CMS COLLEGE KOTTAYAM

(AUTONOMOUS)

Affiliated to the Mahatma Gandhi University, Kottayam, Kerala

CURRICULUM FOR
UNDER GRADUATE PROGRAMME

BACHELOR OF SCIENCE IN ZOOLOGY

UNDER CHOICE BASED CREDIT SYSTEM 2018
(With effect from 2018)

Approved by the Board of Studies on 26-03-2018

CONTENTS

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Above all we thankfully acknowledge Almighty God for strengthening us to accomplish this work.

Chairman
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PREFACE

Science equips us to find solutions to the present social and environmental challenges so as to achieve sustainable development as well as to play their part in the international scientific domain. Linking science to society is essential to create societies that interact with nature and complement the knowledge. Science and technology is developing in a fast pace with emergence of new disciplines, which demands the need to restructure the curriculum. It is imperative to revise the existing curriculum to make it compatible with other universities for effective science education. The present BSc Degree programme in Zoology is a Choice Based Credit System with six semesters, offering an open course in the fifth semester and an elective course in the sixth semester. In addition to that students will be able to do three certificate courses and two extra credit courses during the three year programme.

The present curriculum will expose students to various basic, advanced and applied fields in Zoology which will facilitate them for a graduate finale course or for pursuing higher studies in Zoology. It is expected that students will have more opportunities to practice their own interests which will enable them to get employed in the biological research institutes, and in related departments. All possible attempts have been made to update the syllabus by incorporating current and most recent developments in various branches of Zoological Sciences and at the same time efforts have been made to make the syllabus student friendly by including URLs and QR codes. Incorporating study of common local varieties ensure to create passion towards animals. The present curriculum includes skill and job oriented courses, awareness regarding physiological functioning of the body and many relevant practicals that foster the development of psycho-motor skills. It also addresses the local needs, social and global issues of concern thereby creating the need to ensure sustainable life practices.

CURRICULUM

GRADUATE PROGRAMME OUTCOMES

At the completion of the under graduate program, the student will be able to accomplish the following programme outcomes

GPO No.	Graduate Programme Outcomes	PSO No.
GPO.1	**Critical Thinking**: Take an informed and analytical approach to learning and demonstrate in-depth knowledge of the subject and give opinion(s) supported by logical reasoning that one have judged to be appropriate and understanding different approaches and using them	**3, 7**
GPO.2	**Effective Communication:** Demonstrate proficiency in communicating competently in groups and organizations, competence in interpersonal communication; possess skills to effectively deliver formal and informal presentations to a variety of audiences in multiple contexts	**6, 8**
GPO.3	**Social Interaction:** Foster social skills and peer interaction enabling them to make all people feel valued and respect their differences by being responsible citizens for creating a socially inclusive society	**1, 2, 8**
GPO.4	**Ethical Standards:** Recognize values such as justice, trust, equity, fairness, kindness and develop a commitment to meeting and upholding standards of ethical behavior in all walks of life and comprehending the moral dimensions of decisions and actions	**1, 2**
GPO.5	**Environmental Consciousness:** Discern the issues of environmental contexts and engages in promoting values and attitudes that claim coexistence and sustainable living with reduced, minimal, or no harm upon ecosystems	**2, 7**
GPO.6	**Lifelong Learning:** Acquire the skill to be an independent lifelong learner embracing real-time changes in the socio-technological context, promoting continuous development and improvement of the knowledge and skills needed for employment and personal fulfillment	**4,5,7, 8**

PROGRAMME SPECIFIC OUTCOMES

PSO No.	Intended Programme Specific Outcomes (PSO) *Upon completion of BSc. Zoology Degree Programmes, the graduates will be able to:*	GPO No.
PSO-1	Develop a broad foundational knowledge of the faunal diversity especially local fauna, pattern of evolution, morphological features, adaptation and classification	**GPO.3** **GPO.4**
PSO-2	Analyze the relationship between plants, animals, microbes and deal with the local national and global environmental issues in a sustainable manner by realizing the rights of an individual and also the need to conserve our biosphere	**GPO.3** **GPO.4** **GPO.5**
PSO-3	Understand the basic concepts in cell biology, biochemistry, developmental biology, genetics, evolution, microbiology, immunology, research methodology, statistics and physiology	**GPO.1**
PSO-4	Understand the application of biological sciences in aquaculture, apiculture, vermiculture, quail farming agricultural pest management and medical coding, there by getting employed or impart skill for a source of additional income and self-employment	**GPO.6**
PSO-5	Generate innovative ideas for performing experiments in the areas of biochemistry, physiology, genetics, microbiology, developmental biology, bioinformatics, taxonomy, economic zoology and ecology	**GPO.6**
PSO-6	Explain the recent developments in genetic engineering, biotechnology, immunology, microbiology, general informatics and bioinformatics for research activities in the department research center or in collaboration with other research institutes	**GPO.2**
PSO-7	Use concepts, tools and techniques related to chemistry and botany to acquire knowledge and its application in zoology	**GPO.1** **GPO.5** **GPO.6**
PSO- 8	Organize and deliver relevant applications of knowledge through effective written, verbal, graphical/ virtual communications and interact productively with people from diverse backgrounds	**GPO.2,** **GPO.3** **GPO.6**

PROGRAMME DESIGN

B.Sc. ZOOLOGY PROGRAMME

The UG programme in Zoology includes compulsory core courses, complementary courses, Open Course, elective /choice based course, project work, English and additional languages namely Malayalam/ Hindi/ Syriac. For the successful completion of this UG programme, a student shall acquire minimum 120 credits. Provision has also been made for three add on courses and two extra credit courses for acquiring extra credits.

The course design is given below.

Sl.No.	Course type	No. of courses	Total credits
1	Common course I-English	6	22
2	Common course II– Additional language	4	16
3	Core	12	34
4	Core Practical	12	12
5	Optional Core	1	3
6	Complementary	12	24
7	Complementary Practical	4	4
8	Open course	1	3
9	Project work and Group activity	1	2
Total		**53**	**120**

PROGRAMME STRUCTURE – B.Sc. ZOOLOGY
(Semester wise)

Course Code	Title of the Course	Course Category	Hours/ week	Total hours	Credits
SEMESTER I					
EN1811501	Fine-tune Your English	Common I - English 1	5	90	4
EN1811502	Pearls from the Deep	Common I - English 2	4	72	3
	Additional Language	Common Course	4	72	4
HN1811501	Prose and One Act Plays	Common II - Hindi 1			
ML1811501	*Kathasahithyam*	Common II - Malayalam 1			
SC 1811501	Poetry/ Grammar & History of Syriac Language & Literature	Common II – Syriac 1			
ZY 1811101	General Perspectives In Science And Protistan Diversity	Core 1	2	36	2
ZY 1811601	General Perspectives In Science And Protistan Diversity	Core Practical 1	2	36	1
CH 1811201	Basic theoretical and Analytical Chemistry	Complementary Chemistry	2	36	2
CH 1811701	Volumetric Analysis	Complementary Chemistry(P)	2	36	1
BY 1811201	Cryptogams, Gymnosperms and Plant pathology	Complementary Botany	2	36	2
BY 1811701	Cryptogams, Gymnosperms and Plant pathology	Complementary Botany (P)	2	36	1
		Total	**25**	**450**	**20**
SEMESTER II					
Course Code	**Title of the Course**	**Course Category**	**Hours /week**	**Total hours**	**Credits**
EN 1812503	Issues that Matter	Common I - English 3	5	90	4
EN 1812504	Savouring the Classics	Common I - English 4	4	72	3
	Additional Language	Common Course			

HN 1812503	Short stories and Novel	Common II - Hindi 2	4	72	4
ML 1812504	*Kavitha*	Common II- Malayalam 2			
SC 1812503	Poetry/ Grammar & History of Syriac Literature	Common II – Syriac 2			
ZY 1812102	Animal Diversity- Non Chordata	Core 2	2	36	2
ZY 1812602	Animal Diversity- Non Chordata	Core Practical 2	2	36	1
CH 1812202	Basic organic chemistry	Complementary Chemistry	2	36	2
CH 1811701	Volumetric Analysis	Complementary Chemistry(P)	2	36	1
BY 1812202	Plant Physiology	Complementary Botany	2	36	2
BY 1812702	Plant Physiology	Complementary Botany (P)	2	36	1
		Total	**25**	**450**	**20**

SEMESTER III

Course Code	Title of the Course	Course Category	Hours /week	Total hours	Credits
EN 1813505	Literature and/ as Identity	Common I- English 5	5	90	4
	Additional Language	Common Course	5	90	4
HN 1813505	Poetry Grammar and Translation	Common II - Hindi 3			
ML 1813507	*Drishyakalasahithyam*	Common II- Malayalam 3			
SC 1813505	Prose, Grammar & Literature	Common II- Syriac 3			
ZY 1813103	Animal Diversity- Chordata	Core 3	3	54	3
ZY 1813603	Animal Diversity- Chordata	Core Practical 3	2	36	1
CH 1813203	Advanced Inorganic And Organic Chermistry	Complementary Chemistry	3	54	3
CH 1813703	Organic Analysis	Complementary Chemistry (P)	2	36	1
BY 1813203	Angiosperm Taxonomy and Economic Botany	Complementary Botany 3	3	54	3
BY 1813703	Angiosperm Taxonomy and Economic Botany	Complementary Botany 3 Practical	2	36	1
		Total	**25**	**450**	**20**

SEMESTER IV

Course Code	Title of the Course	Course Category	Hours /week	Total hours	Credits
EN 1814507	Illuminations	Common I - English 6	5	90	4
	Additional Language	Common Course	5	90	4
HN1814506	Drama and Long Poem	Common II- Hindi 4			
ML1814508	*Malayala Gadyarachanakal*	Common II- Malayalam 4			
SC1814506	Poetry, Grammar & Syriac Heritage in India	Common II- Syriac 4			
ZY1814104	Research Methodology, Biophysics and Biostatistics	Core 4	3	54	3
ZY1814604	Research Methodology, Biophysics and Biostatistics (P)	Core Practical 4	2	36	1
CH1814204	Advanced Bio organic chemistry	Complementary Chemistry 4	3	54	3
CH1814704	Organic Analysis	Complementary practical 4	2	36	1
BY 1814204	Anatomy and Applied Botany	Complementary Botany 4	3	54	3
BY 1814704	Anatomy and Applied Botany (P)	Complementary Botany 4 practical	2	36	1
		Total	**25**	**450**	**20**

SEMESTER V

Course Code	Title of the Course	Course Category	Hours /week	Total hours	Credits
ZY1815105	Environmental Biology and Human Rights	Core 5	3	54	3
ZY1815605	Environmental Biology and Human Rights (P)	Core Practical 5	2	36	1
ZY1815106	Cell Biology and Genetics	Core 6	3	54	3
ZY1815606	Cell Biology and Genetics	Core Practical 6	2	36	1
ZY1815107	Evolution, Ethology and Zoogeography	Core 7	3	54	3

ZY1815607	Evolution, Ethology and Zoogeography	Core Practical 7	2	36	1
ZY1815108	Human Physiology, Biochemistry	Core 8	3	54	3
ZY1815608	Human Physiology, Biochemistry	Core Practical 8	2	36	1
ZY1815401	Vocational Zoology (Apiculture, Vermiculture, Ornamental fish cultures)	Open Course	4	72	3
ZY1816801	Project Work (Credit 2 will be given in 6th semester with investigatory project)	Project	1	18	
		Total	**25**	**450**	**19**

SEMESTER VI

Course Code	Title of the Course	Course Category	Hours /week	Total hours	Credits
ZY1815107	Developmental Biology and Endocrinology	Core 9	3	54	3
ZY1816609	Developmental Biology and Endocrinology (Practical)	Core 9 Practical	2	36	1
ZY1816110	Microbiology and Immunology	Core 10	3	54	3
ZY1816610	Microbiology and Immunology (Practical)	Core 10 Practical	2	36	1
ZY1816111	Biotechnology, Bioinformatics and Molecular biology	Core 11	3	54	3
ZY1816611	Biotechnology, Bioinformatics and Molecular Biology (Practical)	Core Practical 11	2	36	1
ZY1816112	Occupational Zoology (Aquaculture, Apiculture,	Core 12	3	54	3

	Vermiculture and Quail farming)				
ZY1816612	Occupational Zoology(Aquaculture, Apiculture, Vermiculture and Quail farming) (Practical)	Core Practical 12	2	36	1
ZY1816301	Elective: Agricultural Pest Management	Choice based Core Elective Courses	4	72	3
ZY1816801	Project & Industrial Visit	Project	1	18	2
		Total	**25**	**450**	**21**

PROGRAMME STRUCTURE – B.SC. ZOOLOGY

COMMON COURSES

Course code	Course Name		Credit	Hrs/ W	Semester
EN1811501	Common I -English 1 Fine-tune Your English		4	5	1
EN1811502	Common I- English 2 Pearls from the Deep		3	4	1
EN1811503	Common I -English 3 Issues that Matter		4	5	2
EN1811504	Common I- English 4 Savouring the Classics		3	4	2
EN1811505	Common I – English 5 Literature and/ as Identity		4	5	3
EN1811507	Common I – English 6 Illuminations		4	5	4
HN1811501	Additional language –1		4	4	1
ML1811501	Prose and One Act Plays	Common II - Hindi 1			
SC 1811501	*Kathasahithyam*	Common II - Malayalam 1			
	Poetry/ Grammar & History of Syriac Language &Literature	Common II –Syriac 1			
HN 1812503	Additional language –1		4	4	2
ML 1812504	Short stories and Novel	Common II - Hindi 2			
SC 1812503	*Kavitha*	Common II- Malayalam 2			
	Poetry/ Grammar & History of Syriac Literature	Common II –Syriac 2			

	Additional Language – 1		4	4	3
HN 1812503	Poetry Grammar and Translation	Common II - Hindi 3			
ML 1812504	*Drishyakalasahithyam*	Common II- Malayalam 3			
SC 1812503	Prose, Grammar & Literature	Common II- Syriac 3			
	Additional Language – 1		4	4	4
HN 1813505	Drama and Long Poem	Common II- Hindi 4			
ML 1813507	*Malayala Gadyarachanakal*	Common II- Malayalam 4			
SC 1813505	Poetry, Grammar & Syriac Heritage in India	Common II- Syriac 4			
Total			**38**	**45**	

CORE COURSES

Course code	Title of the Course	Hrs/week	Credit	Semester	PSO
ZY 1811101	General perspectives in Science and Protistan Diversity	2	2	1	1
ZY 1811601	General perspectives in Science and Protistan diversity (Practical)	2	0	1	5
ZY 1811102	Animal Diversity – Non Chordata	2	2	2	2
ZY 1811602	Animal Diversity – Non Chordata (Practical)	2	2	2	5
ZY 1811103	Animal Diversity - Chordata	3	3	3	2
ZY 1811603	Animal Diversity - Chordata (Practical)	2	0	3	5
ZY 1811104	Research Methodology, Biophysics and Biostatistics	3	3	4	3
ZY 1811604	Research Methodology, Biophysics and Biostatistics (Practical)	2	2	4	5
ZY1815105	Environmental Biology and Human rights	3	3	5	3
ZY1815605	Environmental Biology and Human rights (Practical)	4	0	5	5
ZY1815106	Cell Biology and Genetics	3	3	5	3
ZY1815606	Cell Biology and Genetics (Practical)	2	0	5	5
ZY1815107	Evolution, Ethology and Zoogeography	3	3	5	3
ZY1815607	Evolution, Ethology and Zoogeography (Practical)	2	0	5	5
ZY1815108	Human Physiology and Biochemistry	3	3	5	3
ZY1815608	Human Physiology and Biochemistry (Practical)	2	0	5	5

ZY1815107	Developmental Biology and Endocrinology	3	3	6	3
ZY1816609	Developmental Biology and Endocrinology (Practical)	2	2	6	5
ZY1816110	Microbiology and Immunology	3	3	6	3
ZY1816610	Microbiology and Immunology (Practical)	2	2	6	5
ZY1816111	Biotechnology, Bioinformatics and Molecular biology	3	3	6	3
ZY1816611	Biotechnology, Bioinformatics and Molecular Biology (Practical)	4	2	6	5
ZY1816112	Occupational Zoology (Aquaculture, Apiculture, Vermiculture and Quail farming)	3	3	6	4
ZY1816612	Occupational Zoology(Aquaculture, Apiculture, Vermiculture and Quail farming) (Practical)	2	2	6	5
	Total	**62**	**46**		

COMPLEMENTARY COURSES

Course code	Title of the Course	Hrs/week	Credit	Semester	PSO
ZY1811201	Non chordate diversity	2	2	1	1
ZY1811701	Non chordate diversity (Practical I)	2	1	1	5
ZY1811202	Chordate Diversity	2	2	2	1
ZY1811702	Chordate Diversity (Practical II)	2	1	2	5
ZY1811203	Physiology and Immunology	3	3	3	3
ZY1811702	Physiology and Immunology (Practical III)	2	1	3	5
ZY1811204	Applied Zoology	3	3	4	4
ZY1811704	Applied Zoology (Practical IV)	2	1	4	5
	Total	**18**	**14**		

OPEN COURSE - CHOICE BASED

Course code	Course Name	Credit	Hrs/ Week	Semester	PSO
ZY1815401	Vocational Zoology (Apiculture, Vermiculture and Ornamental Fish Culture)	3	4	5	4

CHOICE BASED CORE - ELECTIVE

Course code	Course Name	Credit	Hrs/ Week	Semester	PSO
ZY1816301	Agricultural Pest Management	3	4	6	4

EXTRA CREDIT COURSES

Course code	Course Name	Credit	Total Hrs	Semester	PSO
ZYX181201	Environmental Microbiology	2	2	2	6
ZYX181402	Genomics and Proteomics	2	2	4	6

ADD ON COURSES

Course code	Course Name	Credits	Total Hrs	Semester	PSO
ZYA181201	Certificate course in Applied biology for sustainable livelihood	2	2	2	4
ZYA181402	Diploma in Applied biology for sustainable livelihood	2	2	4	4
ZYA181603	Advanced Diploma in Medical Coding- Human Anatomy & Physiology	2	4.5	6	4

ZYA181604	Advanced Diploma in Medical Coding-Healthcare Common Procedure Coding Systems	2	4.5	6	4
ZYA181605	Advanced Diploma in Medical Coding-Current Procedural Terminology	2	4.5	6	4
ZYA181606	Advanced Diploma in Medical Coding-International statistical classification of diseases (ICD-10 CM)	2	4.5	6	4

DETAILED SYLLABUS OF THE COURSES

Offered by the Department

SEMESTER 1

Course Code	Title of the Course	Course Category	Hours/ week	Credits
EN1811501	Fine-tune Your English	Common I - English 1	5	4
EN1811502	Pearls from the Deep	Common I - English 2	4	3
	Additional Language	Common Course	4	4
HN1811501	Prose and One Act Plays	Common II - Hindi 1		
ML1811501	*Kathasahithyam*	Common II - Malayalam 1		
SC 1811501	Poetry/ Grammar & History of Syriac Language & Literature	Common II – Syriac 1		
ZY 1811101	General Perspectives In Science And Protistan Diversity	Core 1	2	2
ZY 1811601	General Perspectives In Science And Protistan Diversity	Core Practical 1	2	1
CH 1811201	Basic theoretical and Analytical Chemistry	Complementary Chemistry	2	2
CH 1811701	Volumetric Analysis	Complementary Chemistry(P)	2	1
BY 1811201	Cryptogams, Gymnosperms and Plant pathology	Complementary Botany	2	2
BY 1811701	Cryptogams, Gymnosperms and Plant pathology	Complementary Botany (P)	2	1
		Total	**25**	**20**

Course	Details				
Code	ZY 1811101				
Title	**GENERAL PERSPECTIVES IN SCIENCE AND PROTISTAN DIVERSITY**				
Degree	B.Sc				
Branch(s)	Zoology				
Year/Semester	I/I				
Type	**Core course**				
Credits	2	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	Understand the various branches and scope of Zoology	U	**1**
2	Analyze the methods of scientific studies	An	**2**
3	Examine the concepts of Taxonomy	Ap	**1**
4	Discuss the diversity of protista and their significances	U	**1**
5	Analyse the medical significance of parasitic protists	An	**2**
6	Create an action plan for the local needs such as vector prevention and control during disease outbreak	C	**2**

*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	**PERSPECTIVES IN SCIENCE**	**8**	
1.1	**Introduction to scientific studies** :Types of knowledge: practical, theoretical, and scientific knowledge	1	2
1.2	What is science, features of science, deductive and inductive models	1	2
1.3	Scientific temper, empiricism	1	2
1.4	Vocabulary of science	1	2
1.5	**What is Biology** :Life and its manifestations	1	1
1.6	History of Biology: Biology in ancient times	1	1
1.7	Landmarks in the progress of Biology	1	1
1.8	Branches of Zoology, scope of Zoology	1	1
2.0	**SYSTEMATICS**	**10**	
2.1	**Taxonomical principles and tools :**Systematics, Taxonomy, Phylogeny (brief account),	1	3
2.2	Approaches to taxonomy,moleculartaxonomy, bar coding	1	3
2.3	Zoological nomenclature, International Code of Zoological Nomenclature (ICZN), law of priority	1	3
2.4	Five Kingdom classification; Linnaean classification	1	3
2.5	Basis for animalkingdom classification	1	3
2.6	Levels of organization, symmetry, coelom, metamerism	2	3
2.7	**Identification tool :** Taxonomic key,Types: single access key- dichotomous (linked and nested) and polytomous key	1	3
2.8	Multi access key, computer aided interactive key	1	3
2.9	Advantages and disadvantages	1	3
3.0	**PROTISTANDIVERSITY**	**18**	
3.1	**Kingdom Protista**:Salient featuresofKingdom Protista , Type study: *Paramecium*	7	4
3.2	Classification of protistaupto phyla Phylum Rhizopoda eg.*Amoeba* Phylum Actinopoda eg. *Actinophrys* Phylum Dinoflagellata eg. *Noctiluca*	1	4
3.3	Phylum Parabasalia eg. *Trychonympha* Phylum Metamonada eg. *Giardia* Phylum Kinetoplasta eg. *Trypanosoma* Phylum Euglenophyta eg. *Euglena*	1	4
3.4	Phylum Cryptophyta eg. *Cryptomonas* Phylum Opalinata eg. *Opalina* Phylum Bacillariophyta eg. Diatoms Phylum Choanoflagellata eg. *Proterospongia*	1	4
3.5	Phylum Ciliophora eg. *Balantidium coli* Phylum Sporozoa eg. *Plasmodium* Phylum Microsporidia eg. *Nosema*	1	4
3.6	Parasitic protists (diseases, mode of transmission and prophylactic measures) –*Plasmodium* (detailed account of life cycle),	3	5,6
3.7	*Entamoeba, Trypanosoma*	2	5,6
3.8	*Leishmania*	2	5,6

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2. Prema A.K, Joseph M.L, Terrence Rebello.V (Eds) (2011).Invertebrate Diversity of Kerala.Zoological Society of Kerala, Kottayam.
3. Thomas A.P (Ed) (2017). Biology – General Perspectives in Biology and Protistan Diversity. Green Leaf Publications, TIES, Kottayam.

