

# **B.C.M COLLEGE, KOTTAYAM**

Affiliated to Mahatma Gandhi University, Kottayam, Kerala

## **B.Sc. ZOOLOGY PROGRAMME**

**Curriculum for undergraduate programme**

**Under choice based credit system**

**(Based on the Syllabus of Mahatma Gandhi University for 2017  
Admission onwards)**

## **BOARD OF STUDIES**

NAME	DESIGNATION
Dr. Nisha P. Aravind	Assistant Professor Department of Zoology C.M.S College, Kottayam
Dr. Philip Litto Thomas	Assistant Professor Department of Zoology S.B. College, Changanassery
Dr. Elezabeth Basil	Assistant Professor Department of Zoology B.C.M. College, Kottayam
Ms. Priya Thomas	Assistant Professor Department of Zoology B.C.M. College, Kottayam
Ms. Emi Mathew	Assistant Professor Department of Zoology B.C.M. College, Kottayam

# CURRICULUM

## Graduate Programme Outcomes

At the completion of the B.Sc Zoology Programme, the student will be able to accomplish the following outcomes.

GPO	Graduate Programme Outcomes
GPO No.1	<b>Disciplinary Knowledge &amp; Critical Thinking:</b> Articulate knowledge of one or more disciplines that form a part of UG programme. Critically think, analyse, apply and evaluate various information and follow scientific approach to the development of knowledge.
GPO No. 2	<b>Communication Skill:</b> Communicate thoughts and ideas clearly in writing and orally. Develop careful listening, logical thinking and proficiency in interpersonal communication.
GPO No. 3	<b>Environmental Awareness:</b> Sustainable approach to use of natural resources. Capable of addressing issues, promoting values and give up practices that harm the ecosystem and our planet.
GPO No. 4	<b>Ethical Awareness:</b> Uphold ethics/morals in all spheres of life. Identify and avoid unethical behaviour in all aspects of work.
GPO No. 5	<b>Social Commitment:</b> Be aware of individual roles in society as nation builders, contributing to the betterment of society. Foster social skills to value fellow beings and be aware of one's responsibilities as international citizens.
GPO No. 6	<b>Lifelong learners:</b> Equip students to be life long learners. Be flexible to take up the changing demands of work place as well as for personal spheres of activities.

<b>PSO No.</b>	<b>Programme specific outcomes</b>	<b>GPO NO</b>
1.	Understands the general perspectives in basic sciences, distribution and classification of animals, salient features, structure, organisation, diversity and interactions with their environment.	1
2.	Understand the internal structure of cell, functions of cell organelles and correlates the physiological and biochemical aspects of animal as well as human body.	1
3.	Understands the complex evolutionary history of origin of life, animal phylogeny, animal behaviour, ecological concepts, importance of biodiversity, environmental protection and conservation of nature and natural resources.	1,3
4.	Understands the concepts of heredity and variations, genetic disorders and its application in human traits, human reproduction and assisted reproductive technologies and reproductive health.	1
5.	Apply the knowledge of apiculture, vermicomposting, aquaculture and animal breeding to carry out self employment, entrepreneurship and development of small scale industries.	3,5,6
6.	Develops practical skills in the areas of biochemistry, physiology, biotechnology genetics, microbiology, developmental biology, bioinformatics, taxonomy, applied zoology and ecology.	1,6
7.	Apply their knowledge to carry out research in biology, biological data management and generation of data bank for uploading of nucleotide sequences.	1,2
8.	Designs and constructs novel plans for dealing emerging diseases, pollution, water scarcity, natural disasters and resource management.	3,4,5
9.	Contributes and evaluates their knowledge about environment and its sustainability, its relation to human kind, agriculture, medicine and sociobiology in nation building.	3,4,5
10.	Understand the importance of maintaining good physical, mental and social health and to apply different strategies such as balanced diet, life skill education and safety education in day-to-day life.	2,3,4,5

## COURSE DETAILS OF THE DEPARTMENT

Semester	Course Code	Course
First	ZY1CRT01 ZY1CMT01	General perspectives in Science & Protistan Diversity (Core) General perspectives in Science & Protistan Diversity (Practical) Non Chordate Diversity (Complementary offered to Botany, FACS, FSQC) Non Chordate Diversity (Practical)
Second	ZY2CRT02 ZY2CRP01 ZY2CMT02 ZY2CMP01	Animal Diversity- Non Chordata (Core) Animal Diversity- Non Chordata (Practical) Chordate Diversity (Complementary offered to Botany, FACS, FSQC) Chordate Diversity (Practical)
Third	ZY3CRT03 ZY3CRP03 ZY3CMT03	Animal Diversity - Chordata (Core) Animal Diversity – Chordata (Practical) Physiology and Immunology (Complementary offered to Botany, FACS, FSQC) Physiology and Immunology (Practical)
Fourth	ZY4CRT04 ZY4CRP02 ZY4CMT04	Research methodology, Biophysics & Biostatistics (Core) Research methodology, Biophysics & Biostatistics (Practical) Applied Zoology (Complementary offered to Botany, FACS, FSQC) Applied Zoology(Practical)
Fifth	ZY5CRT05 ZY5CRP05 ZY5CRT06 ZY5CRP06 ZY5CRT07 ZY5CRP07 ZY5CRT08 ZY5CRP08 ZY5OPT02	Environmental Biology& Human rights (Core) Environmental Biology& Human rights (Practical) Cell Biology & Genetics (Core) Cell Biology & Genetics (Practical) Evolution, Ethology & Zoogeography(Core) Evolution, Ethology & Zoogeography(Practical) Human Physiology,Biochemistry &Endocrinology (Core) Human Physiology,Biochemistry &Endocrinology (Practical) Public health andNutrition (Open course)
Sixth	ZY6CRT09 ZY6CRT09 ZY6CRT10 ZY6CRP10 ZY6CRT11 ZY6CRP11 ZY6CRT12 ZY6CRP12 ZY6CBT04	Developmental Biology (Core) Developmental Biology(Practical) Microbiology & Immunology(Core) Microbiology & Immunology(Practical) Biotechnology,Bioinformatics and Molecular Biology(Core) Biotechnology,Bioinformatics andMolecular Biology(Practical) Occupational Zoology (Core) Occupational Zoology (Practical) Nutrition, Health & life style management (Elective)

Course	Details
Code	ZY1CRT01
Title	General Perspectives In Science and Protistan Diversity
Degree	B.Sc.
Branch	Zoology
Year	1/1
Type	Core Course
Credits	2

CO No.	Expected Course outcomes	Cognitive level	PSO No.
1.	Understand the relevance of Science, scope of Zoology and the various branches of Zoology.	U	1
2.	Analyze the different methods used in scientific studies.	An	7
3.	Examine the concepts, importance and various approaches in taxonomy.	Ap	6
4.	Understand the basis of animal classification	U	1
5.	Discuss protistan diversity and its significance.	U	1
6.	Analyse various parasitic protists, their life cycle, mode of infection and pathology.	An	1
7.	Create an activity plan for prevention of vectors of parasitic protists and disease outbreaks.	C	1,8

\*PSO-Program Specific Outcome; CO-Course Outcome; **Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create**

Module	Course Description	Hours	CO No.
<b>1</b>	<b>Introduction to Scientific Studies</b>	<b>4</b>	
1.1	Types of knowledge: practical, theoretical, and scientific knowledge.	1	1
1.2	What is science, features of science, Deductive and inductive models.	1	1,2
1.3	Scientific temper, empiricism.	1	1,2
1.4	Vocabulary of science.	1	1,2
<b>2</b>	<b>What is Biology</b>	<b>4</b>	
2.1	Life and its manifestations.	2	1
2.2	History of Biology: Biology in ancient times Landmarks in the progress of Biology.	1	1
2.3	Branches of Zoology, Scope of Zoology	1	1
<b>3</b>	<b>Taxonomical Principles and tools</b>	<b>10</b>	
3.1	Systematic, Taxonomy, Phylogeny, Approaches to taxonomy.	2	3
3.2	Molecular taxonomy, Barcoding.	2	3
3.3	Zoological nomenclature, International Code of Zoological Nomenclature (ICZN), Law of Priority.	2	3
3.4	Five Kingdom Classification; Linnaean classification, Basis for Animal kingdom classification [Levels of organization, Symmetry, Coelom].	2	4
3.5	Taxonomic key, Types: Single access key- Dichotomous [linked and nested] and Polytomous key, Multi access key, Computer aided Interactive Key- Advantages and Disadvantages	2	3

<b>4</b>	<b>Protistan Diversity</b>	<b>18</b>	
4.1	Kingdom Protista Type: <i>Paramecium</i> Salient features of Kingdom Protista	6	4,5
4.2	Phylum Rhizopoda :Eg. <i>Amoeba</i> Phylum Actinopoda : Eg. <i>Actinophrys</i> Phylum Dinoflagellata : Eg. <i>Noctiluca</i>	1	4,5
4.3	Phylum Parabasalia : Eg. <i>Trychonympha</i> Phylum Metamonada : Eg. <i>Giardia</i> Phylum Kinetoplasta : Eg. <i>Trypanosoma</i>	1	4,5
4.4	Phylum Euglenophyta : Eg. <i>Euglena</i> Phylum Cryptophyta : Eg. <i>Cryptomonas</i> Phylum Opalinata : Eg. <i>Opalina</i> Phylum Bacillariophyta :Eg. Diatoms	1	4,5
4.5	Phylum Chlorophyta :Eg. <i>Volvox</i> Phylum Choanoflagellata :Eg. <i>Proterospongia</i> Phylum Ciliophora : Eg. <i>Balantidium coli</i>	1	4,5
4.6	Phylum Sporozoa : Eg. <i>Plasmodium</i>  Phylum Microsporidia :Eg. <i>Nosema</i>  Phylum Rhodophyta :Eg. Red Alga	1	4,5
4.7	Parasitic protists (diseases mode of transmission and prophylactic measures) - Entamoeba, Trypanosoma	3	6,7
4.8	Plasmodium (detailed account of life cycle)	2	6,7
4.9	Leishmania	2	6,7

## References

- Anderson D.T. 2001 Invertebrate Zoology Sec Edition Oxford University Press
- Barnes R.D. 1987. Invertebrate Zoology. W. B. Saunders. New York.
- Bowler Peter J. and Iwan Rhys Morus. 2005 *Making Modern Science: A Historical Survey*. University of Chicago Press, Chicago, IL:
- Dhami.P.S. and Dhami J.K. 1979 Invertebrate Zoology. R. Chand and Co. Delhi.
- Ekambaranatha Ayyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.
- Ernst Mayr 1982. *The Growth of Biological Thought: Diversity, Evolution and Inheritance*. Published by Harvard University Press.
- Ervin Schrodinger 1944. What is life? Mind and Matter. Cambridge University Press.
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- Kotpal R. L, Agarval S. K. and R. P. Khetharpal 2002. Modern Textbook of Zoology.
- Mayr, E. (1980). Principles of Systematic Zoology (Tata McGraw Hill Publishing Co., New Delhi)
- Parker and Hanswell, 2004, Text Book of Zoology, Vol I (Invertebrate), 7th Edition,

A.Z.T,B.S. Publishers and Distributors, New Delhi – 110 051

Pechenik J A (2005) Biology of Invertebrates, (Tata McGraw Hill Publishing Co., NewDelhi.)

Prema A.K., Joseph M.L. and Terrence Rebello V. (Eds) (2011).Invertebrate Diversity of Kerala.Zoological Society of Kerala, Kottayam.

Taylor, Green, Stout (2008) Biological Science, Cambridge University, Press, p

Thomas, A.P. (Editor) 2009. Biology – Perspectives and Methods. Green Leaf Publshers, Kottayam.

Thomas A P (Editor) 2010 The Invertebrates, Green leaf publications Kottayam.



<b>Course</b>	<b>Details</b>
Code	ZY1CRP
Title	Perspectives in Science and Protistan Diversity (P)
Degree	B.Sc.
Branch	Zoology
Year/Semester	I/I
Type	Core Practical
Credits	2

<b>CO No.</b>	<b>Expected Course outcomes</b>	<b>Cognitive level</b>	<b>PSO No.</b>
1	Understand the basis of classification and identification techniques used to differentiate the organisms.	U, Ap	1,6
2	Identify the organisms using standard keys	Ap	1,6
3.	Understand and identify the protistans through microscopic and pictorial representation.	U	1,6
4.	Identification of Protistans from pond water	Ap	1,6
*PSO-Program Specific Outcome; CO-Course Outcome; <b>Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create</b>			

<b>Module</b>	<b>Course Description</b>	<b>Hrs</b>	<b>CO. No.</b>
<b>1</b>	<b>Perspectives in Science and Protistan Diversity</b>	<b>36</b>	
1.1	Taxa, identification techniques- Bird body parts Butterfly/ dragonfly body parts	6	1
1.2	Identification using keys Insect, Fish, Snake (Poisonous & Non Poisonous )	6	2
1.3	General identification - Protistans	8	3
1.4	Identification of any 4 economically important protists/parasitic protists	8	3
1.5	Identification of two Protistan from pond water	8	

<b>COURSE</b>	<b>DETAILS</b>
CODE	ZY1CMT01
TITLE	<b>ANIMAL DIVERSITY – NON CHORDATA (T)</b>
DEGREE/YEAR	B.SC ZOOLOGY, I SEMESTER
TYPE	<b>COMPLEMENTARY COURSE</b>
CREDITS	36 HRS

