Material Zoological Society of Kerala, CMS College Campus, Kottayam.
2. Addison Webb (1947), Bee Keeping- for profit and pleasure, Museum Press, Agrobios India Ltd.

3. Alka Prakash (2011), Laboratory Manual of Entomology, New age International, New Delhi.
4. Arumugan N. (2008) Aquaculture, Saras publication.
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8. David Alderton (2008). Encyclopedia of Aquarium and Pond fish. Published by Dorling Kindersley, DK Books.
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10. George Cust and & Peter Bird. (1978). Tropical Fresh water Aquaria, Published by Hamlyn London. illustrated by George Thompson.
11. Harisankar J. Alappat and Bijukumar. A. (2011) Aquarium Fishes. B. R. Publ. Corporation, Delhi.
12. Herbert R. and Leonard P. Schultz Axelrod (1955) Handbook of Tropical Aquarium Fishes, McGraw-Hill, 1955.
13. Joy P.J., George Abraham K., Aloysius M. Sebastian and Susan Panicker (Eds)(1998) Animal Diversity, Zoological Society of Kerala, Kottayam
14. Michael B. New; Alber G.J. Tacon (1994) Farm made aquafeeds FAO fisheries technical paper No.343, Rome, FAO. 1994
15. Nalina Sundari, M.S and Santhi, R (2006) Entomology. MJP Publishers
16. NPCS Board of Consultants & Engineers, Chennai.(2015) The complete book on Bee keeping and honey processing, 2nd Edition, NIIR Project consultancy services, 106- E kamala Nagar Delhi – 110007.
17. Ronald j. Roberts (1978) Fish pathology , Cassel Ltd London .
18. Vijayakumaran Nair, K, Manju, K.G. and Minimol, K. C.(2015) Applied Zoology, Academia press, Thiruvananthapuram

OPEN COURSE (FOR OTHER STREAMS)

ZYSOPT02

2. PUBLIC HEALTH AND NUTR

72 Hrs

4hrs/WeekCredits

3

Objectives:

- To inculcate a general awareness among the students regarding the real sense of health.
- To understand the role of balanced diet in maintaining health.
- To motivate them to practice yoga and meditation in day-to-day life.

PART I HEALTH, EXERCISE & NUTRITION

Module 1 Definition and Meaning of Health

10 Hrs

Dimensions and Determination of Health Physical Activity and Health benefits
Effect of exercise on body systems – Circulatory, Respiratory, Endocrine, Skeletal and Muscular
Programmes on Community health promotion (Individual, Family and Society) Dangers of alcoholic and drug abuse, medico-legal implications

Module 2 Nutrition and Health

10 Hrs

Concept of Food and Nutrition, Balanced diet Vitamins, Malnutrition, Deficiency Disease Determining Caloric intake and expenditure Obesity, causes and preventing measures
Role of Diet and Exercise, BMI

Module 3 Safety Education in Health promotion

8 Hrs

Principles of Accident prevention Health and Safety in daily life.
Health and Safety at work. First aid and emergency care.

Common injuries and their management. Modern life style and hypokinetic diseases.
Diabetes, Cardiovascular disorders-Prevention and Management.

Module 4 Life Skill Education

8 Hrs

Life skills, emotional adjustment and well being,. Yoga, Meditation and Relaxation, Psychoneuroimmunology

PART II PUBLIC HEALTH AND SANITATION

Module 5 Public health and water quality.

11 Hrs

Potable water, Health and Water quality

Faecal bacteriae and pathogenic microorganisms transmitted by water. Determination of sanitary quality of drinking water, water purification techniques

Module 6 Public health and diseases

15 Hrs

Water borne diseases-Cholera and Typhoid. Prevention of Water borne diseases.

