



MAHATMA GANDHI UNIVERSITY
Priyadarshini Hills, Kottayam 686 560

CURRICULUM OF
CHOICE BASED CREDIT SYSTEM
FOR
UNDERGRADUATE
ZOOLOGY PROGRAMME
2017 ADMISSION ONWARDS

**PREPARED
BY
BOARD OF STUDIES
AND
FACULTY OF SCIENCE**

CONTENTS

- 1. Introduction**
- 2. Aims and objectives**
- 3. Duration of course**
- 4. Programme structure**
- 5. Evaluation**
- 6. Consolidated scheme for I to VI Semesters**
- 7. Scheme of distribution of instructional hours for B.sc
Zoology Programme – Model I (Core courses)**
- 8. Scheme of distribution of hours and credits for B.Sc
Zoology Programme- Model I (Core course)**
- 9. Scheme of distribution of hours and credits for
Open course & Elective courses**
- 10. Scheme of examinations:**
 - a. Scheme of Theory examination(Core course)**
 - b. Scheme of practical examination(Core course)**
 - c. Total credits for core course**
 - d. Scheme of field study, research institute visit, group
activity, project and viva(Core course)**
- 11. Scheme of distribution of hours and credits for
Complimentary Zoology courses**
- 12. B.Sc Zoology programme Model I (Core course):**

Syllabus – Theory and Practical

13. B.Sc Zoology Complementary course:

Syllabus for Model I, II &III:

Model I – B.Sc Botany / B.Sc Home Science

Model II - B.Sc Botany

Model II - B.Sc Vocational Courses:

B.Sc Aquaculture,

B.Sc Food Microbiology,

B.Sc Medical Microbiology

Model III - B.Sc Biological Techniques,

B.Sc Industrial Microbiology

14. Model II B.Sc Vocational Courses

a. Different subjects for Vocational Courses

1. Aquaculture

2. Food Microbiology

3. Medical Microbiology

b. Consolidated distribution of hours for Vocational courses

c. Scheme of examination– Theory & Practical

d. Scheme of distribution of hours & credits

e. Syllabus – Theory & Practicals:

1. Aquaculture

2. Food Microbiology

3. Medical Microbiology

15. Model III B.Sc Zoology programme

I. Biological Techniques & Specimen preparation

a. Scheme of distribution of hours, credits

& examination: i. Theory

ii. Practical

b. Syllabus – Theory and Practicals

2. Industrial Microbiology

a. Scheme of distribution of hours, credits

& examination: i. Theory

ii. Practical

b. Syllabus – Theory and Practical

1. INTRODUCTION

Curriculum restructuring is the responsibility of any University that offers different courses. As per U.G.C guidelines it should be revised every three years. Accordingly the authorities of M.G University have taken the initiative to restructure the syllabus of each course for the benefit of the students.

According to Altman and Cashin “the primary purpose of a syllabus is to communicate to one’s students what the course is about, why the course is taught, where it is going, and what will be required of the students, for them to complete the course with a passing grade. Claire Johnson says “the syllabus functions as a major communication device that provides details of how student learning will be assessed and about the roles of both Students and Instructors in the learning and assessment process. The syllabus is a “description” and “plan” for a course and if well written may be a tool that improves student learning, facilitates faculty teaching, improves communication between faculty members about their courses and assists with monitoring program quality says Claire Johnson (2006). Additionally Parke,Fix and Harris suggest that “ the syllabus serves as a contract between the Instructor and the learner”.

The M.G. University is well recognised among Universities for their quickness in updating technologies. It is the recipient of the award for computerization among the Universities. Ever since its inception, the M.G.University has had the history of updating its syllabi for the various courses offered. Presently, this exercise has resulted in the syllabus of Zoology, for the undergraduate students undergoing model I, II and III courses, reaching successful updation.

India, a mega biodiversity nation stands out as a fascinating destination, exhibiting an incredible diversity in its fauna and flora. Innumerable species of organisms live here contributing to India’s most beautiful natural topography.. All round development becomes possible only by exploring the vast potential of the still unknown resources of nature. Zoology undergraduate students are therefore made to go through the realities like Biota,anatomy and physiology of living organisms, DNA biotechnology, diseases, pathogens and parasites, environment, resources, protection of endangered organisms and their conservation, the “right to live” of all organisms in this world, and finally scientific knowledge about cottage industries, prompting students to involve in self employment programs.

The constant and unstinted efforts of the entire faculty of Zoology within M.G.University has been instrumental in framing this syllabus for the subject Zoology in this form. The faculty of Zoology proudly and sincerely submit herewith this updated syllabus in Zoology for its implementation in the coming three years.

2. AIMS & OBJECTIVES

The BSc. Zoology programme is designed to help the students to:

1. Acquire basic knowledge of various disciplines of Zoology and General Biology meant both for a graduate terminal course and for higher studies.
2. Inculcate interest in nature and love of nature.
3. Understand the rich diversity of organisms and their ecological and evolutionary significance
4. Imbibe basic skills in the observation and study of nature, biological techniques, experimental skills and scientific investigation
5. Create awareness on the internal harmony of different body systems and the need for maintaining good health through appropriate lifestyle.
6. Acquire basic knowledge and skills in certain applied branches for self employment
7. Impart awareness of the conservation of the biosphere.

3. DURATION OF THE COURSE

The duration of U.G. programmes have 6 semesters. There shall be two Semesters in an academic year, the odd semester commences in June and on completion, the even Semester commences after a semester-break of three days with two months vacation during April and May. (The commencement of first semester may be delayed owing to the finalization of the admission processes.)

A student may be permitted to complete the Programme, on valid reasons, within a period of 12 continuous semesters from the date of commencement of the first semester of the programme.

4. PROGRAMME STRUCTURE - B.Sc Model I

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	22
d	Credits required from Common Course II	16
e	Credits required from Core course and Complementary courses including Project	79
f	Open course	3

g	Minimum attendance required	75%
---	-----------------------------	-----

B.Sc Model II

A	Programme Duration	6 Semesters
B	Total Credits required for successful completion of the Programme	120
C	Credits required from Common Course I	16
D	Credits required from Common Course II	8
E	Credits required from Core + Complementary + Vocational Courses including Project	93
F	Open course	3
G	Minimum attendance required	75%

B.Sc Model III

A	Programme Duration	6 Semesters
B	Total Credits required for successful completion of the Programme	120
C	Credits required from Common Course I	8
D	Credits required from Core + Complementary + Vocational Courses including Project	109
E	Open course	3
F	Minimum attendance required	75%

5. EVALUATIONS:

The evaluation of each paper shall contain two parts:

- (i) Internal Assessment
- (ii) External Assessment

The internal to external assessment ratio shall be 1:4.

EXTERNAL EXAMINATION AND INTERNAL EVALUATION

The external theory examination of all semesters shall be conducted by the University at the end of each semester. Internal evaluation is to be done by continuous assessment

ASSIGNMENTS

Assignments are to be done from 1st to 4th Semesters. At least one assignment should be done in each semester for all papers.

INTERNAL ASSESSMENT TEST PAPERS

The test papers & evaluations of all components are to be published and are to be acknowledged by the candidates. All documents of internal assessments are to be kept in the college for two years and shall be made available for verification by the University. The responsibility of evaluating the internal assessment is vested on the teacher(s), who teach the paper.

EXTERNAL EXAMINATION

The external theory examination of all semesters shall be conducted by the University at the end of each semester. Students having a minimum of 75% average attendance for all the courses only can register for the examination. Condonation of shortage of attendance to a maximum of 10 days in a semester subject to a maximum of 2 times during the whole period of the programme may be granted by the University on valid grounds. This condonation shall not be counted for internal assessment. Benefit of attendance may be granted to students attending University/College union/Co-curricular activities by treating them as present for the days of absence, on production of participation/attendance certificates, within one week, from competent authorities and endorsed by the Head of the institution. This is limited to a maximum of 10 days per semester and this benefit shall be considered for internal assessment also. Those students who are not eligible even with condonation of shortage of attendance shall repeat the **semester** along with the next batch after obtaining readmission.