CO No.	Expected Course outcomes: <b>ANIMAL DIVERSITY - NON CHORDATA</b>	Cognitive level	PSO No.
1.	Understand the basics of taxonomical classification and the diversity of protozoans and higher invertebrates.	U	PSO-1, PSO-2, PAO-8
2.	Classify and describe the general features of Kingdom Protista with examples and to explain the parasitic protozoans.	U	PSO-1, PSO-2, PSO-8
3.	Classify and describe the salient features of acoelomates with examples by giving special reference to their morphological and ecological importance.	U	PSO-1, PSO-2, PSO-8
4.	Classify and describe pseudocoelomates with special reference to pathogenic nematodes.	U	PSO-1, PSO-2, PSO-8
5.	Understand and classify coelomates with interpretation of their evolutionary relationships.	U	PSO-1, PSO-2, PSO-8
6.	Understand the general features of minor phyla	U	PSO-1, PSO-2, PSO-8
7.	Instigate curiosity of students in the biota around them and to generate a positive attitude towards its conservation.	Ap	PSO-1, PSO-2, PSO-8

\*PSO-Program Specific Outcome; CO-Course Outcome;  
**Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create**

<b>MODU LE</b>	<b>COURSE DECSRIPTION</b>	<b>Hrs.</b>	<b>CO.No.</b>
<b>1.0</b>	<b>Introduction:</b> Five kingdom classification	1	1,7
1.1	<p><b>Kingdom Protista:</b> Salient features (any five important salient features) of each phylum with one example each (detailed account of example is not necessary).</p> <p>Phylum Rhizopoda (eg: Amoeba)</p> <p>Phylum Actinopoda (eg: Actinophrys)</p> <p>Phylum Dinoflagellata (eg: Noctiluca)</p> <p>Phylum Parabasalia (eg: Trychonympha)</p> <p>Phylum Metamonada (eg: Giardia)</p> <p>Phylum Kinetoplasta (eg: Trypanosoma)</p> <p>Phylum Euglenophyta (eg: Euglena)</p> <p>Phylum Cryptophyta (eg: Cryptomonas)</p> <p>Phylum Opalinata (eg: Opalina)</p> <p>Phylum Bacillariophyta (eg: Diatoms)</p> <p>Phylum Chlorophyta (eg: Volvox)</p> <p>Phylum Choanoflagellata (eg: Proterospongia)</p> <p>Phylum Ciliophora (eg: Paramecium)</p> <p>Phylum Sporozoa (eg: Plasmodium)</p> <p>Phylum Microsporidia (eg: Nosema)</p> <p>Phylum Rhodophyta (eg: Red algae)</p>	8	2,7
1.2	<b>General Topic:</b> Pathogenic Protists – Plasmodium, Entamoeba	1	1,2,7
<b>2.0</b>	<b>Phylum Porifera:</b> Salient features (eg: Leucosolenia)	1	1,3,7
2.1	<p><b>Phylum Coelenterata:</b> Salient features and classification upto class</p> <p>Class 1: Hydrozoa (eg: Physalia)</p> <p>Class 2: Scyphozoa (eg: Aurelia)</p>	1	1,3,7

	Class 3: Anthozoa (eg: Adamsia)		
2.2	<b>General Topic:</b> Corals and Coral reefs.	1	1,3,7
3.0	<b>Phylum Platyhelminthes:</b> Salient features and classification up to class. Class 1: Turbellaria (eg: Planaria) Class 2: Trematoda (eg: Fasciola) Class 3: Cestoda (eg: Taenia solium)	2	1,3,7
3.1	<b>Phylum Nematoda:</b> Salient features and classification up to class. Class 1: Phasmida (eg: Wuchereria) Class 2: Aphasmda (eg: Trichinella)	2	1,4,7
3.2	<b>Phylum Annelida:</b> Salient features and classification up to class. Class 1: Polychaeta (eg: Nereis) Class 2: Oligochaeta (eg: Pheretima) Class 3: Hirudinomorpha (eg: Hirudinaria )	2	1,5,7
4.0	<b>Phylum Arthropoda:</b> Salient features. Type study – Fenneropenaeus (Penaeus) – habitat, morphology, appendages, sexual dimorphism, digestive system, respiratory system, circulatory system, excretory system, nervous system, sense organs, reproductive system, larval stages.	8	1,5,7
4.1	Classification up to class with one example each <b>Subphylum Trilobitomorpha</b> Class 1: Trilobita (Extinct) (eg: Dalmanites) <b>Subphylum: Chelicerata</b> Class 1: Merostoma (eg: Limulus) Class 2: Arachnida (eg: Spider) Class 3: Pycnogonida (eg: Nymphon) <b>Subphylum Mandibulata</b> Class 1: Crustacea (eg: Daphnia) Class 2: Chilopoda (eg: Centipede) Class 3: Symphyla (eg: Scutigereella) Class 4: Diplopoda (eg: Millipede)	3	1,5,7

	Class 5: Pauropoda (eg: Pauropus) Class 6: Insecta (eg: Butterfly)		
5.0	<b>Phylum Mollusca:</b> Salient features and classification up to class Class 1: Aplacophora (eg: Neomenia) Class 2: Monoplacophora (eg: Neopilina) Class 3: Polyplacophora (eg: Chiton) Class 4: Bivalvia (eg: Perna) Class 5: Gastropoda (eg: Xancus) Class 6: Cephalopoda (eg: Sepia) Class 7: Scaphopoda (eg: Dentalium)	3	1,5,7
5.1	<b>Phylum Echinodermata :</b> Salient features and classification up to class. Class 1: Asteroidea (eg: Astropecten) Class 2: Ophiuroidea (eg: Ophiothrix) Class 3: Echinoidea (eg: Echinus) Class 4: Holothuroidea (eg: Holothuria) Class 5: Crinoidea (eg: Antedon)	2	1,5,7
5.2	<b>Phylum Hemichordata :</b> Salient features (eg: Balanoglossus.)	1	1,6,7

#### References:

- Animal Diversity (2002). Published by Zoological Society of Kerala.
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<b>COURSE</b>	<b>DETAILS</b>
TITLE	<b>ANIMAL DIVERSITY-NON CHORDATA (P)</b>
DEGREE/YEAR	B.SC ZOOLOGY, I SEMESTER
TYPE	<b>COMPLEMENTARY COURSE</b>
CREDITS	36 HRS

<b>CO.No.</b>	<b>Expected course outcomes</b>	<b>Cognitive Level</b>	<b>PSO.No.</b>
1	Use scientific drawing technique	Ap	PSO-9
2	Identify common invertebrates	U	PSO-9
3	Examine microscopic organisms	An	PSO-9
4	Carry out dissections and temporary mounting	Ap	PSO-9

\*PSO-Program Specific Outcome; CO-Course Outcome;  
**Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create**

<b>Exp</b>	<b>Course Description</b>	<b>Hrs.</b>	<b>CO.No.</b>
1	Scientific drawing - 5 specimens	10	1
2	Simple identification - 10 invertebrates, out of which 5 by their scientific names	8	2
3	T.S - Earthworm, T.S Fasciola	2	3
4	Dissection - Nervous system of Prawn	6	4
5	Dissection - Nervous system of Cockroach	6	4
6	Mounting - Prawn Appendages	4	4

<b>COURSE</b>	<b>DETAILS</b>
CODE	ZY2CRT02
TITLE	<b>ANIMAL DIVERSITY – NON CHORDATA (T)</b>
DEGREE/YEAR	B.SC ZOOLOGY, II SEMESTER
TYPE	<b>CORE COURSE</b>
CREDITS	36 HRS

CO No.	Expected Course outcomes: <b>ANIMAL DIVERSITY - NON CHORDATA</b>	Cognitive level	PSO No.
1.	Understand the basics of taxonomical classification	U	PSO-1, PSO-2, PSO-8
2.	Organize the diverse fauna around them into three branches of Kingdom Animalia.	An	PSO-1, PSO-2, PSO-8
3.	Classify and describe the salient features of acoelomates with examples by giving special reference to their morphological and ecological importance.	U	PSO-1, PSO-2, PSO-8
4.	Classify and describe pseudocoelomates with special reference to pathogenic nematodes.	U	PSO-1, PSO-2, PSO-8
5.	Understand and classify coelomates with interpretation of their evolutionary relationships.	U	PSO-1, PSO-2, PSO-8
6.	Understand the general features of minor phyla	U	PSO-1, PSO-2, PSO-8
7.	Instigate curiosity of students in the biota around them and to generate a positive attitude towards its conservation.	Ap	PSO-1, PSO-2, PSO-8

\*PSO-Program Specific Outcome; CO-Course Outcome;  
**Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create**

<b>MOD ULE</b>	<b>COURSE DESCRIPTION</b>	<b>Hrs.</b>	<b>CO.No.</b>
<b>1.0</b>	<b>Kingdom Animalia</b> Outline classification of Kingdom Animalia Three branches - Mesozoa, parazoa and Eumetazoa	1	1,2,3
1.1	<b>Mesozoa:</b> <b>Phylum Orthonectida</b> - eg. Rhopalura (mention 5 salient features)	1	1,2,3
1.2	<b>Parazoa:</b> <b>1. Phylum Placozoa</b> – Eg. Trycoplax adherens <b>2. Phylum Porifera</b> – Classification upto classes; Mention gemmules Class I- Calcarea. Eg.Sycon., Class II – Hexactinellida .Eg.Euplectella. Class III - Demospongia Eg.Cliona. <b>General Topics</b> 1. Canal system in sponges.	2	1,2,3
1.3	<b>Phylum Coelenterata</b> -Classification upto classes Class I - Hydrozoa Eg. Eg. Obelia - mention Metagenesis Class II- Scyphozoa Eg. Rhizostoma. Class III- Anthozoa Eg. Metridium.	1	1,2,3
1.4	<b>General Topics:</b> 1. Coral and coral reefs with special reference to conservation of reef fauna. 2. Polymorphism in Coelenterates <b>Phylum Ctenophora</b> - Eg. Pleurobrachia.	2	1,2,3,7
<b>2.0</b>	<b>Phylum Platyhelminthes</b> Salient features; classification up to classes Class I - Turbellaria. Eg. Planaria. Class II –Trematoda Eg. Fasciola Class III- Cestoda Eg. Taenia saginata.	1	1,2,3



2.1	<p><b>General Topics:</b></p> <p>1. Life history of Fasciola hepatica.</p> <p>2. Platyhelminth parasites of Man and Dog (Schistosoma, Taenia solium, Echinococcus ).</p>	2	
2.2	<p><b>Phylum Nematelminthes(Nematoda)</b> Salient features, classification up to classes Class: Phasmodia Eg. Enterobius, Class: Aphasmodia Eg. Trichinella</p>	1	1,2,4
2.3	<p><b>General Topic</b> Pathogenic nematodes in man. (Wuchereria bancrofti, Ascaris lubricoides, Ancylostoma duodenale, Trichinella).</p>	1	1,2,4
2.4	<p><b>Phylum Annelida:</b> Salient features, Classification upto classes. Class I- Archiannelida Eg. Polygordius Class II -Polychaeta Eg. Chaetopterus ClassIII- Oligochaeta Eg. Megascolex. Class IV- Hirudinea Eg. Ozobranchus, Hirudinaria</p>	2	1,2,5
3.0	<p><b>Phylum Onychophora</b> Eg. Peripatus (Mention its affinities).</p>	1	1,2,5
3.1	<p><b>Phylum Arthropoda</b> Salient features, Classification upto classes Type: Prawn –Fenneropenaeus (Penaeus)</p>	5	1,2,5
3.2	<p><b>1. Sub Phylum - Trilobitomorpha</b> Class -Trilobita (mention the salient features). Eg. Triarthrus – A trilobite (extinct)</p> <p><b>2. Subphylum –Chelicerata</b> Class 1 Merostomata (Xiphosura) (Eg. Limulus) Class 2. Arachnida (Eg., Palamnaeus- Scorpion) Class 3 Pycnogonida (Eg. Pycnogonum – Sea spider)</p> <p><b>3. Subphylum- Crustacea</b> Class 1 Branchiopoda Eg. Daphnia</p>	8	1,2,5

	<p>Class 2 Ostracoda Eg. Cypris -seed shrimp</p> <p>Class 3 Copepoda Eg. Cyclops</p> <p>Class 4 Remipedia Eg. Speleonectes (eyeless crustacean seen in caves)</p> <p>Class 5.Branchiura Eg.,Argulus (common fish louse)</p> <p>Class 6 Cirripedia Eg. Sacculina (parasitic castrator of crabs)</p> <p>Class 7 Malacostraca Eg. Squilla (spot tail mantis shrimp)</p> <p><b>4. Subphylum- Uniramia</b></p> <p>Class 1 Chilopoda Eg. Scolopendra – (Centipede)</p> <p>Class 2 Symphyla Eg. Scutigera – (garden centipedes or pseudocentipedes)</p> <p>Class 3 Diplopoda Eg. Spirostreptus- (Millipede)</p> <p>Class 4 Pauropoda Eg. Pauropus</p> <p>Class 5 Hexapoda (Insecta) Eg.Bombyx mori – (silk moth)</p>		
<b>4.0</b>	<p><b>Phylum Mollusca</b></p> <p>Salient features, Classification upto classes</p> <p>Class I- Aplousobranchia Eg. Neomenia</p> <p>Class II- Monoplacophora Eg. Neopilina</p> <p>Class III Amphineura Eg. Chiton</p> <p>Class IV Gastropoda Eg. Aplysia</p> <p>Class V Scaphopoda Eg. Dentalium</p> <p>Class VI Pelecypoda (Bivalvia) Eg. Pinctada</p> <p>Class VII Cephalopoda Eg. Sepia</p>	3	1,2,5
4.1	<p><b>Phylum Echinodermata</b></p> <p>Classification upto classes</p> <p>Class I- Asterozoa Eg. Astropecten</p> <p>Class II- Ophiurozoa Eg. Ophiothrix</p> <p>Class III- Echinozoa Eg. Echinus</p> <p>Class IV- Holothurozoa Eg. Holothuria</p> <p>Class V – Crinozoa Eg. Antedon</p>	2	1,2,5
4.2	<b>General Topics</b>	1	1,2,5

	1. Water vascular system in Echinodermata		
<b>5.0</b>	<b>Phylum Hemichordata:</b> Eg. Balanoglossus <b>Minor Phyla</b> 1. Chaetognatha Eg. Sagitta 2. Sipunculida Eg. Sipunculus	2	1,2,6