Food borne diseases and Prevention Botulinum, Salmonellosis, Hepatitis A

Vector borne diseases & Control measures Chikungunya , Filariasis and

Dengu fever **Zoonotic disease**-Leptospirosis & its control

Emerging diseases - Swine flue (H1N1), bird flue (H5N1), SARS, Anthrax

Re-emerging diseases –TB, Malaria

Health Centre visit & Report Presentation

10 Hrs

References:

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3. K Park, (2008) Park's Text Book of Preventive and Social Medicine 18th Edition. Banarasidas Bhanot Publication
4. Norman Bezzaant HELP First Aid for everyday emergencies. Jaico Publishing House, Bombay, Delhi

5. Tom Sanders and Peter Emery. (2004) Molecular basis of human nutrition: Taylor & Francis Publishers Ane Book
6. Pelczar M.J. Jr. E.C.S. Chan & N.R. Krieg, Microbiology (Concept & Applications). 5th edition. Tata McGraw Publishing Company Ltd.

SEMESTER V.

OPEN COURSE (FOR OTHER STREAMS)ZY5OPT03

3. MAN, NATURE AND SUSTAINABLE DEVELOPMENT

72 Hrs
4Hrs/WeekCredits
3

Objectives:

1. To understand how Man originated and attained present status
2. To learn the basic concepts of Ecosystems and its functioning
3. To study the use and abuse of nature by Man
4. To learn the different resources available on earth
5. To study global environmental problems and its impact on human well being
6. To appreciate the perspectives of Man on nature and learn the strategies for conservation
7. To familiarize with sustainable development and develop an attitude for sustainability

Module I. Man in Nature

10 Hrs

Introduction Evolution of Man

Out of Africa and Candelabra Model The Fossils and the Molecular

Evidences Hunter-Gatherer and the Agriculturist Speech and

Languages

Cultural Evolution Altruism and

Morality

Module II. The Biosphere

10 Hrs

Earth-Continents and Continental drift

Concept of Landscapes and Habitats Lithosphere- Forest (Tropical and Temperate) Grasslands, Deserts and Montane
The Biomes of the World Hydrosphere- Oceans, Estuaries

Freshwater

Water the Elixir of Life

Atmosphere- Structure and stratification

Module III. Dominance of Man on Earth

7 Hrs

Industrial Revolution

Human Population Growth Resource

Utilization

Environmental Consequences Modern Agriculture and

Green Revolution

Environmental Impacts Imperialism and its Ecological

Root

Module IV. Natural Resources

7 Hrs

Renewable and Non- renewable Biodiversity

Importance of Biodiversity -the Six E^s

Hotspots of Biodiversity

Biotic Richness of India

Monoculture and loss of Genetic Diversity Extinction Crisis, IUCN and

Red Data Book

Module V. Global Environmental Issues Threatening Natural

Resources and Human Life

10 Hrs

Deforestation, Landscape alterations, Soil erosion, Flood and Drought, Desertification, Overexploitation, Pollution (Air, Water and Soil- Pollutants and Consequences only), Acid rain, Ozone depletion, Greenhouse effect and Global Warming (use case studies to illustrate the points) Waste disposal (Biodegradable and Non-degradable eg. Plastic and E- waste), Oil spill Energy - Production, Consumption and its Impact on Environment Quality of the Environment and Human Health

Module VI. Man's Perspective on Nature**10 Hrs**

Eco Spirituality, Eco-theology and Eco-feminism
Community initiatives
Indigenous People's Perspective (tribal and traditional communities)
Native American, Amazonian, Australian Aborigines, Bishnoi Contributions of -John Muir, Aldo Leopold, Thoreau, Rachel Carson Edward Abbey, Arne Ness, Carolyn Merchant, Vandana Shiva

Module VII. Global Strategies for Conservation**8 Hrs**

UN conference on Man and Environment-1972
UNEP and its Contributions
The World Conservation Strategy-1980
World Commission on Environment and Development
The Earth Summit -1992
The UNFCCC and IPCC
Conservation Strategies in India-MoEF
Legal System- Mention Major Conservation Acts
People's Participation in Conservation:
Chipko Movement and Narmada Bachao Andolan, Silent Valley

Module VIII Sustainable Development**10 Hrs**

Definition and Concept
Principles and Goals
Environment versus Development Debate
Johannesburg Conference - 2002
Strategies for Sustainable development
Sustainable Development in the era of Globalization
Gandhian Environmentalism
Education for Sustainable Development (UNESCO-ESD)
Building a Sustainable society
Sustainable life styles

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SEMESTER VI.