URLs

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https://www.biologycorner.com/bio1/parasitic-protists.html
https://biology.tutorvista.com/organism/kingdom-protista.html
Life cycle of plasmodium animation:
https://highered.mheducation.com/olcweb/cgi/pluginpop.cgi?it=swf::535::535::/sites/dl/free/0072437316/120090/bio44.swf::Malaria%20-%20Life%20Cycle%20of%20Plasmodium

Course	Details				
Code	ZY 1811601				
Title	**PERSPECTIVES IN SCIENCE AND PROTISTAN DIVERSITY (P)**				
Degree	Undergraduate				
Branch(s)	Zoology				
Year/Semester	I/1				
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	Apply classical and modern computer aided key for identification.	Ap	1,5
2	Understand and identify protozoans through microscopic or pictorial representations	U	1
3	Understand the basis for Animal Kingdom classification	U	1
4	Show and observation the mounting and culture technique of protists	Ap	1

*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	**Taxonomic identification using key (upto order)**	**6**	**1**
1.1	Identification of insects (any 4 specimens).	3	1
1.2	Identification using computer aided interactive key for marine protists	3	1
2.0	**General identification**	**7**	**2**
2.1	Any 6 Protistans (*Amoeba*, *Actinophrys*, *Foraminifera*, *Ceratium*, *Euglena*, Diatoms, *Vorticella*, *Noctiluca*, *Ephelota*).	4	2
2.2	Any 4 parasitic protists (slides/figures may be used foridentification)-*Entamoeba, Trypanosoma, Plasmodium, Monocystis, Nosema, Giardia.*	3	2
3.0	Identification of symmetry(1 animal belonging to each symmetry)	3	3
4.0	Identification of and body cavity in animals (1 representative example from each category)	3	3
5.0	Experiments using protozoans	17	4
5.1	Preparation of Paramecium culture by hay infusion method.	6	4
5.2	Mounting of Paramecium from culture	3	4
5.3	Study of rectal ciliates of frog (slides/figures may be used for identification)	4	4
5.4	*Trichonympha* in termites (Demonstration)	4	4

SEMESTER II

Course Code	Title of the Course	Course Category	Hours/ week	Total hours	Credits
EN 1812503	Issues that Matter	Common I -English 3	5	90	4
EN 1812504	Savouring the Classics	Common I - English 4	4	72	3
	Additional Language	Common Course	4	72	4
HN 1812503	Short stories and Novel	Common II - Hindi 2			
ML 1812504	*Kavitha*	Common II- Malayalam 2			
SC 1812503	Poetry/ Grammar & History of Syriac Literature	Common II –Syriac 2			
ZY 1812102	Animal Diversity-Non Chordata	Core 2	2	36	2
ZY 1812602	Animal Diversity-Non Chordata	Core Practical 2	2	36	1
CH 1812202	Basic organic chemistry	Complementary Chemistry	2	36	2
CH 1811701	Volumetric Analysis	Complementary Chemistry(P)	2	36	1
BY 1812202	Plant Physiology	Complementary Botany	2	36	2
BY 1812702	Plant Physiology	Complementary Botany (P)	2	36	1
		Total	**25**	**450**	**20**

Course	Details				
Code	ZY 1812102				
Title	**ANIMAL DIVERSITY-NON CHORDATA**				
Degree	Undergraduate				
Branch(s)	Zoology				
Year/Semester	I/II				
Type	**Core course**				
Credits	2	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	Organize the myriad organisms into three branches of Kingdom Animalia and forecast the classification category of given organism	C	1
2	Describe and classify branch parazoa, with examples and salient features	U	1
3	Describe and classify phylum Coelentrata and Ctenophora along with their ecological and morphological significance	U	1
4	Describe and classify phylum Platyhelminthes and identify the problems caused by parasitic forms	U	1
5	Describe and classify phylum Nemathelminthes and explain the pathogenic nematodes	U	1
6	Classify Coelomates and interpret general evolutionary relationships among and between these animal groups	Ap	1
7	Understand the anatomical features of non-chordates through type study of Phylum Arthropoda	U	1
8	Generate an understanding about minor phyla	U	1

*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	**Classification of Kingdom Animalia**	**4**	**1,2, 3**
1.1	Three branches - Mesozoa, Parazoa and Eumetazoa Branch 1 **Mesozoa:** Phylum Orthonectida eg. *Rhopalura* (mention 5 salient features)	1	1
1.2	Branch 2 **Parazoa**: Phylum Placozoa eg. *Trycoplax adherens*. Phylum Porifera: Classification up to classes; Mention gemmules Class 1 Calcarea eg. *Sycon* Class 2 Hexactinellida eg. *Euplectella* Class 3 Demospongia eg. *Cliona.* General topic: Canal system in sponges.	2	2
1.3	Branch 3 **Eumetazoa**	1	1
2.0	**Radiata**	**3**	**1,3**
2.1	Phylum CoelenterataClassification upto classes Class 1 Hydrozoa eg. *Obelia* - mention metagenesis Class 2 Scyphozoa eg. R*hizostoma.*(mention life cycle) Class 3 Anthozoa eg. *Metridium*.	1	1,3
2.2	Polymorphism in Coelenterates Coral and coral reefs with special reference to conservation of reef fauna.	1	3
2.3	Phylum Ctenophora eg. *Pleurobrachia.*	1	3
3.0	**Acoelomata and Pseudocoelomata**	**5**	**1,4, 5**
3.1	**Phylum Platyhelminthes** Salient features; classification upto classes Class 1 Turbellaria eg. *Planaria* Class 2 Trematoda eg. *Fasciola* Class 3 Cestoda eg. *Taenia saginata*	1	1,4
3.2	Life history of *Fasciolahepatica.*	1	1,4
3.3	Platyhelminth parasites of man and dog *Schistosoma* *Taenia solium* *Echinococcus*	1	4
3.4	Phylum Nemathelminthes (Nematoda) Salient features, classification up toclasses Class 1 Phasmidia eg. *Enterobius* Class 2 Aphasmidia eg. *Trichinella*	1	1,5
3.5	Pathogenic nematodes in man *Wuchereria bancrofti* *Ascaris lumbricoides*	1	5

	Ancylostoma duodenale *Trichinella*		
4.0	**Eucoelomata I-Annelida, Onychophora, Arthropoda**	**16**	**1,6,7**
4.1	Phylum Annelida Salient features, classification upto classes. Class 1 Archiannelida eg. *Polygordius* Class 2 Polychaeta eg. *Chaetopterus* Class 3 Oligochaeta eg. *Megascolex.* Class 4 Hirudinea eg. *Ozobranchus*, *Hirudinaria*	2	1,6
4.2	Phylum Onychophoraeg.*Peripatus* (mention its affinities)	1	1,6
4.3	Phylum Arthropoda Salient features, classification upto classes	1	1,6
4.4	Type study: Prawn – *Fenneropenaeus (Penaeus)*	6	7
4.5	Sub Phylum Trilobitomorpha Class Trilobita (mention the salient features). eg. *Triarthrus* (an extinct trilobite)	1	1,6
4.6	Sub Phylum Chelicerata Class 1 Merostomata eg. *Limulus* (horse shoe crab) Class 2 Arachnida eg. *Palamnaeus* (scorpion) Class3 Pycnogonida eg. *Nymphon* (sea spider)	1	1,6
4.7	Sub Phylum Crustacea (mention larval forms) Class 1 Branchiopoda eg. *Daphnia* (water flea) Class 2 Ostracoda eg. *Cypris* (seed shrimp) Class 3 Copepoda eg. *Cyclops* Class 4 Remipedia eg. *Speleonectes* (eyeless crustacean seen in caves) Class 5 Branchiura eg. *Argulus* (common fish louse) Class 6 Cirripedia eg. *Sacculina* (parasitic castrato of crabs) Class 7 Malacostraca eg. Palinurus (spiny lobster), *Cancer* (crab), *Squilla* (spot tail mantis shrimp)	2	1,6
4.8	Sub Phylum Uniramia Class 1 Chilopoda eg. *Scolopendra* (centipede) Class 2 Symphyla eg. *Scutigerella* (garden centipedes) Class 3 Diplopoda eg. *Spirostreptus*(millipede) Class 4 Pauropoda eg. *Pauropus* Class 5 Hexapoda eg. Dragonfly, *Bombyx mori* (silk moth), Mosquito	2	1,6
5.0	**Eucoelomata II-Mollusca. Echinodermata, Hemichordata and minor phyla**	**8**	**1,6,7**
5.1	Phylum Mollusca Salient features, classification upto classes Class 1 Aplacophora eg. *Neomenia* Class 2 Monoplacophora eg. *Neopilina*	3	1,6

	Class 3 Amphineura eg. *Chiton* Class 4 Gastropoda eg. *Aplysia* Class 5 Scaphopoda eg. *Dentalium* Class 6 Pelecypoda eg. *Pinctada, Mytilus* Class 7 Cephalopoda eg. *Sepia, Octopus*		
5.2	Phylum Echinodermata Classification upto classes, mention larval forms Class1 Asteroidea eg. *Astropecten* Class2 Ophiuroidea eg. *Ophiothrix* Class3 Echinoidea eg. *Echinus* Class 4 Holothuroidea eg. *Holothuria* Class 5 Crinoidea eg. *Antedon*	2	1,6
5.3	Water vascular system in Echinodermata	1	6
5.4	Phylum Hemichordata: eg. Balanoglossus	1	6
5.5	Minor Phyla Chaetognatha eg. *Sagitta* Sipunculida eg. *Sipunculus*	1	8

Text Books for Reference

1. Dhami, P.S, Dhami.J.K (1979). Invertebrate Zoology. S. Chand and Co. New Delhi.
2. Ekambaranatha Ayyar .M (1990). A Manual of Zoology, Volume I. Invertebrate Part I and part II. S. Viswanathan Printers and Publishers. Pvt.Ltd.
3. Jordan E.L Verma P.S (2007). Invertebrate Zoology. S.Chand and Co. New Delhi.
4. Joy P.J, George Abraham K, Aloysius M. Sebastian, Susan Panicker (Eds) (1998). Animal Diversity, Zoological Society of Kerala, Kottayam
5. Prema A.K, Joseph M.L, Terrence Rebello .V (Eds) (2011). Invertebrate Diversity of Kerala. Zoological Society of Kerala, Kottayam.
6. Thomas .A. P (Ed) (2010).The Invertebrates- Diversity and Adaptations. Green Leaf publications TIES, Kottayam

Text Books for Enrichment

1. Barnes, R.D (1987). Invertebrate Zoology, W.B. Saunders, NewYork.
2. Barrington, E.J.W (1967). Invertebrate Structure and function. ELBS and Nelson,
3. Edward E. Ruppert, Richard S. Foxand, Robert D. Barnes (2004).Invertebrate Zoology: A Functional Evolutionary Approach, 7th Edition, Thomson-Brooks/Cole.London.
4. Groove, A.J,Newell, G.E. (1974). Animal Biology–Indian Reprint, University Book Stall, New Delhi. 6. Hyman, L.H (1942). The Invertebrate volumes. McGraw-Hill.
5. James R.D (1987). Invertebrate Zoology, W.B. Saunders, NewYork.
6. Kotpal R. L (1988-92) (All series). Porifera, Coelentereta, Helminthes, Annelida, Arthropoda, Mollusca, Echinodermata, Rastogi Publishers, Meerut.
7. Kotpal R.L,Agarwal S.K, R.P. Khetharpal (2002). Modern Text Book of Zoology. Rastogi Publications, Meerut.
8. Marshall, A.J,Williams, W.D. (1972). Text Book of Zoology, Vol. Invertebrates, ELBS and Macmillan, London.
9. Mayr, E (1980). Principles of Systematic Zoology Tata McGraw Hill Publishing Co., New Delhi
10. Parker, Haswell (2004).Text Book of Zoology,Vol I (Invertebrate), 7thEdition, AZTBS. Publishers and Distributors, New Delhi
11. Pechenik J. A (2005). Biology of Invertebrates, (Tata McGraw Hill Publishing Co. NewDelhi.)

QR code for the non-chordate examples

Sycon	Cliona	Euplectella	Obelia	Rhizostoma
Metridium	Pleurobrachia	Planaria	Fasciola	*Taenia*
Enterobius	Trichinella	Polygordius	Chaetopterus	Megascolex
Ozobranchus	Hirudinaria	Peripatus	Trilobite	Limulus
Scorpion	Sea spider	Daphnia	Shrimp	Copepod
Remipedia	Argulus	Sacculina	Squilla	Scolopendra
Garden centipede	Millipede	Pauropus	Silk moth	Neomenia
Dentalium	Aplysia	Pinctada	Chiton	Sepia
Feather star	Sea cucumber	Sea lilly	Star fish	Echinus

Course	Details				
Code	ZY 1812602				
Title	**ANIMAL DIVERSITY- NON CHORDATA (P)**				
Degree	Undergraduate				
Branch(s)	Zoology				
Year/Semester	I / II				
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	Illustrate the invertebrate specimens with precision	Ap	1
2	Compare the anatomy and morphology of non-chordates through transverse or longitudinal sections, dissections and mountings	An	1
3	Understand, identify and classify the various groups of non-chordates	Ap	1
4	Understand the evolutionary, adaptation and taxonomic significance of non-chordates	U	1

*PSO-Program Specific outcome; CO-Course Outcome;

Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

Experiment	Course Description	Hrs.	CO. No.
1.0	**Scientific Drawing**	**3**	**1**
1.1	Make scientific drawings of 5 locally available invertebrate specimens belonging to different phyla	3	1
2.0	**Anatomy**	**2**	**2**
2.1	Study of sections (any three) *Hydra* *Fasciola* *Ascaris*(male andfemale) Earthworm	2	2
3.0	**Dissections**	**8**	**2**
3.1	Prawn – Nervous system	4	2
3.2	Cockroach - Nervous system	4	2
3.3	Cockroach – Digestive system		
4.0	**Mounting:-**	**10**	**2**
4.1	Nereis – parapodium	1	2
4.2	Earthworm – setae	1	2
4.3	Prawn –appendages	2	2
4.4	Mouth parts – Cockroach/Plant bug/ House fly/Mosquito -any 2	4	2
4.5	Cockroach –Salivary apparatus	2	2
5.0	**Identification:-**General identification and Classification The students are expected to identify, classify and describe the following Phylum wise number of animals by their common names, generic names and 30% of these by their scientific names.	**13**	**3,4**
5.1	**Poriferans**: -*Leucosolenia, Euplectella, Spongilla* (any 1) **Cnidarians:** Sedentary hydrozoans -*Hydra, Obelia* (any 1) Pelagic hydrozoans -*Physalia, Velella* (any 1) Pelagic scyphozoan -*Aurelia, Rhizostoma* (any 1) Common anthozoans -*Adamsia, Madrepora,* - *Fungia*(any 1)	2	3,4
5.2	**Platyhelminths:** Free living flat worm - *Bipalium, Dugesia* (any 1) Parasitic flat worms -*Fasciola, Taenia solium* (any 1)	1	3,4
5.3	**Annelids:** Polychaetes -*Aphrodite, Chaetopterus, Arenicola*(any 1) Common earthworm -*Megascolex, Pheretima* (any 1) Leech -*Hirudinaria, Heamadipsa, Branchellion* (any 1)	1	3,4
5.4	**Arthropods**: Items of adaptational / taxonomic /evolutionary importance - (1 from each category) Living fossils -*Limulus*, Trilobite, tadpole	4	3,4

	shrimp (*Triopscancriformis*) Common barnacle -*Lepas, Balanus* Parasitic crustaceans -*Sacculina, Cymathoa, Argulus* Crustacean of the sandy shore -*Emerita, Albunea* Symbiotic crustacean -*Eupagurus* Economically important crustacean -Prawn, crab Vectors -Cyclops, mosquito, housefly, rat flea Insect pests -*Lepisma*, termite queen, pest of paddy, Pest of coconut, pest of stored grains Aquatic insects -*Belostoma, Nepa, Ranatra* Predatory insect -Dragonfly, antlion, *Mantis* Insect which camouflages -Stick insect, *Phyllium* Common myriapods -*Scolopendra, Scutigerella, Julus/ Spirostreptus,Jonespeltis* Common arachnids -*Palamnaeus*, spider, tick, mite		
5.5	**Molluscs**: (1 from each category) Inter tidal mollusks -*Chiton,Patella, Onchidium, Aplysia* Ornamental gastropods - *Cypraea, Murex, Turbinella* Poisonous gastropod -*Conus* Pelecypods of economic importance -*Perna, Pinctada, Teredo* Scaphopod -*Dentalium* Cephalopods of economic or evolutionary importance -*Sepia, Loligo, Octopus, Nautilus*	2	3,4
5.6	**Echinoderms** -sea lily, star fish, brittle star, sea cucumber, sea urchin, cake urchin, heart urchin (any 2)	2	3,4
5.7	**Hemichordata**: *Balanoglossus* Onychophora: *Peripatus* (Evolutionary significance)	1	3,4

SEMESTER III

Course Code	Title of the Course	Course Category	Hours /week	Total hours	Credits
EN 1813505	Literature and/ as Identity	Common I- English 5	5	90	4
	Additional Language	Common Course	5	90	4
HN 1813505	Poetry Grammar and Translation	Common II - Hindi 3			
ML 1813507	*Drishyakalasahithyam*	Common II- Malayalam 3			
SC 1813505	Prose, Grammar & Literature	Common II- Syriac 3			
ZY 1813103	Animal Diversity- Chordata	Core 3	3	54	3
ZY 1813603	Animal Diversity- Chordata	Core Practical 3	2	36	1
CH 1813203	Advanced Inorganic And Organic Chermistry	Complementary Chemistry	3	54	3
CH 1813703	Organic Analysis	Complementary Chemistry (P)	2	36	1
BY 1813203	Angiosperm Taxonomy and Economic Botany	Complementary Botany 3	3	54	3
BY 1813703	Angiosperm Taxonomy and Economic Botany	Complementary Botany 3 Practical	2	36	1
		Total	**25**	**450**	**20**

Course	Details				
Code	ZY 1813103				
Title	**ANIMAL DIVERSITY-CHORDATA**				
Degree	Undergraduate				
Branch(s)	Zoology				
Year/Semester	II / III				
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	Explain the diversity and phylogeny of chordates	U	1
2	Understand the distinguishing characteristics and classification of the major vertebrate phyla	U	1
3	Describe and compare the adaptations displayed by the vertebrates	An	1
4	Compare the anatomy and complexity of two groups of chordata through type study	U	1
5	Examine the local chordate diversity	C	1,2
6	Predict the classification category of given chordates based on morphological features	C	1

*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	**Classification of Chordates**	**7**	**1,2,6**
1.1	**Introduction** General characters and outline classification of chordata up to class, origin of chordates (mention theories in brief)	1	1
1.2	**Protochordates** General characters and classification	1	2,6
1.3	**Sub Phylum: Urochordata** Class 1 Larvacea eg. *Oikopleura* Class 2 Ascidiacea eg. *Ascidia* (mention retrogressive metamorphosis) Class 3 Thaliacea eg. *Doliolum, Salpa*	2	2,6
1.4	**Sub Phylum: Cephalochordata** eg. *Amphioxus* (structure and affinities)	1	2,6
1.5	**Sub phylum: Vertebrata :** General characters and classification	1	2,6
1.6	Division 1 Agnatha Class 1 Ostracodermi eg. *Cephalaspis* Class 2 Cyclostomata eg. *Petromyzon, Myxine* Division 2 Gnathostomata	1	2,6
2.0	**Super class Pisces**	**10**	**2,3,6**
2.1	General Characters and Classification	1	2,6
2.2	Class Chondrichthyes and Class Osteichthyes: General characters	1	2,6
2.3	Sub class Elasmobranchii eg. *Scoliodon, Narcine* Sub class Holocephali eg. *Chimaera*	1	2,6
2.4	Sub class Choanichthyes Order1.Crossopterigii eg. *Latimeria* (Evolutionary significance) Order2.Dipnoi eg. *Lepidosire*n- Distribution, affinities and systematic position of lungfishes	1	2,6
2.5	Sub class Actinopterygii Super order 1.Chondrostei eg. *Acipencer* Super order 2. Holostei eg. *Amia* Super order 3. Teleostei eg. *Sardinella, Mugil, Cybium*	2	2,6
2.6	Accessory respiratory organs in fishes	1	3
2.7	Parental care in fishes	1	3
2.8	Scales in fishes and Migration in fishes	2	3
3.0	**Super class Tetrapoda –Amphibia, Reptilia, Aves and Mammalia**	**20**	**2,3,4, 5,6**
3.1	General characters, classification upto orders	1	2,6

3.2	**Class Amphibia** Type study: Frog (*Euphlyctis hexadactylus*)	8	4
3.3	Order 1.Anura eg. *Hyla,Bufo* Order 2.Urodela eg. *Amblystoma* (mention axolotl larva and Paedomorphosis/neotony) Order 3.Apoda eg. *Ichthyophis*	2	2,6
3.4	**Class Reptilia** Basis of classification, salient features	1	2,6
3.5	Sub class 1. Anapsida Order Chelonia eg. *Chelone, Testudenidae* (Tortoise) Sub class 2.Parapsida eg. *Ichthyosaurus* Sub class 3. Diapsida Order 1 Rhynchocephalia eg. *Sphenodon*(affinities) Order 2 Squamata eg. *Chamaleon,Naja* Order 3 Crocodilia eg. *Crocodylus,* Sub class 4: Synapsida eg. *Cynognathus*	2	2,6
3.6	Identification of venomous snakes of Kerala	1	5
3.7	**Class Aves** General characters, mention origin of birds	1	2,6
3.8	Sub classI: Archeornithes eg. *Archaeopteryx*(Affinities) Sub class II: Neornithes Super order I: Palaeognatha eg. *Struthio,* Emu, Kiwi Super order II: Neognathe eg. Brahminykite,*Columba, Pavo, Eudynamus*	2	2,6
3.9	Migrations in birds	1	3
3.10	Flight adaptations in birds	1	3
4.0	**Class Mammalia**	**17**	**2,3,4, 5,6**
4.1	Type study: Rabbit (*Oryctolagus cuniculus*)	6	4
4.2	General characters and classification up to order with example (mention any five salient features of each order)	1	2,6
4.3	Sub class I:Prototheria eg. Echidna,*Ornithorhynchus* Sub classII:Metatheria eg. *Macropus*	1	2,6
4.4	Sub class III: Eutheria Order1. Insectivora eg. *Talpa* Order2.Dermoptera eg. *Galeopithecus* Order 3.Chiroptera eg. *Pteropus* Order4.Primates eg. *Loris* Order5.Carnivora eg. *Panthera* Order6.Edentata eg. *Armadillo* Order7.Pholidota eg. *Manis* Order 8.Proboscidea eg. *Elephas* Order 9.Hydracoidea eg. *Procavia* Order10.Sirenia eg. *Dugong* Order 11.Perissodactyla eg. *Rhinoceros* Order12.Artiodactyla	6	2,6

	Order 13.Lagomorpha eg. *Camelus* (mention ruminant stomach) Order 14.Rodentia eg.*Oryctolagus* Order 15.Tubulidentata eg.*Hystrix* (Porcupine) Order 16.Cetacea eg.*Orycteropus* eg.*Delphinus*		
4.5	Dentition in mammals	1	3
4.6	Aquatic mammals and their adaptations.	1	3
4.7	Indigenous cattle breed of Kerala and their advantages over exotic varieties with special emphasis to Vechoor cow (briefly mention the other breeds -Kasargod, Vilwadri, Periyar cow and Vadakara cow)	1	5

Text Books for Reference

1. Ekambaranatha Ayyer (2000).A Manual of Zoology Vol. II .S. Viswanathan and Co. 37
2. Nigam H. C (1983). Zoology of Chordates, Vishal Publications, Jalandhar
3. Parker , Haswell (2004).Text Book of Zoology, Vol II (Chordata), A.Z.T,B.S. Publishers and Distributors, New Delhi
4. Joy P.J, George Abraham K,Aloysius M. Sebastian (1998). Animal Diversity. Zoological Society of Kerala, Kottayam
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1. Ashok Captain,Romulus Whitaker (2008). Snakes of India- The field Guide. Draco Books.
2. Charpurey K. G (2008). The Snakes of India. Fabri Press
3. Daniel J.C (2002). The book of Indian reptiles and Amphibians First edition. Oxford University Press.
4. Daniel J C. (2005). Amphibians of Peninsular India, First edition, University Press.
5. Dinesan Cheruvat et al., (2006) Handbook of Mammals of Kerala, ZSI.
6. Jayson E A (1996). Rare and endangered mammals of Kerala, KFRI
7. Jhingran V. G (1982). Fish and Fisheries of India, Hindustan Publishing Corporation, New Delhi.
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QR Codes for Chordate examples

Amphioxus	Petromyzon	Ascidia	Latimeria	*Salpa*
Doliolum	*Oikopleura*	Acipensor	Lepidosiren	Myxine
Amia	Cephalaspis	Chimaera	Narcine	Mugil
General topics in fishes	Neoteny in Salamander	Archaeopteryx		

Course	Details				
Code	ZY 1813603				
Title	**ANIMAL DIVERSITY- CHORDATA (P)**				
Degree	B. Sc				
Branch(s)	Zoology				
Year/Semester	II / III				
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	Identify the local chordate diversity through collection, observation and identification	U	5
2	Examine the anatomy, morphology and osteology of vertebrates	An	5
3	Apply taxonomic keys in classification of vertebrates	Ap	5
4	Determine the bird diversity of a local habitat	U	5
*PSO-Program Specific outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.			