All students are to do a **project in the area of core course**. This project can be done individually or in groups (not more than three students) which may be carried out in or outside the campus. Special sanction shall be obtained from the Vice Chancellor to those **new generation programmes** and programmes on **performing arts** where students have to take projects which involve larger groups. The projects are to be identified during the fifth semester of the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department at the sixth semester and are to be produced before the examiners appointed by the University. External Project evaluation and Viva / Presentation is compulsory for all subjects and will be conducted at the end of the programme. There will be no supplementary exams. For reappearance/ improvement, the students can appear along with the next batch.

6. CONSOLIDATED SCHEME FOR BSC ZOOLOGY PROGRAMME

MODEL-1 (1-VI SEMESTERS)
(TOTAL CREDITS 120)
(TOTAL HOURS 150 Hrs.)

Semester 1

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1		English - 1	Common Course I	5	4	1	4
2		English - 2	Common Course II	4	3	1	4
3		Second Language – 1	Common Course III	4	4	1	4
4	ZY1CRT01	General perspectives in Science & Protistan Diversity	Core Course I : Theory	2	2	1	4
5		Practical : General perspectives in Science & Protistan Diversity	Core Course I : Practical	2	0	0	0
6		Chemistry 1/ Biochemistry 1	Complementary Course I : Theory	2	2	1	4
7		Chemistry 1	Complementary Course I : Practical	2	0	0	0
8		Botany 1	Complementary Course II : Theory	2	2	1	4
9		Botany 1	Complementary Course II : Practical	2	0	0	0
Total				25 hrs	17		

Semester 2

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1		English 3	Common Course	5	4	1	4

			IV				
2		English 4	Common Course V	4	3	1	4
3		Second Language -2	Common Course VI	4	4	1	4
4	ZY2CRT02	Animal Diversity- Non Chordata	Core Course II : Theory	2	2	1	4
5	ZY2CRP01	Animal Diversity – Non Chordata	Core Course II : Practical	2	2	1	4
6		Chemistry – II / Biochemistry - II	Complementary Course I : Theory	2	2	1	4
7		Chemistry – II / Biochemistry - II	Complementary Course I : Practical	2	2	1	4
8		Botany – II	Complementary Course II : Theory	2	2	1	4
9		Botany – II	Complementary Course II : Practical	2	2	1	4
Total				25 hrs	23		

Semester 3

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1		English 5	Common Course VII	5	4	1	4
2		Second Language 3	Common Course VIII	5	4	1	4
3	ZY3CRT03	Animal Diversity - Chordata	Core Course III : Theory	3	3	1	4
4	ZY3CRPO3	Animal Diversity- Chordata	Core Course III : Practical	2	0	0	0
5		Chemistry – III / Biochemistry - III	Complementary Course I : Theory	3	3	1	4
6		Chemistry – III / Biochemistry - III	Complementary Course I : Practical	2	0	0	0

7		Botany III	Complementary Course II : Theory	3	3	1	4
8		Botany III	Complementary Course II : Practical	2	0	0	0
Total				25 hrs	17		

Semester 4

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1		English - 6	Common Course IX	5	4	1	4
2		Second language - 4	Common Course X	5	4	1	4
3	ZY4CRT04	Research methodology, Biophysics & Biostatistics	Core Course IV : Theory	3	3	1	4
4	ZY4CRP02	Research methodology, Biophysics & Biostatistics	Core Course IV : Practical	2	2	1	4
5		Chemistry – IV / Biochemistry - IV	Complementary Course I : Theory	3	3	1	4
6		Chemistry – IV / Biochemistry - IV	Complementary Course I : Practical	2	2	1	4
7		Botany - IV	Complementary Course II : Theory	3	3	1	4
8		Botany - IV	Complementary Course II : Practical	2	2	1	4
Total				25 hrs	23		

Semester 5

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1	ZY5CRT05	Environmental Biology & Human rights	Core Course V : Theory	3	3	1	4
2	ZY5CRPO5	Environmental Biology & Human rights	Core Course V : Practical	2	0	0	0
3	ZY5CRT06	Cell Biology & Genetics	Core Course VI : Theory	3	3	1	4
4	ZY5CRPO6	Cell Biology & Genetics	Core Course VI : Practical	2	0	0	0
5	ZY5CRT07	Evolution, Ethology & Zoogeography	Core Course VII : Theory	3	3	1	4
6	ZY5CRPO7	Evolution, Ethology & Zoogeography	Core Course VII : Practical	2	0	0	0
7	ZY5CRT08	Human Physiology, Biochemistry & Endocrinology	Core Course VIII : Theory	3	3	1	4
8	ZY5CRPO8	Human Physiology, Biochemistry & Endocrinology	Core Course VIII : Practical	2	0	0	0
9	ZY5OPT01	1 – Vocational Zoology (Apiculture, Vermiculture, Ornamental fish culture)	Open Courses for other streams (<i>Select any one out of three</i>)	4	3	1	4
	ZY5OPT02	2 – Public health and Nutrition					
	ZY5OPT03	3 – Man, nature & Sustainable Development					
10	ZY6CRPRP	Project work (Credit 2 will be given in 6 th semester with investigatory project).	Project	1	0		
Total				25 hrs	15		

Semester 6

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1	ZY6CRT09	Developmental Biology	Core Course IX : Theory	3	3	1	4
2	ZY6CRP09	Developmental Biology	Core Course IX : Practical	2	2	1	4
3	ZY6CRT10	Microbiology & Immunology	Core Course X : Theory	3	3	1	4
4	ZY6CRP10	Microbiology & Immunology	Core Course X : Practical	2	2	1	4
5	ZY6CRT11	Biotechnology, Bioinformatics and Molecular Biology	Core Course XI : Theory	3	3	1	4
6	ZY6CRP11	Biotechnology, Bioinformatics and Molecular Biology	Core Course XI : Practical	2	2	1	4
7	ZY6CRT12	Occupational Zoology (Aquaculture, Apiculture, Vermiculture & Quail farming)	Core Course XII : Theory	3	3	1	4
8	ZY6CRP12	Occupational Zoology (Aquaculture, Apiculture, Vermiculture & Quail farming)	Core Course XII : Practical	2	2	1	4
9	ZY6CBT01	Elective 1: Ecotourism & Sustainable Development	Choice Based Core Elective Courses (<i>Select any one out of four</i>)	4	3	1	4
	ZY6CBT02	Elective 2: Agricultural pest management					
	ZY6CBT03	Elective 3: Vector & Vector borne Diseases					
	ZY6CBT04	Elective 4: Nutrition, Health & life style management					
10	ZY6CRPRP	Project Work	Project	1	2		
Total				25 hrs	25		

7. SCHEME OF DISTRIBUTION OF INSTRUCTIONAL HOURS

B.Sc. ZOOLOGY PROGRAMME : CORE COURSES –MODEL I

Name of semester	Theory	Practical
First semester	2	2
Second semester	2	2
Third semester	3	2
Fourth semester	3	2
Fifth semester	16	8
Field study & group activity	1	
Sixth semester	16	8
Project work (in sixth sem.), Visit to research institute	1	
Total	44	24

RECORDS

1. General perspectives in Science & Protistan Diversity
2. Animal Diversity –Non Chordata
3. Animal Diversity - Chordata
4. Research Methodology, Biophysics and Biostatistics
5. Environmental Biology & Human rights
6. Cell Biology & Genetics
7. Evolution and Ethology & Zoogeography
8. Human Physiology, Biochemistry & Endocrinology
9. Developmental Biology
10. Microbiology and Immunology
11. Biotechnology, Bioinformatics & Molecular Biology
12. Occupational Zoology

Each Record will be having external and internal evaluation. A total of 1 credit will be allotted for each record and respective practical.