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<b>COURSE</b>	<b>DETAILS</b>
TITLE	<b>ANIMAL DIVERSITY-NON CHORDATA (P)</b>
DEGREE/YEAR	B.SC ZOOLOGY, II SEMESTER
TYPE	<b>CORE COURSE</b>
CREDITS	36 HRS

<b>CO.No</b>	<b>Expected course outcomes</b>	<b>Cognitive Level</b>	<b>PSO.No.</b>
1	Use scientific drawing technique	Ap	PSO-1, PSO-2
2	Identify common invertebrates	U	PSO-1, PSO-2
3	Examine microscopic organisms	An	PSO-1, PSO-2
4	Carry out dissections and temporary mounting	Ap	PSO-1, PSO-2

\*PSO-Program Specific Outcome; CO-Course Outcome;  
**Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create**

<b>Exp</b>	<b>Course Description</b>	<b>Hrs.</b>	<b>CO.No.</b>
1	<b>Scientific drawing</b> - Make scientific drawings of 5 locally available invertebrate specimens belonging to different phyla.	6	1
2	<b>Anatomy:-</b> <b>Study of sections.</b> (Any two) 1. Hydra. 2. Ascaris(male and female) 3. Earthworm 4. Fasciola	4	3
3	<b>Dissections</b> 1. Prawn - Nervous system 2. Cockroach - Nervous system	8	4
4	<b>Mounting:-</b> 1. Prawn appendages. 2. Mouth parts - Cockroach/ Plant bug/ House fly / Mosquito. (Any Three)	5	4
5	<b>Identification:-</b> <b>General identification &amp;classification</b> - The students are expected to identify, classify and	8	2

	<p>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</p> <p>Identification of (a) Parasitic protest – any 2 (b) larval forms of Fasciola- any 2 (c) Nematode parasites of man- any 3 (Slides/figures may be used for study)</p>		
6	<p><b>Taxonomic identification with key:-</b> Identification of insects up to the level of Order (any Four).</p>	5	2

<b>COURSE</b>	<b>DETAILS</b>
CODE	ZY2CMTO2
TITLE	<b>CHORDATE DIVERSITY (T)</b>
DEGREE/YEAR	B.SC ZOOLOGY, II SEMESTER
TYPE	<b>COMPLEMENTARY COURSE</b>
CREDITS	36 HRS

CO No.	Expected Course outcomes: <b>CHORDATE DIVERSITY</b>	Cognitive level	PSO No.
1.	Understand the diversity, classification and phylogeny of Chordates.	U	PSO-1, PSO-2
2.	Outline and parse the adaptive features exhibited by the vertebrates.	An	PSO-1, PSO-2
3.	Compare the anatomy and physiological peculiarities of Chordates through type study of <i>Euphylysia hexadactyla</i>	U	PSO-1, PSO-2
4.	Understand the economic importance and evolutionary significance of selected Chordate groups.	U	PSO-1, PSO-2
5.	Determine the classification category of a given chordate based on the external observable features.	Ap	PSO-1, PSO-2
<p>*PSO-Program Specific Outcome; CO-Course Outcome;  <b>Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create</b></p>			

<b>MODULE</b>	<b>COURSE DESCRIPTION</b>	<b>Hrs.</b>	<b>CO.No.</b>
1.0	<b>Phylum Chordata:</b> Fundamental characters and outline classification upto class.	1	1,2,5
1.1	<b>Sub phylum Urochordata:</b> General characters,	3	1,2,5

	<p>Classification:</p> <p>Class 1: Larvacea (eg: Oikopleura)</p> <p>Class 2: Ascidiacea (eg: Ascidia) , Retrogressive metamorphosis.</p> <p>Class 3: Thaliacea (eg: Salpa)</p> <p><b>Sub phylum Cephalochordata:</b> Salient features (eg: Branchiostoma)</p>		
<b>2.0</b>	<p><b>Sub phylum Vertebrata:</b> Salient features</p> <p><b>Division Agnatha :</b> salient features and classification</p> <p>Class 1: Cyclostoma (eg: Petromyzon)</p> <p>Class 2: Class Ostracodermi (eg: Cephalapsis)</p>	2	1,2,5
2.1	<p><b>Division Gnathostomata:</b> Salient features</p> <p>Super class Pisces</p> <p>Super class Tetrapoda.</p>	1	1,2,5
2.2	<p><b>Super class Pisces:</b> Salient features and classification</p> <p>Class 1: Chondrichthyes (eg: Narcine)</p> <p>Class 2: Osteichthyes (eg: Latimeria)</p>	2	1,2,5
2.3	<p><b>General Topic:</b> Accessory respiratory organs in fishes.</p>	1	1,2,5
<b>3.0</b>	<p><b>Super class Tetrapoda:</b> Salient features</p>	1	1,2,5
3.1	<p><b>Class 1: Amphibia :</b> Salient features. Type study: Euphyctis hexadactyla - Habitat, morphology, sexual dimorphism, coelom and viscera, skeletal system, digestive system, respiratory system, circulatory system, excretory system, nervous system, sense organs, reproductive system, development.</p>	9	1,2,3,5
3.2	<p>Classification up to order:</p> <p><b>Order 1:</b> Urodela (eg: Amblystoma)</p> <p><b>Order 2:</b> Anura (eg: Bufo)</p> <p><b>Order 3:</b> Apoda (eg: Ichthyophis)</p>	4	1,2,5
<b>4.0</b>	<p><b>Class Reptilia:</b> Salient features and classification up to subclass</p>	1	1,2,5
4.1	<p><b>Sub class 1:</b> Anapsida (eg: Chelone)</p> <p><b>Sub class 2:</b> Diapsida (eg: Chamaeleon)</p>	2	1,2,5



	<b>Sub class 3:</b> Parapsida (eg: Ichthyosaurus) <b>General Topics:</b> Poisonous and non poisonous snakes of Kerala.		
4.2	<b>Class Aves:</b> Salient features and classification up to subclass <b>Sub class Archeornithes</b> (eg: Archaeopteryx) <b>Sub class Neornithes</b> (eg: Struthio) <b>General Topics:</b> Flight adaptation of birds	3	1,2,4,5
5.0	<b>Class Mammalia:</b> Salient features and classification up to subclass <b>Sub class 1:</b> Protheria (eg: Echidna) <b>Sub class 2:</b> Metatheria (eg: Macropus) <b>Sub class 3:</b> Eutheria (eg: Elephas) <b>General Topic:</b> General adaptation of aquatic mammals with example.	6	1,2,5

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<b>COURSE</b>	<b>DETAILS</b>
CODE	ZY2CMPO2
TITLE	<b>CHORDATE DIVERSITY (P)</b>
DEGREE/YEAR	B.SC ZOOLOGY, II SEMESTER
TYPE	<b>COMPLEMENTARY COURSE</b>
CREDITS	36 HRS

CO No.	Expected Course outcomes: <b>ANIMAL DIVERSITY – CHORDATA (P)</b>	Cognitive level	PSO No.
1.	Understand and classify the local chordate diversity.	U	PSO-9
2.	Examine the morphology, anatomy and osteology of chordates.	An	PSO-9
3.	Carry out identification of snakes using taxonomic keys.	Ap	PSO-9
4.	Carry out temporary mounting.	Ap	PSO-9
*PSO-Program Specific Outcome; CO-Course Outcome; <b>Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create</b>			

<b>MODULE</b>	<b>COURSE DESCRIPTION</b>	<b>Hrs.</b>	<b>Co No.</b>
<b>1.0</b>	Simple identification of 10 chordates, out of which 5 by their scientific names	<b>8</b>	1
<b>2.0</b>	Osteology - Vertebrae and girdles of Frog	<b>6</b>	2
<b>3.0</b>	Snake identification - 3 poisonous and 3 non poisonous snakes with key	<b>6</b>	3
<b>4.0</b>	Mounting of placoid scales of shark	<b>6</b>	4
<b>5.0</b>	Dissections: Frog: Photographs/Diagrams/ models may be used for the study. 1. Frog - Viscera 2. Frog - Digestive System 3. Frog - Arterial System 4. Frog - Brain	<b>10</b>	2

COURSE	DETAILS
CODE	ZY3CRT03
TITLE	<b>ANIMAL DIVERSITY – CHORDATA (T)</b>
DEGREE/YEAR	B.SC ZOOLOGY, III SEMESTER
TYPE	<b>CORE COURSE</b>
CREDITS	54 HRS

CO No.	Expected Course outcomes: <b>ANIMAL DIVERSITY – CHORDATA (T)</b>	Cognitive level	PSO No.
1.	Understand the diversity, classification and phylogeny of Chordates.	U	PSO-1
2.	Outline and parse the adaptive features exhibited by the vertebrates.	An	PSO-1
3.	Compare the anatomy and physiological peculiarities of of Chordates through type study.	U	PSO-1
4.	Understand the economic importance and evolutionary significance of selected Chordate groups.	U	PSO-3
5.	Determine the classification category of a given chordate based on the external observable features.	Ap	PSO-7
*PSO-Program Specific Outcome; CO-Course Outcome; <b>Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create</b>			

MODULE	COURSE DESCRIPTION	Hrs.	Co No.
<b>1.0</b>	<b>Introduction</b> General Characters and outline classification of Chordata up to class, Origin of Chordates – mention theories in brief	1	1,2,5
1.1	<b>Protochordates:</b> General characters and Classification	1	1,2,5
1.2	<b>Sub phylum:Urochordata</b> Class I Larvacea Eg. <i>Oikopleura</i> Class II Ascidiacea Eg: <i>Ascidia</i> (Mention Retrogressive Metamorphosis) Class III Thaliacea Eg: <i>Doliolum</i>	1	1,2,5
1.3	<b>Sub phylum: Cephalochordata</b> Example - <i>Amphioxus</i> (Structure and affinities)	2	1,2,4,5
<b>2.0</b>	<b>Sub phylum: Vertebrata</b> General characters and Classification	1	1,2,5

2.1	<b>Division 1– Agnatha</b> Class I Ostracodermi                      Eg: <i>Cephalaspis</i> Class II Cyclostomata                      Eg: <i>Petromyzon</i>	1	1,2,5
2.2	<b>Division 2 – Gnathostomata</b> <b>Super class Pisces</b> General Characters and Classification	1	1,2,5
2.3	<b>Class: Chondrichthyes</b> - General Characters Sub class – Elasmobranchi    Eg: Narcine Sub class - Holocephali        Eg: Chimaera	2	1,2,5
2.4	<b>Class: Osteichthyes</b> - General Characters Sub class – Choanichthyes Order 1 Crossopterigii(Coelocanths) 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	5	1,2,4,5
2.5	<b>General topics</b> 1. Accessory respiratory organs in fishes. 2. Parental care in fishes. 3. Scales in fishes. 4. Migration in fishes	2	2
3.0	<b>Super class: Tetrapoda</b> General characters, Classification up to Orders	1	1,2,5
3.1	<b>Class Amphibia</b> - Type Frog ( <i>Euphlyctis hexadactylus</i> ) Order I Anura                      Eg: Hyla Order II Urodela                      Eg: Amblystoma (mention axolotl larva and Paedomorphosis /neotony) Order III Apoda                      Eg: Ichthyophis.	10	1,2,3,5
3.2	<b>Class Reptilia</b> 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: Cynognathu	3	1,2,5
3.3	<b>General topic :</b> Identification of poisonous and non-poisonous snakes	1	1,2,5
3.4	<b>Class Aves</b> <b>Sub class I:</b> Archeornithes Eg: Archaeopteryx (Affinities) <b>Sub class II:</b> Neornithes Super order I: Palaeognathe Eg: Struthio	3	1,2,,45

	Super order II: Neognathe Eg: Brahminy kite		
3.5	<b>General topics</b> 1. Migrations in birds 2. Flight adaptations in birds	2	2
4.0	<b>Class Mammalia</b> Type: Rabbit ( <i>Oryctolagus cuniculus</i> )	6	1,2,4,5
4.1	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) <b>Sub class I: Prototheria</b> Eg: Echidna, Ornithorhynchus <b>Sub class II: Metatheria</b> Eg: Macropus	1	1,2,5
4.2	<b>Sub class III: Eutheria</b> Order 1 Insectivora Eg: Talpa Order 2 Dermoptera Eg: Galeopithecus Order 3 Chiroptera Eg: Pteropus Order 4 Primates Eg: Loris Order 5 Carnivora Eg: Panthera Order 6 Edentata Eg: Armadillo Order 7 Pholidota Eg: Manis Order 8 Proboscidea Eg: Elephas Order 9 Hydracoidea Eg: Procvavia Order 10 Sirenia Eg: Dugong Order 11 Perissodactyla Eg: Rhinoceros Order 12 Artiodactyla Eg: Camelus-mention ruminant stomach Order 13 Lagomorpha Eg: Oryctolagus Order 14 Rodentia Eg: Hystrix (Porcupine) Order 15 Tubulidentata Eg: Orycteropus Order 16 Cetacea Eg: Delphinus	8	1,2,5
4.3	<b>General topics</b> 1. Dentition in Mammals 2. Aquatic Mammals and their adaptations.	2	2

## References

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<b>COURSE</b>	<b>DETAILS</b>
TITLE	<b>ANIMAL DIVERSITY – CHORDATA (P)</b>
DEGREE/YEAR	B.SC ZOOLOGY, III SEMESTER
TYPE	<b>CORE COURSE</b>
CREDITS	36 HRS

CO No.	Expected Course outcomes: <b>ANIMAL DIVERSITY – CHORDATA (P)</b>	Cognitive level	PSO No.
1.	Understand and classify the local chordate diversity.	U	1,6
2.	Examine the morphology, anatomy and osteology of chordates.	An	6
3.	Carry out identification of vertebrates using taxonomic keys.	Ap	6
4.	Use scientific drawing technique	Ap	6
*PSO-Program Specific Outcome; CO-Course Outcome; <b>Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create</b>			