Exp No	Course Description	Hrs	CO. No.
1	Make scientific drawing of 5 locally available vertebrate specimens belonging to different classes	3	1
2	(i). Frog: a). virtual dissection, b). dissected and preserved specimen of the following: Viscera, Digestive system, Arterial system, Cranial nerves (5^{th} , 7^{th}, 9^{th},$10^{th}$and spinal nerves), Sciatic plexus, Brain	2	2
3	(ii) Dissection of digestive system (any teleost fish) (major) (iii) Digestive system of calotes, pigeon and rat (dissected and preserved specimen)	2	2
4	Mounting of placoid, cycloid and ctenoidscales of fishes (minor)	2	2
5	Frog vertebrae - typical, atlas, 8th and 9^{th} Rabbit vertebrae – atlas, axis and typical vertebra	1	2
6	Pectoral and pelvic girdles of frog and rabbit Bird - keel and synsacrum Turtle/Tortoise - plastron and carapace	1	2
7	*Amphioxus* T. S. through pharynx and T.S. through intestine	1	2
8	Identify, classify and describe the following animals by their generic names and 30% of them by their scientific names.	1	1
9	Identification of fishes up to the level of order	2	3
10	Identification of snakes up to family	2	3
11	Report of bird watching programme/report on local birds and photo album of local chordates	4	4

SEMESTER IV

Course Code	Title of the Course	Course Category	Hours/ week	Credits
EN 1814507	Illuminations	Common I - English 6	5	4
	Additional Language	Common Course	5	4
HN1814506	Drama and Long Poem	Common II- Hindi 4		
ML1814508	*Malayala Gadyarachanakal*	Common II- Malayalam 4		
SC1814506	Poetry, Grammar & Syriac Heritage in India	Common II- Syriac 4		
ZY1814104	Research Methodology, Biophysics and Biostatistics	Core 4	3	3
ZY1814604	Research Methodology, Biophysics and Biostatistics (P)	Core Practical 4	2	1
CH1814204	Advanced Bio organic chemistry	Complementary Chemistry 4	3	3
CH1814704	Organic Analysis	Complementary practical 4	2	1
BY 1814204	Anatomy and Applied Botany	Complementary Botany 4	3	3
BY 1814704	Anatomy and Applied Botany (P)	Complementary Botany 4 practical	2	1
		Total	**25**	**20**

Course	Details				
Code	ZY1814104				
Title	**RESEARCH METHODOLOGY, BIOPHYSICS AND BIOSTATISTICS**				
Degree	B.Sc				
Branch(s)	Zoology				
Year/Semester	II / IV				
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	Carry out research work and research documentation	Ap	**3**
2	Apply suitable statistical methods to research studies	Ap	**3**
3	Understand the use microscopes as well as modern laboratory instruments	U	3
4	Describe the process of collection and preservations techniques	U	3
5	Recognize the ethical aspects as well as laws relevant in India to protect animals	U	3
6	Create basic idea about the statistical approach in biology	C	3

*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	**RESEARCH METHODOLOGY**	**13**	
1.1	Basic concepts of research: Meaning, objectives, approaches, types of research	1	1
1.2	Research Process: Scientific method in research (eight steps).	1	1
1.3	Importance of literature reviewing in defining a problem, identifying gap areas from literature review	1	1
1.4	Sources of Information: Primary and secondary sources.	1	1
1.5	Library- books, journals, periodicals, reviews, internet.	1	1
1.6	Search engines: Online libraries, e-Books, e-Encyclopedia, institutional websites.	1	1
1.7	Plagiarism	1	1
1.8	Communication and Documentation --Research Communication and scientific documentation: Project proposal writing, research report writing	2	2
1.9	Research Communication and scientific documentation: structure of a scientific paper, thesis, dissertation, research article.	2	1, 2
1.10	Presentation techniques: Oral presentation, debate	1	1
1.11	Presentation techniques: assignment, seminar, workshop, colloquium, conference	1	1
2.0	**ANIMAL COLLECTION TOOLS AND TECHNIQUES**	**11**	
2.1	Sampling techniques: Quadrat, line transect	2	4
2.2	Measurements: Density abundance, Frequency	2	4
2.3	Biodiversity indices-concepts, Simpson index, Shannon-Wiener index	2	4
2.4	Collection methods, techniques and equipment- Plankton, insects	2	4

2.5	Collection methods, techniques and equipment- fish, bird	1	4
2.6	Preservation techniques – Dry and wet preservation	1	4
2.7	Laboratory rearing techniques of experimental animals	1	4
3.0	**BIOPHYSICS**	**15**	
3.1	Units of measurements Units, SI system, equivalent weight, normality, molarity	1	1
3.2	Microscopy(principle and uses) : light microscopy	1	3
3.3	Bright field (compound microscope),	1	3
3.4	Microscopy(principle and uses) : phase contrast	1	3
3.5	Darkfield microscopy	1	3
3.6	Fluorescence, polarization microscopy, videomicroscopy.	1	3
3.7	Electron microscopy- SEM, TEM andSTEM	1	3
3.8	Micrometry – stage and eyepiece micrometers, camera lucida	1	3
3.9	Separation Techniques: Centrifuge	1	3
3.10	Separation Techniques: chromatography (Paper, Thin layer and HPLC-brief account only)	1	3
3.11	Separation Techniques: electrophoresis (Agarose Gel and SDS-PAGE)	2	3
3.12	Analytical techniques: pH meter, colorimeter	1	3
3.13	Analytical techniques: spectrophotometer, X-ray crystallography	2	3
4.0	**BIOETHICS**	**5**	
4.1	Bioethics: Introduction, 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 (Refined- to minimize suffering, Reduced – to minimize animals, Replaced – modern tools and alternate means)	1	5
4.3	Animal use in research and education	1	5
4.4	Laboratory animal use, care and welfare, animal protection initiatives- animal welfare board of India, CPCSEA, ethical commitment.	1	5

4.5	Working with human: consent, harm, risk and benefits.	1	5
5.0	**BIOSTATISTICS**	**10**	
5.1	Sample and sampling techniques: Collection of data, classification of data, frequency distribution tables	2	6
5.2	Graphical representation: - Bar diagrams, histogram, pie diagram and frequency curves - ogives.	1	6
5.3	Measures of Central Tendency: Mean, median, mode (problem - direct method only)	2	6
5.4	Measures of dispersion: Range, quartile deviation, mean deviation	1	6
5.5	Standard deviation (merits and demerits and problems on SD), standard error.	1	6
5.6	Correlation: definition, types of correlation (mention in brief).	1	6
5.7	Test of Hypothesis and Test of Significance: Basic concept, procedure for testing hypothesis	1	6
5.8	Types of hypothesis- Null hypothesis and alternate hypothesis, Errors in hypothesis testing, levels of significance (Mention in brief).	1	6

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Course	Details				
Code	ZY1814604				
Title	**RESEARCH METHODOLOGY, BIOPHYSICS AND BIOSTATISTICS (P)**				
Degree	B. Sc				
Branch(s)	Zoology				
Year/Semester	II / IV				
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	Apply suitable statistical methods to research studies	Ap	5
2	Execute sampling, collection and preservation techniques	Ap	5
3	Use of microscope and scientific instruments	Ap	5
4	Compute statistical problems using computer and graphical means	Ap	5
5	Apply the units of measurements in chemical preparation	Ap	5

*PSO-Program Specific outcome; CO-Course Outcome;

Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

Exp No	Course Description	Hrs	CO. No.
	RESEARCH METHODOLOGY	**13**	
1	**Sampling and measurements** 1. Quadrat method 2. Line transect method 3. Simpsonindex 4. Shannon –Wiener index	8	1&2
2	**Collection and Preservation** 1. Plankton collection 2. Insect collection and preservation	5	1&2
	BIOPHYSICS	**10**	
1	Microscopes and handling	2	3
2	Micrometry –calibration and measurement of microscopic objects	2	3
3	Camera lucida drawings	2	3
4	Instrumentation: pH meter, colorimeter/ spectrophotometer, centrifuge (demonstration) - principle, working and application	2	3
5	Preparation of two solutions of varying normality and molarity	2	5
	BIOSTATISTICS	**13**	
1	MS Excel: To create mean and median, correlation using any biological data, construction of bar diagram, pie diagram and line graphs.	4	4
2	MS Access: To create grade ofstudents	1	4
3	Measure the size of given leaves /any sample of data and calculate the mean, median and mode	2	4
4	Determine the range and standard deviation for a biologicaldata	1	4
5	Graphical representation of data and interpretation (manual using graph paper). Construction of bar diagrams, histograms, pie diagram and line graphs.	2	4
6	Measure the size of given shells /any sample of data and represent it in a graphical form and interpret it	1	4
7	Census of the avian fauna/any fauna of an area and present the data in a suitable graphical form	2	4

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SEMESTER V

Course Code	Title of the Course	Course Category	Hours /week	Total hours	Credits
ZY1815105	Environmental Biology and Human Rights	Core 5	3	54	3
ZY1815605	Environmental Biology and Human Rights (P)	Core Practical 5	2	36	1
ZY1815106	Cell Biology and Genetics	Core 6	3	54	3
ZY1815606	Cell Biology and Genetics	Core Practical 6	2	36	1
ZY1815107	Evolution, Ethology and Zoogeography	Core 7	3	54	3
ZY1815607	Evolution, Ethology and Zoogeography	Core Practical 7	2	36	1
ZY1815108	Human Physiology, Biochemistry	Core 8	3	54	3
ZY1815608	Human Physiology, Biochemistry	Core Practical 8	2	36	1
ZY1815401	Vocational Zoology (Apiculture, Vermiculture, Ornamental fish cultures)	Open Course	4	72	3
ZY1816801	Project Work (Credit 2 will be given in 6th semester with investigatory project)	Project	1	18	
		Total	**25**	**450**	**19**

Course	Details				
Code	ZY1815105				
Title	**ENVIRONMENTAL BIOLOGY AND HUMAN RIGHTS**				
Degree	BSc				
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	Identify various types of natural resources, human impact on these resources, and common resource management practices	R	2
2	Develop skills and a commitment to act independently and collectively to sustain and enrich the environment.	U	2
3	Understand the multidisciplinary nature, important theories and concepts of environmental science, ecosystems, natural resources and conservation	U	2
4	Describe environmental hazards and risks and the social and economic ramifications	E	2
5	Familiarize with the major environmental problems its causes and potential solutions	U	2
6	Identify issues and problems relating to the human rights.	U	2
7	Analyse country's situation or international situation in terms of human rights.	An	2
8	Create awareness on various environmental acts in India	C	2

*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	**Module I**	**18**	1,3
1.1	**Multidisciplinary nature of environmental studies** Definition, scope and importance. Need for public awareness	2	3
1.2	**Natural Resources and associate problems -** Introduction, renewable and non-renewable resources	1	1,3
1.2.1	**Forest resources**: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.	1	1
1.2.2	**Water resources:** Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.	1	1
1.2.3	**Mineral resources:** Use and exploitation, environmental effects of extracting and using mineral resources, case studies.	2	1
1.2.4	**Food resources:** World food problems, changes caused by agriculture and over grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.	2	1
1.2.5	**Energy resources:** Growing energy needs, use of alternate energy sources, case studies.	1	1
1.2.6	**Land resources:** Land as a resource, land degradation, man induced landslides, soil erosion and desertification	1	1
1.2.7	Role of individual in conservation of natural resources. Equitable use of resources for sustainable life styles	1	2
1.3	**Ecosystems** - Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem	1	3
1.3.1	Food chains, food webs and ecological pyramids. Ecological succession, climax community	1	3
1.3.2	Introduction, types, characteristic features, structure and function of the given ecosystem- Forest ecosystem, grassland, desert	1	3
1.3.3	Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries.	1	3
1.3.4	Concept of limiting factors- Liebig's and Shelford's laws of limiting factors. Biogeochemical cycles- concept.	1	3
1.3.5	Gaseous and sedimentary cycles, carbon cycle, nitrogen cycle	1	3
2.0	**Module 2**	**26**	1,3,4
2.1.1	**Biodiversity and its conservation-** Introduction to biodiversity: Types of biodiversity- Alpha, beta and gamma diversity. Concept and importance of biodiversity.	1	3

2.12	Biogeograhical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values	1	4
2.13	Biodiversity at global and local levels, India as a mega-diversity nation	1	3
2.14	Wild life conservation in India- sanctuary, national parks, biosphere reserve, core zone, buffer zone, corridor concept (brief account only)	1	3
2.15	Hot-spots of biodiversity, conservation of biodiversity: In situ and Ex situ conservation of biodiversity	1	1,3
2.16	Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India.	1	5
2.17	IUCN categories: extinct, extinct in the wild, critically endangered, endangered, vulnerable, near threatened, least concern and data deficient, Red and Green data books (brief account only)	1	1,3
2.18	Conservation of indigenous cattle breeds of India (any 4)	1	1
2.2.1	**Pollution and social issues:** Introduction and types of pollution	1	4,5
2.2.2	Causes, effects and control measures of: - Air pollution**,** Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Municipal solid waste and household waste	3	4,5
2.2.3	Pollution case studies (Local and National). Role of an individual in prevention of pollution.	2	4,5
2.2.4	Disaster management: floods, earthquake, cyclone and landslides.	2	4,5
2.2.5	Environmental ethics: Consumerism, sustainable development	1	2
2.2.6	Water conservation, rain water harvesting, watershed management: its problems and concerns. Ramsar sites in Kerala	2	5,2
2.2.7	Climate change, global warming	1	5
2.2.8	Acid rain, ozone layer depletion	1	5
2.2.9	Environment Protection Act (1986) Air (Prevention and Control of Pollution) Act (1981)	2	8
2.2.10	Water (Prevention and control of Pollution) Act (1974), Wildlife Protection Act (1972).	1	8
2.2.11	Forest Conservation Act (1980). Issues involved in enforcement of environmental legislation. Biodiversity Act (2002)	2	8
3.0	**Module 3**	**4**	3
4.1	**Animal interactions-** Positive- Commensalism, mutualism, proto-cooperation, Negative- predation, parasitism, competition, antibiosis.	1	3
3.2	**Characteristics of a community** -Species diversity- richness, eveness, stratification, dominance	1	3
3.3	Ecological indicators, ecotone and edge effect, keystone species, Concepts of ecological niche and guild	1	3

3.4	**Concept of population:** Population attributes- Population growth forms, Basic concepts of growth rates, density, natality, mortality, growth curves (brief account only).	1	3
4.0	**Human Rights**	**6**	6,7
4.1	An introduction to human rights, meaning, concept and development.	1	7
4.2	Three Generations of human rights (civil and political rights; economic, social and cultural rights).	1	7
4.3	Human Rights and United Nations Contributions, main human rights related organizations- UNESCO, UNICEF, WHO, ILO	1	7
4.4	Mechanisms for checking violations of Human rights, National human right commission	1	6,7
4.5	Human rights in India – fundamental rights and Indian constitution, rights for children and women, Euthanasia, scheduled castes, scheduled tribes, other backward castes and minorities	2	6,7

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Course	Details				
Code	ZY1815605				
Title	**ENVIRONMENTAL BIOLOGY AND HUMAN RIGHTS(P)**				
Degree	BSc				
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 parameters of soil and water	An	2 &5
2	Understand the current environmental issues	U	2
3	Classify the various ecosystems and animal interactions	Ap	2
4	Identify planktons and equipments used in ecology	R	2&5
5	Create love towards nature	C	2

*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	Estimation of dissolved Oxygen	**4**	1
2	Estimation of carbon dioxide	2	1
3	Estimation of potassium in soil / water using flame photometer	2	1
4	Estimation of soil organic carbon (demonstration)	2	1
5	Estimation of phosphate in soil/water using spectrophotometer (group activity)	2	1
6	Identification of marine and fresh water planktons	4	4
7	Counting of plankton using plankton counting chamber	2	4
8	Equipments - Secchi disc, Plankton net\	2	4
9	Study of sandy/rocky shore fauna (activity)	2	3
10	Study of animal association -one from each category	4	3
11	Construction of food chain and food web from the given specimen	2	3
12	Identify the pollution, pollutants and its harmful effect (photographs of accidental emission/factory/vehicle) (Any two)	1	2
13	Identify the environmental issues and measures of prevention (photographs)- ozone depletion, melting of glaciers, green house emissions, urban waste disposal	2	2
14	**Field study** and report of any one important areas of bio diversity (compulsory) : Field study report: Forest, sea shore, mangrove, wetland, bird sanctuary, wildlife sanctuary, sacred groves **Visit to a local area**: community Initiatives in watershed management: **Case study** – Meenachil- Meenanthara- Kodur River re-linking Programme (Kottayam district)	5	5

Course	Details				
Code	ZY1815106				
Title	**CELL BIOLOGY AND GENETICS**				
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	Understand the structure and function of cell and cell inclusions	U	**3**
2	Understand basic concepts in genetics	U	**3**
3	Identify the genetic disorders and take steps to prevent the same	U	**3**
4	Evaluate the significance of mutation	E	**3**
5	Create ideas about the application of genetics in human welfare	C	**3**

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	**CELL BIOLOGY**	**22**	
1.1	Introduction of cell and diversity of cells :History, cell theory,	1	1
1.2	Introduction of cell and diversity of cells: prokaryotes, eukaryotes, mycoplasmas, virus, virions and viroids, prions.	1	1
1.3	Cell membrane and permeability Molecular models of cell membrane (sandwich model, unit membrane model, fluid mosaic model).	1	1
1.4	Cell properties - permeability, transport (diffusion, osmosis, passive transport, active transport, bulk transport),	2	1
1.5	Cell coat and cell recognition	1	1
1.6	Cell communication: Basic principles of cell communications, cell signaling (in brief)	2	1
1.7	Cell communication: types of signaling, mention signaling molecules (neurotransmitters, hormones, growth factors, cytokines, vitamin A and D derivatives).	2	1
1.8	Cell division: Cell cycle - G1, S, G2 and M phases	1	1
1.9	Cell division: mitosis and meiosis .The difference between mitosis and meiosis.	1	1
1.10	Cell organelles: Structure and functions: Endoplasmic reticulum	1	1
1.11	Structure and functions: ribosomes(prokaryoticandeukaryotic)	1	1
1.12	Structure and functions:golgicomplex	1	1
1.13	Structure and functions:Lysosomes - polymorphism - GERL concept	1	1
1.14	Structure and functions:Mitochondria	2	1

1.15	Structure and functions:interphase nucleus, nuclear membrane, pore complex,nucleolus	1	1
1.16	Chromosomes: Structure and organization-heterochromatin, euchromatin, nucleosomes, polytene chromosomes-balbiani rings, endomitosis, lamp brush chromosomes.	3	1
2.0	**GENETICS**	**32**	
2.1	Mendelian genetics: Mendel's experiments-Monohybrid Cross, dihybrid cross	1	2
2.2	Mendel's laws, test cross, back cross and reciprocal cross	1	2
2.3	Chromosome theory of inheritance	1	2
2.4	Interaction of genes: Allelic: Incomplete dominance (Four O' Clock Plant), co-dominance (skin colour in cattle).	1	2
2.5	Interaction of genes: Lethal alleles: dominant lethal gene [creeper chicken] and recessive lethal gene [cystic fibrosis].	1	2
2.6	Interaction of genes: Non Allelic: Complementary (flower colour in sweet pea), supplementary (coat colour in mice), epistasis - dominant (plumage in poultry) and recessive (coat colour in mice).	2	2
2.7	Interaction of genes: Polygenes (skin colour inheritance in man), pleiotropism (vestigial wing gene in Drosophila).	1	2
2.8	Multiple alleles: ABO blood group system, Rh group and its inheritance.	1	2
2.9	Erythroblastosisfoetalis	1	2
2.10	Sex determination : Chromosome theory of sex determination (autosome and sex chromosomes)	1	2
2.11	Maleheterogamy and female heterogamy, (XX-XY, XX-XO, ZZ-ZW, ZZ-ZO).	1	2

2.12	Genic Balance theory of Bridges. Barr bodies, Lyon's hypothesis,	1	2
2.13	Gynandromorphism, sexmosaics, intersex (Drosophila)	1	2
2.14	Hormonal (free martin in calf) and environmental (Bonellia) influence on sex determination	1	2
2.15	Recombination and linkage:linkage and recombination of genes based on Morgan'swork in drosophila	1	2
2.16	Linked genes, linkage groups, chromosome theory of linkage,	1	2
2.17	Types of linkage- complete and incomplete.	1	2
2.18	Recombination, cross over value, chromosome mapping (in brief).	1	2
2.19	Sex linked inheritance : Characteristics of sex linked inheritance, X linked inheritance of man (Hemophilia), Y linked inheritance (holandric genes), incompletely sex linked genes or pseudoautosomal genes (bobbed bristles in Drosophila)	2	2
2.20	Sex limited genes (beard in man) and sex influenced genes (inheritance of baldness in man).	1	2
3.0	**HUMAN GENETICS**	**10**	
3.1	Mutation: Types of mutations - Somatic, germinal, spontaneous, induced, autosomal and allosomal	1	4
3.2	Mutation: Chromosomal mutations, structural and numerical changes.	1	4
3.3	Mutation: Gene mutations (addition, deletion and substitution).	1	4
3.4	Humangenetics Karyotyping, normal human chromosome complement, pedigree analysis, aneuploidy and non- disjunction	1	3
3.5	Autosomal abnormalities (Down syndrome, Cri-du chat syndrome)	1	3

3.6	Sex chromosomal abnormalities (Klinefelter syndrome, Turner syndrome).	1	3
3.7	Single gene disorder (brief mention), autosomal single gene disorder (sickle cell anaemia)	1	3
3.8	Inborn errors of metabolism such as phenylketonuria, alkaptonuria, albinism.	1	3
3.9	Multifactorial traits – polygenic disorder- cleft lip and cleftpalate.	1	3
3.10	Genetic counseling, eugenics and euthenics –brief account only	1	3

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3. BeckerW.M, Kleinsmith L.J, Hardin. J, Bertoni, G. P (2009).The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
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10. Hartl, L.D, E.W. Jones. (2009). Genetics: Analysis of Genes and Genomes (7th edn) Jones and Barlett Publishers Inc, USA.
11. James Darnell (1998) .Molecular Biology. Scientific American Books Inc.John Wiley and Sons. Inc.
12. Karp .G (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition.
13. Klug W.S, CummingsM.R. (2011). Concepts of Genetics (7th edn). Pearson Education Inc. India.
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Course	Details				
Code	ZY1815606				
Title	**CELL BIOLOGY AND GENETICS (P)**				
Degree	BSc.				
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	Identify cell organelles, barr body, mitotic stages, blood cells and polytene chromosome	**R**	3
2	Conduct pedigree analysis, karyotyping	Ap	3
3	Prepare whole mounts, blood smear, squash preparation of root tip	Ap	3
4	Familiarise Mendelian genetics	Ap	3

*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	**CELL BIOLOGY**	18	
1.1	Squash preparation of onion root tip for mitoticstages	4	1
1.2	Squash preparation of polytene chromosome (Drosophila/Chironomous)-Demonstration	1	1, 4
13	Identification of cell organelles (models/photographs)	1	1
1.4	Preparation of temporary wholemount: epithelial cells (buccal smear), striated muscle fibers (cockroach), nerve cells (spinal cord)- (any 2)	4	3
1.5	Preparation of permanent whole mount(demonstration) - histological sections	2	3
1.6	Preparation of human blood smear and identification of leucocytes	4	4, 1
1.7	Photomicrography technique for the capture of images (demonstration)	1	1
2	**GENETICS**	18	
2.1`	Genetic problems on monohybrid, dihybrid crosses and blood group inheritance	4	4
2.2	Study of normal male and female human karyotype (use photographs)	2	2
	Preparation of karyo-idiogram from microphotographs		
2.3	Abnormal human karyotypes- Down, Edwards, Klinefelter and Turner syndrome(use photographs)	2	2
2.4	Sexing of Drosophila	4	4
2.5	Study of Barr body in human buccal epithelium	2	1
2.6	Pedigree Analysis chart	4	2

Course	Details				
Code	ZY1815107				
Title	**EVOUTION, ETHOLOGY AND ZOOGEOGRAPHY**				
Degree	BSc				
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	Understand the concept on the origin of life, theories on organic evolution and its evidences	U	3
2	Describe the concept of speciation, types and causes	U	3
3	Apply the principles of population genetics to study the progression of biological evolution	Ap	3
4	Understand the science of animal behavior and on the concept of learning	U	3
5	State the origin of continents, factors affecting animal distribution and zoogeographical realms	U	3
6	Create a mind set about application of population genetics and modern trends in evolutionary biology in establishing phylogeny studies	C	3