FIELD STUDY/ (STUDY TOUR)

Study tour/ field study, visit to research institute and various places of zoological Importance

A study tour is compulsory. Field study/study tours should be conducted for not less than 6 days (completed during the entire programme), preferably spreading the study in the first to sixth semesters. Students are expected to visit research institutes and various places of zoological importance.

GROUP ACTIVITY

Students are expected to do one group activity in the fifth semester and submit the report in the sixth semester for external practical examination, along with study tour report.

A maximum of ten students can choose any one group activity like aquarium management, vermicomposting, bee keeping, and conduct of zoological exhibitions, designing of posters of zoological importance, surveys related to disease outbreaks, community health programmes or any matter of zoological interest.

A brief report on any two activities mentioned in each elective paper should be submitted as a component of assignment for internal evaluation.

8. SCHEME OF DISTRIBUTION OF HOURS AND CREDIT

B.Sc. ZOOLOGY PROGRAMME : MODEL -1 CORE COURSE

Semester	Title of the Course	Hrs	Inst Hrs/week	Credit
1	General perspectives in Science & Protistan Diversity	36	2	2
1	General perspectives in Science & Protistan diversity (Practical)	36	2	0
2	Animal Diversity – Non Chordata	36	2	2
2	Animal Diversity – Non Chordata (Practical)	36	2	2
3	Animal Diversity - Chordata	54	3	3
3	Animal Diversity - Chordata (Practical)	36	2	0
4	Research Methodology, Biophysics and Biostatistics	54	3	3
4	Research Methodology, Biophysics and Biostatistics (Practical)	36	2	2
5	Environmental Biology & Human rights	54	3	3
5	Environmental Biology & Human rights (Practical)	36	4	0
5	Cell Biology & Genetics	54	3	3
5	Cell Biology & Genetics (Practical)	36	2	0
5	Evolution, Ethology & Zoogeography	54	3	3
5	Evolution, Ethology & Zoogeography (Practical)	36	2	0
5	Human Physiology, Biochemistry & Endocrinology	54	3	3

5	Human Physiology, Biochemistry & Endocrinology (Practical)	36	2	0
6	Developmental Biology	54	3	3
6	Developmental Biology (Practical)	36	2	2
6	Microbiology & Immunology	54	3	3
6	Microbiology & Immunology (Practical)	36	2	2
6	Biotechnology, Bioinformatics & Molecular biology	54	3	3
6	Biotechnology, Bioinformatics & Molecular Biology (Practical)	36	4	2
6	Occupational Zoology (Aquaculture, Apiculture, Vermiculture & Quail farming)	54	3	3
6	Occupational Zoology (Aquaculture, Apiculture, Vermiculture & Quail farming) (Practical)	36	2	2

9. SCHEME OF DISTRIBUTION OF HOURS AND CREDITS :

OPEN COURSES (FOR OTHER STREAMS) & ELECTIVES

Seme ster	Course No	Title of the Course (Select any one from each group)	Hrs	Inst Hrs/ week	Cre dit
5	Open course - 1	Vocational Zoology (Apiculture, Vermiculture & Ornamental Fish Culture)	72	4	3
5	Open course-2	Public Health & Nutrition			
5	Open course-3	Man, Nature & Sustainable Development			
6	Choice Based Core Elective - 1	Ecotourism & Sustainable Development	72	4	3
6	Choice Based Core Elective - 2	Agricultural Pest Management			
6	Choice Based Core Elective - 3	Vector & Vector Borne Diseases			
6	Choice Based Core Elective - 4	Nutrition, Health & Life Style Management			

10. SCHEME OF EXAMINATIONS

a. SCHEME OF EXAMINATION - THEORY (CORE COURSE)

Theory Examinations will be conducted by the University at the end of the respective semester in which the course is conducted. Duration 3 Hrs (Internal External ratio =1:4)

Sem	Course Code	Course Title	Course Category	Duration	Marks ratio		Credits
				Hrs	Internal (I)	External (E)	
1	ZY1CRT01	General perspectives in Science & Protistan Diversity	1	2	1	4	2
2	ZY2CRT02	Animal Diversity – Non Chordata	2	2	1	4	2
3	ZY3CRT03	Animal Diversity- Chordata	3	3	1	4	3
4	ZY4CRT04	Research Methodology, Biophysics and Biostatistics	4	3	1	4	3
5	ZY5CRT05	Environmental Biology & Human rights	5	3	1	4	3
5	ZY5CRT06	Cell Biology & Genetics	6	3	1	4	3
5	ZY5CRT07	Evolution, Ethology & Zoogeography	7	3	1	4	3
5	ZY5CRT08	Human Physiology, Biochemistry & Endocrinology	8	3	1	4	3
6	ZY6CRT09	Developmental Biology	9	3	1	4	3
6	ZY6CRT10	Microbiology and Immunology	10	3	1	4	3
6	ZY6CRT11	Biotechnology, Bioinformatics & Molecular Biology	11	3	1	4	3
6	ZY6CRT12	Occupational Zoology (Aquaculture, Apiculture, Vermiculture)	12	3	1	4	3

		& Quail farming)					
Zoology Open Course Sem 5 (<i>Select any 1 from 3</i>)	ZY5OPT01	Vocational Zoology (Apiculture, Vermiculture, & Ornamental Fish Culture)	Open course (for other streams)-1	4	1	4	3
	ZY5OPT02	Public Health & Nutrition	Open course -2				
	ZY5OPT03	Man, Nature & Sustainable Development	Open course -3				
Sem 6 (<i>Select any 1 from the four</i>)	ZY6CBT01	Ecotourism & Sustainable Development	Choice Based Course-1	4	1	4	3
	ZY6CBT02	Agricultural Pest Management	Choice Based Course-2				
	ZY6CBT03	Vector & Vector Borne Diseases	Choice Based Course-3				
	ZY6CBT03	Nutrition, Health & Life Style Management	Choice Based Course -4				

b. SCHEME OF PRACTICAL EXAMINATIONS

University Practical Examinations will be conducted at the end of even semester 2,4 and 6.

Sem e ster	Code	Practic al No.	Course Title	Duration	Marks ratio		Credit s
				Hrs	Internal (I)	Externa l (E)	
2	ZY2CRP01	I	General Perspectives in Science, Protistan Diversity Biodiversity & Animal Diversity – Non Chordata	3 Hrs	1	4	2
4	ZY4CRP02	II	Animal Diversity – Chordata, Research methodology, Biophysics &	3 Hrs	1	4	2

			Biostatistics				
6	ZY6CRP03	III	Environmental Biology, Toxicology, Cell Biology & Genetics	3 Hrs	1	4	2
6	ZY6CRP04	IV	Evolution, Ethology, Zoogeography, Human Physiology, Biochemistry & Endocrinology	3 Hrs	1	4	2
6	ZY6CRP05	V	Developmental Biology, Microbiology & Immunology	3 Hrs	1	4	2
6	ZY6CRP06	VI	Biotechnology, Bioinformatics, Molecular Biology & Occupational Zoology	3 Hrs	1	4	2

c. Total Credits for Core Course

Theory	
Core + Choice Based Core (Elective)	37
Open course	3
Practical	12
Project	2
Total	54

d. SCHEME OF FIELD STUDY, RESEARCH INSTITUTE VISIT, GROUP ACTIVITY, PROJECT AND VIVA-CORE COURSE (Credit 2)

Marks Maximum 100

	Internal Assessments (I)	External Assessments (E)
Project:- Log book showing the progress of project work duly signed by the supervising teacher & HOD	20	<p>Project report – 50 marks</p> <p>Title- 2 Marks</p> <p>Abstract- 3 Marks</p> <p>Introduction & Review of literature- 10 Marks</p> <p>Methodology- 10 Marks</p> <p>Results- 10 Marks</p> <p>Discussion & Conclusion - 10 Marks</p> <p>Neat presentation and Novelty- 5 Marks</p> <p>Presentation & Viva- 30Marks</p> <p>(Student can present the project using OHP or LCD, in 7 Minutes) Viva Voce.</p>
Total	20	80