ZOOLOGY CORE CHOICE BASED COURSES

FOR B.Sc. ZOOLOGY PROGRAMME ZY6CBT01. ELECTIVE COURSE.

1. ECOTOURISM & SUSTAINABLE DEVELOPMENT

72 Hrs
4hrs/week
Credits 3

Objectives:

1. To introduce the concepts, principles and applications of tourism and its sustainability
2. To critically analyse the cost and benefits of ecotourism, including related laws and policies, community involvement and future trends
3. To develop an appreciation among students with respect to tourism development from the

sustainability perspective

4. To equip the students with basic knowledge for the emerging ecotourism industry

Module I. Fundamentals of Tourism

12 Hrs

Introduction- Tourism, concepts and definitionsHistory, types, Characteristics

The facilitating sectorsAttractions

Geography, heritage Wildlife, nature

Quality Control

Module II. Major areas of eco-tourism

10 Hrs

Concepts, practices and case studies for each:

Marine tourism Wildlife

tourism Adventure tourism

Module III. Emerging trends in eco-tourism

10Hrs

Cultural tourism Pilgrimage

tourismFarm tourism Backwater

tourismHealth tourism

Module IV. Problems and prospects of eco-tourism

10 Hrs

Economics and benefits of ecotourism

Cultural issues and negative aspects of ecotourismEnvironmental Impacts of Tourism

Module V. Sustainable tourism

12 Hrs

Quality, Standards

Systems of sustainable tourism: environmental, sociocultural, EconomicalEnvironment and conservation: basic principles

Current practices of eco-conservation in tourism industrySustainable tourism and society

Community based ecotourism

Eco-development committee (EDC) of Periyar Tiger RerservePeople initiatives

Module VI. Eco-tourism guides**8 Hrs**

Ecotourism guiding and case studies

Activity

Field visit to Ecologically relevant places & Report writing

10 Hrs**References**Bruner, E.M. 2005. *Culture on tour: ethnographies of travel*. The University of Chicago Press.

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Ratandeep Sing. 2003. National Ecotourism and Wildlife tourism: Policies and guidelines.

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ELECTIVE COURSE . ZY1716301**2. AGRICULTURAL PEST MANAGEMENT****72 Hrs****Hrs/week - 3 Credits**

Objectives

1. To acquire basic skills in the observation and study of nature.
2. To impart basic awareness regarding pest problem and crop loss due to their dominance.
3. To inculcate interest in adopting biological control strategies for pest control.
4. To understand various pests affecting our local crops and select the best method for their control

5. To acquire basic knowledge and skills in agriculture management to enable the learner for self-employment.

Module I

5 Hrs

Pest and crop loss: Introduction, historical perspective-origin of pest, Evolution of pest. Causes of pest outbreak- biotic, abiotic and genetic factors. Modern agricultural practices and pest problem - high yielding varieties, monoculture, fertilizers, pesticides, irrigation, and cultural practices.

Module II

15 Hrs

Pest categories: Types of pests- insect pest and non-insect pest.

Insect pest: insect structure and function-external features (body parts), mouth parts of phytophagous insects, internal anatomy, growth, development, reproduction, life cycle and metamorphosis (one example each from ametabolous, hemimetabolous and holometabolous insect), diapause. types of insect pests-key pests, occasional pests, potential pests.

Non insect pests: General features, different types-Rodents(mention the nature of crop loss by them), Mites-Main types of mites; plant injury caused by mite, millipedes and centipedes, slugs and snails (mention the damage of invasive Giant African Snail).

Activity: Identify a minimum of 5 invasive species (plant / animal) in your locality and make a report on their ecological impact.

Module III

7 Hrs

Pest and plants: Plant feeding insects-plant host range, types of injury, relationship of pest injury and yield.

Host plant resistance: Characterization of resistance, mechanism of resistance (antixenosis, antibiosis, tolerance), biophysical, biochemical and genetic bases of resistance.

Module IV

20 Hrs

Pest control-principles and practices: Types of control-cultural control, biological control, chemical control, integrated pest management, miscellaneous control.