*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.
	EVOLUTION	**30**	
1.0	**Classical and modern approaches in evolution**	**17**	
1.1	**Originof life:** Theories- Panspermia theory or cosmozoic theory, Theory of spontaneous generation(abiogenesis or autogenesis), special creation, biogenesis, endosymbiosis.	2	1
1.2	Chemical evolution: Oparin and Haldane theory, Miller-Urey experiment	2	1
1.3	**Evidences of evolution:**Anatomical and morphological - homologous organs and analogous organs.	1	1
1.4	Paleontological evidence (fossils, kinds of fossils, fossil dating)	1	1
1.5	Embryological evidence (recapitulation theory of Haeckel)	1	1
1.6	Taxonomical evidence and biochemical evidence	1	1
1.7	**Theories of organic evolution** : Lamarckism and its criticism	1	1
1.8	Weismann's germplasm theory	1	1
1.9	Darwinism and itscriticism	1	1
1.10	Neo-Darwinism,	1	1
1.11	Theory of Hugo deVries	1	1
1.12	**Population genetics and evolution** : Gene frequency,gene pool, Hardy-Weinberg Equilibrium, factors that upset Hardy-Weinberg equilibrium	2	3
1.13	Effects of genetic drift on population: bottleneck effect and founder effect.	2	3
2.0	**NATURE OF EVOLUTION**	**13**	
2.1	**Speciation :** Species and speciation: Species concept, subdivisions of species (sub species, sibling species, cline and deme),	2	2
2.2	Speciation: types of speciation, phyletic speciation(autogenous and allogenous transformations), true speciation	2	2
2.3	Instantaneous and gradual speciation, allopatric and sympatric speciation	2	2
2.4	**Isolation:** Types of isolating mechanisms-Geographic isolation (mention examples) and reproductive isolation. Role of isolating mechanisms in evolution.	2	2
2.5	Microevolution, macroevolution (adaptive radiation-Darwin's finches)	1	2
2.6	Mega evolution, punctuated equilibrium	1	2
2.7	Geological time scale and mass extinction (brief accountonly).	1	2

2.8	Evolution of Horse	2	2
	ETHOLOGY	**14**	
3.0	**Behaviour and social organisation**	**14**	
3.1	**Introduction** : Definition, history and scope of ethology	1	4
3.2	**Learning, imprinting and behaviour :** Types of learning with examples; patterns of behaviour – types of rhythms	1	4
3.3	Navigation	1	4
3.4	Homing instinct	1	4
3.5	Hibernation	1	4
3.6	Aestivation	1	4
3.7	Pheromones- types and their effect on behaviour,	2	4
3.8	Hormones and their action on behaviour (aggressive and parental behaviour)	2	4
3.9	**Socialorganization** : Social organization in insects (ants) and mammals (monkey)	2	4
3.10	Courtship behaviour and reproductivestrategies	2	4
	ZOOGEOGRAPHY	**10**	
4.0	**Fundamentals of faunal distribution**	**10**	5
4.1	**General Topics**: Origin of continents- continental drift theory.	1	5
4.2	Types and means of animal distribution, factors affecting animal distribution.	2	5
4.3	Insular fauna – oceanic islands and continental islands	1	5
4.4	**Zoogeographical realms** (brief account with physical features and fauna)Palaearctic region, Nearctic region	1	5
4.5	Neotropical region, Ethiopian region	1	5
4.6	Oriental region, Australian region	1	5
4.7	Wallace's line,Weber's line,	1	5
4.8	Biogeography of India with special reference to WesternGhats	2	5

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2. Barnes C.W (1988). Earth, Time and Life. John Wiley andSons,NewYork
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5. Mani M.S (1974). Ecology and Biogeography of India; The Hague: W. Junk B.V. Publishers
6. Nair C.S (1991). The Southern Western Ghats: A Biodiversity Conservation Plan. INTACH, New Delhi.
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Course	Details				
Code	ZY1815607				
Title	**EVOLUTION, ETHOLOGY AND ZOOGEOGRAPHY (P)**				
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	Identify zoogeographical realms, endemic species, distribution patterns of animals in each realm and types of continents	U	5
2	Compare homologous, analogous and vestigial organs as well as adaptive radiation	U	5
3	Recall the route of HMS Beagle	U	5
4	Prepare cladogram, solve Hardy Weinberg equilibrium problems	Ap	5
5	Examine connecting links and variations in Drosophila	An	5
6	Identify stages of horse evolution and solve problems	U	5
7	Identify behavioural patterns and use of pheromones	U	5

*PSO-Program Specific outcome; CO-Course Outcome;

Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Exp No	Course Description	Hrs	CO. No
	Evolution	**20**	1
1	Identification of zoogeographical realms using world map	1	1
2	Study on endemic species of each realm	1	1
3	Show the discontinuous distribution (lung fishes, camel, elephant in a world map)	**1**	1
4	Trace the route of HMS Beagle in a World map.	1	3
5	In a world map mark the continental/oceanic islands (Greenland, Madagascar, New Zealand, New Guinea, Maldives, Iceland, Hawaii)	1	1
6	Preparation of cladogram using the specimens provided	4	4
7	Problems based on Hardy -Weinberg equilibrium	**4**	4
8	Identification of different stages of horse evolution	1	6
9	Homologous organs (limbs of 5 different groups of vertebrates).	1	2
10	Analogous organs (wings of bird, insect and bat)	1	2
11	Vestigial organs in humans- photographs(any four)	1	2
12	Adaptive radiation in beak of birds (picture/photograph)	1	2
13	Study on connecting links (*Peripatus*, Archaeopteryx, *Protopterus*, Echidna)	1	5
14	Study of variations in *Drosophila* (wing venation, body colour	1	5
	Ethology	16	
1	Pheromone traps	1	7
2	Skinner box and T Maze	2	7
3	Experiment to demonstrate phototaxis and chemotaxis using Drosophila/Earthworm	4	7
4	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)	8	7
5	Demonstration on the effect of alarm pheromones in ants	1	7

Course	Details				
Code	ZY1815108				
TITLE	**HUMAN PHYSIOLOGY AND BIOCHEMISTRY**				
Degree	BSc				
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	Understand the importance of Physiology and branches of it.	U	3
2	Create an awareness on life style diseases by applying the concept of nutrition	C	3, 5
3	Understand the various organ systems, functions, normal metabolite levels and diseases	U	3, 5
4	Understand the physiology of muscle contraction	U	3
5	Understand nerve physiology and diseases associated with its function	U	U
6	Describe the structure and classification of major bio molecules	R	5
7	Understand biochemical reaction involved in enzymes action	U	5
8	Discuss the metabolism of different types of biomolecules	U	5
10	Create a general appreciation about the functioning of the organ system	C	3

*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	**PHYSIOLOGY**	**37**	
	Nutrition	**4**	1, 2
1.1	Types of nutrition, Nutritional requirements – carbohydrates, proteins, lipids, minerals (Ca, P, Fe, I), vitamins (sources and deficiency disorders). Importance of dietary fibre and antioxidants	1	1,2
1.2	Balanced diet, Recommended Dietary Allowance (RDA), Malnutrition	1	2
1.3	Nutrition during pregnancy and lactation, Infant nutrition	1	2
1.4	Defects of modern food habits: Obesity, Anorexia, Acidity and ulcers, flatulence	1	2
	Digestion:	**3**	1, 3
1.5	Digestive glands (liver, pancreas, salivary, gastric and intestinal) and their secretions.	1	1, 3
1.6	Digestion and absorption of carbohydrates, proteins and fats. Normal metabolite levels in human blood	1	3
1.7	Nervous and hormonal control of digestion	1	3
	Respiration	**7**	1, 3
1.8	Respiration in animals: cutaneous, tracheal, branchial, and pulmonary.	1	3
1.9	Respiratory pigments: Haemoglobin, Myoglobin (Structure and functions). Phases of respiration (external respiration, gas transport and internal respiration).	1	3
1.10	Transport of respiratory gases : transport of oxygen- oxy-haemoglobin curve, Bohr effect, reverse Bohr effect and Haldane effect,	1	3
1.11	Transport of carbon dioxide - chloride shift.	1	3
1.12	Control of respiration. Respiratory disturbances (anoxia, hypoxia, hypocapnia, hypercapnia, Asphyxia, Apnoea, Dyspnoea, cyanosis).	1	3

1.13	Physiological effect of smoking, carbon monoxide poisoning,	1	3
1.14	Oxygen therapy and artificial respiration.	1	3
	Circulation	**8**	1, 3
1.15	Types of heart, cardiac cycle, Control and rhythmicity of beat, Pace makers	1	3
1.16	Pulse, blood pressure and disorders, neural and hormonal control.	1	3
1.17	Human blood and its constituents,haemopoesis.Buffering mechanism in blood	1	3
1.18	Haemostasis (blood coagulation) –intrinsic and extrinsic pathways, clotting factors.	1	3
1.19	Disorders of blood clotting, anticoagulants	1	3
1.20	Blood groups and transfusion.	1	3
1.21	Cardiovascular diseases - Jaundice, Arteriosclerosis and Atherosclerosis, Myocardial infarction, Thrombus, Stroke.	1	3
1.22	Clinical analysis - normal levels of blood constituents, ESR, ECG, Haematocrit, Angiogram and angioplasty.	1	3
	Excretion	**6**	1, 3
1.23	Patterns of nitrogen excretion in animals: ammonotelism, ureotelism, urecotelism.	1	1, 3
1.24	Structure of nephron, Urine formation – glomerular filtration, tubular reabsorption, tubular secretion.	1	3
1.25	Urine concentration – counter current mechanism. Acid – base balance, Composition of urine – normal and abnormal constituents.	1	3
1.26	Hormonal regulation of kidney function	1	3
1.27	Renal disorders (kidney stone, pyelonephritis, acute and chronic renal failure, and dialysis)	1	3
1.28	Homeostasis: Definition, concept and importance in biological system	1	3
2	**Muscle physiology**	**4**	1, 4

2.1	Types of muscles - Vertebrate skeletal muscle: Structure and function;	1	1, 4
2.2	Mechanism, biochemistry, and energetics of muscle contraction, whole muscle contraction, isotonic and isometric contraction, latent and refractory periods, summation, tetanus, tonus, staircase phenomenon, muscle fatigue, oxygen debt, rigor mortis.	2	4
2.3	Electrophysiology of muscle, threshold and spike potentials, simple muscle twitch, Kymograph,	1	4
2.4	**Nerve physiology**	**5**	1, 5
2.5	Types of neuron, ultrastructure of neuron.	1	1, 5
2.6	Nerve impulse production (resting membrane potential, action potential), transmission of impulse along the nerve fibre	1	5
2.7	Interneuron (synaptic) transmission, neuromuscular junction and transmission of impulses.	1	5
2.8	Neurotransmitters (acetyl choline, adrenalin, dopamine), EEG, Memory	1	5
2.9	Neural disorders (brief account on Schizophrenia, Parkinson's disease, Alzheimer's disease, Dyslexia, Autism and Epilepsy).	1	5
	BIOCHEMISTRY	**17**	
3.0	**Biomolecules**	**9**	6
3.1	**Structure and classification: Carbohydrates**: Basic structure, biological importance. Classification of monosaccharides, oligosaccharides, polysaccharides with examples.	2	6
3.2	**Proteins**: Basic structure and classification of amino acids; structure, biological importance and classification of proteins with examples.	2	6
3.3	**Lipids**: Structure of fatty acid, saturated and unsaturated fatty acid, biological importance and classification of lipids with examples.	1	6

3.4	**Vitamins and minerals**: Major fat soluble and water soluble vitamins. Important minerals and trace elements required for living organisms. Biological importance of vitamins and minerals.	2	6
3.5	**Enzymes**: Chemical nature of enzymes, enzyme activation, enzyme inhibition, allosteric enzymes, isoenzymes, co-enzymes. Michaelis–Menton enzyme kinetics.	2	7
4.0	**METABOLISM**	**8**	8
4.1	**Carbohydrate metabolism:** Glycogenesis, glycogenolysis, gluconeogenesis, Hexose monophosphate shunt	1	8
4.2	Glycolysis, citric acid cycle,	2	8
4.3	Electron transport chain and ATP synthesis.	1	8
4.4	**Protein metabolism:** Deamination, transamination, transmethylation, decarboxylation, Ornithine cycle.	2	8
4.5	**Lipid metabolism:** Biosynthesis of fatty acids, Beta oxidation, Physiologically important compounds synthesized from cholesterol.	2	8

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1. Albert L. Lehninger, Michael Cox , David L. Nelson(2004). Biochemistry. Lehninger.Palgrave – Macmillan.
2. Arthur C. Guyton, John E. Hall (2016). Text Book of Medical Physiology: Guyton, 13th edition; Elsevier
3. Awapara J (1968). Introduction to Biological chemistry. Prentice Hall. New Jersey
4. Bhagavan N. V (2007). Medical biochemistry, fourth edition Academic Press,
5. Boyer R (2004). Modern Experimental Biochemistry, 3e, Pearson Edn.
6. Chatterjee C.C (1997). Human Physiology. Medical and allied agency, Calcutta
7. Conn, E.E. *et al*., Outlines of Biochemistry, 5e (2001). John Wiley and Sons.
8. Kim E. Barrett (2012). Ganong's Review of Medical Physiology, 24th Edition (Lange Basic Science)
9. Geetha N (2014). Textbook of Medical Physiology. Paras Medical Publishers, 3rd edition
10. Guyton A.C, Hall, J.E (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia

PTE Ltd. /W.B. Saunders Company.
11. Jain A K (2016) Textbook of Physiology. Avichal Publishing Company
12. MathewsC.K. *et al*., Biochemistry, 3rded (2003). Pearson Edn. (Indian Edn.).
13. Prosser, Brown (1962). Comparative Animal Physiology, W. B. Saunders Co., West Washington Square, Philadelphia 5.
14. RastogiS. C (2007). Outlines of Biochemistry. CBSPublishers, New Delhi.
Robert K. Murray, Victor W. Rodwell (2012) Harper's Illustrated Biochemistry, Harper. 29th edition (Lange basic science)
15. Sarada Subramanyam, K. Madhavankutty (2014). Textbook of human physiology, S. Chand and Company Ltd.
16. Satyanarayana U, Chakrapani U (2013). Biochemistry Elsevier; 4thedition
17. Tortora G.J, Grabowski S (2006). Principles of Anatomy and Physiology. XI Edition John Wiley and sons

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1. Chatterjee C.C (1997). Human Physiology. Medical and allied agency, Calcutta.
2. Rastogi, S. C (2007) Outlines of Biochemistry. CBS Publishers, New Delhi
3. Schmidt-Nelson K (1970). Animal Physiology. WB Saunders Company
4. Satyanarayana U, Chakrapani U (2013). Biochemistry Elsevier; 4th edition
5. Jain A .K (2016). Textbook of Physiology. Avichal Publishing Company
6. Zoological society of Kerala study material (2002). Biochemistry, Physiology and Developmental Biology published by Zoological Society of Kerala
7. Thomas A P (Ed) (2012). Biochemistry, Human Physiology and Endocrinology. TIES, Green Leaf publications, Kottayam

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Course	Details				
Code	ZY1815608				
Title	**HUMAN PHYSIOLOGY AND BIOCHEMISTRY (P)**				
Degree	BSc				
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	Carry out experiments to find out the blood constituents	An	5
2	Identify medical instruments and disorders of different physiological systems	U	5
3	Analyze the biomolecules in the sample provided	An	5
4	Use chromatographic technique for separation of mixtures	Ap	5
5	Identify tissue using permanent slides	U	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.
1.0	Tissue identification using permanent slides- epithelial tissue, striated muscle, smooth muscle, cartilage and bone	2	5
2.0	Analysis of blood- Haemoglobin content, RBC and WBC count, Plasma corpuscle ratio using microhaematocrit,	10	1
2.1	Effect of hypertonic, hypotonic and isotonic solutions on diameter of RBC	2	2
2.2	Measurement of blood pressure using sphygmomanometer	1	2
3.0	Study of instruments- Kymograph and stethoscope	1	2
4.0	Identification of diseases using photographs- nutritional disorders, renal disorders, cardiac disorders and neural disorders	5	2
5.0	Qualitative analysis of protein, glucose, starch and lipids	10	3
6.0	Determination of Rf value of amino acids and identification of amino acids using Chromatography.	5	4

OPEN COURSE - CHOICE BASED

Course code	Course Name	Credit	Hrs/ Week	Semester	PSO
ZY1815401	Vocational Zoology (Apiculture, Vermiculture and Ornamental Fish Culture)	3	4	5	4

Course	Details				
Code	ZY1815401				
Title	**VOCATIONAL ZOOLOGY (APICULTURE, VERMICULTURE AND ORNAMENTAL FISH CULTURE)**				
Degree	B.Sc				
Branch(s)	Zoology				
Year/Semester	III / V				
Type	**Open Course**				
Credits	3	Hrs/Week	4	Total hours	72

CO No.	*Expected Course Outcomes* *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Design and manage an aquarium	C	4
2	Construct an ornamental fish culture unit for self employment	C	4
3	Construct and maintain quail farming practices for self-employment	C	4
4	Apply the concept of vermicomposting to undertake waste management measures	Ap	4
5	Monitor and maintain meliponini culture and or apiculture as hobby or as a source of additional income	Ap	4

*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	**AQUARIUM MANAGEMENT**	**12**	**1**
1.1	General introduction to Aquarium	1	1
1.2	Aims and types of aquarium (material, size and shape)	2	1
1.3	Requirements of an aquarium - filtration of waste, physical, chemical and biological	2	1
1.4	Setting an aquarium (self-sustainable with biological filters)	2	1
1.5	Major indigenous aquarium fishes of Kerala.	3	1
1.6	**Activity:** Setting up of a freshwater aquarium and rearing of aquarium fishes	2	1
2.0	**ORNAMENTAL FISH CULTURE**	**20**	**2**
2.1	Introduction to ornamental fishes	1	2
2.2	Present status of ornamental fish culture in India with special reference to Kerala	2	2
2.3	Breeding of Gold fish,fighter, gourami (Osphroneus), and guppy (live bearer).	3	2
2.4	Nutrition and types feed for aquarium fishes	2	2
2.5	Use of live fish feed organisms in ornamental fish culture	2	2
2.6	Methods and techniques involved in the formulation of fish feed	2	2
2.7	Fish transportation: Live fish packing and transport	1	2
2.8	Common diseases of aquarium fishes and their management	3	2
2.9	Establishment of commercial ornamental fish culture unit	2	2
2.10	Activity: field visit to an ornamental fish breeding center to understand breeding practices of various aquarium fishes	2	2

3.0	**QUAIL FARMING**	**10**	**3**
3.1	Introduction	1	3
3.2	Care of quail chicks	2	3
3.3	Care of adult quails	1	3
3.4	Care of breeding quails	1	3
3.5	Ration for quail	1	3
3.6	Care of hatching eggs	1	3
3.7	Health care	1	3
3.8	Use of quail egg and meat	1	3
3.9	Sources of quality chicks	1	3
4.0	**VERMICULTURE AND COMPOSTING**	12	4
4.1	Introduction, composting methods	1	4
4.2	Ecological classification of earth worms	1	4
4.3	Reproduction and life cycle	1	4
4.4	Species of earth worms used for vermiculture	2	4
4.5	Preparation of vermibed	1	4
4.6	Preparation of vermicompost,	1	4
4.7	Maintenance and management of vermicomposting unit	1	4
4.8	Harvesting. Preparation of vermiwash	1	4
4.9	Role of vermiculture in solid waste management.	1	4
4.10	**Activity**: - Preparation of a vermiculture unit or visit to a vermicomposting unit.	2	4
5.0	**APICULTURE**	**18**	5
5.1	Introduction,Species of bees cultured	1	5
5.2	Organization of honey bee colony	2	5
5.3	Adaptation of different castes of honey bee	2	5

5.4	Bee keeping methods (modern method only)	1	5
5.5	Bee keeping equipments	1	5
5.6	Management and maintenance of an apiary	1	5
5.7	Growth period, Dividing the colony, Uniting two colonies, replacing old queen with new queen	2	5
5.8	Honey flow period, dearth period, Bee pasturage	2	5
5.9	Major enemies of bees, Major Bee diseases	2	5
5.10	Uses of honey and wax	1	5
5.11	Apitherapy, propolis, royal jelly	1	5
5.12	Agencies supporting apiculture.	1	5
5.13	**Activity:** Identify different types of honey bees and rearing equipments	1	5

Text Books for Reference

1. Addison Webb (1947), Bee Keeping- for profit and pleasure, Museum Press, Agro Bios India Ltd.
2. Chauhan, H.V.S. and S. Roy, (2008). Fungal Diseases. In: Poultry Diseases, Diagnosis and Treatment, Chauhan, H.V.S. and S. Roy (Eds.). 3rd Ed., New Age International (P) Ltd., New Delhi
3. Cowey C. B. Mackie, A.M. and Bell, J. G (1985) Nutrition and feeding in fishes. Academy press.
4. David Alderton (2008). Encyclopedia of Aquarium and Pond fish. Published by Dorling Kindersley, DK Books.
5. Dey, V.K. (1997). A Hand Book on Aquafarming- Ornamental fishes. Manual. MPEDA Cochin.
6. Francicokumu (2015) Quails: About raising quails.
7. George Cust and and Peter Bird. (1978). Tropical Fresh water Aquaria, Published by Hamlyn London. Illustrated by George Thompson.

8. Harisankar J. Alappat and Bijukumar. A. (2011) Aquarium Fishes. B. R. Publ. Corporation, Delhi.
9. Herbert R. and Leonard P. Schultz Axelrod (1955) Handbook of Tropical Aquarium Fishes, McGraw-Hill.
10. Michael B. New; Alber G.J. Tacon (1994) Farm made aquafeeds. FAO fisheries technical paper No.343, Rome, FAO. 1994
11. NalinaSundari, M.S and Santhi, R (2006) Entomology. MJP Publishers
12. NPCS Board of Consultants and Engineers, Chennai (2015). The complete book on Bee keeping and honey processing, 2nd Edition, NIIR Project consultancy services, 106- E Kamala Nagar,NewDelhi
13. Ronald J Roberts (1978) Fish Pathology, Cassel Ltd. London.