<b>MODULE</b>	<b>COURSE DESCRIPTION</b>	<b>Hrs.</b>	<b>Co No.</b>
<b>1.0</b>	<b>Scientific Drawing</b>	<b>5</b>	<b>4</b>
1.1	Make scientific drawing of 5 locally available vertebrate specimens belonging to different classes	3	4
<b>2.0</b>	<b>Dissections</b>	<b>6</b>	<b>2</b>
2.1	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	5	2
<b>3.0</b>	<b>Mounting of placoid scales; study of cycloid and ctenoid scales</b>	<b>5</b>	<b>2</b>
<b>4.0</b>	<b>Osteology</b>	<b>5</b>	<b>2</b>
4.1	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	2
<b>5.0</b>	<b>Study of sections.</b>	<b>5</b>	<b>2</b>

5.1	Amphioxus T. S. through pharynx/T.S. through intestine	5	2
<b>6.0</b>	<b>Identification:</b>	<b>10</b>	<b>3</b>
6.1	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.	5	3
6.2	Taxonomic identification with key:- i) Identification of fishes up to the level of order. ii) Identification of snakes up to family.	5	3



Course title	<b>PHYSIOLOGY AND IMMUNOLOGY</b>
Course code	<b>ZY3CMT03</b>
Programme	<b>BSc. ZOOLOGY</b>
Semester	<b>III</b>
Course type	<b>COMPLEMENTARY</b>
Credits	<b>1</b>

<b>C O N o</b>	<b>Expected Course Outcomes</b> <i>Upon completion of this course, the students will be able to:</i>	<b>Cognitive Level</b>	<b>PSO No.</b>
1	Understand the physiology of various organ systems, including respiratory, circulatory, muscular, excretory and nervous systems with special reference to humans and their disorders.	U	<b>PSO – 3,4,5</b>
2	Describe different types of nutrition, nutritional requirements and disorders	U	<b>PSO – 3,5</b>
3	Discuss endocrine system, functions, diseases and hormone action	U	<b>PSO – 3,5</b>
4	Explain basic concepts of Immunology and antigen antibody reactions	U	<b>PSO - 3</b>
5	Identify various immune response systems, vaccines and immune disorders	An	<b>PSO – 3,5</b>

<b>MOD U L E</b>	<b>COURSE DESCRIPTION</b>	<b>HOURS</b>	<b>CO.NO.</b>
1.1	<b>Nutrition:</b> Types of nutrition – autotrophy, heterotrophy. Nutritional requirements – carbohydrates, proteins, lipids, minerals (Ca, Fe, I), vitamins (sources and deficiency disorders), nutritional disorders	5	2
1.2	<b>Respiration:</b> Transport of respiratory gases in blood - transport of oxygen, transport of carbon dioxide, chloride shift. Respiratory disturbances – Hypoxia, Hypercapnia, Asphyxia, physiological effect of smoking, carbon monoxide poisoning.	4	1
1.3	<b>Circulation:</b> Composition and functions of blood. Plasma and formed elements - WBC, RBC and platelets, Mechanism of blood coagulation – clotting factors, intrinsic and extrinsic pathways, anticoagulants. ECG, Blood pressure, Arteriosclerosis, Hemophilia, cerebral and pulmonary thrombosis.	5	1
2.1	<b>Excretion:</b> Structure of a nephron. Urine formation – glomerular filtration, tubular reabsorption, tubular secretion. Urine concentration – counter current mechanism. Composition of urine – normal and abnormal constituents. Hormonal regulation of kidney function. Kidney stone, dialysis.	5	1

2.2	<b>Neuro physiology:</b> Structure of a neuron. Myelinated and non-myelinated nerve fibre, nerve impulse production (resting membrane potential, action potential), Impulse propagation, All or none law, saltatory conduction, synaptic transmission. Neurotransmitters (acetyl choline, adrenalin, dopamine), brain waves, EEG. Neural disorders - Parkinson's disease, Alzheimer's disease.	5	1
2.3	<b>Muscle physiology:</b> Types of muscles: striated, non striated and cardiac. Ultra structure of striated muscle, Mechanism of muscle contraction, Cori cycle and muscle relaxation. Muscle fatigue, oxygen debt, Rigor mortis.	4	1
3.1	<b>Endocrinology:</b> Introduction to Endocrine system. Mechanism of hormone action	2	3
3.2	Endocrine glands - hypothalamus, pituitary gland, pineal gland, thyroid gland, parathyroid gland, endocrine pancreas, adrenal gland, thymus gland, testis and ovary.	5	3
3.3	Physiological role of hormones, Hormonal disorders.	1	3
4.1	<b>Immunology:</b> Introduction to immunology, types of immunity – innate, acquired, passive, active, mechanism of innate immunity (barriers, inflammation, phagocytosis).	4	4
4.2	Types of antigens.	1	4
4.3	Basic structure of immunoglobulins, Classes of immunoglobulins and functions.	3	4
4.4	Antigen antibody reactions, Precipitation test, agglutination test, WIDAL, VDRL, HIV test (ELISA),	4	4
5.1	<b>Immune response system:</b> (Brief accounts of the followings) Primary and secondary lymphoid organs.	1	5
5.2	Cells of Immune system - T&B lymphocytes, natural killer cells, macrophages, plasma cells , memory cells.	1	5
5.3	Monoclonal antibodies, Hybridoma technology.	1	5

5.4	<b>Immune disorders:</b> Hypersensitivity, Auto immunity (rheumatoid arthritis) & Immunodeficiency (AIDS).	2	5
5.5	Vaccines - BCG, DPT, Polio vaccine.	1	5

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Course title	<b>PHYSIOLOGY AND IMMUNOLOGY-PRACTICALS</b>
Course code	
Programme	<b>BSc. ZOOLOGY</b>
Semester	<b>III</b>
Course type	<b>COMPLEMENTARY</b>
Credits	<b>1</b>

<b>CO No.</b>	<b><i>Expected Course Outcomes</i></b> <i>Upon completion of this course, the students will be able to:</i>	<b>Cognitive Level</b>	<b>PSO No.</b>
1	Develop skills in performing and interpreting various laboratory procedures to investigate blood parameters of diagnostic significance.	An	<b>PSO - 9</b>
2	Analyse the action of salivary amylase on starch.	An	<b>PSO - 9</b>
3	Acquaint with various diagnostic instruments used in physiology.	U	<b>PSO - 9</b>
4	Acquire skills in qualitative analysis of nutrients and obtaining results through observation of appropriate reactions and documentation.	An	<b>PSO - 9</b>

\*PSO-Program Specific outcome; CO-Course Outcome;  
**Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create**

<b>MODULE</b>	<b>COURSE DESCRIPTION</b>	<b>HOURS</b>	<b>CO.NO.</b>
1	Clinical analysis of blood - Preparation of Human Blood smear & identification of leucocytes , Estimation of Haemoglobin, Identification of human blood groups, A, AB, B and O, Rh factor	20	1
2	Qualitative analysis of Reducing Sugar, Protein and Lipid	10	4
3	Action of Salivary amylase on Starch	3	2
4	Study of Instruments: Sphygmomanometer , Stethoscope	2	3

Course	Details
Code	ZY4CRT04
Title	Research Methodology, Biophysics and Biostatistics
Degree	B.Sc.
Branch	Zoology
Year/Semester	II/IV
Type	Core Course
Credits	3

CO No.	Expected Course outcomes	Cognitive level	PSO No.
1.	Understand the scientific methods followed in research process.	U	7
2.	Execute the different skills in research communication and documentation.	Ap	7
3.	Apply various statistical methods in research studies.	Ap	7
4.	Understand the principle and use of scientific instruments.	U, Ap	7
5.	Identify the ethical values to be followed in biological studies.	An	7

\*PSO-Program Specific Outcome; CO-Course Outcome; **Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create**

Module Description	Course	Hrs	CO.No
<b>RESEARCH METHODOLOGY</b>			
Module I		13	1,2
1.0	Basic concepts of research:		
1.1	Meaning, Objectives, Approaches, Types of research.	1	1
1.2	Research Process: Scientific method in research	1	1
1.3	Importance of literature reviewing in defining a problem, Identifying gap areas from literature review.	2	1
1.4	Research Communication and scientific documentation:		2
1.4.1	Project proposal writing Research report writing, Thesis, dissertation, research article.	2	2
1.4.2	Presentation techniques: Oral presentation, Assignment, Seminar, Debate, Workshop, Colloquium, Conference	2	2
1.5	Sources of Information:		
1.5.1	Primary and secondary sources. Library- Books, Journals, Periodicals, Reviews, Internet	2	1
1.5.2	Search engines Online libraries, e-Books, e-Encyclopedia, Institutional Websites.	2	1
1.6	Plagiarism	1	1
Module II			
2.0	<b>Animal Collection – Tools &amp; techniques</b>	12	1
2.1	Sampling techniques - Quadrante, Line transect	1	1

2.2	Measurements - Density, Abundance, Frequency	2	1
2.3	Biodiversity indices – concepts , Simpson index	2	1
2.4	Collection methods, techniques and equipments Plankton, Insects, Fish, Bird.	2	1
2.5	Preservation techniques – Taxidermy	1	1
2.6	Rearing techniques: Laboratory and field.	2	1
2.7	Units of measurements- units, SI system, Equivalent weight, normality, molarity	2	1
	<b>BIOPHYSICS</b>		
	Module III	14	4
3.0	<b>Basic understanding on principle and uses of the following:</b>		
3.1	Microscopy:		4
3.1.1	(a) Light microscopy, Bright field (Compound Microscope), Phase contrast, Dark field microscopy, Fluorescence, Polorization microscopy, Video microscopy.	4	4
3.1.2	(b) Electron – Scanning (SEM), Transmission (TEM) and STEM Micrometry – Stage and Eyepiece micrometers Camera Lucida.	4	4
3.3	Instrumentation: pH Meter	1	4
3.4	Separation Techniques:		4
3.4.1	Centrifuge, Chromatography, Electrophoresis	2	4
3.5	Analytical techniques:		
3.5.1	Colorimeter, Spectrophotometer, X-ray crystallography	3	4
	<b>BIOETHICS</b>		
4.0	Module IV	5	5
4.1	Introduction	1	5
4.1.1	Animal rights and animal laws in India: Prevention of cruelty to animals Act 1960, Biodiversity Act 2003.	1	5
4.2	Concept of 3 R – conservation	1	5
4.3	Animal use in research and education.		5
4.3.1	Laboratory animal use, care and welfare, Animal protection initiatives- Animal Welfare Board of India, CPCSEA.	1	5
4.3.2	Ethical commitment. Working with human: Consent,harm, risk and benefits.	1	5
	<b>BIOSTATISTICS</b>		
5.0	Module V	10	3
5.1	Sample & Sampling techniques:		
5.1.1	Collection of data, classification of data, frequency distribution tables	1	3
5.1.2	graphical representation: - Bar diagrams, Histogram, Pie diagram and Frequency curves - Ogives.	1	3
5.2	Measures of Central Tendency: Mean, Median, Mode.	2	3
5.3	Measures of dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Standard error.	2	3
5.4	Correlation: Definition, Types of correlation	1	3
5.5	Test of Hypothesis and Test of Significance:		3
5.5.1	Basic concept, Levels of significance, test of significance	1	3
5.5.2	Procedure for testing hypothesis	1	3
5.5.3	Types of hypothesis- Null hypothesis and Alternate hypothesis	1	3

## References

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<b>Course</b>	<b>Details</b>
Code	ZY4CRP04
Title	Research Methodology, Biophysics and Biostatistics
Degree	B.Sc.
Branch	Zoology
Year/Semester	II/IV
Type	Core Practical
Credits	2

<b>CO No.</b>	<b>Expected Course outcomes</b>	<b>Cognitive level</b>	<b>PSO No.</b>
1.	Apply animal sampling, collection and preservation techniques.	Ap	7
2.	Determine the use of microscopes and other scientific instruments.	Ap	7
3.	Solve statistical problems using computer applications.	Ap	7

\*PSO-Program Specific Outcome; CO-Course Outcome; **Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create**

<b>Exp. No</b>	<b>Course Description</b>	<b>Hrs</b>	<b>CO</b>
	<b>RESEARCH METHODOLOGY</b>	12	
1	Animal collection Tools, Techniques & Estimation		1
	1. Quadrature study	2	1
	2. Transect study	2	
	3. Sampling Methods	4	
	4. Species area curve	2	
	5. Simpson index	2	
	<b>BIOPHYSICS</b>	12	
1	Study of simple and compound light microscopes	1	2
2	Micrometry –calibration and measurement of microscopic objects –low power	1	2
3	Camera Lucida drawings	3	2
4	Paper chromatography	3	2
5	Instrumentation – pH Meter, Colorimeter/ Spectrophotometer, Centrifuge	4	2
	<b>BIOSTATISTICS</b>	12	
1	MS Excel : To create mean and median, Construction of bar diagram, Pie diagram and Line graphs.	2	3
2	MS Access: To create grade of students	2	3
3	Internet: Access a web page on any biological topic.	2	3
4	Frequency distribution of the given samples to find out	2	3



	arithmetic mean, median, mode.		
5	Range and standard deviation for a biological data	2	3
6	Correlation using any biological data.	2	3

COURSE	DETAILS
CODE	ZY4CMT04
TITLE	<b>APPLIED ZOOLOGY (T)</b>
DEGREE/YEAR	B.SC ZOOLOGY, IV SEMESTER
TYPE	<b>COMPLEMENTARY COURSE</b>
CREDITS	54 HRS