11. COMPLEMENTARY ZOOLOGY COURSES OFFERED BY ZOOLOGY**DEPARTMENT FOR - MODEL I – BSc BOTANY / BSc****HOME SCIENCE****MODEL II – BSc BOTANY / VOCATIONAL****SUBJECTS****MODEL III – BSc (BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION)**

Semester	Code	Title of the Course	Hrs	Inst Hrs/week	Credit
1	ZY1CMT01	Non Chordate Diversity	36	2	2
1		Non Chordate Diversity (Practicals)	36	2	0
2	ZY2CMT02	Chordate Diversity	36	2	2
2		Chordate Diversity (Practicals)	36	2	0
2	ZY2CMP01	Practical 1 Non Chordate Diversity + Chordate Diversity (Practicals)			2
3	ZY3CMT03	Physiology and Immunology	54	3	3
3		Physiology and Immunology (Practicals)	36	2	0
4	ZY4CMT04	Applied Zoology	54	3	3
		Applied Zoology (Practicals)	36	2	
4	ZY4CMP02	Practical 2 Physiology and Immunology + Applied Zoology (Practical)			2

12. SYLLABUS:

B.Sc ZOOLOGY PROGRAMME

MODEL – I

THEORY & PRACTICALS

SEMESTER 1. ZY1CRT01. CORE COURSE 1.

GENERAL PERSPECTIVES IN SCIENCE & PROTISTAN DIVERSITY

36 Hrs

Credits 2

Objectives:

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

PART I PERSPECTIVES IN SCIENCE

8Hrs

Module I Introduction to Scientific Studies

4Hrs

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

Module II What is Biology?

4 Hrs

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

PART II SYSTEMATICS

10 Hrs

Module III–Taxonomical Principles and tools

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

Identification tools

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

Advantages and Disadvantages

PART III: PROTISTAN DIVERSITY

18 Hrs

Module IV – Kingdom Protista Type: *Paramecium*

5 Hrs

Salient features of Kingdom Protista

10 Hrs

Classification of Protista up to phyla

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

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

General Topics:

3 Hrs

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

References

Anderson D.T. 2001 Invertebrate Zoology Sec Edition Oxford University Press

Barnes R.D. 1987. Invertebrate Zoology. W. B. Saunders. New York.

- Bowler Peter J. and Iwan Rhys Morus. 2005 *Making Modern Science: A Historical Survey*.
University of Chicago Press, Chicago, IL:
- Dhami.P.S. and Dhami J.K. 1979 *Invertebrate Zoology*. R. Chand and Co. Delhi.
- Ekambaranatha Ayyar M. 1990. *A Manual of Zoology*. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.
- Ernst Mayr 1982. *The Growth of Biological Thought: Diversity, Evolution and Inheritance*.
Published by Harvard University Press.
- Ervin Schrodinger 1944. *What is life? Mind and Matter*. Cambridge University Press.
- Hyman L. H. *The Invertebrate Volumes*. Mc Graw Hill.
- Jacques Monod 1971. *Chance and Necessity: An Essay on the Natural Philosophy of Modern Biology*. Vintage Pub. NY
- Jordan. E. L., and Verma P.S. 2000. *Invertebrate zoology*. S. Chand and Co. Ltd., New Delhi.
- Kapoor ,V.C.1998. *Theory and Practice of Animal Taxonomy*. Oxford and IBH Pub.Co, New Delhi.
- Kotpal.R. L., 1988-92; (Protozoa).Rastogi Publishers, Meerut.
- Kotpal R. L, Agarwal S. K. and R. P. Khetharpal 2002. *Modern Textbook of Zoology*.
- Mayr, E. (1980). *Principles of Systematic Zoology* (Tata McGraw Hill Publishing Co., New Delhi)
- Parker and Hanswell, 2004, *Text Book of Zoology, Vol I (Invertebrate)*, 7th Edition,
A.Z.T,B.S. Publishers and Distributors, New Delhi – 110 051
- Pechenik J A (2005) *Biology of Invertebrates*, (Tata McGraw Hill Publishing Co., NewDelhi.)
- Prema A.K., Joseph M.L. and Terrence Rebello V. (Eds) (2011). *Invertebrate Diversity of Kerala*. Zoological Society of Kerala, Kottayam.
- Taylor, Green, Stout (2008) *Biological Science*, Cambridge University, Press, p
- Thomas, A.P. (Editor) 2009. *Biology – Perspectives and Methods*. Green Leaf Publishers, Kottayam.
- Thomas A P (Editor) 2010 *The Invertebrates*, Green leaf publications Kottayam

SEMESTER 1

CORE COURSE PAPER 1 PERSPECTIVES IN SCIENCE & PROTISTAN DIVERSITY (PRACTICAL)

36 Hrs

2 Credits

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

SEMESTER 11. ZY2CRT02

CORE COURSE 11: ANIMAL DIVERSITY - NON CHORDATA

36 Hrs

Credits 2

Objectives:

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

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

MODULE I Kingdom Animalia

7 Hrs

Outline classification of Kingdom Animalia

Three branches - **Mesozoa, parazoa and Eumetazoa**

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

Parazoa:

1. Phylum Placozoa – Eg. *Trypanoxenus*

2. Phylum Porifera – Classification upto classes; Mention gemmules

Class I- Calcarea. Eg. *Sycon*,

Class II – Hexactinellida .Eg. *Euplectella*.

Class III - Demospongia Eg. *Cliona*.

General Topics

1. Canal system in sponges.

Phylum Coelenterata -Classification upto classes

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

Class II- Scyphozoa Eg. *Rhizostoma*.

Class III- Anthozoa Eg. *Metridium*.

General Topics:

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

2. Polymorphism in Coelenterates

Phylum Ctenophora - Eg. *Pleurobrachia*.

MODULE II

Phylum Platyhelminthes Salient features; classification up to classes **3 Hrs**

Class I - Turbellaria. Eg. *Planaria*.

Class II –Trematoda Eg. *Fasciola*

Class III- Cestoda Eg. *Taenia saginata*.

General Topics:

1. Life history of *Fasciola hepatica*.

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

Phylum Nematelminthes(Nematoda)

2 Hrs

Salient features, classification up to classes

Class: Phasmodia Eg. *Enterobius*,

Class: Aphasmodia Eg. *Trichinella*

General Topic

Pathogenic nematodes in man. (*Wuchereria bancrofti*, *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Trichinella*).

Phylum Annelida:

2 Hrs

Salient features, Classification upto classes.

Class I- Archannelida Eg. *Polygordius*

Class II -Polychaeta Eg. *Chaetopterus*

ClassIII- Oligochaeta Eg. *Megascolex*.

Class IV- Hirudinea Eg. *Ozobranchus*, *Hirudinaria*

MODULE III

14 Hrs

Phylum Onychophora

Eg. *Peripatus* (Mention its affinities).

Phylum Arthropoda Salient features, Classification upto classes

Type: Prawn –*Fenneropenaeus (Penaeus)*

1. Sub Phylum - Trilobitomorpha

Class -Trilobita (mention the salient features).