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1. Addison Webb (1947), Bee Keeping- for profit and pleasure, Museum Press, Agro Bios India Ltd.
2. Alka Prakash (2011). Laboratory Manual of Entomology, New age International, New Delhi.
3. Arumugan N (2008). Aquaculture, Saras publication.
4. Biju Kumar A, Harishanker J and Alappat (1995). A Complete Guide To Aquarium Keeping. Published by Books For All, New Delhi.
5. Applied Zoology, Study Material Zoological Society of Kerala, CMS College Campus, Kottayam.
6. Vijayakumaran Nair, K, Manju, K.G. and Minimol, K. C.(2015) Applied Zoology, Academia press, Thiruvananthapuram
7. Vermicology: The Biology of Earthworms, (Ismail, S.A.) Orient Longman. 92pp. 1997

SEMESTER VI

Course Code	Title of the Course	Course Category	Hours /week	Total hours	Credits
ZY1815107	Developmental Biology and Endocrinology	Core 9	3	54	3
ZY1816609	Developmental Biology and Endocrinology (Practical)	Core 9 Practical	2	36	1
ZY1816110	Microbiology and Immunology	Core 10	3	54	3
ZY1816610	Microbiology and Immunology (Practical)	Core 10 Practical	2	36	1
ZY1816111	Biotechnology, Bioinformatics and Molecular biology	Core 11	3	54	3
ZY1816611	Biotechnology, Bioinformatics and Molecular Biology (Practical)	Core Practical 11	2	36	1
ZY1816112	Occupational Zoology (Aquaculture, Apiculture, Vermiculture and Quail farming)	Core 12	3	54	3
ZY1816612	Occupational Zoology(Aquaculture, Apiculture, Vermiculture and Quail farming) (Practical)	Core Practical 12	2	36	1
ZY1816301	Elective: Agricultural Pest Management	Choice based Core Elective Courses	4	72	3
ZY1816801	Project & Industrial Visit	Project	1	18	2
		Total	**25**	**450**	**21**

Course	Details				
Code	ZY1815107				
Title	**DEVELOPMENTAL BIOLOGY AND ENDOCRINOLOGY**				
Degree	B.Sc.				
Branch(s)	Zoology				
Year/Semester	III / VI				
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	To understand the basic concepts and theories related to developmental biology	U	3
2	Understand reproductive organs, gametogenesis and fertilization	U	3
3	Illustrate cleavage, blastulation and gastrulation	R	3
4	Differentiate the embryology of chick, frog and humans	An	3
5	State the techniques on experimental embryology, prenatal diagnostic procedures and different types of placentation in mammals	Ap	5
6	Describe the organisation and structure of the endocrine systems and their relation to other organ systems	U	5
7	Understanding the phenomenon of regeneration in animals	U	3
8	Create awareness on the impact of teratogens.	C	3
9	Understand the concept of cell differentiation and gene action in development	U	3

*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	**REPRODUCTION**	**9**	1,2
1.1	**Introduction :** Definition, Scope of developmental biology, sub-divisions (descriptive, comparative, experimental and chemical)	1	1
1.2	Historical perspectives, basic concepts and theories.Reproductive health and importance of sex education.	1	1
1.3	**Gonads and Reproduction:** Gonads- anatomy of testis and ovary, spermatogenesis, oogenesis.	1	2
1.4	Structure of mammalian sperm and egg	1	2
1.5	**Egg types -** Classification of eggs based on the amount, distribution and position of yolk.	1	2
1.6	Mosaic and regulative, cleidoic and noncleidoic eggs.Polarity and symmetry of egg	1	2
1.7	**Fertilization:** Mechanism of fertilization encounter of spermatozoa and ova, approach of the spermatozoon to the egg, acrosome reaction and contact of sperm and ovum.	1	2
1.8	Activation of ovum, migration of pronuclei and amphimixis	1	2
1.9	Significance of fertilization, polyspermy, parthenogenesis- different types and significance	1	2
2.0	**PROCESS OF DEVELOPMENT**	**11**	3
2.1	**Cleavage:** Types of cleavage and planes of cleavage	1	3
2.2	Patterns of cleavage	1	3
2.3	Cell lineage of *Planaria*. Influence of yolk on cleavage.	1	3
2.4	**Blastulation -** Morula, blastula formation, types of blastula with examples.	1	3
2.5	Fate maps:Concept of fate maps, construction of fate maps (artificial and natural)	1	3

2.6	Structure of a typical chordate fate map. Significance of fate map.	1	3
2.7	**Gastrulation -** Major events in gastrulation. Morphogenetic cell movements.	1	3
2.8	Influence of yolk on gastrulation.Concept of germ layers and derivatives.	1	3
2.9	Cell differentiation and gene action, Potency of embryonic cells (totipotency, pleuripotency, unipotency of embryonic cells).	1	9
2.10	Determination and differentiation in embryonic development (brief mention)	1	9
2.11	Gene action during development with reference to Drosophila (mention maternal effect genes and zygotic genes).	1	9
3.0	**DEVELOPMENTAL STAGES**	**15**	4
3.1	**Embryology of Frog :** Gametes, fertilization, cleavage	1	4
3.2	Blastulation, fate map	1	4
3.3	Gastrulation, neurulation, notogenesis	1	4
3.4	Differentiation of mesoderm and endoderm, development of eye.	1	4
3.5	Metamorphosis of frog, hormonal and environmental control.	1	4
3.6	**Embryology of chick -** Structure of egg, fertilization, cleavage	1	4
3.7	Blastulation, fate map, gastrulation.	1	4
3.8	Development and role of primitive streak	1	4
3.9	Salient features of 18hour, 24 hour, 33 hour and 48 hour chick embryo.	1	4
3.10	Extra embryonic membranes in chick.	1	4
3.11	**Human development :** Fertilisation, cleavage, blastocyst	1	4
3.12	Implantation, placenta	1	4
3.13	Gestation, parturition and lactation.(Role of hormones)	1	4

3.14	Human intervention in reproduction, contraception and birth control.	1	4
3.15	Infertility, embryo transfer technology,*invitro* fertilization (test tube baby)	1	4
4.0	**TECHNIQUES AND FUNCTIONS**	**10**	5,7,8
4.1	Spemann's constriction experiments	1	5
4.2	Organizers and embryonic induction.	1	5
4.3	**Teratology / dysmorphology, developmental defects:**Teratogenesis, important teratogenic agents (radiations, chemicals and drugs, infectious diseases)	1	8
4.4	Genetic teratogenesis in human beings	1	8
4.5	**Developmental defects:** Prenatal death (miscarriage and still birth). Intrauterine growth retardation (IUGR).	1	8
4.6	Classification and functions of placenta in mammals.	1	5
4.7	Prenatal diagnosis -amniocentesis, chorionic villi sampling	1	5
4.8	Ultra sound scanning, foetoscopy	1	5
4.9	Maternal serum alpha-fetoprotein, maternal serum beta-HCG.	1	5
4.10	Regeneration in animals.	1	7
5.0	**ENDOCRINOLOGY**	**9**	6
5.1	Endocrine glands and hormones	1	6
5.2	Hormones – classification and mechanism of hormone action, Homeostasis and feedback mechanism.	2	6
5.3	Major endocrine glands (Histology is not included) their hormones, Normal hormone levels in man, functions and disorders (hypothalamus, pituitary gland, pineal gland, thyroid gland, parathyroid gland, islets of Langerhans, adrenal gland). GI hormones	3	6
5.4	Gonadal hormones and their functions. Female reproductive cycles (Estrous cycle, Menstrual cycle)	3	6

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3. Berril N.J, Kars G (1986). Developmental biology, Mc Graw Hills
4. Dutta (2007). Obstrestics , Church Livingston 17 Ed
5. Gilbert S. F (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA
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11. Pattern M B, Carlson B C (1974). Foundations of Embryology, TMH, New Delhi
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13. Barrington, E. J. W (1975). General and Comparative Endocrinology, Oxford, Clarendon Press.
14. Martin C.R (1985). Endocrine Physiology: Oxford University Press
15. Melmed, Shlomo, Williams, Robert Hardin (2011).Textbook of Endocrinology: Elsevier,12th edition

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6. Thomas A.P(Ed) (2012). Reproductive and Developmental Biology, TIES, Green Leaf publications.

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Course	Details				
Code	ZY1816609				
Title	**DEVELOPMENTAL BIOLOGY (P)**				
Degree	BSc				
Branch(s)	ZOOLOGY				
Year/Semester	III /VI				
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	Compare blastula and gastrula of chick and frog, and identify various stages of embryonic development in chick	An	5
2	Understand various prenatal diagnostic procedures and technological application in human development	U	5
3	Carry out dissection to understand the reproductive organs	Ap	5
4	Identify placenta found in animals	An	5
5	Visualization of blastoderm and cell migration during embryonic development	An	5
6	Examine the reproductive capacity of fish	Ap	5
7	Visualise the endocrine glands in brain and 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

Expt. No.	**Course Description**	**Hrs**	**CO. No.**
1	Frog, Chick: Blastula, Gastrula (slide/model)	2	1
2	Embryo transfer, cloning, amniocentesis (photographs/ diagrams)	3	2
3	Study of placenta- pig and man	2	4
4	18 hour, 24 hour, 33 hour and 48 hour chick embryo (slide)	4	1
5	Candling method.	2	5
6	Vital staining of chick embryo (demonstration).	4	5
7	Dissection- Male and female reproductive organs in cockroach	4	3
8	Calculate the fecundity of fish.	4	6
9	Calculate the gonado-somatic index of given fish.	4	6
10	Cockroach – Corpora cardiaca and Corpora allata (Demonstration)	4	7
11	Effect of adrenalin on heartbeat of Cockroach (Demonstration)	3	7

Course	Details				
Code	ZY1816110				
Title	**MICROBIOLOGY AND IMMUNOLOGY**				
Degree	Undergraduate				
Branch(s)	Zoology				
Year/Semester	III / VI				
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	Understand the history, classification and in microbiology	U	3
2	Recall the use of culture, staining and preservation techniques in microbiology	Ap	3
3	Describe the structure and reproduction of bacteria	U	3
4	Understand structure, types replication and culture techniques of viruses	U	3
5	Understand the diseases caused by microorganisms and their transmission	U	3
6	Identify and describe the types, organs, cells of immunity and immunological processes	U	3
7	Predict Antigen- antibody interactions and serological tests and describe Antigens and Immunoglobulins	C	3
8	Analyse the immune mechanisms behind autoimmunity, hypersensitivity, immunodeficiency and transplantation rejection	An	3
9	Understanding about vaccines and recent trends in immunization	U	3
10	Create a positive attutide towards maintaining the proper community health	C	3

*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	**MICROORGANISMS AND CULTURE**	**8**	**1,2**
1.1	Introduction History and scope of microbiology. Outline classification of Microbes. (bacteria, fungus and virus)	1	1
1.2	Methods in microbiology Sterilization and disinfection - physical and chemical methods.	2	2
1.3	Culture media – selective media, enrichment media, differential media	2	2
1.4	Plating techniques and isolation of pure colony.	1	2
1.5	Culture preservation techniques: refrigeration, deep freezing, freezing under liquid nitrogen, lyophilization.	2	2
2.0	**STRUCTURE AND REPRODUCTION**	**15**	**2,3,4**
2.1	Morphology and fine structure of bacteria Size, shape, cilia, pili, flagella	1	3
2.2	capsule, cell wall and its composition	1	3
2.3	Cytoplasmic membrane, protoplast, spheroplast, intracellular membrane systems,	2	3
2.4	cytoplasm, vacuoles, genetic material, cell inclusions, bacterial spores	2	3
2.5	Bacterial growth Curve	1	3
2.6	Staining techniques – gram staining.	1	2
2.7	Bacterial reproduction Sexual – conjugation, transduction	2	3
2.8	Asexual - budding, fragmentation.	1	3
2.9	Virology: Structure of virus	1	4
2.10	Human, animal, and bacterial virus	1	4
2.11	Viral replication	1	4
2.12	Cultivation of animal viruses.	1	4
3.0	**MICROBIAL INFECTIONS**	**9**	**5**
3.1	Infections and diseases	1	5

	Types of infections – primary, secondary and nosocomial infections (brief account only)		
3.2	Contagious diseases – epidemic, endemic and pandemic	2	5,10
3.3	Mode of Transmission – food, water, air, vectors and carriers.	2	5
3.4	Epidemiology, symptomology, diagnosis and treatment of Bacterial disease - *Clostridium tetani* (tetanus)	1	5
3.5	Epidemiology, symptomology, diagnosis and treatment of Viral – HIV virus (AIDS)	2	5
3.6	Epidemiology, symptomology, diagnosis and treatment of fungal –*Candida albicans*(candidiasis).	1	5
	IMMUNOLOGY	**22**	
4.0	**FUNDAMENTALS OF IMMUNOLOGY**	**11**	**6**
4.1	Introduction to immunology -Innate and acquired immunity	1	6
4.2	Passive (natural and artificial) and active immunity (natural and artificial)	1	6
4.3	Mechanisms of innate immunity - barriers, inflammation, phagocytosis	2	6
4.4	Lymphoid organs- Primary (Thymus, Bone marrow)	2	6
4.5	Lymphoid organs- secondary lymphoid organs (lymph nodes, spleen)	2	6
4.6	Lymphocytes: T and B cells, natural killer cells, memory cells, macrophages	2	6
4.7	MHC (brief account)	1	6
5.0	**IMMUNE RESPONSE**	**11**	**6,7,8,9**
5.1	Immune reactions Antigens -Types of antigens, haptens, adjuvants	1	7
5.2	Immunoglobulin structure, classes and functions of immunoglobulins, Monoclonal and polyclonal antibodies	2	7

5.3	Complement system, biological effects of complements – a brief study. Types of Immunity, humoral and cell mediated immunity	1	6
5.4	Antigen – antibody reactions, Precipitation test, Agglutination test, VDRL WIDAL, ELISA.	2	7
5.5	Auto immune diseases: Pernicious Anemia, Rheumatoid Arthritis. Immunodeficiency-AIDS	1	8
5.6	Hyper sensitivity- Type I (E.g. Anaphylaxis), Type II(Transfusion reaction) , Type III (Arthus reaction) and Type IV (Mantaux Test) (in brief)	1	8
5.7	Transplantation immunity – Graft rejection	1	8
5.8	Introduction, types of vaccines, current vaccines, recent trends in vaccine preparation.	2	9

Text Books for Reference

1. Ivan Roitt I (2002). Essentials of Immunology ELBS
2. Ananthanarayan R, Jayaram Paniker C K (2009). Text Book of Microbiology Orient Longman Private Ltd.
3. Sharma K (2005). Manual of Microbiology: Tools and Techniques, Ane books
4. Gladys Francis, Mini K.D (Editors) (2012). Microbiology, Zoological Society of Kerala, Kottayam.
5. Susan Panicker, George Abraham (Editors) (2008). Micro Biology and Immunology, Zoological Society of Kerala, Kottayam

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2. Darla J. Wise, Gordon R. Carter (2004). Immunology A Comprehensive Review. Iowa state University Press. A Blackwell science company,
3. Hans G. S. Legal General Microbiology, Seventh Ed. Cambridge Low Price Edn.
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5. Heritage J, E.G.V. Evaus, R.A. Killungten (2007). Introductory Microbiology Cambridge University Press

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7. Laning, M Prescott, John P Harley, Donald A Klein, (2008). Microbiology (7th edn.). Mc Grew Hill International , NJ, USA
8. Talaro, Park, Katheleee N, Talaro, Arthur (2002). Foundations of microbiology. Mc Grew Hill Higher Education NY,
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Course	Details				
Code	ZY1816610				
Title	**MICROBIOLOGY AND IMMUNOLOGY (P)**				
Degree	BSc				
Branch(s)	Zoology				
Year/Semester	III / VI				
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	Carry out microbial culture in sterilised conditions	Ap	5
2	Identify microorganisms using gram stain	An	5
3	Identify fungus using lactophenol cotton blue stain	U	5
4	Observe motility of bacteria and understand antibiotic sensitivity	U	5
5	Analyse the blood group of the sample provided	An	5
6	Understand the primary and secondary lymphoid organs	U	5

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

Exp No	Course Description	Hrs	CO. No.
1.0	Study of instruments- Autoclave, Hot air Oven, Bacteriological incubator, Laminar air flow	2	1
2.0	Preparation of media- Solid, Liquid	2	1
3.0	Culture methods- Streak plate technique, Lawn culture, Pour plate culture, Liquid culture	2	1
4.0	Study of microbes- Hanging drop method to demonstrate motility	5	4
4.1	Gram staining to demonstrate differential staining property	5	2
4.2	Antibiotic sensitivity test	2	4
4.3	Streak plating	5	1
5.0	Preparation of fungal smear	5	3
6.0	Determination of ABO blood groups and Rh factor	5	5
7.0	Study through photographs and illustrations- primary and secondary lymphoid organs	3	6

Course	Details				
Code	ZY1816111				
Title	**BIOTECHNOLOGY, BIOINFORMATICS AND MOLECULAR BIOLOGY**				
Degree	BSc.				
Branch(s)	Zoology				
Year/Semester	III / VI				
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	Demonstrate tools and techniques in biotechnology	U	**3, 6**
2	Understand animal cell culture methods, application and potential hazards of biotechnology	U	**3, 6**
3	Discuss the role of bio-fertilizers in enhancing the soil nutrients	An	**2, 6**
4	Explain the role of bioinformatics in academic and research fields	U	**6**
5	Show the importance of acquiring different databases using bioinformatics tools	Ap	**6**
6	Explain the nature of genetic material and gene concept	U	**3, 6**
7	Summarize gene expression and gene regulations	U	**3, 6**
8	Create an appreciation about the new developments in biotechnology	C	**3**
*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	**TOOLS AND TECHNIQUES**	**11**	
1.1	Brief History, Scope and Importance, Major biotechnology research centres in India	1	1
1.2	Enzymes (restriction endonucleases, ligases, linkers and adapters)	1	1
1.3	Vectors (plasmids, phage vectors, cosmids, artificial chromosomes), host cells	1	1
1.4	Basic steps and techniques in rDNA technology	1	1
1.5	Gene Libraries, construction of genomic library and cDNA Library	1	1
1.6	PCR technique and DNA amplification	1	1
1.7	Brief description of screening methods – probes, nucleic acid hybridization	1	1
1.8	In situ hybridization, fluorescence In situ hybridization (FISH), colony hybridization	1	1
1.9	Methods of transfer of desired gene into target cell	1	1
1.10	Blotting Techniques- Southern, Northern, Western blotting	1	1
1.11	DNA finger printing (DNA profiling) and its application, molecular markers – RFLP	1	1
2.0	**APPLICATIONS AND HAZARDS OF BIOTECHNOLOGY**	**9**	
2.1	Brief account on methods substrates of animal cell culture	1	2
2.2	Media and procedure of animal cell culture	1	2
2.3	Stem Cells, types potential use and ethical issue, organismal cloning- reproductive and therapeutic- brief account only	1	2,8

2.4	Applications in medicine(insulin, growth hormone, antibiotics, gene therapy)	1	2,8
2.5	Applications in :Agriculture(GM plants and biopesticides), environment (bioremediation using microorganism - oil spills, sewage waste)	1	2,8
2.6	Biofertilisers- (compost, microbes, cow products) and applications of fermentation technology- lactic acid, vitamins, food and beverages.	1	2,8
2.7	Applications in : Waste management (aerobic and anaerobic composting, EM solution) industry (Single Cell Protein)	1	3,8
2.8	Risks related to genetically modified organisms (GMO) and biologically active products, biological warfare and biopiracy.	1	3
2.9	Protection of biotechnological inventions. Intellectual property rights, patenting and patent protection	1	3
3.0	**BIOINFORMATICS**	**14**	
3.1	Definition, importance and role of bioinformatics in life sciences. Computational Biology	2	4, 5
3.2	Nucleotide sequence databases, NCBI-GENBANK,DDBJ,EMBL	3	4, 5
3.5	Protein databases - structure and sequence databases, PDB, SWISSPROT, UNIPROT	2	4, 5
3.8	Introduction to Sequences alignments, Local alignment and global alignment	1	4, 5
3.10	Pair wise alignment (BLAST and FASTA] and multiple sequence alignment.	2	4, 5
3.11	Human genome project.	1	4, 5
3.12	Basic concepts of drug discovery pipe line, Computer aided drug discovery and its applications.	1	4, 5
3.13	Phylogenetic tree construction and analysis.	1	4, 5
3.14	Molecular visualization software- RASMOL	1	4, 5

4.0	**MOLECULAR BIOLOGY**	**8**	
4.1	Discovery of DNA as genetic material – Griffith's transformation experiments.	1	6
4.2	Avery McCarty and Macleod, Hershey and Chase Experiment of Bacteriophage infection,	1	6
4.3	Prokaryotic genome, eukaryotic genome	1	6
4.4	Structure and types of DNA and RNA.	1	6
4.5	DNA replication.	1	6
4.6	Modern concept of gene (Cistron, muton, recon, viral genes).	1	6
4.7	Brief account of the following-- Split genes (introns and exons), junk genes, pseudogenes	1	6
4.8	Overlapping genes, transposons.	1	6
5.0	**GENE EXPRESSION**	**12**	
5.1	Central dogma reverse, one-gene-one enzyme hypothesis, one-gene-one polypeptide hypothesis	2	7
5.2	Characteristics of genetic code, contributions of HarGobind Khorana	1	7
5.3	Transcription of mRNA, Reverse transcription	1	7
5.4	Post transcriptional modifications	1	7
5.5	Translation, Post translational modifications	2	7
5.8	prokaryotic gene regulation (inducible and repressible systems)	1	7
5.9	Operon concept: Lac operon, Tryptophan operon	3	7
5.12	Brief account of eukaryotic gene regulation.	1	7

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1. Singh B.D. Biotechnology (2002). Kalyan Publishers NewDelhi.
2. Brown C.H, Campbell I, Priest F.G(1987). Introduction of Biotechnology (Blackwell scientific publishersOxford).
3. Colin Ratledge, Bijorn Kristiansen (2008). Basic Biotechnology 3rd Edn. Cambridge University.

4. Janarathanan S, Vincent S (2007). Practical Biotechnology, Method of Protocols. UniversityPress.
5. John E. Smith (2002). Biotechnology. Cambridge Low priced ed. (Third Ed)
6. Madigan, Martinko, Parker (2005). Biology of Microorganisms, Brock Eighth Edn. PrenticeHall.
7. Sudha Gangal (2007). Biotechnology Principles and Practice of Animal Tissue culture, UniversitiesPress.

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1. De Robertis, E.D.P, De Robertis (2006). Cell and Molecular Biology.VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
2. Gupta P. K (2002). Cell and Molecular Biology, (2ed), Rastogi Publications. Meerut
3. James Darnell (1998). Molecular Biology. Scientific American Books Inc.
4. Thomas AP (Ed) (2011). Cell and Molecular Biology, the Fundamentals. Green Leaf Publications, TIES, Kottayam
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URL

https://www.khanacademy.org/science/biology/biotech-dna-technology

Course	Details				
Code	ZY1816611				
Title	**BIOTECHNOLOGY, BIOINFORMATICS AND MOLECULAR BIOLOGY (P)**				
Degree	BSc.				
Branch(s)	Zoology				
Year/Semester	III / VI				
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	Use the techniques involved in biotechnology	U	6
2	Carry out preparation of biofertilizers and biopesticides	U	2
3	Familiarize the tools and techniques of bioinformatics	Ap	6
4	Understand the techniques involved in the extraction of bioactive products as well as analysis of compounds	An	2
5	Perform isolation of genetic material	U	3
*PSO-Program Specific outcome; CO-Course Outcome; **Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create**			

Expt.	Course Description	Hrs	CO. No.
1	**BIOTECHNOLOGY**	18	
1.1	Study of the principle and applications of the techniques(photographs)-Western blotting, southern blotting, northern blotting, PCR, DNA sequencing, DNA fingerprinting	2	1
1.2	ELISA – demonstration	2	1
13	Biopesticide preparation (any 2) (group activity)	4	2
1.4	Biofertizers - EM soltion, panchagavya, archae bacteria (any one) (group activity)	4	2
1.5	Soxhlet extraction method forextracting the bioactive products from medicinal plants (Ocimum, Nerium, Azadirecta) (any1) (demonstration)	2	4
1.6	Study of the activity of the extracted bioactive products (microbial inhibition zone)	2	1
1.7	Electrophoresis (SDS -PAGE and agarose gel) (demonstration only)	2	1
2	**BIOINFORMATICS**	10	
2.1`	Download/use print out/pictures of genome sequences of any 2 organisms. Identify and mention the characteristic features of both.	2	3
2.2	Sequence similarity search using BLAST (Demonstration only)	2	3
2.3	Download a protein sequence, identify it and comment on its amino acid composition	2	3
2.4	Download a macromolecule and visualize its structure using RASMOL.	4	3
3	**MOLECULAR BIOLOGY**	8	
3.1	Identify and comment on its molecular composition / structural orientation / functional significance (DNA, DNA replication, RNA differenttypes using models or diagrams)	4	5
3.2	Isolation of DNA from microorganism using DNA isolation kit (group activity)	4	5

Course	Details				
Code	ZY1816112				
Title	**OCCUPATIONAL ZOOLOGY**				
Degree	B.Sc				
Branch(s)	Zoology				
Year/Semester	III / VI				
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	Understand different species of culturable fishes, ornamental fishes, fish culture practices, management of fish culture, fish processing and preservation	U	4,5
2	Design and management of an aquarium	C	4,5
3	Construct an ornamental fish culture unit for self employment	Ap	4
4	Construct and maintain quail farming practices for self-employment	Ap	4
5	Apply the concept of vermicomposting to undertake waste management measures	Ap	4
6	Monitor and maintain meliponini culture and apiculture as hobby or as an additional income	Ap	4
7	Understand different honey bee species, bee products and earthworm species	U	4
8	Identify fish diseases, apiculture tools and equipments	R	4
9	Carry out qualitative test for honey adulteration	C	4
10	Produce fish seed by breeding ornamental fishes and Prepare artificial feed for fish culture	Ap	4,5