Cultural control: Water management, tillage, sanitation, plant diversity, crop rotation, planting time, harvesting practices etc

Biological control: Parasitoids and predators, control by insect pathogens. Techniques in biological control-conservation, introduction and augmentation. Biopesticides

Chemical control: Origin of chemical control, chemistry, mode of action and nomenclature (organochlorines, organophosphates, carbamates, synthetic pyrethroids, miscellaneous group) of pesticides, pesticide formulations and pesticide appliances (sprayers and dusters). Brief mention of attractants, repellents, chemosterilants and pheromones

Activity 1: Conduct a workshop on preparation of biopesticides of various types suitable for kitchen garden and agricultural fields.

Integrated Pest Management (IPM)

Miscellaneous control: Mechanical (hand picking, exclusion by screens and barriers, trapping, clipping, pruning etc), physical (hot and cold treatment, moisture, light traps etc), sterility principle

Module V

25 Hrs

Bionomics and control of major pests of crops and stored grains: Biology, life cycle and nature of damage by different pests of following crops and their control

Pests of paddy: *Leptocorisa acuta*, *Scirpophaga incertulas*, *Spodoptera mauritia*, *Orseolia oryzae*, *Nilaparvata lugens*

Pests of coconut: *Oryctes rhinoceros*, *Rhyncophorus ferrugineus*, *Opisina arenosella*, *Aceria guerreronis*

Pests of Banana: *Cosmopolites sordidus*, *Pentalonia nigronervosa*

Pests of vegetables - Brinjal: *Leucinodes orbonalis*, *Euzophera perticella*, *Henosepilachna vigintioctopunctata*, *Urentius hystricellus*

Gourds - *Bactera cucurbitae*, *Anadeniavapeponis*, *Epilachna* spp. *Raphidopalpa foveicollis*, *Baristrichosanthus*

Pest of stored grains: *Sitophilus oryzae*, *Corcyra cephalonica*, *Tribolium castaneum*, *Trogoderma granarium*, *Callosobruchus chinensis*

Activity 2: Conduct a poster exhibition on various types of pests of paddy, coconut, banana and vegetable varieties of Kerala.

Activity 3: Collect different types of pest of stored grains from the local provision shops or houses and make a taxonomic study and prepare a powerpoint presentation on them.

Activity 4: Visit a minimum of 5 kitchen gardens in the neighborhood and enlist the common traditional pest control measures used in them.

Activity 5: Organise awareness classes on the ill effects of chemical pesticides and manure on human health with the support of local examples.

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ELECTIVE COURSE. ZY6CBT03.

3. VECTOR AND VECTOR BORNE DISEASES

72 Hrs

3 Credits

Objectives:

Module I

10Hrs

Introduction: Vector : mechanical and biological vector, Reservoirs, Host-vector relationship, Vectorial capacity, Host Specificity.

Insect vectors: Mosquitoes, flies, fleas, lice, ticks and bugs- General account of ecology morphology and mouth parts

Module II

6 Hrs

Salient features and distribution of mosquito species: *Anopheles*, *Aedes*, *Culex*, and *Mansonia*.

Module III

25 Hrs

Study of Vector Borne disease [Life cycle and pathology]: Mosquito-borne diseases – Malaria, Dengue, Chikungunya, Filariasis. Sand fly-borne diseases – Leishmaniasis, Phlebotomus fever. Tse-tse fly – sleeping sickness. House fly borne diseases : typhoid fever, cholera, dysentery, anthrax, Myiasis. Flea-borne diseases – Plague, Typhus fever. Louse-borne diseases – Relapsing fever, Trench fever, Vagabond's disease, Phthiriasis.

Module IV

13 Hrs

Introduction to Vector control: Aims, objectives and advantages. History and background, recent trends, alternatives to the use of insecticides (chemical & microbial), types of vector control - selective, integrated and comprehensive vector control.

Control measures of mosquitoes, sand fly, tsetse fly and domestic flies

Module V

8Hrs

Introduction to epidemiology: History, Definition, scope and uses of epidemiology. Epidemiology and public health. Achievements in epidemiology: Smallpox Methyl mercury

poisoning Rheumatic fever and rheumatic heart disease Iodine deficiency diseases Tobacco, asbestos and lung cancer, Hip fractures. HIV/AIDS, SARS.