Eg. *Triarthrus* – A trilobite (extinct)

2. Subphylum –Chelicerata

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

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

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

3. Subphylum- Crustacea

Class 1 Branchiopoda Eg. *Daphnia*

Class 2 Ostracoda Eg. *Cypris* -seed shrimp

Class 3 Copepoda Eg. *Cyclops*

Class 4 Remipedia Eg. *Speleonectes* (eyeless crustacean seen in caves)

Class 5. Branchiura Eg., *Argulus* (common fish louse)

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

Class 7 Malacostraca Eg. *Squilla* (spot tail mantis shrimp)

4. Subphylum- Uniramia

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

- Class 2 Symphyla Eg. *Scutigereilla* – (garden centipedes or pseudocentipedes)
 Class 3 Diplopoda Eg. *Spirostreptus*- (Millipede)
 Class 4 Pauropoda Eg. *Pauropus*
 Class 5 Hexapoda (Insecta) Eg. *Bombyx mori* – (silk moth)

MODULE IV

Phylum Mollusca

3 Hrs

Salient features, Classification upto classes

- Class I- Aplousobranchia Eg. *Neomenia*
 Class II- Monoplacophora Eg. *Neopilina*
 Class III Amphineura Eg. *Chiton*
 Class IV Gastropoda Eg. *Aplysia*
 Class V Scaphopoda Eg. *Dentalium*
 Class VI Pelecypoda (Bivalvia) Eg. *Pinctada*
 Class VII Cephalopoda Eg. *Sepia*

Phylum Echinodermata

3 Hrs

Classification upto classes

- Class I- Asterozoa Eg. *Astropecten*
 Class II- Ophiurozoa Eg. *Ophiothrix*
 Class III- Echinozoa Eg. *Echinus*
 Class IV- Holothurozoa Eg. *Holothuria*
 Class V – Crinozoa Eg. *Antedon*

General Topics

1. Water vascular system in Echinodermata

Phylum Hemichordata:

2 Hrs

Eg. *Balanoglossus*

Minor Phyla

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

References:

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. Dhama, P.S. and Dhama, J.K. (1979). Invertebrate Zoology. S. Chand and Co. New Delhi.
4. Ekamberanatha Ayyar M. (1990) A Manual of Zoology, Volume I. Invertebrate Part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.
5. Groove, A.J. and Newell, G.E. (1974). Animal Biology – Indian Reprint, University Book Stall, New Delhi.
6. Hyman, L.H. (1942) The Invertebrate volumes. McGraw-Hill.
7. James R.D. (1987). Invertebrate Zoology, W.B. Saunders, New York.
8. Jordan E.L and Verma P.S (2007). Invertebrate Zoology. S.Chand and Co.New Delhi.
9. Joy P.J., George Abraham K., Aloysius M. Sebastian and Susan Panicker (Eds) (1998). Animal Diversity, Zoological Society of Kerala, Kottayam
10. Kapoor, V.C. (1994). Theory and Practice of Animal Taxonomy, Oxford and IBH Publishing Co., New Delhi.
11. Kotpal.R. L., 1988-92 (All series). Protozoa, Porifera, Coelentereta, Helminthes, Annelida, Arthropoda, Mollusca, Echinodermata, Rastogi Publishers, Meerut.
12. Kotpal R.L. Agarwal S.K. and R.P. Khetharpal (2002). Modern Text Book of Zoology. Rastogi Publications, Meerat – 250 002.
13. Marshall, A.J. and Williams, W.D. (1972). Text Book of Zoology Vol. Invertebrates (ELBS and Macmillan, London).
14. Mayr, E. (1980). Principles of Systematic Zoology (Tata McGraw Hill Publishing Co., New Delhi)
15. Parker and Hanswell, 2004, Text Book of Zoology, Vol I (Invertebrate), 7th Edition, A.Z.T,B.S. Publishers and Distributors, New Delhi – 110 051
16. Pechenik J A (2005) Biology of Invertebrates, (Tata McGraw Hill Publishing Co., NewDelhi.)
17. Prema A.K., Joseph M.L. and Terrence Rebello V. (Eds) (2011). Invertebrate Diversity of Kerala. Zoological Society of Kerala, Kottayam.
18. Thomas A P (Editor) 2010 The Invertebrates, Green leaf publications Kottayam

PRACTICAL

ANIMAL DIVERSITY- NON CHORDATA

36 Hrs.

Credit 1

Scientific Drawing:-

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

Anatomy:-

Study of sections. (Any two)

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

Dissections

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

Mounting:-

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

Identification:-

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

Identification of (a) Parasitic protist – any 2 (b) larval forms of *Fasciola*- any 2 (c) Nematode parasites of man- any 3 (Slides/figures may be used for study)

Taxonomic identification with key:-

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

SEMESTER 111. ZY3CRT03

CORE COURSE 111: ANIMAL DIVERSITY –CHORDATA

54 Hrs

3 Credits

Objectives

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

MODULE I

Introduction

1 Hr

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

Protochordates: General characters and Classification

2 Hrs

1. Sub phylum: Urochordata

Class I Larvacea Eg. *Oikopleura*

Class II Ascidiacea Eg: *Ascidia* (Mention Retrogressive Metamorphosis)

Class III Thaliacea Eg: *Doliolum*

2. Sub phylum: Cephalochordata

2 Hrs

Example - *Amphioxus* (Structure and affinities)

MODULE II

3. Sub phylum: Vertebrata General characters and Classification

2 Hrs

4. Division 1– Agnatha

Class I Ostracodermi Eg: *Cephalaspis*

Class II Cyclostomata Eg: *Petromyzon*

Division 2 – Gnathostomata

10 Hrs

Super class Pisces General Characters and Classification

Class: Chondrichthyes - General Characters

Sub class – ElasmobranchI Eg: *Narcine*

Sub class - Holocephali Eg: *Chimaera*

Class: Osteichthyes - General Characters

Sub class – Choanichthyes

Order 1 Crossopterigii(Coelocanth) Eg: *Latimeria*(Evolutionary

Significance)

Order 2 Dipnoi Eg: *Lepidosiren* - Distribution, affinities and systematic position of lung fishes.

Sub class: - Actinopterygii

Super order 1. Chondrostei Eg: *Acipenser*

Super order 2. Holostei Eg: *Amia*

Super order 3. Teleostei Eg: Sardine

General topics

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

MODULE III

Super class: Tetrapoda General characters, Classification up to Orders **11 Hrs**

Class Amphibia - Type Frog (*Euphlyctis hexadactylus*)

Order I Anura Eg: *Hyla*

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

Order III Apoda Eg: *Ichthyophis*.

Class Reptilia

4 Hrs

Sub class I: Anapsida

Order Chelonia Eg: *Chelone*

Sub class II: Parapsida Eg: *Ichthyosaurus*

Sub class III: Diapsida

Order I Rhynchocephalia Eg: *Sphenodon*

Order II Squamata Eg: *Chamaleon*

Order III. Crocodilia Eg: *Crocodylus*

Sub class IV: Synapsida Eg: *Cynognathus*

General topic

Identification of poisonous and non-poisonous snakes

Class Aves

5 Hrs

Sub class I: Archeornithes Eg: *Archaeopteryx* (Affinities)

Sub class II: Neornithes

Super order I: Palaeognathe Eg: *Struthio*

Super order II: Neognathe Eg: Brahminy kite

General topics

1. Migrations in birds
2. Flight adaptations in birds

MODULE IV

Class Mammalia Type: Rabbit (*Oryctolagus cuniculus*)

17 Hrs

Brief mention of general characters and classification up to order with example. (Mention any five salient features of each order, detailed accounts of examples are not necessary)

Sub class I: Prototheria Eg: Echidna, *Ornithorhynchus*

Sub class II: Metatheria Eg: *Macropus*

Sub class III: Eutheria

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

General topics

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

References

1. Ekambaranatha Iyer (2000), A Manual of Zoology Vol. II .S. Viswanathan and Co.
2. Jhingran (1977), Fish and Fisheries of India, Hindustan Publishing Co.
3. Jordan E L and P.S. Verma, (2002), Chordate Zoology, S. Chand and Co. New Delhi
4. Joy P.J., George Abraham K.,Aloysius M. Sebastian (1998). Animal Diversity.
Zoological Society of Kerala, Kottayam
5. Kotpal R.L. (2000), Modern Text Book of Zoology, Vertebrates, Rastogi Publications,

Meerut.– 250 002.