CO No.	Expected Course outcomes: <b>APPLIED ZOOLOGY (T)</b>	Cognitive level	PSO No.
1.	Understand the common cultivable fishes, types of aquaculture, its management and fish processing and preservation.	U	PSO-6
2.	Construct aquaculture units for self employment	C	PSO-7
3.	Design and management of aquariums.	C	PSO-7
4.	Understand the various silkworm rearing techniques and mounting of silkworm.	U	PSO-6
5.	Use vermicomposting technique for better waste management.	Ap	PSO-7
6.	Carry out apiculture for self employment or as a hobby.	Ap	PSO-7
7.	Understand the various species of earthworms, silk worms, honey bees and be products.	U	PSO-6, PSO-8
8.	Identify diseases of fishes, earthworms, silkworms and honeybees.	U	PSO-6

\*PSO-Program Specific Outcome; CO-Course Outcome;  
**Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create**

MODULE	COURSE DESCRIPTION	Hrs.	Co No.
1.0	<b>Aquaculture:</b> Advantages of aquaculture, Traditional methods of aquaculture, Biotic and abiotic factors in water, Pond culture – construction and maintenance.	5	1
1.1	Types of aquaculture, composite fish culture, integrated fish culture,	6	1,2

	induced breeding of carp & prawn, Importance of algae in aquaculture.		
1.2	Aquarium management - Setting up of an aquarium, biological filter and aeration. Common cultivable fishes of Kerala.	7	1,3
1.3	Fish diseases, Prawn culture, mussel culture, pearl culture, Fish processing and preservation.	6	1,8
<b>2.0</b>	<b>Sericulture:</b> Four species of silkworms, life history of silkworm, silk worm rearing techniques	4	4,7
	Mounting of silkworm - Chandrika, defective cocoons, harvesting and stifling of cocoons.	4	4
	Silkworm diseases and pest, preventive and control measures	4	8
<b>3.0</b>	<b>Vermiculture:</b> Species of earthworms, ecological classification of earthworms, life cycle and reproduction of earthworm. Physical & chemical effects of earthworms on soil.	3	7
3.1	Vermicomposting – site selection, preparation of pit, maintenance, monitoring and harvesting of vermicompost.	3	5
<b>4.0</b>	<b>Apiculture:</b> Species of honey bees, organization of honey bee colony. Bee keeping methods and equipments.	5	7
4.1	Apiary management and maintenance. Bee pasturage, byproducts of honey bees and their uses.	4	6
4.2	Diseases, pests of honey bees and control measures.	3	8

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Sinhan, V.R.P. & Ramachandran, V., 1985, Fresh water Fish Culture (ICAR, New Delhi)

<b>COURSE</b>	<b>DETAILS</b>
CODE	ZY4CMP04
TITLE	<b>APPLIED ZOOLOGY (P)</b>
DEGREE/YEAR	B.SC ZOOLOGY, IV SEMESTER
TYPE	<b>COMPLEMENTARY COURSE</b>
CREDITS	36 HRS

CO No.	Expected Course outcomes: <b>APPLIED ZOOLOGY (P)</b>	Cognitive level	PSO No.
1	Identify the types of culturable fishes, earthworms, silk worms and honey bees.	U	PSO-9
2	Determine the castes of honey bees.	Ap	PSO-9
3	Determine various bee keeping equipments	Ap	PSO-9
4	Identify bee products, silk, chandrika, natraka and vermicompost	U	PSO-9
*PSO-Program Specific Outcome; CO-Course Outcome; <b>Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create</b>			

<b>MODUL E</b>	<b>COURSE DESCRIPTION</b>	<b>Hrs.</b>	<b>Co No.</b>
<b>1.0</b>	General identification, economic importance, morphology, scientific names and common names of the following a. Economic importance and morphology of culturable fishes (Catla, Rohu, Grass carp, Common carp, Silver carp, Etroplus, Tilapia) b. Two species of earthworms used in Vermiculture c. Two species of honey bees d. Silkworm. Cocoon/Adult	15	1
<b>2.0</b>	Castes of honey bees	6	2
<b>3.0</b>	Bee keeping equipments - Bee hive, Smoker, honey extractor	5	3

<b>4.0</b>	Identification and uses - Bee wax, Honey, Silk, Vermicompost	6	4
<b>5.0</b>	Chandrika / Natrika used in sericulture	4	4

Course		Details			
Code		ZY5CRT05			
Title		<b>ENVIRONMENTAL BIOLOGY AND HUMAN RIGHTS</b>			
Degree		B.Sc			
Branch(s)		ZOOLOGY			
Year/Semester		III/V			
Type		Core course			
Credits	3	Hrs/Week	3	Total hours	54

CO No	Expected Course Outcomes Upon completion of this course, the students will be able to:	Cognitive Level	PSO No.
1	Develop knowledge on basic concepts of Environmental Sciences, types of natural resources, human impacts on it and its management practices.	R	3
2	Develop skills to utilize environment sustainably and to enrich it.	U	3
3	Understand important theories and concepts of environmental sciences, population and community, Biodiversity and its conservation.	U	3
4	Explicate environmental hazards, their risk and the socio – economical ramifications.	E	3
5	To determine the causes and potential solutions of major environmental problems.	U	3
6	Identify issues and problems relating to Human Rights.	U	3
7	Analyse country's current scenario in terms of human rights.	An	3
8	Impact awareness on various environmental acts in India.	C	3

- PSO- Program Specific Outcome; CO- Course Outcome;
- Cognitive Level: R- Remember; U- Understanding; Ap- Apply; An- Analyse; E- Evaluate; C- Create.

<b>Module Description</b>	<b>Course</b>	<b>Hrs</b>	<b>CO.No</b>
<b>1.0</b>	Module I	8	1,3
1.1	<b>BASIC CONCEPTS OF ECOSYSTEM</b> structure and function of an ecosystem, Biotic and Abiotic components of ecosystem, producers, consumers and decomposers, energy flow in the ecosystem.	2	1,3
1.1.1	Food chains, food webs and ecological pyramids. Laws of Thermodynamics	1	3
1.1.2	Introduction, types, characteristic features, structure and function of the given ecosystem- Forest ecosystem, grassland, desert	1	1
1.1.3	Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries), Wetland & Biome.	1	1
1.1.4	Concept of limiting factors- Liebig's and Shelford's laws of limiting factors. Biogeochemical cycles- concept.	1	3
1.1.5	Gaseous and sedimentary cycles, carbon cycle, nitrogen cycle	1	3
1.2	Natural Resources and associated problems - Introduction, renewable and non-renewable resources	1	1
<b>2.0</b>	Module II	7	3
2.1	<b>CONCEPTS OF POPULATION AND COMMUNITY:</b> Concept of population: Population attributes- Population growth forms, Basic concepts of growth rates, density, natality, mortality, growth curves (brief account only).	2	3
2.2	<b>Animal interactions-</b> Positive- Commensalism, mutualism, proto-cooperation, Negative- predation, parasitism, competition, antibiosis.	2	3
2.3	<b>Characteristics of a community</b> -Species diversity- richness, evenness, stratification, dominance	1	3
2.3.1	Ecological indicators, ecotone and edge effect, keystone species, Concepts of ecological niche and guild	1	3
2.3.2	Ecological succession and community evolution- climax	1	3
3.0	Module III	16	3,4,5
3.1	<b>BIODIVERSITY AND ENVIRONMENTAL ISSUES:</b> Introduction to Biodiversity: Types of biodiversity- Alpha, Beta and Gamma diversity. Concept and importance of biodiversity.	2	3
3.1.1	India as a mega-diversity nation, Biodiversity hotspots	1	3,4
3.2	<b>Environmental Issues:</b>	3	4,5
3.2.1	Global Environmental Issues: Ozone depletion, Greenhouse effect, Global warming, Climate change, Carbon trading, carbon credit; Carbon sequestration, Acid rain, Oil spills, Nuclear accidents, IPCC/UNFCC.		
3.2.2	National Environmental issues: Deforestation, forest fire, pollution(air, water, soil, noise thermal, nuclear) solid waste management, sewage, drinking water crisis and water logging.	3	4,5
3.2.3	Local Environmental issues: Landscape alteration, sand mining, quarrying, changing crop pattern, conversion of paddy lands.	2	4,5
3.3	<b>Toxic products and disaster:</b> Types of toxic substances –	3	4,5

	degradable, non degradable, Impact on human – case studies: Endosulphan tragedy, Bhopal disaster Flood, drought, cyclone, earthquake and landslide		
3.4	<b>Threats to water resources of Kerala:</b> Degrading Mangrove and wetland ecosystems of Kerala. RAMSAR sites, Marine ecosystem crisis- pollution, overfishing etc. Impact of tourism on Environment.	2	4,5
<b>4.0</b>	Module IV	5	3,8
4.1	<b>CONSERVATION OF BIODIVERSITY</b> Protected area concept – Sanctuary, National Park, Biosphere reserve, Core Zone, Buffer Zone, Corridor concept. Conservation reserves	1	3
4.2	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.	1.5	3
4.3	Man–animal conflict		
4.4	Water conservation- rainwater harvesting, watershed management	1.5	3
4.5	Environmental laws: The Wildlife Protection Act, 1972, Biodiversity Act, 2002.	1	8
<b>5.0</b>	Module V	18	6,7
5.1	<b>Human Rights:</b> Introduction to Human rights, meaning, Concept and development, History of human rights. Universality of Human Rights	5	6,7
5.2.0	Human Rights and United Nations: Human rights coordination within UN system. Commission of Human Rights.	4	6,7
5.2.1	The committee on the elimination of discrimination against Women. Human rights committee.	4	6,7
<b>5.3</b>	Human Rights in Indian constitution, Science Technology and Human Rights, State human rights commission, Human rights awareness in Education.	5	6,7

## References

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### **Human Rights**

1. Amartya Sen (2009). The Idea Justice, New Delhi: Penguin Books, 2009.
2. Chatrath, K. J.S (ed.)(1998). Education for Human Rights and Democracy (Shimla: Indian Institute of Advanced Studies.
3. Law Relating to Human Rights (2001). Asia Law House.
4. Shireesh Pal Singh, Human Rights Education in 21st Century, Discovery Publishing House Pvt.Ltd, New Delhi
5. Khanna, S.K. (1998) and(2011).Children andthe Human Rights, Common Wealth Publishers
6. Sudhir Kapoor (2001). Human Rights in 21st Century, Mangal Deep Publications, Jaipur.
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Course	Details				
Code	ZY5CRP05				
Title	<b>ENVIRONMENTAL BIOLOGY AND HUMAN RIGHTS (P)</b>				
Degree	B.Sc				
Branch(s)	ZOOLOGY				
Year/Semester	III/V				
Type	Core practical				
Credits	1	Hrs/Week	2	Total hours	36

CO No	Expected Course Outcomes Upon completion of this course, the students will be able to:	Cognitive Level	PSO No.
1	Analyse the different soil and water quality parameters	An	3&6
2	Understand the current environmental issues	U	3
3	Classify the various ecosystems and animal interactions	Ap	3
4	Identify planktons and equipments used in ecology	R	3&6
5	Create love towards nature	C	3
PSO- Program Specific Outcome; CO- Course Outcome; Cognitive Level: R- Remember; U- Understanding; Ap- Apply; An- Analyse; E- Evaluate; C- Create.			

Module	Course Description	Hrs	CO
1	Estimation of dissolved Oxygen	4	1
2	Estimation of carbon dioxide	4	1
3	Estimation of soil organic carbon (Demonstration)	2	1
4	Identification of marine/ fresh water planktons	4	4
5	Counting of plankton using plankton counting chamber	4	4
6	Study of equipments - Sechi disc, Plankton net	2	1, 4
7	Study of sandy shore fauna, rocky shore fauna	2	2,3
8	Study of animal Association	4	3
9	Field study and report of any two important areas of bio diversity (compulsory): Field study report: Forest, sea shore, mangrove, wetland, bird sanctuary, wildlife sanctuary, sacred groves	10	3,5

COURSE	DETAILS
CODE	ZY5CRT07
TITLE	EVOLUTION,ETHOLOGY &ZOOGEOGRAPHY
DEGREE/YEAR	B.SC ZOOLOGY, V SEMESTER
TYPE	CORE COURSE
CREDITS	54 HRS
NAME OF THE TEACHER	DR.ELEZABETH BASIL

CO NO.	EXPECTED COURSE OUTCOME- Upon completion of this course the students will be able to ;	COGNITIVE LEVEL	PSO NO.
1	Understand the concept of unity of life,theories on the origin of organic evolution and its evidences.	U	PSO1
2.	Acquire basic skills in the observation and study of nature, rich diversity of organisms and their ecological and evolutionary significance and scientific investigation on biological origin of life from simple to more complex forms.	Ap	PSO3
3.	Describe the causes of diversification of life,concept of speciation its types and the current status of different species.	U	PSO3
4.	Understand the different techniques used for fossilstudy with reference to geological time scale.	U	PSO2
5.	Compare animals with reference to their distribution on earth, geological parametes affecting distribution and different biogeographical realms.	U	PSO2
6.	Understands and develops skills to analyse the different behavioral patterns of animals,leaning and their sociobiology.	A	PSO7
7.	Plan and design the application of population genetics in modern evolutionary biology and in phylogeny studies.	Ap	PSO7

MODULE	COURSE DESCRIPTION	Hrs.	CO.No.
<b>PART I – EVOLUTION</b>		<b>( 30 Hrs.)</b>	
<b>1.0</b>	<b>Module I - Origin of life</b>	<b>8</b>	<b>1,4</b>
1.1	Theories - Panspermia theory or Cosmozoic theory, Theory of spontaneous generation (Abiogenesis or Autogenesis), Special creation, Biogenesis,	3	1