Field report on two case studies of epidemiology in India.

10 Hrs

References

1. Bates M (1949) Natural History of mosquitoes The Macmillan Co.
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16. Rao, T. R. 1984. The Anophelines of India. Malaria Research Centre, ICMR, New Delhi.
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18. Speight, M.R., Hunter, M.D. & Watt, A.D. 1999. Ecology of Insects- Concepts and Applications. Blackwell Science Ltd., London.
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23. R Bonita R Beaglehole T Kjellström Basic epidemiology 2nd edition WHO Library Cataloguing-in-Publication Data Bonita ISBN 92 4 154707 3
(NLM classification: WA 105) ISBN 978 92 4 154707 9 © World Health Organization 2006.

ELECTIVE COURSE. ZY6CBT04

4. NUTRITION, HEALTH AND LIFESTYLE MANAGEMENT

72 Hrs.

3 Credits

Objectives:

1. To provide students with a general concept of health and the parameters that define health and wellness.
2. To understand principles of nutrition and its role in health.
3. To familiarize the students regarding food safety, food laws & regulations.
4. To provide knowledge and understanding regarding life style diseases.
5. To promote an understanding of the value of good life style practices, physical fitness and healthy food habits for life style disease management.

Module I

15 Hrs

Nutrition and health: Nutritional requirements of man, classification of major nutrients

including protein, vitamins and minerals, water, role of fibre, biological value of food components, food groups and sources, balanced diet, RDA, BMI, BMR, Calorie intake and expenditure, Healthy eating pyramid, Nutrition in infancy, preschool, school, adolescent, pregnancy, lactation and old age. Nutrition in diseases and special conditions. Food safety: Nutrition education, food sanitation and hygiene, food adulteration and consumer protection.

Module II

18 Hrs

Understanding of health: Define health, basic concepts, dimensions of health, basic parameters of health care. (Health Parameters: Individual normal standards, devices. 1. Blood pressure, 2. Brain activities and sleep, 3. Focus or attention, 4. Pulse, 5. Body temperature,

6. Daily physical activities, 7. Electrocardiogram (ECG), 8. Cardiac fitness 9. Stress,

10. Haematological parameters, 11. BMI

Module III

15 Hrs

Introduction to Life style diseases

Common life style diseases: Alzheimer's disease and other neural disorders, asthma, cancer, cardio vascular diseases - including hypertension, Atherosclerosis and stroke, chronic obstructive pulmonary disease, Diabetes Mellitus or Type 2 Diabetes, kidney disorders and chronic renal failure, constipation, depression, gastro-intestinal disturbances including diarrhoea and peptic ulcer, liver cirrhosis and other liver diseases, obesity, osteoporosis, occupational lifestyle diseases.

Modern lifestyle disorders: sleeping habits, junk food, poor eating habits, anxiety, food poisoning

Module IV

10 Hrs

Causes of lifestyle diseases: Defects of modern food habits and unbalanced diet options, food adulteration, environmental pollution, poor life style choices, drug abuse, tobacco smoking, alcohol and drug consumption, lack of adequate exercise, wrong body posture,

disturbed biological clock, stressful environmental conditions

Module V

14 Hrs

Prevention and control of life style diseases:

Healthy life style habits and practices, healthy eating habits, exercise and fitness, good sleep patterns, a strict no to alcohol, drugs, and other illegal drugs.

Uncontrollable factors like age,gender, heredity and race.

Healthy diet: disease prevention through appropriate diet and nutrition, avoiding foods that are high in fats, salt and refined products. Avoid junk food and replace by natural food/ organic food.

Physical exercise: Moderate exercise for fitness of body, walking, stretching, right postures of sitting & standing, relaxation and cutting down of stress, sports, aerobic exercise and yoga.

Health literacy as a public health goal: Awareness programs in schools, colleges and through mass media.

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13. COMPLEMENTARY ZOOLOGY COURSES OFFERED BY ZOOLOGY DEPARTMENT FOR - MODEL I – BSc BOTANY / BSc

HOME SCIENCE

MODEL II – BSc BOTANY, BSc (AQUACULTURE)

MODEL III – BSc (BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION)