6. Nigam, H. C. (1983). Zoology of Chordates, Vishal Publications, Jalandhar - 144008
7. Nigam, H.C. and Sobti (2000), Functional Organization of Chordates, Shoban Lal Nagin Chand and Co., New Delhi.
8. Parker and Hanswell, (2004), Text Book of Zoology, Vol II (Chordata), A.Z.T,B.S. Publishers and Distributors, New Delhi – 110 051
9. Pough H. (2009) Vertebrate life, VIII Edition, Pearson International
10. Prema A.K., Terrence V.R. and Mini K.D.(Eds.) (2011). Chordate Diversity of Kerala, Zoological Society of Kerala, Kottayam
11. Thomas A. P. (Editor) (2010) Chordata .Green leaf publications Kottayam
12. Young J.Z.(2004), The life of Vertebrates, Oxford University Press (Third Ed.) India Ed.

PRACTICAL

ANIMAL DIVERSITY - CHORDATA

36 Hrs

Credit 1

1. Scientific Drawing

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

2. Dissections

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

1. Frog Viscera
2. Frog Digestive System
3. Frog Arterial System
4. Frog 9th & 1st Spinal nerve
5. Frog Sciatic Plexus
6. Frog Brain

3. Mounting of placoid scales; study of cycloid and ctenoid scales

4. Osteology

Frog vertebrae - typical, atlas, 8th and 9th

Rabbit – Atlas, Axis and typical vertebra

Pectoral and pelvic girdles of Frog and Rabbit

Bird - Keel and Synsacrum

Turtle/Tortoise - plastron and carapace

5. Study of sections.

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

6. Identification:-

General identification-

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

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

Taxonomic identification with key:-

- i) Identification of fishes up to the level of order.
- ii) Identification of snakes up to family.

SEMESTER IV. ZY4CRT04

CORE COURSE IV

RESEARCH METHODOLOGY, BIOPHYSICS AND BIostatISTICS

54 Hrs

3 Credits

Objectives

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

RESEARCH METHODOLOGY

Module I

13 Hrs

Basic concepts of research: Meaning, Objectives, Approaches, Types of research.

Research Process: Scientific method in research (eight steps).

Importance of literature reviewing in defining a problem,

Identifying gap areas from literature review.

Research Communication and scientific documentation: Project proposal writing,

Research report writing, (Structure of a scientific paper), Thesis, dissertation, research article.

Presentation techniques: Oral presentation, Assignment, Seminar, Debate, Workshop,

Colloquium, Conference

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

Periodicals, Reviews, Internet.

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

Plagiarism

Module II

12 Hrs

Animal Collection – Tools & techniques

Sampling techniques

 Quadrat

 Line transect

Measurements

 Density

 Abundance

 Frequency

Biodiversity indices – concepts

 Simpson index

Collection methods, techniques and equipments

 Plankton

 Insects

 Fish

Bird

Preservation techniques – Taxidermy

Rearing techniques

Laboratory and field.

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

BIOPHYSICS

Module III

14 Hrs

Basic understanding on principle and uses of the following:

Microscopy

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

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

Micrometry – Stage and Eyepiece micrometers

Camera Lucida

Instrumentation

pH Meter

Separation Techniques: Centrifuge, Chromatography, Electrophoresis

Analytical techniques: Colorimeter, Spectrophotometer, X-ray crystallography

BIOETHICS

Module IV

5 Hrs

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

Concept of 3 R – conservation (Refined- to minimize suffering, Reduced – to minimize animals, Replaced – modern tools and alternate means), Animal use in research and education.

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

Module V

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

Measures of Central Tendency: Mean, Median, Mode (Problem - Direct method only)

Measures of dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Standard error. (Merits & demerits and problems on SD).

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

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

References

1. Gupta K.C, Bhamrah, H.S and G.S.Sandhu (2006) Research Techniques in Biological Sciences. Dominant Publishers and Distributors, New Delhi.
2. Khan and Khanum, (1990) Fundamentals of biostatistics.Press, Chicago,
3. Rastogi, V.B (2009) Fundamentals of Biostatistics, Ane Books Pvt. Ltd. New Delhi.
4. Ackoff, R.L. (1962) Scientific Method, New York : John Wiley Press.
5. Aggarwal. S.K.(2009) Foundation Course in Biology, 2nd Ed.. Ane's Student Edition. Ane Books Pvt. Ltd.
6. Anderson, J, Durston, B.H. and Poole, M. (1992). Thesis and assignment writing. Wiley Eastern Ltd.
7. Best, J.W.and K.V. James, (1986) Research in Education.5th Edn. Prentice- Hall of India Pvt.Ltd.

8. Campell, R. (1990). Statistics for biologists. CBS Publishers and distributors.
9. Day, R.A. (1993). How to write and publish a scientific paper. Cambridge University Press.
10. Day, R.A. (2000) Scientific English: A guide for Scientists and other Professionals. Universities Press.
11. Fischer, R.A.(1960)The Design of Experiment. 7th rev.edn. New York: Hafner Publishing Co.,
12. Hawkins C. and Sorgi, M. (1987). Research: How to plan, speak and write about it. Narosa Publishing House.
13. Killick, H.J. (1971). Beginning ecology. Ibadan University Press.
14. Kleinbaum, D.G. and M.Klein (2009) Survival analysis-Statistics for Biology & Health 2nd Ed. Springer International ed.
15. Knudsen J. W (1966) Biological Techniques: Collecting,Preserving, and Illustrating Plants and Animals.
16. Kothari, C.R. and G.Garg. (2014) Research Methodology. Methods and Techniques. 3rd edn.
17. Marie, M. (2005). Animal Bioethics: Principles and Teaching Methods Wageningen Academic Publishers.
18. Norman T.J. (2007) Bailey Statistical methods in biology, Cambridge University press.
19. Roberts, M. T. King and M. Reiss.(1994) Practical Biology for Advance Level. Thomas Nelson and Sons Ltd. Surrey, UK.
20. Ruxton, G.D. and Colegrave, N. (2006), Experinmental design for the life sciences. Oxford University Press.
21. Sateesh, M.K. (2008) Bioethics and Biosafety; I.K. International Publishing House .

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

CORE COURSE IV

RESEARCH METHODOLOGY, BIOPHYSICS AND BIostatISTICS

(PRACTICAL) 2 credits

PART A. RESEARCH METHODOLOGY

Animal collection Tools, Techniques & Estimation

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

PART B - BIOPHYSICS

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

PART C BIostatISTICS

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

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

SEMESTER V. ZY5CRT05

CORE COURSE V

ENVIRONMENTAL BIOLOGY AND HUMAN RIGHTS

54 Hrs

Objectives

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

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

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

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

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

MODULE 1 ECOSYSTEM

12 Hrs

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

Biogeochemical cycles: Concept, gaseous and sedimentary cycles, Carbon cycle, Nitrogen cycle.

Renewable resources (solar, wind, hydroelectric, biomass and geothermal) **and Non renewable resources** (mineral and metal ore, fossil fuels)

MODULE 2 CONCEPTS OF POPULATION AND COMMUNITY 8 Hrs

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

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

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

MODULE 3 BIODIVERSITY AND ENVIRONMENTAL ISSUES 16 Hrs

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

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

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

Toxic products and disaster: Types of toxic substances – degradable, non degradable, Impact on human – case studies: Endosulphan tragedy, Bhopal disaster

Flood, drought, cyclone, earthquake and landslide (Management and mitigation)

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

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

RAMSAR sites, Marine ecosystem crisis- pollution, overfishing etc. Impact of tourism on Environment.