	Endosymbiosis.		
1.2	Chemical evolution - Haldane and Oparin theory, Miller-Urey experiment;	2	1
1.3	Direct evidences of evolution – Recapitulation Theory of Haeckel, Fossilization, Kinds of fossils, fossil dating, Homologous organs and analogous organs.	3	1, 4
<b>2.0</b>	<b>Module II - Theories of organic evolution</b>	<b>9</b>	<b>1, 7</b>
2.1	Lamarckism and its Criticism, Weismann's Germplasm theory, Darwinism and its Criticism, Neo-Darwinism, Theory of De Vries	4	1
2.2	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	5	1, 7
<b>3.0</b>	<b>Module III – Nature of evolution</b>	<b>13</b>	<b>2,3</b>
3.1	Species and Speciation: Species concept, subdivisions of species (sub species, sibling species, cline and deme), Speciation: Types of speciation, Phyletic speciation (autogenous and alloigenous transformations), True speciation, Instantaneous and gradual speciation, allopatric and sympatric speciation	4	2,3
3.2	Isolation: Types of isolating mechanisms-Geographic isolation (mention examples) and Reproductive isolation. Role of isolating mechanisms in evolution	3	2,3
3.3	Microevolution, Macroevolution (Adaptive radiation -Darwin finches) Mega evolution, Punctuated equilibrium, Geological time scale, and Mass extinction (brief account only).	3	2,3
	Evolution of Horse	3	
<b>PART II – ETHOLOGY</b>		<b>(14 Hrs.)</b>	
<b>4.0</b>	<b>Module IV – Introduction</b> Definition, History and scope of ethology	<b>1</b>	<b>6</b>
<b>5.0</b>	<b>Module V – Learning, imprinting and behaviour</b>	<b>9</b>	<b>6</b>
5.1	Types of learning with examples; patterns of behaviors – types of rhythms, navigation, homing instinct, hibernation, aestivation	5	6
5.2	Pheromones- types and their effect on behavior, hormones and their action on behavior (aggressive and parental behavior)	4	6
<b>6.0</b>	<b>Module VI – Social organization</b> Social organization in insects (ants) and mammals (monkey), Courtship behaviour and reproductive strategies	<b>4</b>	<b>6</b>
<b>PART III – ZOOGEOGRAPHY</b>		<b>(10 Hrs.)</b>	

<b>7.0</b>	<b>Module VII – General Topics</b> Continental drift theory, Types and means of animal distribution, Factors affecting animal distribution; insular fauna – oceanic islands and continental islands	<b>4</b>	<b>5</b>
<b>8.0</b>	<b>Module VIII - Zoogeographical realms</b> Palearctic 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	<b>6</b>	<b>5</b>

## REFERENCES :

### EVOLUTION

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2. Barnes, C.W. (1988). Earth, Time and Life. John Wiley & Sons, New York
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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.
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USA.(Module 9).

### **ZOOGEOGRAPHY**

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3. Chundamannil Mammen.1993, History of Forest management in Kerala. Report No.89. Kerala Forest Research Institute, Peechi, India.
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5. Mani, M.S. (1974). Ecology and Biogeography of India; The Hague: .Dr. W. Junk b.v. Publishers,
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COURSE	DETAILS
CODE	ZY5CRP07
TITLE	EVOLUTION,ETHOLOGY &ZOOGEOGRAPHY (P)
DEGREE/YEAR	B.SC ZOOLOGY, V SEMESTER
TYPE	COURSE COURSE
CREDITS	36 HRS
NAME OF THE TEACHER	DR.ELEZABETH BASIL

CO NO.	EXPECTED COURSE OUTCOME- Upon completion of this course the students will be able to ;	COGNITIVE LEVEL	PSO NO.
1	Identify various zoogeographical realms, endemic species and distribution of animals.	U	1
2	Understand the concept of homology, analogy and adaptive radiation.	U	3
3	Understand the route of HMS Beagle	U	1
4	Examine connecting links	An	1,3
5	Identify various stages of horse evolution	U	3
6	Identify various behavioural patterns and the use of pheromones.	U	3

MODUL E	COURSE DESCRIPTION	Hrs.	CO.N o.
1.0	Identification of Zoogeographical realms using map	4	1
2.0	Study on endemic species of each realm	5	1
3.0	Show the discontinuous distribution of (lung fishes, camel, elephant)	4	1
4.0	Providing a map trace the route of HMS Beagle	3	3
5.0	Providing a map mark any two continental/oceanic islands.: Greenland, Madagascar, New Zealand, New Guinea, Maldives, Iceland, Hawaii – any two	2	1
6.0	Contributions of scientists (showing photos) - Any four	3	1
7.0	Identification of different stages of horse evolution	3	5
8.0	Study on Homology and Analogy	2	2
9.0	Study on connecting links (Peripatus, Archaeopteryx, Protopterus, Echidna)	2	4
10.0	Pheromone traps	2	6

11.0	Skinner box & T Maze	2	6
12.0	Experiment to demonstrate phototaxis and chemotaxis using Drosophila/House fly	2	6
13.0	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)2	<b>2</b>	<b>6</b>



Course title	<b>HUMAN PHYSIOLOGY, BIOCHEMISTRY, AND ENDOCRINOLOGY -</b>
Course code	
Programme	<b>BSc. ZOOLOGY</b>
Semester	<b>5</b>
Course type	<b>CORE</b>
Credits	<b>1</b>

<b>CO No.</b>	<b><i>Expected Course Outcome</i></b> <i>Upon completion of this course, the students will be able to:</i>	<b>Cognitive Level</b>	<b>PSO No.</b>
1	Develop skills in performing and interpreting various laboratory procedures to investigate blood parameters of diagnostic significance.	An	5
2	Identify the instruments used in Physiological analysis.	An	5
3	Acquire skills in qualitative analysis of nutrients and obtaining results through observation of appropriate reactions and documentation.	An	5
4	Develop skills in identification of amino acids and their Rf values by using chromatography.	Ap	5
5	Visualise the endocrine glands in brain and analyse the effect of hormones on heartbeat of cockroach.	An	5

\*PSO-Program Specific outcome; CO-Course Outcome;  
**Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create**

<b>MODUL E</b>	<b>COURSE DESCRIPTION</b>	<b>HOURS</b>	<b>CO.NO.</b>
1.1	<b>Nutrition:</b> 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).	4	1,2
1.2	<b>Digestion:</b> 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.	4	1
2.1	<b>Respiration:</b> 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.	2	1
2.2	Respiratory disturbances (Hypoxia, Hypercapnia, Asphyxia).Physiological effect of smoking, carbon monoxide poisoning, Oxygen therapy and artificial respiration.	2	2
2.3	<b>Circulation:</b> ESR, Haemopoiesis, blood pressure, ECG. Haemostasis (blood coagulation) – clotting factors, intrinsic and extrinsic pathways, anticoagulants and its mechanism of action.	2	1
2.4	Cardiovascular diseases (Jaundice, Atherosclerosis, Myocardial infarction, Thrombus, Stroke).Angiogram and angioplasty.	2	2
3.1	<b>Excretion:</b> Histology of Bowman’s capsule and tubular part. Urine formation – glomerular filtration, tubular reabsorption, tubular secretion. Urine concentration – counter current mechanism. Acid – base balance,	2	1
3.2	hormonal regulation of kidney function. Renal disorders (kidney stone, acute and chronic renal failure, and dialysis).	2	1,2
3.3	Homeostasis: Definition, concept and importance in biological system. Thermal regulation and thermal adaptation in homeotherms.	1	3

4.1	<b>Nerve physiology:</b> 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.	3	1
4.2	Neurotransmitters (acetyl choline, adrenalin, dopamine). EEG. Memory, Neural disorders (brief account on Dyslexia, Parkinson's disease, Alzheimer's disease, Epilepsy).	2	1,2
4.3	<b>Muscle physiology:</b> 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.	3	1
4.4	Cori cycle. Kymograph, Simple muscle twitch, muscle fatigue, tetanus, rigor mortis.	2	1
5.1	<b>Carbohydrates:</b> Basic structure, biological importance and classification of monosaccharides, oligosaccharides, polysaccharides with examples.	1	4
5.2	<b>Proteins:</b> Basic structure and classification of amino acids; structure, biological importance and classification of proteins with examples.	1	4
5.3	<b>Lipids:</b> Structure of fatty acid, saturated and unsaturated fatty acid, biological importance and classification of lipids with examples.	1	4
5.4	<b>Vitamins and minerals:</b> Major fat soluble and water soluble vitamins. Important minerals and trace elements required for living organisms. Biological importance of vitamins and minerals.	1	4
5.5	<b>Enzymes:</b> Chemical nature of enzymes, enzyme activation, enzyme inhibition, allosteric enzymes, isoenzymes, co-enzymes. Michaelis-Menten enzyme kinetics.	1	5
6.1	<b>Carbohydrate metabolism:</b> Glycogenesis, Glycogenolysis, Gluconeogenesis, Hexose monophosphate Shunt.	3	4
6.2	Glycolysis, Citric Acid Cycle, Electron Transport Chain and ATP synthesis. Ethanol metabolism.	3	4

6.3	<b>Protein metabolism:</b> Deamination, Transamination, Transmethylation, Decarboxylation, Ornithine cycle.	2	4
6.4	<b>Lipid metabolism:</b> Biosynthesis of fatty acids, Beta oxidation, physiologically important compounds synthesized from cholesterol.	2	4
7.1	<b>Endocrine physiology:</b> Hormones – classification and mechanism of hormone action.	2	7
7.2	Major endocrine glands, their hormones, functions and disorders (hypothalamus, pituitary gland, pineal gland, thyroid gland, parathyroid gland, islets of Langerhans, adrenal gland).	5	6
7.3	Homeostasis and feedback mechanism.	1	7

## References

1. Albert L. Lehninger, Michael Cox and David L. Nelson; 2004; Biochemistry Lehninger. Palgrave – Macmillan.
2. Arthur C. Guyton and John E. Hall; 2016; Text Book of Medical Physiology: Guyton, 13th edition; Elsevier
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Course title	<b>HUMAN PHYSIOLOGY, BIOCHEMISTRY, AND ENDOCRINOLOGY - PRACTICALS</b>
Course code	
Programme	<b>BSc. ZOOLOGY</b>
Semester	<b>V</b>
Course type	<b>CORE</b>
Credits	<b>1</b>

<b>CO No.</b>	<b><i>Expected Course Outcome</i></b> <i>Upon completion of this course, the students will be able to:</i>	<b>Cognitive Level</b>	<b>PSO No.</b>
1	Develop skills in performing and interpreting various laboratory procedures to investigate blood parameters of diagnostic significance.	An	5
2	Identify the instruments used in Physiological analysis.	An	5
3	Acquire skills in qualitative analysis of nutrients and obtaining results through observation of appropriate reactions and documentation.	An	5
4	Develop skills in identification of amino acids and their Rf values by using chromatography.	Ap	5
5	Visualise the endocrine glands in brain and analyse the effect of hormones on heartbeat of cockroach.	An	5
<p>*PSO-Program Specific outcome; CO-Course Outcome;  <b>Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create</b></p>			

COURSE	DETAILS
CODE	ZY5OPT02
TITLE	PUBLIC HEALTH AND NUTRITION
DEGREE/YEAR	B.SC ZOOLOGY, V <sup>TH</sup> SEMESTER
TYPE	OPEN COURSE
CREDITS	72 HRS

CO NO.	EXPECTED COURSE OUTCOME- Upon completion of this course the students will be able to ;	COGNITIVE LEVEL	PSO NO.
1	Understand the role of physical activity and balanced diet in maintaining health.	U	PSO-10
2	Use Body Mass Index to determine the current state of health.	Ap	PSO-10
3	Understand the importance of yoga and meditation in daily life.	U	PSO-10
4	Describe public health, diseases and its prevention.	U	PSO-10
5	Use safety measures in daily life to promote health and well-being	Ap	PSO-10

MODULE	COURSE DESCRIPTION	Hrs.	CO. No.
<b>PART I HEALTH, EXERCISE &amp; NUTRITION</b>			
<b>1.0</b>	<b>Definition and Meaning of Health</b>	<b>10</b>	<b>1</b>
1.1	Dimensions and Determination of Health	1	1
1.2	Physical Activity and Health benefits	1	1
1.3	Effect of exercise on body systems – Circulatory, Respiratory, Endocrine, Skeletal and Muscular	4	1
1.4	Programmes on Community health promotion (Individual, Family and Society) Dangers of alcoholic and drug abuse, medico-legal implications	4	1
<b>2.0</b>	<b>Nutrition and Health</b>	<b>10</b>	<b>1,2</b>
2.1	Concept of Food and Nutrition, Balanced diet	2	1
2.2	Vitamins, Malnutrition, Deficiency Disease	2	1
2.3	Determining Caloric intake and expenditure	2	1
2.4	Obesity, causes and preventing measures	2	1
2.5	Role of Diet and Exercise, BMI	2	2
<b>3.0</b>	<b>Safety Education in Health promotion</b>	<b>8</b>	<b>5</b>

3.1	Principles of Accident prevention	1	5
3.2	Health and Safety in daily life. Health and Safety at work.	2	5
3.3	First aid and emergency care. Common injuries and their management.	2	5
3.4	Modern life style and hypokinetic diseases. Diabetese, Cardiovascular disorders-Prevention and Management.	3	5
<b>4.0</b>	<b>Life Skill Education</b>	<b>8</b>	<b>3</b>
4.1	Life skills, emotional adjustment and well being.	4	3
4.2	Yoga, Meditation and Relaxation, Psychoneuroimmunology	4	3
<b>PART II PUBLIC HEALTH AND SANITATION</b>			
<b>5.0</b>	<b>Public health and water quality</b>	<b>11</b>	<b>4</b>
5.1	Potable water, Health and Water quality	3	4
5.2	Faecal bacteriae and pathogenic microorganisms transmitted by water.	4	4
5.3	Determination of sanitary quality of drinking water, water purification techniques	4	4
<b>6.0</b>	<b>Public health and diseases</b>	<b>15</b>	<b>4</b>
6.1	Water borne dseases-Cholera and Typhoid.Prevention of Water borne diseases.	2	4
6.2	Food borne diseases and Prevention Botulinum, Salmenellosis, Hepatitis A	3	4
6.3	Vector borne diseases & Control measures Chikungunya , Filariasis and Dengu fever	3	4
6.4	Zoonotic disease-Leptospirosis & its control	3	4
6.5	Emerging diseases - Swine flue (H1N1), bird flue (H5N1), SARS, Anthrax	2	4
6.6	Re-emerging diseases –TB, Malaria	2	4
<b>7.0</b>	<b>Health Centre visit &amp; Report Presentation</b>	<b>10</b>	<b>1,4,5</b>