*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.
1.0	**APICULTURE**	**18**	**6,7,8,9**
1.1	Definition, Different species of honey bees	1	7
1.2	Organization of honey bee colony, Social life	1	6
1.3	Adaptation of honey bees, Communication among honey bees	2	6
1.4	Bee keeping methods,Bee keeping equipment and accessories	2	6
1.7	Management and maintenance of an apiary	1	6
1.8	Growth period, honey flow period and dearth period,	1	6
1.9	Division of the colony, uniting two colonies, replacing old queen with new queen,	1	6
1.10	Swarming management, monsoon management. Bee pasturage.	1	6
1.11	Enemies of bees. diseases of bees	1	6
1.12	Meliponini culture	1	6
1.13	Uses of honey bees, by-products of honey bees	1	7
1.14	Honey and wax composition.Royal jelly, propolis, apitherapy	1	7
1.15	Testing the quality of honey	1	9
1.16	Extraction of wax, uses of honey and wax	1	6
1.17	Agencies supporting apiculture	1	6
2.0	**VERMICULTURE**	**8**	**4,6**
2.1	Introduction, Role of earthworm in solid waste management, in agriculture, in medicine etc.	1	4
2.2	Morphology, reproduction and life cycle.	1	4
2.3	Classification- Ecological classification of earthworms.Species of earthworms used for vermiculture.	1	4,6
2.4	Change in soil properties by the influence of earthworms - physical, chemical and biological	1	4

2.5	Preparation of vermibed	1	4
2.6	Factors affecting the growth and multiplication of earthworm.	1	4
2.7	Maintenance, monitoring and waste addition, Vermiwash and its application.	1	4
2.8	Preparation of vermicompost, harvesting and packing.	1	4
3.0	**QUAIL FARMING**	**4**	**3**
3.1	Introduction	1	3
3.2	Care of quail chicks, care of adult quails, care of breeding quails, Ration for quail,	1	3
3.3	Care of hatching eggs, health care, Sources of quality chicks.	1	3
3.4	Use of quail egg and meat.	1	3
4.0	**AQUACULTURE**	**24**	**1,2,3 8,10**
4.1	Advantages and salient features of aquaculture	1	1
4.2	Types of aquaculture	1	1
4.3	Biotic and abiotic factors of water	1	1
4.4	Importance of algae in aquaculture	1	1
4.5	Common cultivable fishes of Kerala	1	1
4.6	Composite fish culture, integrated fish culture	1	1
4.7	Carp culture	1	1
4.8	Prawn culture	1	1
4.9	Mussel culture	1	1
4.11	Pearl culture	1	1
4.12	Fish processing and preservation.	2	1
4.13	Aquarium management - Setting up of an aquarium	1	2
4.14	Biological filter and aeration	1	2
4.15	Breeding of gold fish	1	10
4.16	Breeding of Gourami (Osphronemus)	1	10
4.17	Breeding of Fighter and Guppy (live bearers).	1	10
4.18	Nutrition and types of feed for aquarium fishes.	1	10

4.19	Establishment of commercial ornamental fish culture unit.	1	3
4.20	Fish Transportation - Live fish packing and transport.	1	1
4.21	Common fish diseases and management.	3	8
4.22	Aquaponics	1	1

Text Books for Reference

1. Addison Webb, Bee Keeping for profit and pleasure, Agrobios Ltd.
2. Amber Richards. 2014. Aquaponics at home.
3. Animal breeding and Rearing, Study Material Zoological Society of Kerala , CMS college Campus
4. Applied Zoology, Study Material Zoological Society of Kerala , CMS college Campus
5. Bone Packer. 2014. Aquaponic system
6. Chauhan, H.V.S. Poultry, Disease, diagnosis and treatment, Wiley eastern Ltd. New Delhi.
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19. Pradip V Jabde , Text book of applied zoology(2005)
20. Ronald j. Roberts (1978) Fish pathology, Cassel Ltd London.
21. Santhanam R, Sukumaran N, and Natarajan P (1990). A Manual of Freshwater Aquaculture.

22. Shukla G.S, and Updhyay V.B, Economic zoology. Rastogi Publ. Meerut.
23. Venkitaraman, P.R,1983, Text book of Economic zoology (Sudharsana Publ. Kochi)
24. Verreth J. Fish larval nutrition, Chapman and Hall Publ.

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1. Addison Webb (1947), Bee Keeping- for profit and pleasure, Museum Press, Agro Bios India Ltd.
2. Biju Kumar A, Harishanker J and Alappat (1995). A Complete Guide to Aquarium Keeping. Published by Books For All, New Delhi.
3. T.V.R Pillay (1979). Advances in Aquaculture
4. Applied Zoology, Study Material Zoological Society of Kerala, CMS College Campus, Kottayam.
5. Vermicology: The Biology of Earthworms, (Ismail, S.A.) Orient Longman. 92pp. 1997
6. Vijayakumaran Nair, K, Manju, K.G. and Minimol, K. C.(2015) Applied Zoology, Academia press, Thiruvananthapuram

Course	Details				
Code	ZY1816612				
Title	**OCCUPATIONAL ZOOLOGY (P)**				
Degree	B.Sc				
Branch(s)	Zoology				
Year/Semester	III / VI				
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	Identify the types of culturable fishes, bee species, ornamental fishes and earthworm species, mussel and Quail	Ap	4
2	Identify fish parasites, bee parasites, apiculture tools and equipment and by-products	Ap	4
3	Carry out qualitative test for honey adulteration and mountings	Ap	4
4	Prepare artificial feed for culture of aquarium fishes	Ap	4
5	Setting up a miniature vermicomposting unit, ornamental fish tank	C	4

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

Experiment No.	Course Description	Hrs	CO. No.
1.1	General identification, economic importance, morphology, scientific names and common names of the following	12	4
1.1.1.	Economic importance and morphology of culturable fishes (Catla, Rohu, Mrigal, Grass carp, Silver carp, Common carp, *Etroplussuratensis, Oreochromis /Tilapia, Mugilcephalus and Anabas testudineus*)	5	4
1.1.2.	Identification and morphology of ornamental fishes (gold fish, fighter, Gourami, Angel fish, Guppy	2	4
1.1.3.	Two species of earthworms used in vermiculture	1	4
1.1.4.	Four species of honey bees	2	4
1.1.5.	Economic importance and morphology of shell fishes (Any two species of prawn, two oysters: one rock oyster - *Crasostria* and pearl oyster – *Pinctadafucata*, one marine mussel and one freshwater mussel – *Lamellidensmarginalis*).	2	4
1.2	Setting up of ornamental fish tank (small aquarium) (group activity)	2	5
1.3	Castes of bees- identification	1	4
1.4	Principle and uses of - aquarium filters, aquarium aerator, aquarium plants, oven, pelletizer, screw Press, die plate	2	4
1.5	Identification and study of fish parasites and diseases (five numbers each)using slides/pictures	2	2
1.6	Bee keeping equipment and accessories: Bee box, smoker, honey extractor, queen Cage	2	2
1.7	Identification and study of bee diseases (4 numbers each) using slides/photographs	2	2
1.8	Bees wax, honey, vermicompost, quail egg, quail meat (uses)	2	2
1.9	Formulation of artificial feed for aquarium fishes – demonstration	3	4
2.0	Tests for determining the adulteration in honey.	2	3
2.1	Mounting - mouth parts of honeybee	2	3
2.2	Mounting - legs of honey bee	2	3
2.3	Preparation of a miniature vermibed using the materials provided	2	5

Course	Details				
Code	ZY1816301				
Title	**AGRICULTURAL PEST MANAGEMENT**				
Degree	Undergraduate				
Branch(s)	Zoology				
Year/Semester	VI				
Type	**Elective course**				
Credits	3	Hrs/Week	4	Total hours	72

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Understand historical perspectives of pest, factors contributing to pest outbreak	U	4
2	Outline about modern agricultural practices	U	4
3	Analyze the types of pests, their morphology, life cycle and nature of crop loss	An	4
4	Ranking of a pest relative to damage to specific crop	Ap	4
5	Explain the ecology, morphology and life history of agricultural pest	Ap	4
6	Understand and evaluate the interactions between pest and plants	U	4
7	Formulate different pest management techniques and types of insecticides used in controlling agricultural pest	C	4
8	Describe the integrated pest management practice and its significance	Ap	4
9	Identify major pests of paddy, coconut, fruits, vegetables and stored grain	Ap	4

*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	**AGRICULTURAL PESTS**	**5**	**1,2**
1.1	Pest and crop loss: Introduction, historical perspective- origin of pest, evolution of pest.	1	1
1.2	Causes of pest outbreak- biotic, abiotic and genetic factors	2	1
1.3	Modern agricultural practices and pest problem - high yielding varieties, monoculture, fertilizers, pesticides, irrigation, and cultural practices.	2	2
2.0	**PEST CATEGORIES**	**15**	**3,4,5**
2.1	Types of pests- insect pest- insect structure and function- external features (body parts), mouth parts of phytophagous insects, internal anatomy	3	3
2.2	Types of pests- insect pest- growth, development, reproduction, life cycle and metamorphosis; diapause. (one example each from ametabolous, hemimetabolous and holometabolous insect)	3	3
2.3	Types of insect pests-key pests, occasional pests, potential pests.	1	4
2.4	Types of pests- non-insect pest- General features Different types: rodents(mention the nature of crop loss by them)	1	3
2.5	Types of pests- non-insect pest :mites- main types of mites; plant injury caused by mite	2	3
2.6	Types of pests- non-insect pest: millipedes, centipedes, slugs and snails (mention the damage of invasive giant African snail).	1	3
2.7	Activity 1: Identify a minimum of 5 invasive species (plant / animal) in your locality and make a report on their ecological impact.	4	5
3.0	**INSECT PLANT INTERACTION**	**7**	**6**
3.1	Pest and plants: Plant feeding insects-plant host range, types of injury	2	6
3.2	Pest and plants: Relationship of pest injury and yield.	1	6
3.3	Host plant resistance: Characterization of resistance, mechanism of resistance (antixenosis, antibiosis, tolerance)	2	6
3.4	Host plant resistance: biophysical, biochemical and genetic bases of resistance.	2	6
4.0	**PEST CONTROL**	**20**	**7, 8**
4.1	Pest control-principles and practices: Types of control- Cultural control: Water management, tillage, sanitation, plant diversity, crop rotation, planting time, harvesting practices etc.	2	7
4.2	Biological control: Parasitoids and predators, control by insect pathogens.	2	7

	Techniques in biological control-conservation, introduction and augmentation.		
4.3	Biopesticides	2	7
4.4	Chemical control: Origin of chemical control, chemistry, mode of action and nomenclature (organochlorines, organophosphates, carbamates, synthetic pyrethroids, miscellaneous group) of pesticides	2	7
4.5	pesticide formulations and pesticide appliances (sprayers and dusters).	2	7
4.6	Brief mention of attractants, repellents, chemosterilants and pheromones	2	7
4.7	Miscellaneous control:Mechanical (hand picking, exclusion by screens and barriers, trapping, clipping, pruning etc.), physical (hot and cold treatment, moisture, light traps etc.), sterility principle	2	7
4.8	Integrated Pest Management (IPM)	3	8
4.9	Activity 2: Conduct a workshop on preparation of biopesticides of various types suitable for kitchen garden and agricultural fields.	3	7
5.0	**PESTS ON FOOD CROPS**	**25**	**7, 9**
5.1	**Insect pests -Bionomics and control of major pests of crops and stored grains**: Biology, life cycle and nature of damage Pests of paddy: *Leptocorisa acuta, Scirpophaga incertulas, Spodoptera mauritia, Orseolia oryzae, Nilaparvata lugens*	3	9
5.2	Biology, life cycle and nature of damage Pests of coconut: *Oryctes rhinoceros, Rhyncophorus ferrugineus, Opisina arenosella, Aceria guerreronis*	2	9
5.3	Biology, life cycle and nature of damage Pests of Banana: *Cosmopolites sordidus, Pentalonia nigronervosa*	2	9
5.4	Pests of vegetables Biology, life cycle and nature of damage Brinjal: *Leucinodes orbonalis, Euzophera perticella, Henosepilachna vigintioctopunctata, Urentius hystricellus*	2	9
5.5	Pests of vegetables Biology, life cycle and nature of damage Gourds –*Bactocera cucurbitae, Anadevidia peponis, Epilachna spp. Raphidopalpa foveicollis, Baris trichosanthis*	2	9
5.6	Biology, life cycle and nature of damage Pest of stored grains: *Sitophilus oryzae, Corcyra cephalonica, Tribolium castraneum,Trogoderma granarium, Callasobruchus chinensis*	2	9
5.7	Activity 3: Conduct a poster exhibition on various types of pests of paddy, coconut, banana and vegetable varieties of Kerala.	3	9

5.8	Activity 4: Collect different types of pest of stored grains from the local provision shops or houses and make a taxonomic study and prepare a powerpoint presentation on them	3	9
5.9	Activity 5: Visit a minimum of 5 kitchen gardens in the neighborhood and enlist the common traditional pest control measures used in them.	3	9
5.10	Activity 6: Organize awareness classes on the ill effects of chemical pesticides and manure on human health with the support of local examples.	3	7

Text Books for Reference

1. Ananthakrishnan, T.N (1992). Dimensions of Insect – Plant Interactions. Oxford and IBH
   Publishing Co. Ltd. New Delhi.
2. Awasthi, V.B. (2002). Introduction to General and Applied Entomology (2nd edn). Scientific
   Publishers (India), Jodhpur.
3. Fenemore, P.G and Prakash Alka. (2009) Applied Entomology. New Age International Publishers, New Delhi.
4. John P.C (Editor) (1998). Applied Zoology, Zoological Society of Kerala, Kottayam
5. Nair, K.K., Ananthakrishnan, T.N. and. David, B.V. (1976). General and Applied Entomology.
   Tata McGraw Hill Publ. Co. Ltd New Delhi
6. Srivastava, K.P (1996). A Textbook of Applied Entomology Vol I and II. Kalyani Publishers,
   Ludhiana, New Delhi.

Text Books for Enrichment

1. Atwal, A.S (1986). Agricultural Pests of India and South East Asia. Kalyani Publications
   NewDelhi.
2. Dhaliwal,G.S. and Arora Ramesh (2000). Principles of insect pest Management. Kalyani
   Publishers, New Delhi.
3. Dent, D (1991). Insect Pest Management. CAB International, UK.
4. Dhaliwal,G.S. and Arora Ramesh (2000). Principles of insect pest Management. Kalyani
   Publishers, New Delhi.
5. Hill, D.S (1983). Agricultural Insect Pests of Tropics and Their Control. Cambridge University
   Press Cambridge.
6. Larry P. Pedigo (2002). Entomology and Pest management, 4th Edition, Prentice Hall - India,
   Delhi
7. Nair, M.R.G.K (1978). A Monograph of Crop Pests of Kerala and Their Control. Kerala Agricultural University.
8. Nair, M.R.G.K (1986). Insects and Mites of Crops in India. ICAR New Delhi.

COMPLEMENTARY ZOOLOGY COURSES OFFERED BY ZOOLOGY DEPARTMENT FOR - MODEL I – BSc BOTANY / BSc HOME SCIENCE and MODEL II – B.Sc. BIOTECHNOLOGY

Course code	Title of the Course	Hrs/week	Credit	Semester	PSO
ZY1811201	Non chordate diversity	2	2	1	1
ZY1811701	Non chordate diversity (Practical I)	2	1	1	5
ZY1811202	Chordate Diversity	2	2	2	1
ZY1811702	Chordate Diversity (Practical II)	2	1	2	5
ZY1811203	Physiology and Immunology	3	3	3	3
ZY1811702	Physiology and Immunology (Practical III)	2	1	3	5
ZY1811204	Applied Zoology	3	3	4	4
ZY1811704	Applied Zoology (Practical IV)	2	1	4	5
	Total	**18**	**14**		

Course	Details				
Code	ZY1811201				
Title	**NONCHORDATE DIVERSITY**				
Degree	BSc				
Branch(s)	Zoology				
Year/Semester	I / 1				
Type	Complementary				
Credits	2	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	Decipher basics of taxonomic classification	U	BOT-6, H.Sc-7 BT-3
2	Understand rich diversity of protista, its classification and pathogenic protists	U	BOT-6, H.Sc-7 BT-3
3	Instigate curiosity of students in the biota living around them.	A	BOT-6, H.Sc-7 BT-3
4	Understand diversity of higher invertebrates	A	BOT-6, H.Sc-7 BT-3
5	Summarize the physiological and anatomical peculiarities of non chordate through type study.	A	BOT-6, H.Sc-7 BT-3
6	Create a positive attitude towards conservation of biodiversity	C	BOT-6, H.Sc-7 BT-3
*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	**PROTISTA**	**10**	
1.1	**Introduction:** Five Kingdom Classification	1	1
1.2	**Kingdom Protista- S**alient features (any five important salient features) of each phylum with one example each (detailed account of example is not necessary).	1	2
1.3	**Holozoic protists**: **Amoeba** (Phylum Rhizopoda) **Paramecium** (Phylum Ciliophora) **Actinophrys** (Phylum Actinopoda)	1	2
1.4	**Noctiluca** (Phylum Dinoflagellata) **Trychonympha** (Phylum Parabasalia) **Proterospongia** (Phylum Choanoflagellata)	1	2
1.5	**Holophytic protists**: **Euglena** (Phylum Euglenophyta) **Volvox** (Phylum Chlorophyta) **Cryptomonas** (Phylum Cryptophyta)	1	2
1.6	**Parasitic protists**: **Giardia** (Phylum Metamonada) **Trypanosoma** (Phylum Kinetoplasta) **Plasmodium** (Phylum Sporozoa) **Nosema** (Phylum Microsporidia)	1	2
1.7	**Algal Protists**: **Diatoms** (Phylum Bacillariophyta) **Red Algae** (Phylum Rhodophyta)	1	2
1.8	**General topic:** Pathogenic Protists and their life cycle – *Plasmodium,*	2	2
1.9	*Entamoeba*	1	2
2.0	**Phylum Porifera**	**3**	
2.1	Salient features eg. *Leucosolenia*	1	4

2.2	**Phylum Coelenterata:** Salient features and classification upto class Class1: Hydrozoa eg. *Physalia* Class2: Schyphozoa eg. *Aurelia*	1	4
2.3	Class3: Anthozoa eg. *Adamsia* **General topic:** Corals and Coral reefs.	1	4,6
3.0	**Phylum Platyhelminthes**	**5**	
3.1	Salient features and classification upto class. Class 1 Turbelleria eg. *Planaria*	1	4
3.2	Class 2 Trematoda eg. *Fasciola* Class3 Cestoda eg. *Taenia solium*	1	4
3.3	**Phylum Nematoda** Salient features and classification upto class. Class1 Phasmida eg. *Wuchereria* Class 2 Aphasmida eg. *Trichinella*	1	4
3.4	**Phylum Annelida** Salient features and classification upto class. Class1 Polychaeta eg. *Nereis*	1	4
3.5	Class2 Oligochaeta eg. *Pheretima* Class 3 Hirudinomorpha eg. *Hirudinaria*	1	4
4.0	**Phylum Arthropoda**	**11**	
4.1	**Phylum Arthropoda :** Salient features	1	5
4.2	Type study – ***Fenneropenaeus*** (Penaeus) - habitat, morphology, appendages, sexual dimorphism,	1	5
4.3	Digestive system, respiratory system, circulatory system,	1	5
4.4	Excretory system, nervous system, sense organs	1	5
4.5	Reproductive system, larval stages	1	5
4.6	**Classification :** Classification upto class with one example each. Subphylum Trilobitomorpha Class 1 Trilobita (Extinct) eg. *Dalmanites*	1	4
4.7	Subphylum Chelicerata Class 1 Merostoma eg. *Limulus*	1	4
4.8	Class 2 Arachnida eg. Spider	1	4

	Class 3 Pycnogonida eg. *Nymphon*		
4.9	Subphylum Mandibulata Class 1 Crustacea eg. *Daphnia* Class 2 Chilopoda eg.Centipede	1	4
4.10	Class 3 Symphyla eg. *Scutigerella* Class 4 Diplopoda eg. Millipede	1	4
4.11	Class 5 Pauropoda eg. *Pauropus* Class 6 Insecta eg. Butterfly	1	4
5.0	**Phylum Mollusca**	**7**	
5.1	Salient features and classification upto class Class1 Aplacophora eg. *Neomenia* Class 2 Monoplacophora eg. *Neopilina* Class 3Polyplacophora eg. *Chiton*	1	4
5.2	Class 4 Bivalvia eg. *Perna* Class 5 Gastropoda eg. *Xancus*	1	4
5.3	Class 6 Cephalopoda eg. *Sepia* Class 7 Scaphopoda eg. *Dentalium*	1	4
5.4	**Phylum Echinodermata :** Salient features and classification upto class. Class 1 Asteroidea eg. *Astropecten*	1	4
5.5	Class 2 Ophiuroidea eg. *Ophiothrix* Class 3 Echinoidea eg. *Echinus*	1	4
5.6	Class 4 Holothuroidea eg. *Holothuria* Class 5 Crinoidea eg. *Antedon*	1	4
5.7	**Phylum Hemichordata:** Salient features eg. *Balanoglossus.*	1	4

Text Books for Reference

1. Barnes, R D, (1987). Invertebrate Zoology (W.B. Saunders, New York).
2. Barrington, E.J.W., (1967). Invertebrate Structure and function (ELBS and Nelson, London).
3. Groove, A.J. and Newell, G.E. (1974). Animal Biology – Indian Reprint (University Book Stall, New Delhi).
4. Hyman, L.H. The Invertebrate vols. (McGraw-Hill) 1942. Comparative vertebrate Anatomy

(The University of Chicago Press).
5. James R.D. (1987). Invertebrate Zoology, W.B. Saunders, New York.
6. Kapoor, V.C. 1994. Theory and Practice of Animal Taxonomy (Oxford and IBH Publishing Co., New Delhi.)
7. Kotpal R.L. Agarwal S.K. and R.P. Khetharpal (2002). Modern Text Book of Zoology.
8. Parker T.J and Haswell W.A. (1962). Text Book of Zoology Vol. I. Invertebrate (ELBS Macmillan, London).

Text Books for Enrichment

1. EkambaranathaAyyer M (1990) A Manual of Zoology, Volume 1. Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd.
2. Vijayakumaran Nair, Jayakumar J and Paul P I (2007). Protista and Animal Diversity Academica Publication
3. Animal Diversity (2002). Published by Zoological Society of Kerala.
4. Dhami, P.S. and Dhami, J.K. (1979). Invertebrate Zoology (R. Chand and Co. New Delhi).