MODULE 4 CONSERVATION OF BIODIVERSITY

12 Hrs

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

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

Man–animal conflict (Tiger, Elephant, Dog, Monkey) – causes and concern

Water conservation- rainwater harvesting, watershed management

Environment education

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

MODULE 5 HUMAN RIGHTS

6 Hrs

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

References

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

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

**PRACTICAL
ENVIRONMENTAL BIOLOGY & TOXICOLOGY**

36 HRS

CREDIT 1

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

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

SEMESTER V. ZY5CRT06

CORE COURSE VI CELL BIOLOGY AND GENETICS

**54 Hrs
Credits 3**

Objectives

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

CELL BIOLOGY

22 HRS

Module I

6 Hrs

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

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

Module II

10 Hrs

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

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

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

Module III

6 Hrs

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

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

References

- 1 Zoological Society of Kerala Study material. 2002. *Cell Biology, Genetics and Biotechnology*
2. Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons. Inc.
3. Koshy Thomas & Joe Prasad Mathew (Editors) (2011) *Cell Biology and Molecular Biology*.
4. Sarada K & Mathew Joseph (Editors) (1999) *Cell Biology, Genetics and Biotechnology*,
5. Thomas A.P (Editor) (2011) *Cell & Molecular Biology The Fundamentals*. Green leaf publications. TIES. Kottaya
6. Rastogi S. C. (1998) *Cell Biology*. Tata Mc.Graw Hill Publishing Co., New Delhi.
7. Powar C.B. (1983) *Cell Biology* (Himalaya Pub. Company)
8. Ali, S (2014) *The Cell: Organization Function and Regulatory Mechanisms*, Pearson
9. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World of the Cell*. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco. 4

10. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). *Molecular Biology of the Cell*, V Edition, Garland publishing Inc., New York and London.
11. Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
12. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
13. Gupta, P. K (2002) *Cell and Molecular Biology*, (2ed), , Rastogi Publications., Meerut
14. James Darnell. (1998) *Molecular Biology*. Scientific American Books Inc
15. Ariel G Loewy Philip Sickevitz, John R. Menninger and Jonathan A.N. Gallants (1991) cell structure and function. Saunder's College Publication
16. James Darnell. (1998) *Molecular Biology*. Scientific American Books Inc.

GENETICS **32 Hrs**

Module I **10 Hrs**

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

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

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

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

Module II **12 Hrs**

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

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

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

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

Module III

10 Hrs

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

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

Genetic Counseling, Eugenics and Euthenics -Brief account only

References

1. Gardner, J.E., Simmons, J.M and Snustad D.P..(2007). *Principles of Genetics* (8th edn.). John Wiley and Sons, India.
2. Klug, W.S and Cummings,M.R. (2011). *Concepts of Genetics* (7th edn).Pearson Education Inc.India.
3. Sarada K & Mathew Joseph (Editors) (1999) *Cell Biology, Genetics and Biotechnology*,
4. Shirly Annie Oommen, Sampath Kumar S., and Jinsu Varghese (Editors) (2012), *Gene to Genome*. Zoological Society of Kerala, Kottayam.
5. Singh,B.D.(2006). *Biotechnology*.Kalyani Publishers, New Delhi.
6. Thomas A. P (Editor), (2012). *Genetics and Biotechnology- The Fundamentals*. Green Leaf Publications, TIES, Kottayam.
7. Vijayakumaran Nair K. (2012). *Genetics and Biotechnology*. Academica, Trivandrum.

8. Benjamin Lewin. (2004). *Gene VIII*. Oxford University Press.
9. Brown C.H., Campbell I and Priest F, G. (1987). *Introduction of Biotechnology*.
Blackwell Scientific Publishers, Oxford.
10. Das, H.K. (2007). *Text Book of Biotechnology*. Willey India Pvt. Ltd. New Delhi.
11. Hartl, L.D. and E.W.Jones. (2009). *Genetics: Analysis of Genes and Genomes (7th edn)*
Jones and Barlett Publishers Inc, USA.
12. Primrose, S.B., Twyman, R.M. and Old, R.W. (2001). *Principles of Gene Manipulation*
(6th edn.) Blackwell Science Ltd., London.
13. Sobti, R.C. and Pachauri, S.S. (2009). *Essentials of Biotechnology*. Ane's Book Pvt.
Ltd. New Delhi.
14. Sinnat Dunn & Dobzhansky 1959. *Principles of Genetics* (T.M.H. New Delhi)

SEMESTER V

CORE COURSE VI CELL BIOLOGY AND GENETICS (PRACTICAL)

36 Hrs

2 Credits

PART A: CELL BIOLOGY

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

PART B : GENETICS

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

(use photographs or Xerox copies)

4. Sexing of Drosophila.
5. Study of Barr body in human buccal epithelium

SEMESTER V. ZY5CRT07

CORE COURSE - V11: EVOLUTION, ETHOLOGY & ZOOGEOGRAPHY

54 Hrs

Credits 3

Objectives:

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

Prerequisite:

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

PART I - EVOLUTION

30 Hrs

Module I - Origin of life

8 Hrs

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

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

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

Module II - Theories of organic evolution

9 Hrs

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

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

Module III – Nature of evolution

13 Hrs

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

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

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

Evolution of Horse

PART II- ETHOLOGY

14 Hrs

Module IV – Introduction

1 Hr

Definition, History and scope of ethology

Module V – Learning, imprinting and behaviour

9 Hrs

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

Module VI – Social organization

4 Hrs

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

PART III- ZOOGEOGRAPHY

10 Hrs

Module VII – General Topics

4 Hrs

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

Module VIII - Zoogeographical realms

6 Hrs

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

References:

EVOLUTION

1. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press.
2. Barnes, C.W. (1988). Earth, Time and Life. John Wiley & Sons, New York
3. Bendall, D. S. (ed.) (1983). Evolution from Molecules to Man. Cambridge University Press, U.K.
4. Bull J.J and Wichman H.A..(2001). Applied Evolution. Annu. Rev. Ecol. Syst. 32:183-217
5. Campbell, N. A. and Reece J. B. (2011). Biology. IX Edition, Pearson, Benjamin, Cummings.
6. Chattopadhyay Sajib. (2002). Life Origin, Evolution and Adaptation. Books and Allied (P) Ltd. Kolkata, India.
7. Douglas, J. F (1997). Evolutionary Biology. Sinauer Associates.
8. Goodwin, B. (1996). How the Leopard Changed its Spots: The Evolution of Complexity. Simon & Schuster, NY, USA.
9. Hall, B. K. and Hallgrímsson, B. (2008), Evolution. 4th Edition; Jones and Bartlett Publishers.
10. Coyne J.A. and Allen Orr H. (2004). Speciation, Sinauer Associates
11. Ridley, M. (2004), Evolution 3rd Edition. Blackwell Publishing
12. Rob Desalle and Ian Tattersall (2008). Human Origins: What Bones and Genomes Tell Us about Ourselves. Texas A&M University Press, USA.
13. Strickberger, M.W. 2000. Evolution. Jones and Bartlett, Boston.

ETHOLOGY

1. Agarwal. V. K. (2009). Animal Behaviour. S. Chand and Company Pvt. Ltd., New Delhi.
2. Bonner, J.T. (1980). The Evolution of Culture in Animals. Princeton University Press. NJ, USA.
3. David McFarland. (1999). Animal Behaviour. Pearson Education Ltd. Essex, England.
4. Dawkins, M.S. (1995). Unravelling Animal Behaviour. Harlow: Longman.
5. Dunbar, R. (1988). Primate Social Systems. Croom Helm, London.
6. Gundevia J.S. and Singh H.G. (1996), A Text Book of Animal Behaviour. S. Chand and Company Pvt. Ltd., New Delhi.
7. Aubrey M. and Dawkins M.S. (1998). An Introduction to Animal Behaviour. Cambridge University Press, UK.
8. Sherman P.W and Alcock J., (2001) Exploring Animal Behaviour- Readings from

- American Scientist 3rd Edn. Sinauer Associates Inc. MA,USA. (Module 10 & 11).
9. Wilson, E.O. (1975). Sociobiology. Harvard University Press, Cambridge, Mass. USA. (Module 9).

ZOOGEOGRAPHY

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

PRACTICAL

EVOLUTION, ETHOLOGY AND ZOOGEOGRAPHY

36 Hrs

Credit 1

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

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

SEMESTER V. ZY5CRT08

CORE COURSE VIII

HUMAN PHYSIOLOGY, BIOCHEMISTRY, AND ENDOCRINOLOGY

54 Hrs

Credits 3

Objectives:

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

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

HUMAN PHYSIOLOGY

31 Hrs

Module I

8 Hrs

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

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

Module II

8 Hrs

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

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

Module III

5 Hrs

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

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

Module IV

10 Hrs

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

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

BIOCHEMISTRY

15 Hrs

Module V

5 Hrs

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

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

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

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

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

Module VI

10 Hrs

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

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

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

ENDOCRINOLOGY

Endocrinology and reproduction **8 Hrs**

Module VII **8 Hrs**

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

References

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

Palgrave – Macmillan.