### References:

1. Gladys Francis & Mini K.D., (Editors) (2012), Microbiology, Zoological Society of Kerala, Kottayam.
2. Greenberg, Jerol S and Dintiman George B (1997) Wellness Creating a life of Health and Fitness , London Allyn and Bacon Inc.
3. K Park, (2008) Park's Text Book of Preventive and Social Mediine 18th Edition. Banarasidass Bhenot 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

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Course title	<b>DEVELOPMENTAL BIOLOGY</b>
Course code	<b>ZY6CRT09</b>
Programme	<b>BSc. ZOOLOGY</b>
Semester	<b>VI</b>
Course type	<b>CORE</b>
Credits	<b>3</b>

<b>CO No.</b>	<b><i>Expected Course Outcomes</i></b> <i>Upon completion of this course, the students will be able to:</i>	<b>Cognitive Level</b>	<b>PSO No.</b>
1	Understand historical perspectives, basic concepts and theories of developmental biology.	U	PSO - 1
2	Describe fertilization, its significance, polyspermy, parthenogenesis and regeneration	U	PSO - 4
3	Compare and contrast different developmental processes like cleavage, blastulation, gastrulation, and cell differentiation in various organisms and draw diagrams of each.	U	PSO - 4
4	Differentiate between embryological development of frog and Chick.	An	PSO - 4
5	<b>Illustrate Experimental embryology and teratology</b>	U	PSO - 4
6	Understand and explain human <b>Reproductive Physiology and various processes involved in human development.</b>	U	PSO - 4
7	Discuss reproductive health and importance of sex education and critically analyse Physiological and ethological aspects of human intervention in reproduction.	U	PSO - 4
8	Analyse Embryo transfer technology, cloning, stem cell research, Prenatal diagnostic techniques and related Ethical issues.	An	PSO - 4
9	Classify placenta in mammals and discuss its functions.	U	PSO - 4
<p>*PSO-Program Specific outcome; CO-Course Outcome;  <b>Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create</b></p>			

MODULE	COURSE DESCRIPTION	HOURS	CO.NO
1.1	<b>Introduction:</b> Definition, Scope of developmental biology, sub-divisions (descriptive, comparative, experimental and chemical), historical perspectives, basic concepts and theories.	2	1
1.2	<b>Reproductive Physiology:</b> 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).	2	6
1.3	Structure of mammalian sperm and egg, Pregnancy, parturition and lactation. Reproductive health and importance of sex education.	2	7
1.4	<b>Egg types:</b> Classification of eggs based on the amount, distribution and position of yolk. Mosaic and regulative, cleidoic and noncleidoic eggs. Polarity and symmetry of egg.	2	2
1.5	<b>Fertilization:</b> Mechanism of fertilization, Significance of fertilization, Polyspermy.	1	2
1.6	Parthenogenesis- Different types and significance. 6	1	2
2.1	<b>Cleavage:</b> Types, planes and patterns of cleavage, Cell lineage of Planaria. Influence of yolk on cleavage.	3	3
2.2	<b>Blastulation:</b> Morula, blastula formation, types of blastula with examples.	2	3
2.3	<b>Fate maps:</b> Concept of fate maps, construction of fate maps (artificial and natural), structure of a typical chordate fate map. Significance of fate map.	2	3
2.4	<b>Gastrulation:</b> Major events in gastrulation. Morphogenetic cell movements. Influence of yolk on gastrulation. Exogastrulation. Concept of germ layers and derivatives.	3	3
2.5	<b>Cell differentiation and gene action:</b> Potency of embryonic cells (Totipotency, Pleuripotency, Unipotency of embryonic cells). Determination and differentiation in embryonic development, Gene action during development with reference to Drosophila -maternal effect genes, zygotic genes.	4	3

3.1	<b>Embryology of Frog:</b> Gametes, fertilization, cleavage, blastulation, fate map, gastrulation, neurulation, notogenesis. Differentiation of Mesoderm and Endoderm, Development of eye. Metamorphosis of frog, Hormonal and environmental control.	7	4
3.2	<b>Embryology of chick:</b> Structure of egg, fertilization, cleavage, blastulation, fate map, gastrulation. Development and role of Primitive streak, Salient features of 18hour, 24 hour, 33 hour & 48 hour chick embryo. Extra embryonic membranes in chick.	7	4
3.3	<b>Human development:</b> Fertilisation, cleavage, blastocyst, implantation, placenta. Gestation, parturition and lactation. Human intervention in reproduction, contraception and birth control. Infertility, In vitro fertilization (test tube baby)	6	6
4.1	<b>Experimental embryology:</b> Spemann's constriction experiments, Organizers and embryonic induction. Embryo transfer technology, cloning, stem cell research. Ethical issues.	2	5
4.2	<b>Teratology / Dysmorphology, Developmental defects:</b> Teratogenesis, important teratogenic agents. (Radiations, chemicals and drugs, infectious diseases) genetic teratogenesis in human beings.	2	5
4.3	<b>Developmental defects:</b> Prenatal death (miscarriage and still birth). Intrauterine Growth Retardation (IUGR).	1	5
5.1	General topics: Classification and functions of placenta in mammals. Regeneration in animals.	3	9
5.2	Prenatal diagnosis (Amniocentesis, Chorionic villi sampling, Ultra sound scanning, Foetoscopy, Maternal serum alpha-fetoprotein, Maternal serum beta-HCG).	2	8

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( Int. student edition)
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Course title	<b>DEVELOPMENTAL BIOLOGY – PRACTICALS</b>
Course code	<b>ZY6CRP09</b>
Programme	<b>BSc. ZOOLOGY</b>
Semester	<b>VI</b>
Course type	<b>CORE</b>
Credits	<b>1</b>

CO No.	<i>Expected Course Outcomes</i> <i>Upon completion of this course, the students will be able to:</i>	Cognitive Level	PSO No.
1	Compare blastula and gastrula of chick and frog, and identify various stages of embryonic development in chick	An	PSO-5
2	Understand various prenatal diagnostic procedures and technological application in human development	U	PSO-5
3	Carry out candling and vital staining of chick embryo and identify various developmental stages.	Ap	PSO-5
4	Carry out dissection of reproductive organs of cockroach	Ap	PSO-5
5	Identify placenta found in animals	An	PSO-5
6	Examine the reproductive capacity of fish	Ap	PSO-5

Module	Course Description	Hours	CO.No.
1	Embryological studies- Blastula (frog, chick) gastrula (frog, chick), Study of placenta- pig and man	5	1,5
2	Experimental embryology - Amniocentesis, Embryo transfer technology, cloning	3	2
4	Chick developmental studies - Candling method, 18 hour, 24 hour, 33 hour and 48 hour chick embryo, Vital staining- demonstration.	12	3
5	Study of reproductive organs in cockroach	6	4
6	Study of reproduction in Fish (Calculation of fecundity of fish, Calculation of gonado-somatic index)	10	6

COURSE	MICROBIOLOGY AND IMMUNOLOGY
CODE	ZY6CRT10
PROGRAMME	B.SC ZOOLOGY
DEGREE/YEAR	VI SEMESTER
TYPE	CORE COURSE
CREDITS	54 HRS

CO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:	Cognitive level	PSO No.
1	Understand the role of microbes in environment ,human health,infections and diseases and pathogenesis, transmission, prevention and control,epidemiology, symptomology,food and saftey management,therapeutics, industrial application of microbes, role of microbes as deecomposers, role in enegry transfer and ecosystem functioning, different means of trnasport of microbes, bioremediation etc	U	PSO 1,3
2	Understands the history classification of microbes,our immune system,methods in microbiology, sterilization and disinfection,culture media, plating techniques and culture preservation techniques andvaccines and vaccination.	U	PSO 3
3	Applies thier knowledge in operating instruments like Autoclave, Hot air oven, Bacteriological incubator,laminar flow,water bath etc, able to do culture of batceria and fungus, microbes in living condition,plating techniques, Gram staining, Antibiotic sensitivity test and drug resistance in bacteria, determination of ABO blood groups and Rh factor.	Ap	PSO 6
4	Develop proficiency in the quantitative and qualitative estimation of microbes, microbiology laboratory techniques and safety procedures, aseptic and pure culture techniques, preparation of and viewing samples for microscopy, use appropriate methods to identify microorganisms.	Ap	PSO 6,7
5	Design and construct novel plans for dealing emerging microbial diseases, mutiple drug resistant bacteria water purification techniquis and waste management using microbes,	Ap	PSO 8
6	Analyse the transfer of STD,manifestation of allergic reactions, auto immune disorders, blood transfusion reactions etc	An	PSO 9

MODULE	COURSE DESCRIPTION	Hrs.	CO.No
1 1.1	Introduction: History and scope of microbiology. Outline classification of Microbes. (bacteria, fungus & virus ) Methods in Microbiology: Sterilization and disinfection - physical and chemical methods.	5	CO1
1.2	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.	5	CO1
2 2.1	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.	10	CO2
2.2	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.	5	CO2
3 3.1	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.	4	CO3
3.2	Diseases: Epidemiology, symptomology, diagnosis and treatment. Bacterial - Clostridium tetany (tetanus), Viral – HIV virus (AIDS), fungal – Candida albicans (candidiasis).	4	CO3
3 3.1	Introduction to Immunology: Innate and acquired immunity, passive (natural and artificial) and active immunity (Natural and Artificial). Mechanisms of innate immunity - barriers, inflammation, phagocytosis.	5	CO2
3.2	Lymphoid organs: Primary (Thymus, Bone marrow) and secondary lymphoid organs (lymph nodes, spleen). Lymphocytes: T and B cells, Natural killer cells, memory cells, macrophages.	4	CO2
4 4.1	Antigens, Types of antigens, haptens, adjuvants, immunoglobulin structure, classes and functions of immunoglobulins.	3	CO1,2,3 &4
4.2	Types of Immunity- , humoral & cell mediated immunity Monoclonal & polyclonal antibodies. Antigen – antibody reactions, Precipitation test, Agglutination	3	CO1,2,3

	test, VDRL WIDAL, ELISA.		&4
4.3	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).	3	CO1,2
4.4	Introduction Types of vaccines, Current Vaccines, Recent trends in vaccine preparation.	3	CO1,2

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COURSE	MICROBIOLOGY AND IMMUNOLOGY (P)
CODE	ZY6CRP10
PROGRAMME	B.SC ZOOLOGY,
DEGREE/YEAR	VI SEMESTER
TYPE	CORE PRACTICAL
CREDITS	36

CO No	Expected Course Outcomes Upon completion of this course, the students will be able to:	Cognitive Level	PSO No.
1	Develop skills and knowledge on instrumentation and preparation of culture medias and culture techniques used in microbiological studies.	Ap	6
2	Staining and identification of microbes	An	6
3	Observe motility of bacteria and understand antibiotic sensitivity	U	6
4	Analyse blood group of sample provided	An	6
5	Understand the primary and secondary lymphoid organs	U	6

PSO- Program Specific Outcome; CO- Course Outcome;  
Cognitive Level: R- Remember; U- Understanding; Ap- Apply; An- Analyse; E- Evaluate; C- Create.

Module	Course Description	Hrs	CO
1	Instruments –Autoclave, Hot air oven, Bacteriological incubator – Laminar air flow.	2	1
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.	4	1
3	Culture methods (Demonstration) a) Streak plate technique and isolation of pure colonies. (b) Lawn culture (c) Pour plate culture (d) Liquid culture	5	1
4	Examination of microbes in living condition Hanging drop method for demonstrating motility of bacteria.	4	3
5	Gram staining – preparation, procedure, identification of Gram + ve and Gram –ve bacteria.	4	2

6	Antibiotic sensitivity test (demonstration only)	4	1,3
7	Streak plating (individual performance)	4	1
8	Preparation of a fungal smear – Lactophenol cotton blue staining and mounting	3	2
9	Determination of ABO blood groups and Rh factor (Antigen – antibody Reaction)	2	4
10	Study through photographs/ illustration, the primary immune (Bone marrow and thymus) and secondary immune (spleen and lymph nodes) organs in Rat/Man	4	5

<b>Course</b>	Biotechnology, Bioinformatics & Molecular Biology
<b>Code</b>	ZY6CRT11
<b>Programme</b>	B.Sc Zoology
<b>Year/Semester</b>	VI
<b>Type</b>	Core Course
<b>Credits</b>	3

<b>CO No.</b>	<b>Expected Course Outcomes</b>	<b>Cognitive Level</b>	<b>PSO No.</b>
1.	Interpret the importance, tools, techniques, potential applications and hazards of biotechnology.	U	6
2.	Understand animal cell culture methods.	U	6
3.	Analyse the role and action of biofertilizers.	An	5
4.	Understand the principles and application of bioinformatics.	U	6
5.	Explain the genetic concept and nature of genetic material.	U	4,6
6.	Interpret gene expression and gene regulation	U	4,6
PSO-Program Specific Outcome; CO-Course Outcome; <b>Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create</b>			