Course	Details				
Code	ZY1812702				
Title	**NONCHORDATE DIVERSITY (P)**				
Degree	BSc.				
Branch(s)	Zoology				
Year/Semester	1/1				
Type	**Complementary 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	Identify common non chordates	U	BOT-6, H.Sc-7 BT-3
2	Carry out dissections and temporary mounting	U	BOT-6, H.Sc-7 BT-3
3	Examine live microscopic organism	An	BOT-6, H.Sc-7 BT-3
4	Use scientific drawing technique	Ap	BOT-6, H.Sc-7 BT-3

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

Exp	Course Description	Hrs	CO. No.
1	Scientific drawing – 5 specimens	4	4
2	Simple identification –5 out of 14 invertebrates study by their scientific names		1
2.1	Study of the following parasites *Trypansoma, Plasmodium, Schistosoma, Taenia, Ancylostoma,* *Enterobius, Wuchereria, Hirudinaria, Cimex* (Any 5).	4	1
2.2	Study of the following vectors of the following pests *Spodoptera, Leptocorisa, Oryctes, Rhynchophorus, Opisina; Bactocera,* Termite Queen, *Sitophilus* (any 5).	4	1
2.3	Study of following useful insects Apis (worker), *Bombyx* female (any one)	4	1
2.4	Study of following item of economic importance *Perna, Pinctada, Teredo, Loligo, Penaeu*s (any 3)	4	1
3	Study of section- Earthworm- T S, *Fasciola* T.S	2	2
4	Dissection - Nervous system of Prawn	4	2
5	Dissection - Nervous system of Cockroach	4	2
6	Mounting – Prawn appendages and mouth parts of Cockroach	2	2
7	Observation of paramecium in hay infusion	4	3

Course	Details				
Code	ZY1812202				
Title	**CHORDATE DIVERSITY**				
Degree	B.Sc				
Branch(s)	Zoology				
Year/Semester	I / II				
Type	**Complementary**				
Credits	2	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	Observe the diversity in chordates and their classification.	U	BY-6, H.Sc-7 BT-3
2	Analyze the significant adaptive features in fishes	An	BY-6, H.Sc-7 BT-3
3	Understand physiological and anatomical peculiarities through type study.	U	BY-6, H.Sc-7 BT-3
4	Appreciate transitional stages and their significance in evolution	U	BY-6, H.Sc-7 BT-3
5	Understand what transformations are necessary to survive in different adaptive zones	U	BY-6, H.Sc-7 BT-3
6	Create a positive attitude towards conservation of biodiversity	C	BY-6, H.Sc-7 BT-3
*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	**PHYLUM CHORDATA**	**4**	
1.1	**Phylum Chordata:** Fundamental characters and outline classification up to class.	1	1
1.2	**Sub phylum Urochordata:** General characters, Classification: Class 1 Larvacea eg. *Oikopleura* Class 2 Ascidiacea eg. *Ascidia*, retrogressive metamorphosis. Class 3 Thaliacea eg. *Salpa*	2	1
1.3	**Sub phylum Cephalochordata:** Salient features eg. Branchiostoma	1	1
2.0	**VERTEBRATA**	**6**	
2.1	**Sub phylum Vertebrata:** Salient features	1	1
2.2	**Division Agnatha**: Salient features and classification Class 1: Cyclostomata eg. *Petromyzon* Class 2: Ostracodermi eg. *Cephalapsis*	2	1
2.3	**Division Gnathostomata:** Salient features Super class Pisces Super class Tetrapoda.	1	1
2.4	**Super class Pisces:** Salient features and classification Class 1 Chondrichthyes eg. *Narcine* Class 2 Osteichthyes eg. *Latimeria*	1	1
2.5	General topic**:** Accessory respiratory organs in fishes.	1	2,6
3.0	**TETRAPODA**	**14**	
3.1	**Super class Tetrapoda**: Salient features **Class 1 Amphibia** : Salient features.	1	1
3.2	**Type study: *Euphlyctis hexadactyla*-** Habitat, morphology, sexual dimorphism, coelom and viscera	2	3
3.3	Skeletal system	2	3
3.4	Digestive system	1	3
3.5	Respiratory system	1	3
3.6	Circulatory system	2	3
3.7	Excretory system	1	3
3.8	Nervous system, sense organs	1	3
3.9	Reproductive system, development	1	3
3.10	Classification up to order: Order 1 Urodela eg. *Amblystoma* Order 2 Anura eg. *Bufo* Order 3 Apoda eg. *Icthyophis*	1	1
4.0	**REPTILIA AND AVES**	**6**	
4.1	**Class Reptilia:** Salient features and classification up to subclass	1	1
4.2	Sub class 1 Anapsida eg. *Chelone* Sub class 2 Diapsida eg. *Chamaeleon* Sub class 3 Parapsida eg. *Icthyosaurus*	1	1

4.3	General topic**:** Poisonous and non-poisonous snakes of Kerala.	1	1,6
4.4	**Class Aves** Salient features and classification up to subclass	1	1
4.5	Sub class 1. Archeornithes eg. *Archaeopteryx* Subclass 2. Neornithes eg. *Struthio*	1	1&4
4.6	General topic: Flight adaptation of birds	1	1&4
5.0	**MAMMALIA**	**6**	
5.1	**Class Mammalia** Salient features and classification up to subclass	1	1
5.2	Sub class 1 Protheria eg. *Echidna*	1	1
5.3	Sub class 2 Metatheria eg. *Macropus*	1	1
5.4	Sub class 3 Eutheria eg. *Elephas*	1	1
5.5	General topic**:** General adaptation of aquatic mammals with example	2	5

Text Books for Reference

1. Deoras, P.J. (1981). Snakes of India (National Book Trust of India.)
2. Groove, A.J. and Newell, G.E. (1974). Animal Biology - Indian Reprint Universal Book Stall, New Delhi
3. Kapoor, V.C. 1994, Theory and Practice of Animal Taxonomy (Oxford and IBM Publishing Co. New Delhi.
4. Lagler, K.F, Bardach, J.E., Miller, R.R. Passino, D.R.M. 1977 Ichthyology (John Wiley and Sons).
5. Mayer, E. (1980). Principles of Systematic Zoology (Tata McGraw Hill Publishing Co. New Delhi.
6. Newman, H.H. (1939). Phylum Chordata, (Macmillan Pub. Co. New York)
7. Nigam H.C. (1978), Zoology of Chordata (S. Chand and Co. New Delhi).
8. Parker, T.J. and Haswell W.A. (1962). Text Book of Zoology Col. II Vertebrates (ELBS and Macmillan, London).
9. Sinha A.K, Adhikari S. Ganguly, B.B. (1988). Biology of Animals Vol. II (New Central Book Agency, Calcutta.)
10. Whitaker, R. (1978) Common Indian Snakes – A field Guide Macmillan and Co. of India Ltd.)
11. Young J.Z. (1981). The life of Vertebrate s (Oxford University Press).

Text Books for Enrichment

1. EkambaranathaAyyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers and Publishers Pvt. Ltd.
2. EkambaranathaAyyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers and Publishers Pvt. Ltd.
3. Induchoodan, (1986), KeralathilePakshikal (Kerala Sahitya Academy, Trichur).
4. Parter S.H. (1971). The Book of Indian Animal (Bombay Natural History Society).
5. Salim Ali, (1969). Birds of Kerala (Oxford University Press).
6. Animal Diversity (2002). Zoological Society of Kerala Study Material Series. Published by Zoological Society of Kerala

Course	Details				
Code	ZY1812702				
Title	**CHORDATE DIVERSITY**				
Degree	BSc				
Branch(s)	ZOOLOGY				
Year/Semester	I/ II				
Type	**Complementary- 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	Use scientific method of drawing chordates	A	BY-6, H.Sc-7 BT-3
2	Examine the anatomy, morphology and osteology of vertebrates	An	BY-6, H.Sc-7 BT-3
3	Identify snakes using taxonomic key	U	BY-6, H.Sc-7 BT-3
4	Identify diverse and evolutionary significant chordates	U	BY-6, H.Sc-7 BT-3

*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	Scientific drawing: any 3 common fishes	**4**	1
2	Simple identification of 10 chordates, out of which 5 by their scientific names	6	4
3	Osteology - Vertebrae and girdles of Frog	2	2
4	Snake identification - 3 poisonous and 3 non poisonous snakes with key	6	3
5	Mounting of placoid scales of shark	4	2
6	Dissection of the digestive system of common teleost fish	6	2
7	Dissections: Frog: Photographs/Diagrams/ models/virtual lab may be used for the study. Frog -Viscera Frog – DigestiveSystem Frog – ArterialSystem Frog –Brain	8	2

Course	Details				
Code	ZY1813203				
Title	**PHYSIOLOGY AND IMMUNOLOGY**				
Degree	B.Sc				
Branch(s)	Botany/ Family and Community Science/ Biotechnology				
Year/Semester	II/ III				
Type	**Complementary**				
Credits	2	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	Understand the physiology of various organ systems, functions and diseases	U	BY-6, H.Sc-7 BT-3
2	Understand the physiology of muscle contraction	U	BY-6, H.Sc-7 BT-3
3	Apply the concept of nutrition in life style diseases	Ap	BY-6, H.Sc-7 BT-3
4	Understand nerve physiology and diseases associated with its function	U	BY-6, H.Sc-7 BT-3
5	Understand endocrine system, functions, diseasesand hormone action	U	BY-6, H.Sc-7 BT-3
6	Identify and describe the types, organs, cells of immunity and immunological processes	U	BY-6, H.Sc-7 BT-3
7	Predict Antigen- antibody interactions and serological tests and describe Antigens and Immunoglobulins	C	BY-6, H.Sc-7 BT-3
8	Analyse the immune mechanisms behind autoimmunity, hypersensitivity, immunodeficiency and transplantation rejection	An	BY-6, H.Sc-7 BT-3
9	Understanding about vaccines and recent trends in immunization	U	BY-6, H.Sc-7 BT-3

*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	Physiological processes-Nutrition, Respiration, Circulation& Excretion	18	1,3
1.1	**Nutrition**: Types of nutrition – autotrophy, heterotrophy.	1	1
1.2	Nutritional requirements – carbohydrates, proteins, lipids	1	1
1.3	Minerals (Ca, Fe, I), vitamins (sources and deficiency disorders)	2	1,3
1.4	Nutritional disorders	1	3
1.5	**Respiration**: Transport of respiratory gases in blood - transport of oxygen	1	1
1.6	Transport of carbon dioxide, chloride shift.	1	1
1.7	Respiratory disturbances – hypoxia, hypercapnia, asphyxia	1	1
1.8	Physiological effect of smoking, carbon monoxide poisoning	1	1
1.9	**Circulation** Composition and functions of blood. Plasma and formed elements - WBC, RBC and platelets	2	1
1.10	Mechanism of blood coagulation- clotting factors, intrinsic and extrinsic pathways, anticoagulants.	2	1
1.11	ECG, blood pressure, arteriosclerosis, heamophilia, cerebral and pulmonary thrombosis	1	1
1.12	**Excretion:** Structure of nephron.Urine formation – glomerular filtration	1	1
1.13	Tubular reabsorption, tubular secretion.Urine concentration – counter current mechanism.	1	1
1.14	Composition of urine – normal and abnormal constituents.	1	1
1.15	Hormonal regulation of kidney function.Kidney stone, dialysis.	1	1
2.0	**NERVE AND MUSCLE PHYSIOLOGY**	10	1,2,4

2.1	Structure of a neuron. Myelinated and non myelinated nerve fibre	1	1
2.2	Nerve impulse production (resting membrane potential, action potential)	1	1
2.3	Impulse propagation, all or none law, saltatory conduction, synaptic transmission	2	1,4
2.4	Neurotransmitters (acetyl choline, adrenalin, dopamine), brain waves, EEG. Neural disorders - Parkinson's disease, Alzheimer's disease.	2	1,4
2.5	Muscle Physiology Types of muscles: striated, non-striated and cardiac.	1	1
2.6	Ultra-structure of striated muscle	1	1
2.7	Mechanism of muscle contraction	1	1,2
2.8	Cori cycle and muscle relaxation, muscle fatigue	1	1,2
3.0	**Endocrinology**	**7**	**5**
3.1	Introduction to endocrine system	1	5
3.4	Mechanism of hormone action	1	5
3.5	Endocrine glands - hypothalamus, pituitary gland, pineal gland, thyroid gland, parathyroid gland	2	5
3.6	Endocrine pancreas, adrenal gland, thymus gland, testis and ovary	1	5
3.7	Physiological role of hormones	1	5
3.8	Hormonal disorders	1	5
4.0	**IMMUNOLOGY**	**13**	**6,7,8, 9**
4.1	Introduction to immunology, types of immunity – innate, acquired, passive, active	1	6
4.2	Mechanism of innate immunity (barriers, inflammation, phagocytosis).	1	6
4.3	Types of antigens. Basic structure of immunoglobulins, classes of immunoglobulins and functions.	2	7
4.4	Antigen antibody reactions, precipitation test, agglutination	2	7

	test, WIDAL, VDRL, HIV test (ELISA)		
4.5	Primary and secondary lymphoid organs	1	6
4.6	Cells of immune system – T and B lymphocytes, natural killer cells, macrophages, plasma cells , memory cells	2	6
4.7	Immune disorders: Hypersensitivity, auto immunity (rheumatoid arthritis) and immunodeficiency (AIDS),	2	8
4.8	Monoclonal antibodies, Hybridoma technology	1	6
4.9	Vaccines - BCG, DPT, polio vaccine	1	9

Text Books for Reference

1. Chatterjee C.C (1997). Human Physiology. Medical and allied agency, Calcutta
2. Jain A K (2016) Textbook of Physiology. Avichal Publishing Company
3. Sarada Subramanyam, K. Madhavankutty (2014). Textbook of human physiology, S. Chand and Company Ltd
4. Thomas A P (Ed) (2012). Biochemistry, Human Physiology and Endocrinology. TIES, Green Leaf publications, Kottayam
5. Ivan Roitt I (2002) Essentials of Immunology ELBS

Text Books for Enrichment

1. Barret K.E et.al. 2009. Ganong's Review of Medical Physiology 23rdEdn. Mc Graw Hill, New Delhi.
2. Best, C H, Taylor, N B 1991 Physiological basis of Medical practice 12thEdn. Edited by John B. West.
3. Hall J.E and C Guyton 2010 Text Book of Medical Physiology. 12thEdn. Saunders publishers.
4. Prosser C L, Brown J R, Frank A 1962. Comparative Animal Physiology 2ndEdn. Saunders
5. Helen Hapel, Maused Harney Siraj Misbah, Next Snowden (2006). Essentials of Clinical Immunology5th Ed. Blackwell Publishing Company,
6. Kuby J, Kindt T, Goldsby R, Osborne B (2007). Kuby immunology. W H Freeman Co. new York
7. Vijayakumaran Nair K, Sherly P.F, Paul P.I (2017). Functional Zoology. Academic publications, Thiruvananthapuram.

Course	Details				
Code	ZY1813703				
Title	**PHYSIOLOGY AND IMMUNOLOGY (P)**				
Degree	BSc.				
Branch(s)	Zoology				
Year/Semester	II /III				
Type	**Complementary 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	Understand various blood tests and the normal range	U	BY-6, H.Sc-7 BT-3
2	Acquaint with various diagnostic instruments associated with physiological functions.	U	BY-6, H.Sc-7 BT-3
3	Analyze biomolecules qualitatively and observe the action of enzymes	An	BY-6, H.Sc-7 BT-3
4	Observe different types of muscle tissues	Ap	BY-6, H.Sc-7 BT-3

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

Exp	Course Description	Hrs	CO No.
1	Preparation of human blood smear and identification of leucocytes	6	1
2	Qualitative analysis of reducing Sugar, protein and lipid	6	3
2.1	Study of the action of salivary amylase on Starch	4	3
2.2	Estimation of haemoglobin content of the blood	4	1
2.3	Identification of human blood groups, A, AB, B and O, Rh factor	2	1
2.4	Instruments (Principle and uses) - Sphygmomanometer, Stethoscope, Kymograph. Dialysis machine, ECG machine	6	2
3	Mounting of striated muscle fiber of cockroach	4	4
4	Slides- Striated, non-striated, cardiac muscle	4	4

Course	Details				
Code	ZY1814204				
Title	**APPLIED ZOOLOGY**				
Degree	B.Sc.				
Branch(s)	Botany/ Home science/ Biotechnology				
Year/Semester	II/ IV				
Type	**Complementary**				
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	Understand different species of culturable fishes, ornamental fishes, fish culture practices, management of fish culture, fish processing and preservation	AP	BY-6, H.Sc-7 BT-3
2	Design and management of an aquarium	C	BY-6, H.Sc-7 BT-3
3	Construct an ornamental fish culture unit for self employment	C	BY-6, H.Sc-7 BT-3
4	Apply the concept of vermicomposting to undertake waste management measures	AP	BY-6, H.Sc-7 BT-3
5	Monitor and maintain apiculture as hobby or as an additional income	AP	BY-6, H.Sc-7 BT-3
6	Understand different honey bee species, bee products, silk worm species,sericulture and earthworm species	U	BY-6, H.Sc-7 BT-3
7	Identify diseases of fishes, silk worms and honey bees.	R	BY-6, H.Sc-7 BT-3
8	Identify apiculture and sericulture tools and equipment	An	BY-6, H.Sc-7 BT-3

*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	**AQUACULTURE**	**26**	**4,5**
1.1	Advantages and salient features of aquaculture	1	1
1.2	Traditional methods of aquaculture	1	1
1.3	Pondculture (Construction and maintenance)	2	3
1.4	Biotic and abiotic factors of water	1	1
1.5	Importance of algae in aquaculture	1	1
1.6	Common cultivable fishes of Kerala	2	1
1.7	Composite fish culture, integrated fish culture	1	1
1.8	Carp culture	1	1
1.9	Prawn culture	1	1
1.10	Mussel culture	1	1
1.11	Pearl culture	1	1
1.12	Induced breeding of carp and prawn	2	1
1.13	Fish preservation and processing	2	1
1.14	Aquarium management - Setting up of an aquarium	2	2
1.15	Biological filter and aeration	1	2
1.16	Common species of aquarium fishes	3	1
1.17	Common fish diseases and management.	3	7
2.0	**SERICULTURE**	**10**	**4,5**
2.1	Four species of silkworms	1	6
2.2	Life history of silkworms	1	6
2.3	Silkworm RearingTechniques	2	6
2.4	Mounting of silkworms – Chandrika, Natrika	1	8
2.5	Harvesting and stiffling of cocoons	1	6
2.6	Pests of silkworms	1	7
2.7	Silkworm diseases,preventive andcontrol measures	3	7
3.0	**Vermiculture**	**6**	**4**
3.1	Species of earthworms	1	6
3.2	Ecological classification of earthworms	1	4
3.3	Life cycle and reproduction of earthworm	1	4

3.4	Vermicomposting – site selection, preparation of pit	2	4
3.5	Maintenance, monitoring and harvesting of vermicompost	2	4
4.0	**APICULTURE**	**12**	**4**
4.1	Species of honey bees	2	6
4.2	Organization of honey bee colony	1	5
4.3	Bee keeping methods and equipment	2	8
4.4	Apiary management and maintenance	1	5
4.5	Bee pasturage	1	5
4.6	Byproducts of honey bees and their uses	2	5
4.7	Diseases of honeybees	1	7
4.8	Pests of honey bees	1	7
4.9	Control measures to prevent pests and diseases	1	7

Text Books for Reference

1. Bhosh, C.C., (1949), Silk Production and Weaving in India (CSIR), New Delhi)
2. Krishnaswami, S., (1986). Improved Method of Rearing Young age Silk worms (Central Silk board, Bangalore)
3. Kurien, C.V. and Sebastian V.C., Prawn Fisheries in India (Hindustan Publ. Corporation, New Delhi)
4. Mysore Silk Association, (1986). Silkworm rearing and Diseases of Silkworms
5. PadmanabhaAiyer, K.S., (1992). Records of the Indian Museum Vol. XXXI, Part I, PP. 13-76. An account of the Oligochaeta of the Travancore
6. Shiggene, K., (1969). Problems in Prawn Culture (American publ. Co., New Delhi)
7. Sinhan, V.R.P. and Ramachandran, V., (1985), Fresh water Fish Culture (ICAR, New Delhi)
8. Director. Zoological Survey of India, (1994), Earthworms Resources and Vermiculture
9. Edwards, C.A and Lofty, J.R. (1972). Biology of Earthworms (Chapman and Hall Ltd. London)
10. Jhingran, V.G., (1985). Fish and Fisheries of India (Hindustan Publ. Corporation, New Delhi)
11. Lee, K. E., (1985). Earthworms, Their Ecology and relationships with Soils and Land use. Academics Press.

Text Books for Enrichment

1. Alikunhi, K. H, Fish Culture in India (ICAR, New Delhi)Andhra Pradesh Agricultural University, Hyderabad)
2. Applied Zoology (2002) Published by Zoological Society of Kerala
3. Krishnaswami, S., (1986). New Technology of Silkworm Rearing (Central Silk Board Bangalore)
4. Menon, K.N., (1970). Malsyakrishi (State Institute of language, Trivandrum)
5. Shukla G.S., and Upadhyay V.B., Economic Zoology (Rastogi Publ. Meerut)
6. Singh, S., (1962) Bee keeping in India (ICAR), New Delhi

Course	Details				
Code	ZY1814704				
Title	**APPLIED ZOOLOGY (P)**				
Degree	B.Sc				
Branch(s)	Zoology				
Year/Semester	II /IV				
Type	**Complementary 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	Identify the types of culturable fishes, ornamental fishes,bee species, mussel,quail and earthworm species,	Ap	BY-6, H.Sc-7 BT-3
2	Identify fish parasites, silk worm - life cycle, montages, casts of honeybee,bee parasites, apiculture tools, equipment and by-products	Ap	BY-6, H.Sc-7 BT-3
3	Carry out qualitative test for honey adulteration and mountings	Ap	BY-6, H.Sc-7 BT-3
4	Carry out mountings for microscopic examination of parts	U	BY-6, H.Sc-7 BT-
5	Setting up a miniature vermicomposting unit, ornamental fish tank	Ap	BY-6, H.Sc-7 BT-3

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

Expt.	Course Description	Hrs	CO. No.
1.1	General identification, economic importance, morphology, scientific names and common names of the following	12	1,2
1.1.1.	Economic importance and morphology of culturable fishes (Catla, Rohu, Grass carp, Common carp, Silver carp, Etroplus, Tilapia)	6	1
1.1.2.	Two species of earthworms used in Vermiculture	2	1
1.1.3.	Two species of domesticated honey bees	2	1
1.1.4.	Silkworm life cycle. Cocoon/Adult	2	2
1.2	Castes of honey bees	2	2
1.3	Bee keeping equipment & accessories- Bee hive, smoker, honey extractor	4	2
1.4	Identification and uses - Bee wax, honey, silk, vermicompost	4	2
1.5	Chandrika / Natrika used in sericulture	2	2
1.6	Test for determination of adulteration of honey (flame method and determination of pH)	4	3
1.7	Mounting • Leg of honey bee • Mouthparts honey bee	4	4
1.8	Preparation of vermibed (group activity)	4	5

Extra Credit courses

Course code	Course Name	Credit	Total Hrs	Semester	PSO
ZYX181201	Environmental Microbiology	2	2	2	5,6
ZYX181402	Genomics and Proteomics	2	2	4	6

Course	Details				
Code	ZYX181201				
Title	**ENVIRONMENTAL MICROBIOLOGY**				
Degree	B.Sc				
Branch(s)	ZOOLOGY				
Year/Semester	I/II				
Type	**Extra credit**				
Credits	2	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	Understand the foundation of basic microbiology, microbial energetics, and diversity, to applying tools provided by microbiology comprising traditional to recent for addressing the relevant environmental concerns	U	3
2	Understanding of microbial interactions and microbial processes in the advancement in applied microbiology, including biotechnology, protein engineering, bioremediation, and food microbiology	U	6
3	Identify and understand basic pathogenic mechanisms that are critical to disease progression.	Ap	6
4	Predict how an organism or organisms will respond, at the genetic level, to changes in their external environment	An	6
5	Create awareness about microbes dealing with public health and epidemics	C	5
6	Understand the concept of microbes involved in nutrient recycling, waste water recycling and organic fertilizers	U	5
7	Explain the various industrial application of Microbes	R	5
8	Analyse various issues of concern- water quality, public health, epidemics	An	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.
1.0	**Module 1. Introduction to Microbiology**	**11 hrs**	
1.1	History of microbiology	1	1
1.2	General structure and classification of bacteria, fungi and viruses	1	1
1.3	Factors affecting microbial growth (pH, temperature, water, nutrients and oxygen)	1	1
1.4	Methods of sterilization, Types of culture media	2	1
1.5	Isolation of pure culture, Measurement of microbial growth,	1	1
1.6	Prokaryotic diversity and taxonomy	1	1
1.7	Microbial metabolism,	2	1
1.8	Major catabolic pathways, catabolic alternatives	2	1
2.0	**Module 2. Environment genomics and Microbial ecology**	**10 hrs**	
2.1	Introduction to microbial ecology,	1	2
2.2	Microbial ecosystems (acid,hot,cold, dry, marine, high-pressure, deep-sea vents, fresh water, low-nutrient, sediment and rhizosphere habitats),	2	2
2.3	Microbial food webs, biofilms, microbial mats, Picoeukaryotes, Algal blooms, Environmental viral pool, Aero microbiology, Endophytic microbes.	2	2
2.4	Environmental genomics: response of organism at the genetic level, to changes in their external environment, basic pathogenic mechanisms that are critical to disease progression.	2	3,4
2.5	Genetic exchange, Horizontal and vertical gene transfer,	2	4
2.6	Replication, transformation and transduction	1	4
3.0	**Module 3. Applied environmental microbiology**	**15 hrs**	
3.1	Microorganisms as biogeochemical agents (role of microbes in biogeochemical cycles),	1	1
3.2	Role of microorganisms in soil fertility, Biofertilizers,	1	6
3.3	Role of microorganisms in water quality monitoring,	1	8

3.4	Medical microbiology, public health, epidemics,	2	5,8
3.5	Microbiology of milk and food products,	2	2
3.6	Bioremediation, Bio sanitation,	2	2
3.7	Waste water technology	2	6
3.8	Enhanced metal recovery	1	1
3.9	Industrial microbiology and its applications	3	7

Text Books for Reference

1. Ananthanarayan R, Jayaram Paniker C K (2009). Text Book of Microbiology Orient Longman Private Ltd.
2. Dubey R.C. and Maheswari D.K. (2008). A textbook of Microbiology. S. Chand & Co. ltd, New Delhi, India.
3. Talaro, Park, Kathelee N, Talaro, Arthur (2002). Foundations of microbiology. Mc Grew Hill Higher Education NY
4. Sharma K (2005). Manual of Microbiology: Tools and Techniques, Ane books
5. Gladys Francis, Mini K.D (Editors) (2012). Microbiology, Zoological Society of Kerala, Kottayam

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1. Christofere Martin C (2008). Environmental genomics, Methods in molecular biology, Humana press Springer Science & Business Media.
2. Alan Decho et al (2009). Environmental microbiology Vol 11(2), Wiley-Blackwell
3. Eugene L. (2015) Madsen Microbiology: From Genomes to Biogeochemistry, 2nd Edition Wiley-Blackwell
4. Rao. M.N, Datta. A.K (1987). Waste Water treatment Oxford and IBII Publication Co. Pvt. Ltd.345p
5. Wanger K.D (1998). Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p
6. Laning, M Prescott, John P Harley, Donald A Klein (2008). Microbiology (7th edn.). Mc Grew Hill International , NJ, USA
7. Talaro, Park, Kathelee N, Talaro, Arthur (2002). Foundations of microbiology. Mc Grew Hill Higher Education NY,
8. Tortora J. et.al. (2011). Microbiology. Pearson Education INC, Licencee Dorling Kindersley, India.
9. William Clans G. (1989). Understanding Microbes. W.H. Freeman & Co. USA.
10. Madigan, Martinko, Parker (2005). Biology of Microorganisms, Brock Eighth Edn. Prentice Hall.

Course	Details				
Code	ZYX181402				
Title	**GENOMICS AND PROTEOMICS**				
Degree	BSc.				
Branch(s)	Zoology				
Year/Semester	II/ IV				
Type	**Extra Credit Course**				
Credits	2	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	Understand the structural organisation of prokaryotic and eukaryotic genome	U	6
2	Examine the gene regulation	An	6
3	Familiarise the tools and techniques of proteomics and Genomics	U	6
4	Understand the application of Genomics and Proteomics	U	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	**INTRODUCTION TO GENOMICS**	14	
1.1	Introduction to the concept of genome	1	1
1.2	Structure and organization of prokaryotic genome	1	1
1.3	Bacterial operons (basic concepts).	1	1
1.4	Structural organization of genome in Eukaryotes	2	1
1.5	Transcriptional regulators	1	2
1.6	Transposable genetic elements	1	1
1.7	gene networks (basic concepts)	1	3
1.8	Prediction of genes, promoters, splice sites, regulatory regions (basic principles)	2	2
1.9	genome projects	1	4
1.11	Pedigree analysis	1	4
1.12	Physical and genetic mapping	1	3
2	**PROTEOMICS**	12	
2.1	Introduction and scope of proteomics	1	3
2.2	Protein analysis (includes measurement of concentration, amino-acid composition)	2	3
2.3	Ion-exchange, size-exclusion and affinity chromatography techniques	2	3
2.4	Polyacrylamide gel electrophoresis, Isoelectric focusing (IEF)	1	3
2.5	Two dimensional PAGE for proteome analysis	1	3
2.6	Image analysis of 2D gels	1	3
2.7	Introduction to mass spectrometry	1	3
2.8	Strategies for protein identification, Protein sequencing	2	3

2.9	Protein-protein interaction	1	3
3	**FUNCTIONAL GENOMICS**	10	
3.1	Genome wide expression analysis: Microarrays, SAGE, ESTs	1	3
3.2	Transcriptomic	1	3
3.3	Structural proteomics	1	3
3.4	Deriving function from sequence	1	3
3.5	Protein modifications and proteomics	1	3
3.6	Protein engineering	1	4
3.7	Protein chips and functional proteomics	1	4
3.8	Proteome databases	1	4
3.9	Clinical and biomedical application of proteomics	1	3
3.11	Proteomics industry. Proteomics in drug discovery and toxicology.	1	4

REFERENCES

1. Brown T. A. 2007, Genomes 3. Garland Science Publishing, New York.
2. Dunham, I., 2003. Genome Mapping and sequencing. Horizon Scientific
3. Graur, D and W H Li, 2000. Fundamentals of molecular evolution. Sinauer Associates.
4. Hartwell, L. H., L. Hood, M. L. Goldberg, A. E. Reynolds, L. M. Silver and R. G. Veres. 2004. Genetics from Genes to Genomes. McGraw Hill.
5. Lewin B. 2003. Genes VIII. Oxford University Press. Oxford.
6. The Human Genome 2001, Nature Vol. 409.
7. Primrose, S. B., and R. M. Twyman. 2006. Principles of gene manipulation and Genomics, Blackwell Publishing MA. USA

ADD ON COURSES

Course code	Course Name	Credits	Total Hrs	Semester	PSO
ZYA181201	Certificate course in Applied biology for sustainable livelihood	2	2	2	4
ZYA181402	Diploma in Applied biology for sustainable livelihood	2	2	4	4
ZYA181603	Advanced Diploma in Medical Coding- Human Anatomy & Physiology	2	4.5	6	4
ZYA181604	Advanced Diploma in Medical Coding-Healthcare Common Procedure Coding Systems	2	4.5	6	4
ZYA181605	Advanced Diploma in Medical Coding-Current Procedural Terminology	2	4.5	6	4
ZYA181606	Advanced Diploma in Medical Coding-International statistical classification of diseases (ICD-10 CM)	2	4.5	6	4

Course	Details				
Code	ZYA181201				
Title	**CERTIFICATE COURSE IN APPLIED BIOLOGY FOR SUSTAINABLE LIVELIHOOD**				
Degree	Undergraduate				
Branch(s)	Zoology				
Year/Semester	I/II				
Type	**Add on course**				
Credits	2	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	Understanding the scope, need of conservation and benefits of indigenous breeds of cattle	U	4
2	Evaluate the difference between A1 and A2 milk	E	4
3	Apply the concept of organic farming through the preparation of cow products and biopesticides	Ap	4
4	Identify the indigenous cattle breeds of India	An	4
5	Create an awareness program on indigenous breeds and organic farming through organic product fest	C	4
6	Understand the concept of mushroom cultivation, types, substrates and diseases	U	4
7	Apply the concept of Mushroom cultivation in the preparation of mushroom bed	Ap	4
8	Device and formulate method for the artificial spawn production	Ap	4
*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	**Conservation of indigenous cattle breeds of Kerala and its applications**	**5**	1-7
1.1	Scope and importance of indigenous cattle rearing.	1	1
1.2	Major breeds of cattle in India and indigenous cattle breeds of Kerala	1	4
1.3	Common management practices of indigenous cattle rearing & milking. A1 and A2 milk and its implication	1	2
1.4	Value-added products of cattle rearing	1	3,5
1.5	Organic farming and its present relevance, biopesticides and its relevance	1	3,5
2.0	**Practical**	**15**	
1.7	Identification of different local cattle breeds of Kerala	2	4
1.8	Production of value added products from local cattle	6	3
1.9	Biopesticide preparation (any 3)	3	3
1.10	Arranging an organic product fest in the campus	4	5
2.0	**Mushroom Cultivation**	**16**	**6,7**
2.1	Mushrooms – Nutritional and health benefit	1	6
2.2	Common edible mushrooms.	1	6
2.3	Introduction to mushroom cultivation (Button mushroom, Paddy straw mushroom, Oyster mushroom)	1	6
2.4	Substrates for mushroom cultivation	1	6
2.5	Diseases of mushrooms	1	6
2.6	Disinfection methods	1	6
2.7	Preparation of sterilised mushroom beds	6	7
2.8	Mushroom spawn production	4	8

Text Books for Reference

1. Shubhrata R Mishra. Techniques of mushroom cultivation

2. Tradd Cotter. Organic Mushroom Farming and Myco-remediation: Simple to Advanced and Experimental Techniques for Indoor and Outdoor Cultivation

3. Creed Lane, E.C. (1900) Cow-keeping in India; a simple and practical book on their care and treatment, their various breeds, and the means of rendering them profitable THACKER, SPINK & CO. London

4. F. Ware (2017). Survey of Some Important Breeds of Cattle and Buffaloes in India. Printed by the Government of India Press, Delhi – 1942

5. Subratam. Dattas.V. Ngachan Biswas Mushrooms: A Manual for Cultivation

Text Books for Enrichment

1. Malcolm l. Hunter, JR. and James Fundamentals of conservation biology (3rd ed.) Gibbs. Blackwell publishing.

2. Gary K. Meffe and C. Ronald Carrol Principles of Conservation biology. Sinauer Associates Inc.

3. David MacDonald and Katrina. Key topics in conservation biology. Edited by Service. Blackwell publishing

4. Shubhrata R Mishra. Techniques of mushroom cultivation

5. Tradd Cotter. Organic Mushroom Farming and Myco-remediation: Simple to Advanced and Experimental Techniques for Indoor and Outdoor Cultivation

6. Creed Lane, E.C. (1900) Cow-keeping in India; a simple and practical book on their care and treatment, their various breeds, and the means of rendering them profitable THACKER, SPINK & CO. London

7. F. Ware (2017). Survey of Some Important Breeds of Cattle and Buffaloes in India. Printed by The Government of India Press, Delhi – 1942

8. The Complete Book on Organic Farming and Production of Organic Compost NPCS Board of Consultants & Engineers 2008. Asia Pacific Business Press Inc.

9. The Complete Technology Book on Biofertilizer and Organic Farming (2nd Revised Edition) [NI115] by NIIR Board.

10. The Complete Technology Book on Vermiculture and Vermicompost [NI116] by NPCS Board of Consultants and Engineers

11. Biopesticides Handbook [NI210] by NPCS Board of Consultants & Engineers

12. H. Panda, Manufacture of Biofertilizer and Organic Farming [NI239]

Course	Details				
Code	ZYA181402				
Title	**DIPLOMA IN APPLIED BIOLOGY FOR SUSTAINABLE LIVELIHOOD**				
Degree	Undergraduate				
Branch(s)	Zoology				
Year/Semester	II/II				
Type	**Add on course**				
Credits	2	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	Understanding the basic concepts of ornamental fish culture and its future possibility	U	4
2	Design and management of an aquarium	Ap	4
3	Construct an ornamental fish culture unit for self employment	C	4
4	Devise and formulate artificial and live feeds, breeding strategies and packing of fishes	C	4
5	Understand different honey bee species, bee products and its applications.	U	4
6	Understanding colony structure and its diseases, pests and control measures	U	4
7	Understanding bee keeping techniques and instruments	U	4
8	Construct and maintain bee hives and raise apiculture as hobby or as an additional income	C	4

*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	**Basic techniques in ornamental fish culture and breeding**	**20**	1-4
1.1	Introduction and scope of ornamental fish culture	1	1
1.2	Construction of aquarium tank, aquarium accessories, Setting up of aquarium.	2	1
1.3	Common ornamental fishes, Identification of ornamental fishes	1	2
1.4	Fish nutrition, Feed technology	2	3
1.5	Fish diseases and methods of treatment	2	1
1.6	Proximate composition analysis of feed ingredients and foods	1	4
1.7	Preparation of artificial feeds using locally available feed ingredients, Culture of live food organism, Infusoria culture	2	4
1.8	Breeding of ornamental fishes, hybridization	2	4
1.9	Fabrication of glass aquaria	2	1
1.10	Conditioning and Packing of ornamental fishes	1	4
1.11	Visit to aqua farms	4	1
2.0	**Apiculture**	16	5,6, 7,8
2.1	Apiculture with special reference to Melipona	1	5
2.2	Species of Honey bees	1	5
2.3	Diversity of stingless bees, with current status and opportunity of Melipona rearing	1	5
2.4	Organization of honeybee colony	1	6
2.5	By products of honey bees and their uses, medicinal value of Melipona honey	1	5
2.6	Bee keeping methods and equipments	2	7
2.7	Apiary management and maintenance, special reference to Melipona	2	8
2.8	Diseases and pests of honey bees, control measures	1	6
2.9	Hands on training in the management of stingless bees	6	8

Text Books for Reference

1. MPEDA A handbook of Aquafarming- ornamental fishes, MPEDA Cochin.

2. NPCS Board, The complete book on Bee keeping and honey processing, NIR project consultancy services, 106- E Kamala Nagar, New Delhi-7

3. Anshuman D. Dholakia (2009), Ornamental Fish Culture and Aquarium Management, Daya Publication House, New Delhi

4. Rajalakshmi Mishra (2002), Perspectives in Indian apiculture, Anmol Publishers, New Delhi

Text Books for Enrichment

1. Pradip V Jabde (1993)Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac Culture Agricultural Pests and their Controls, Discovery Publishing House, New Delhi
2. Applied Zoology, Study material published by Zoological Society of Kerala, CMS College campus
3. Pillai T V R. And Kutty M.N. (2005) Aquaculture, Principles and practices, Wiley-Blackwell.
4. K.Vijayakumaran Nair and K.G Manju (2013). Ornamental fish keeping. Academia publication.
5. A. Biju Kumar and Harisankar J Alappat..A Complete Guide to Aquarium Keeping. Low Price Publications
6. Jay F. Hemdal (2003).Aquarium Fish Breeding . Barron's publication
7. C.S Tharadevi, K.V. Jayasree, N. Arumugam, (2015).Home Aquarium and Ornamental Fish Culture. Saras publication.
8. V. K Dey (1997). Hand Book on Aquafarming: Ornamental fishes. Manual. MPEDA, Cochin
9. Eprints@cmfri , Open access institutional repository

Course	Details				
Code	ZYA181603				
Title	**ADVANCED DIPLOMA IN MEDICAL CODING - HUMAN ANATOMY AND PHYSIOLOGY**				
Degree	Undergraduate				
Branch(s)	Zoology				
Year/Semester	III/VI				
Type	**Add on course**				
Credits	2	Hrs/Week	4.5	Total hours	36

CO No.	Expected Course Outcomes *Upon completion of this course, the students will be able to*	Cognitive Level	PSO No.
1.	Understand Anatomy and Physiology and explain the relationship between Anatomy and Physiology	U	3
2.	Analyze and synthesize their knowledge and skills to create effective anatomy teaching and learning tools	An	4
3.	Describe the structural organization and functions of each system of the human body	An	3
4.	Identify the major levels of organization in organisms (from molecules to organisms) and explain how simpler levels contribute to the functions of more complex levels.	Ap	3
5.	List the major components of each organ system and describe the main functions of each organ system	C	3
*PSO-Program Specific outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create			

Module	Course Description	Total Hrs	CO No.
1.	Introduction to Body Structure and Medical Terminology	3hrs	1
2.	Dermatology: The Skin	3 hrs	3
3	Ophthalmology: The Eyes	3 hrs	2
4.	Otorhinolaryngology: The Ear, Nose, and Throat	3 hrs	4
5.	Pulmonology: The Respiratory System	3 hrs	4
6.	Cardiology: The Cardiovascular System	3 hrs	3
7.	Gastroenterology: The Digestive System	3 hrs	3
8.	Obstetrics and Gynecology: The Female Reproductive System	3 hrs	4
9.	Urology and Nephrology: The Genitourinary System	3 hrs	5
10.	Orthopedics: The Musculoskeletal System	3 hrs	5
11.	Neurology and Psychiatry	3 hrs	4
12.	Endocrinology and Metabolic Homeostasis	3 hrs	4

REFERENCES

1. Federative Committee on Anatomical Terminology (2008). Terminologia Histologica – International Terms for Human Cytology and Histology. Cardiff: Lippincott Williams & Wilkins.
2. Anatomy of the Human Body". Henry Gray. 20th Edition. 1918
3. Introduction to Medical Terminology, Ann Ehrlich, Carol L. Schroeder – 3rd Edition,2014
4. Anthony's Textbook of Anatomy & Physiology, 21st Edition, 2018, Kevin Patton Gary Thibodeau
5. McMinn and Abrahams' Clinical Atlas of Human Anatomy, 7th Edition,2013, Peter H. Abrahams

Course	Details				
Code	ZYA181604				
Title	**Advanced Diploma in Medical Coding- Healthcare Common Procedure Coding Systems (HCPCS)**				
Degree	Under Graduate				
Branch	Zoology				
Year/Semester	III/VI				
Type	**Add on Course**				
Credits	2	Hrs/Week	4.5	Total Hours	36

CO No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to*	**Cognitive Level**	**PSO No.**
1.	Understand the uniform reporting on claims or services that are medical in nature	U	4
2.	Apply coding system to identify products, supplies and services	Ap	4
3.	Analyse alphanumeric code set primarily non-physician products, supplies, and procedures not included in CPT	An	4
4.	Understand the use of HCPCS codes to represent the medical procedures to the insurance companies	U	4
5.	Explain in detail the differences between HCPCS and CPT code and the use of it.	C	4

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

Module	Course Description	Total Hrs	CO No.
1	Introduction	1 hr	1
2	Symbols and Conventions	1 hr	1
3	Instructions for Using This Manual	1 hr	3
4	HCPCS Coding Procedures	1 hr	4
5	New/Revised/Deleted Codes for 2018	1 hr	5
6	Deleted Codes Crosswalk	1 hr	3
7	G Codes to CPT Codes	1 hr	4
8	Anatomical Illustrations	1hr	2
9	Index to Services, Supplies, Equipment, Drugs	1 hr	4
10	Tabular List	1hr	2
11	Transportation Service Including Ambulance	1hr	3
12	Medical and Surgical Supplies	1hr	3
13	Administrative, Miscellaneous and Investigational	1hr	4
14	Enteral and Parental Therapy	1hr	1
15	Outpatient PPS	1 hr	1
16	Durable Medical Equipment	1 hr	1
17	Procedures/Professional SErvices	1hr	5
18	Alchohol and Drug Abuse Treatment	1 hr	5
19	Drugs Administered Other than Oral Method	1hr	4
20	Chemotherapy Drugs	1hr	3
21	Durable medical equipment	1 hr	2
22	Ortholic Procedures	1 hr	2

23	Prosthetic Procedure	1.5hrs	2
24	Medical services	1.5 hrs	1
25	Pathology and laboratory services	1.5 hrs	2
26	Temporary Codes	1.5 hrs	4
27	Diagnostic Radiology	1.5 hrs	5
28	Temporary National codes	1.5 hrs	1
29	National Codes Established for State Medicaid Agencies	1.5 hrs	5
30	Vision Services	1.5 hrs	1
31	Hearing Services	1hr	1
32	Appendix A to I	1hr	5

REFERENCES

1. HCPCS Level II Professional Edition, 2016, Carol J. Buck.
2. Express Reference Card - CPT & HCPCS Modifiers 2018, American Medical Association.
3. 2015 HCPCS Level II Professional Edition, Carol Buck.
4. HCPCS Level II Professional 2014, Optum.
5. 2010 HCPCS Level II (Professional Edition), Carol J. Buck

Course	Details				
Code	ZYA181605				
Title	**Advanced Diploma in Medical Coding** **Current Procedural Terminology(CPT)**				
Degree	Under Graduate				
Branch	Zoology				
Year/Semester	III/VI				
Type	**Add on Course**				
Credits	2	Hrs/Week	4.5	Total Hours	36

CO No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to*	**Cognitive Level**	**PSO No.**
1.	Explain the organization and format of procedural coding.	U	4
2.	Interpret the definitions and conventions in procedural coding.	An	4
3.	Apply anatomical terms to medical/surgical procedural coding.	Ap	4
4.	Sequence procedure codes in proper order using clinical information found in patient health records and scenarios.	C	4
5.	Code procedures from health charts/abstracts with accuracy rate.	E	4

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

Module	Course Description	Total Hrs	CO. NO
1	Introduction	1 hr	1
2	Illustrated Anatomical and Procedural Review	2 hrs	2
3	Evaluation and Management (E/M) Service Guidelines	3 hrs	3
4	Evaluation and Management	3 hrs	4
5	Anesthesia Guidelines	3 hrs	5
6	Anesthesia	3 hrs	1
7	Surgery Guidelines	3 hrs	3
8	Surgery	3 hrs	5
9	Radiology Guidelines (Including Nuclear Medicine and Diagnostic Ultrasound)	3 hrs	4
10	Radiology	3hrs	2
11	Pathology and Laboratory Guidelines	3 hrs	4
12	Pathology and Laboratory	3 hrs	5
13	Medical Guidelines	3 hrs	2

REFERENCE

1. CPT 2009: Current Procedural Terminology, Michael Beebe; American Medical Association.2008.
2. Cpt 94: Physicians' Current Procedural Terminology, Celeste G. Kirschner, Robin C. Burkett, Judy A. Coy, 1993.
3. Workbook for Step-by-Step Medical Coding, 2018 Edition, Carol J. Buck MS CPC CCS-P.
4. CPT 2017 Professional Edition, American Medical Association.
5. Centore, Anthony. "2013 CPT Code Revisions".

Course	Details				
Code	ZYA181606				
Title	**Advanced Diploma in Medical Coding- International statistical Classification of Diseases (ICD-10 CM)**				
Degree	Under Graduate				
Branch	Zoology				
Year/ Semester	III/VI				
Type	**Add on course**				
Credits	2	Hrs/Week	4.5	Total Hours	36

CO No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to*	**Cognitive Level**	**PSO No.**
1.	Explain the use of General Equivalence Mappings (GEMS) in the coding transitions	U	4
2.	Apply UHDDS definitions for principal diagnosis when coding health records	Ap	4
3.	Adhere to current regulations and established policies in code assignments	C	4
4.	Code procedures from health charts/abstracts with an 82% accuracy rate.	U	4
5.	Explain the organization and format of ICD in current use	An	4

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

Module	Course Description	Total Hrs	CO NO
1	Preface	1 hr	1
2	List of Features	1 hr	1
3	Practical Steps of Using ICD-- CM Book	1 hr	5
4	Symbols and Conventions	1 hr	1
5	Anatomical Illustations	1 hr	1
6	ICD -10 CM	1 hr	4
7	Certain Infectious and Parasitic Diseases	1 hr	2
8	Neoplasms	2 hrs	1
9	Diseases of the Blood and Blood -Forming Organs and Certain Disorders Involving the Immune Mechanism	2 hrs	3
10	Endocrine, Nutritional and Metabolic Diseases	1 hr	1
11	Mental, Behavioral and Neurodevelopmental Disorders	1 hr	1
12	Diseases of the Nervous System	1 hr	1
13	Diseases of the Eye and Adnexa	2hr	1
14	Diseases of the Ear and Mastoid Process	1 hr	1
15	Diseases of the Circulatory System	1hr	1
16	Diseases of the Respiratory System	2 hrs	1
17	Diseases of the Digestive System	1hr	1
18	Diseases of the Skin and Subcutaneous Tissue	1 hr	1
19	Diseases of the Musculoskeletal System and Connective Tissue	1 hr	2
20	Diseases of the Genitourinary System	1 hr	2
21	Pregnancy, Childbirth and the Puerperium	1 hr	2
22	Certain Conditions Originating in the Perinatal Period	1 hr	4

23	Congenital Malformations, Deformations, and Chromosomal Abnormalities	2hrs	4
24	Symptoms, Signs, and Abnormal clinical and Laboratory Findings, Not elsewhere classified	2 hrs	5
25	Injury, Poisoning, and Certain other Consequences of External Causes	2 hr	2
26	External Cause of Morbidity	1 hr	1
27	Factors Influencing Health Status and Contact with Health Services	1 hr	5
28	Appendix A	1hr	1
29	Appendix B	1 hr	1

REFERENCE

1. ICD-10, Edition 1992, UNAIDS World Health Organization.
2. ICD-9-CM Inpatient Coding Reference and Study Guide, Linda Kobayashi.
3. Coders' Desk Reference for ICD-9-CM Procedures 2014, Optum.
4. Principles and Practice of ICD-10 Coding, 2008 Dhirendra Verma , Mohamed El-Sayed Ali
5. 2018 ICD-10-CM 1st Edition, 2017,Carol J. Buck.