<b>Module</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
<b>1.</b>	<b>BIOTECHNOLOGY</b>	<b>20</b>	
1.1	Introduction: Scope, Brief History and Importance	1	1
1.2	Enzymes (restriction endonucleases, ligases, linkers & adapters), Vectors-[ Plasmids, Phage vectors, Cosmids, Artificial Chromosomes] Host cells. Basic steps & techniques in rDNA technology	3	1
1.3	Gene Libraries, Construction of genomic library and cDNA Library.	1	1
1.4	PCR technique and DNA amplification	1	1
1.5	Brief description of screening methods – Probes, Nucleic Acid hybridization	1	1
1.6	In-situ Hybridization, Fluorescence in situ Hybridization (FISH), Colony hybridization.	1	1
1.7	Methods of transfer of desired gene into target cell.	1	1
1.8	Blotting Techniques- Southern, Northern, Western blotting.	1	1
1.9	DNA Finger printing (DNA Profiling) and its application. Molecular markers - RFLP	1	1
<b>2</b>		<b>9</b>	
2.1	Animal Cell Culture: Brief account on methods, substrates, media and procedure of animal cell culture. Stem Cells, types	3	2

	and potential use,		
2.2	Organismal Cloning- reproductive & therapeutic- brief account only.	1	2
2.3	Applications in Medicine (insulin, growth hormone, gene therapy), Agriculture(GM plants and biopesticides).	1	1, 3
2.4	Applications in Environment (bioremediation), Industry (Single Cell Protein) and applications of Fermentation Technology- lactic acid, vitamins, food and beverages.	1	1
2.5	Risks related to genetically modified organisms (GMO) and biologically active products.	1	1
2.6	Biological warfare & Biopiracy. Protection of biotechnological inventions.	1	1
2.7	Intellectual Property Rights, Patenting and patent protection.	1	1
<b>BIOINFORMATICS</b>			
<b>3</b>		<b>8</b>	
3.1	Introduction: Definition, importance and role of bioinformatics in life sciences. Computational Biology.	2	4
3.2	Biological databases: Nucleotide sequence databases (NCBI- GENBANK, DDBJ and EMBL).	1	4
3.3	Protein databases - structure and sequence databases (PDB, SWISSPROT and UNIPROT).	1	4
3.4	Introduction to Sequences alignments: Local alignment and Global alignment, Pair wise alignment (BLAST and FASTA] and multiple sequence alignment.	2	4
3.5	Phylogenetic Tree construction and Analysis	2	4
<b>4</b>		<b>6</b>	
4.1	Molecular visualization software - RASMOL.	2	4
4.2	Basic concepts of Drug discovery pipe line.	2	4
4.3	Computer aided drug discovery and its applications.	1	4
4.4	Human Genome Project.	1	4
<b>MOLECULAR BIOLOGY</b>			
<b>5</b>		<b>8</b>	

5.1	Nature of Genetic Materials: Discovery of DNA as genetic material – Griffith’s transformation experiments.	1	5
5.2	Avery Macarty and Macleod, Hershey Chase Experiment of Bacteriophage infection.	1	5
5.3	Prokaryotic genome, Eukaryotic genome.	1	5
5.4	Structure and types of DNA & RNA.	2	5
5.5	DNA replication.	1	5
5.6	Modern concept of gene (Cistron, muton, recon, viral genes).	1	5
5.7	Brief account of the following-- Split genes (introns and exons), Junk genes, Pseudogenes, Overlapping genes, Transposons.	1	5
<b>6</b>		<b>12</b>	
6.1	Gene Expressions: Central Dogma of molecular biology and central dogma reverse, one gene- one enzyme hypothesis, One gene-one polypeptide hypothesis.	2	6
6.2	Characteristics of genetic code, Contributions of Hargobind Khorana.	2	6
6.3	Protein synthesis [prokaryotic]: Transcription of mRNA, Reverse transcription, post transcriptional modifications.	2	6
6.4	Translation, Post translational modifications.	2	6
6.5	Gene regulations: Prokaryotic( inducible & repressible systems) Operon concept -Lac operon and Tryptophan operon.	3	6
6.6	Brief account of Eukaryotic gene regulation.	1	6

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<b>Course</b>	Biotechnology, Bioinformatics & Molecular Biology (P)
<b>Code</b>	ZY6CRP11
<b>Programme</b>	B.Sc Zoology
<b>Year/Semester</b>	VI
<b>Type</b>	Core Course
<b>Credits</b>	2

<b>CO No.</b>	<b>Expected Course Outcomes</b>	<b>Cognitive Level</b>	<b>PSO No.</b>
1	Recognize and categorise the blotting techniques and DNA isolation procedure used in biotechnological applications.	R, U	6
2	Identify and summarise the characteristic features of genome sequences of organisms	U	6,7
3	Identify and comment on protein sequences	U	6,7
4	Use bioinformatic tools for macromolecule visualization.	Ap	6,7
5	Differentiate the molecular composition, structural orientaton and functional significance of macromolecules.	An	6,7

PSO-Program Specific Outcome; CO-Course Outcome;  
**Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create**

<b>Module</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
1	<b>BIOTECHNOLOGY</b>		
1.1	Identify and comment on the item provided: (Western blotting / Southern blotting / Northern blotting / PCR)	6	1
1.2	Write down the procedure involved in DNA isolation	6	1
2	<b>BIOINFORMATICS</b>		
2.1	Download/use print out/pictures of genome sequences of any 2 organisms. Identify and mention the characteristic features of both.	6	2
2.2	Download/ use print out/pictures of a protein sequence , identify it & comment on its amino acid composition.	6	3
2.3	Download / use print out/pictures of a macromolecule. Write a brief note on the bioinformatics tool used to visualize its structure.	6	4
3	<b>MOLECULAR BIOLOGY</b>		
3.1	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)	6	5

<b>COURSE</b>	<b>OCCUPATIONAL ZOOLOGY . (APICULTURE, VERMICULTURE, QUAIL FARMING &amp; AQUACULTURE) (T)</b>
CODE	ZY6CRT12
DEGREE/YEAR	B.SC ZOOLOGY, VI <sup>th</sup> SEMESTER
TYPE	<b>CORE COURSE</b>
CREDITS	54 HRS

CO No.	Expected Course outcomes: <b>OCCUPATIONAL ZOOLOGY (APICULTURE, VERMICULTURE, QUAIL FARMING &amp; AQUACULTURE) (T)</b>	Cognitive level	PSO No.
1.	Understand the common cultivable fishes, types of aquaculture, its management and fish processing and preservation.	U	PSO-5
2.	Construct ornamental fish culture units for for self employment.	C	PSO-5
3.	Design and management of aquariums.	C	PSO-5
4.	Use vermiculture technique for better waste management.	Ap	PSO-5
5.	Carry out apiculture and quail farming for self employment or as a hobby.	Ap	PSO-5
6.	Understand the various species of earthworms, honey bees and be products.	U	PSO-5
7.	Identify diseases of fishes, earthworms and honeybees.	U	PSO-5

\*PSO-Program Specific Outcome; CO-Course Outcome;  
**Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create**

MODULE	COURSE DESCRIPTION	Hrs.	Co No.
<b>1.0</b>	<b>APICULTURE</b>	<b>18</b>	<b>5,6,7</b>
1.1	Definition, Different species of honey bees, Organization of honey bee colony, Social life and adaptation of honey bees. Communication among honey bees.	2	6
1.2	Bee keeping methods and equipments, Management and maintenance of an apiary, Growth period, honey flow period and	2	6,5



	dearth period Division of the colony, uniting two colonies, , replacing old queen with new queen, swarming management, monsoon management.		
1.3	Enemies of bees. Diseases of bees.	2	7
1.4	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.	2	6,5
1.5	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.	10	6,5
<b>2.0</b>	<b>VERMICULTURE</b>	<b>8</b>	<b>6,7,4</b>
2.1	Introduction, Ecological classification of earth worms. Species of earth worms used for vermicultre, Reproduction & life cycle, Role of earth worm in solid waste management, in agriculture, in medicine etc.	2	6,7
2.2	Preparation of vermibed, Maintenance & monitoring, Preparation of vermicompost, Preparation of vermiwash	2	6,7,4
2.3	Activity : Submission of a report after preparing a vermiculture unit or visiting a vermicomposting unit.	4	6,7,4
<b>3.0</b>	<b>QUAIL FARMING (Coturnix coturnix)</b>	<b>4</b>	<b>5</b>
3.1	Introduction, care of quail chicks, care of adult quails, care of breeding quails, ration for quail, care of hatching eggs, health care.	2	5
3.2	Use of quail egg and meat. Sources of quality chicks.	2	5
<b>4.0</b>	<b>AQUACULTURE</b>	<b>24</b>	<b>1,2,3</b>
4.1	Advantages and salient features of aquaculture, Types of Aquaculture, Biotic and abiotic features of water, Importance of algae in aquaculture.	2	1
4.2	Common cultivable fishes of Kerala, Fish diseases, Composite fish culture, Integrated fish culture, Carp culture, Prawn culture, Mussel culture Pearl culture. Processing & Preservation.	3	1
4.3	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.	2	3,2

4.4	Transportation - Live fish packing and transport Common diseases of aquarium fishes and their management. Aquaponics (a brief introduction only).	2	1
4.5	Activity – Setting up of an Aquarium	5	3
4.6	Field visit – Visiting an Aquaculture farm	10	3

## REFERENCES

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<b>COURSE</b>	<b>OCCUPATIONAL ZOOLOGY . (APICULTURE, VERMICULTURE, QUAIL FARMING &amp; AQUACULTURE) (P)</b>
<b>CODE</b>	ZY6CRP12
<b>PROGRAMME</b>	<b>B.SC ZOOLOGY</b>
<b>DEGREE/YEAR</b>	VI SEMESTER
<b>TYPE</b>	<b>CORE COURSE</b>
<b>CREDITS</b>	36 HRS

CO No.	Expected Course outcomes: <b>OCCUPATIONAL ZOOLOGY (P)</b>	Cognitive level	PSO No.
1	Identify the types of culturable fishes, earthworms and honey bees.	U	PSO-5
2	Determine the castes of honey bees.	Ap	PSO-5
3	Determine various bee keeping equipments and componenets of aquarium.	Ap	PSO-5
4	Identify bee products, silk, chandrika, natrika and vermicompost	U	PSO-5
5	Identify fish diseases and parasites	U	PSO-5
6	Determine adulteration in honey	Ap	PSO-5
7	Carry out temporary mounting and separation of cocoon.	Ap	PSO-5

\*PSO-Program Specific Outcome; CO-Course Outcome;  
**Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create**

<b>MODUL E</b>	<b>COURSE DESCRIPTION</b>	<b>Hrs.</b>	<b>Co No.</b>
<b>1.0</b>	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	4	1

	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).		
<b>2.0</b>	Castes of bees	2	2
<b>3.0</b>	Principle & uses of - Aquarium filters, Aquarium aerator, Aquarium plants, Oven, Pelletiser, Screw Press, die plate	2	3
<b>4.0</b>	Identification and study of fish parasites and diseases (five numbers each) using slides/pictures	3	5
<b>5.0</b>	Bee keeping equipments, Beehive, Smoker, honey extractor, Queen Cage	3	3
<b>6.0</b>	Bees wax, Honey, Vermicompost (Identification-Uses)	3	4
<b>7.0</b>	Formulation of artificial feed for aquarium fishes – demonstration	3	3
<b>8.0</b>	Tests for determining the adulteration in honey.	6	6
<b>9.0</b>	Mounting of pollen basket	2	7
<b>10.0</b>	Mounting of mouth parts of honey bee	4	7
<b>11.0</b>	Separation of cocoon from worm castings.	4	7

<b>Course</b>	Nutrition,, Health and Lifestyle Management
<b>Code</b>	ZY6CBT04
<b>Title</b>	B.Sc Zoology
<b>Year/Semester</b>	III/VI
<b>Credits</b>	3

<b>CO No.</b>	<b>Expected Course Outcomes</b>	<b>Cognitive Level</b>	<b>PSO No.</b>
1	Understand the concept of health, balanced nutrition and good lifestyle practises.	U	8
2	Analyse the normal health standards and the use of devices used to measure different health parameters.	An	8
3	List the food safety laws and regulations	R	8
4	Create good life style practises, follow healthy food habits and maintain physical and mental fitness	C	8

<b>Module</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
<b>1</b>		<b>15</b>	
1.1	Nutrition and health: Nutritional requirements of man, classification of major nutrients including protein, vitamins and minerals, water.	3	1
1.2	Role of fibre, biological value of food components, food groups and sources, balanced diet.	3	1
1.3	RDA, BMI, BMR, Calorie intake and expenditure.	1	1
1.4	Healthy eating pyramid, Nutrition in infancy, preschool, school, adolescent, pregnancy, lactation and old age.	3	1
1.5	Nutrition in diseases and special conditions.	3	1
1.6	Food safety: Nutrition education, food sanitation and hygiene, food adulteration and consumer protection.	2	3
<b>2</b>		<b>18</b>	
2.1	Understanding of health: Define health, basic concepts, dimensions of health, basic parameters of health care.	5	1
2.2	Health Parameters: Individual normal standards	1	2
2.3	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.	12	2
<b>3</b>		<b>15</b>	
3.1	Introduction to Life style diseases	1	4
3.2	Common life style diseases: Alzheimer's disease and other neural disorders, asthma, cancer.	2	4
3.3	Cardio vascular diseases - including hypertension, Atherosclerosis and stroke, chronic obstructive pulmonary disease.	2	4
3.4	Diabetes Mellitus or Type 2 Diabetes, depression, obesity, osteoporosis.	2	4
3.5	Constipation, gastro-intestinal disturbances including diarrhoea and peptic ulcer.	2	4
3.6	Liver cirrhosis and other liver diseases.	2	4

3.7	Occupational lifestyle diseases.	2	4
3.8	Modern lifestyle disorders: sleeping habits, junk food, poor eating habits, anxiety, food poisoning.	2	4
<b>4</b>		<b>10</b>	
4.1	Causes of lifestyle diseases.	2	4
4.2	Defects of modern food habits and unbalanced diet options.	2	4
4.3	Food adulteration, environmental pollution, poor life style choices.	2	4
4.4	Drug abuse, tobacco smoking, alcohol and drug consumption.	2	4
4.5	Lack of adequate exercise, wrong body posture, disturbed biological clock, stressful environmental conditions.	2	4
<b>5</b>		<b>14</b>	
5.1	Prevention and control of life style diseases.	1	4
5.2	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.	6	4
5.3	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.	4	4
5.4	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.	2	4
5.5	Health literacy as a public health goal: Awareness programs in schools, colleges and through mass media.	1	4

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