Arthur C. Guyton and John E. Hall; 2016; Text Book of Medical Physiology: Guyton, 13th edition; Elsevier

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

Bhagavan, N.V.. 2007. Medical biochemistry, fourth edition Academic Press,

Awapara J, 1968. Introduction to Biological chemistry. Prentice Hall. New Jersey

Geetha N. 2014. Textbook of Medical Physiology:.. Paras Medical Publishers, 3rd edition

Jain, A K.; 2016; Textbook of Physiology., Avichal Publishing Company

Martin, C.R. 1985. Endocrine Physiology: Oxford University Press.

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

12th edition

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

Rastogi, S. C.; 2007; Outlines of Biochemistry . CBSPublishers, New Delhi.

Robert K. Murray and Victor W. Rodwell; 2012; Harper's Illustrated Biochemistry, Harper;.
29th edition (Lange basic science.)

Sarada Subramanyam and K. Madhavankutty; 2014; Textbook of human physiology.,
S.Chand & Company Ltd,

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

PRACTICAL

HUMAN PHYSIOLOGY, BIOCHEMISTRY, AND ENDOCRINOLOGY

36 Hrs

Credit1

HUMAN PHYSIOLOGY

- 1). Determination of haemoglobin content of blood
- 2). Total RBC count using Haemocytometer
- 3). Total WBC count using Haemocytometer
- 4). Estimation of microhaematocrit
- 5). Effect of hypertonic, hypotonic and isotonic solutions on the diameter of RBC.
- 6). Instruments: Kymograph, Sphygmomanometer and Stethoscope (principle and use)
- 7). Measurement of blood pressure using sphygmomanometer (demonstration only)

BIOCHEMISTRY

1. Qualitative analysis of protein, glucose, starch and lipids.
2. Chromatography – Determination of Rf value of amino acids and identification of amino acids (Identify the Amino Acids using different solvent front and solute front)

ENDOCRINOLOGY

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

SEMESTER VI. ZY6CRT09

CORE COURSE IX DEVELOPMENTAL BIOLOGY

54 Hrs

3 Credits

Objectives:

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

Module 1

10 Hrs

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

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

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

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

Module II

14 Hrs

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

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

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

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

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

Module III

20Hrs

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

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

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

Module IV

5Hrs

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

Teratology / Dysmorphology, Developmental defects: Teratogenesis, important teratogenic agents.(Radiations, chemicals and drugs, infectious diseases) genetic teratogenesis in human beings,

Developmental defects: Prenatal death (miscarriage and still birth). Intrauterine Growth Retardation (IUGR).

Module V

5 Hrs

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

References

Anthony S. Fauci, Eugene Braunwald, Dennis L. Kasper, Stephen L. Hauser, Dan L. Longo, J. Larry Jameson and Joseph Loscalzo; 2008; Harrison's Principles of Internal Medicine;

Church Livingstone 17th Ed.

Balinsky B.I.; 1981 An Introduction to Embryology, W.B. Saunders and Co.

Berril, N..J.; and Kars, G.; 1986. Developmental biology, Mc Graw Hills

Dutta 2007 Obstetrics , Church Livingstone 17 Ed

Majumdar N. N -1985 Vertebrate embryology; Tata McGraw-Hill, New Delhi

Melissa A & Gibbs, 2006; A practical Guide to Developmental Biology, Oxford university press (Int. student edition)

Scott F. Gilbert; 2003; Developmental biology; Sinauer Associates Inc.,U.S.; 7th Revised edition.

Vijayakumarn Nair, K. & George, P. V. 2002. A manual of developmental biology, Continental publications , Trivandrum

Taylor D J, Green NPO & G W Stout. (2008) Biological Science third edition. Cambridge

university press. Ref pp 748 biology 755

PRACTICAL
DEVELOPMENTAL BIOLOGY

36 Hrs

Credit 1

Model/Chart/ Slide may be used

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

SEMESTER VI. ZY6CRT10

CORE COURSE X. MICROBIOLOGY AND IMMUNOLOGY

54 Hrs

3 Credits

MICROBIOLOGY

Module I

10 Hrs

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

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

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

freezing under liquid nitrogen, lyophilization.

Module II

15 Hrs

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

Bacterial growth Curve, Staining techniques – gram staining.

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

Module III

8 Hrs

Infections & Diseases: Types of infections – primary, secondary and nosocomial infections.

(Brief Account only) Contagious diseases – epidemic, endemic and pandemic, mode of

Transmission – food, water, air, vectors and carriers.

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

IMMUNOLOGY

Module IV

9Hrs

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

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

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

Module V

9 Hrs

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

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

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

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

Vaccines

3 Hrs

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

References

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

9. Helen Hapel, Mased Harney Siraj Misbah and Next Snowden: (2006) Essentials of Clinical Immunology Fifth Ed. Blackwell Publishing Company,
10. Heritage, J, E.G.V. Evas and R.A.Killungten (2007): Introductory Microbiology Cambridge University Press 6. Ivan Roitt I (2002) Essentials of Immunology ELBS.

PRACTICAL

MICROBIOLOGY AND IMMUNOLOGY

72 Hrs

2 Credits

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

SEMESTER VI. ZY6CRT11

CORE COURSE XI.

BIOTECHNOLOGY, BIOINFORMATICS AND MOLECULAR BIOLOGY

BIOTECHNOLOGY

20 Hrs

Module I

11Hrs

Introduction: Scope, Brief History, Scope and Importance

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

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

Module II

9 Hrs

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

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

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

References

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

BIOINFORMATICS

14 Hrs

Module III

8 Hrs

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

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

Module IV

6 Hrs

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

MOLECULAR BIOLOGY

20 Hrs

Module V

8 Hrs

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

Module VI

12 Hrs

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

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

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

References

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

PRACTICAL .

BIOTECHNOLOGY, BIOINFORMATICS & MOLECULAR BIOLOGY

BIOTECHNOLOGY

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

BIOINFORMATICS

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

MOLECULAR BIOLOGY

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

V1 SEMESTER. ZY6CRT12

CORE COURSE XII

OCCUPATIONAL ZOOLOGY .

(APICULTURE, VERMICULTURE, QUAIL FARMING & AQUACULTURE)

54 Hrs

Credits 3

Objectives:

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

3. To make the students aware of cottage industries.

Module 1. APICULTURE

18 Hrs

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

Activity :Visitto an apiculture unit.

Field visit and report submission - 10 Hrs

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

MODULE: 2. VERMICULTURE

8 Hrs

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

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

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

4 Hrs

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

MODULE: 4. AQUACULTURE.

24 Hrs

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

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

Activity – Setting up of an Aquarium

Field visit – Visiting an Aquaculture farm

References

- NPCS Board, The complete book on Bee keeping and honey processing, NIIR Project consultancy services, 106E, Kamala nagar, Delhi- 110007.
- Shukla G.S, & Updhyay V.B, Economic zoology ,Rastogi Publ. Meerut.
- Pradip.V.Jabde , Text book of applied zoology, 2005
- Applied Zoology, Study Material Zoological Society of Kerala , CMS college Campus Clive. A Edwards, Norman. Q. & Rhonda. 2011. Vermitechnology: earthworms, organic waste & environmental management.
- Chauhan, H.V.S. Poultry, Disease, diagnosis and treatment, Wiley eastern Ltd Delhi.
- Otieno.F.O 2014. Quail farming: markets & market strategies
- Pillai T.V.R., Aquaculture, principles and practices.
- Ronald j. Roberts (1978) Fish pathology , Cassel Ltd London.
- Cowey C. B. *et. al.* (1985) Nutrition and feeding in fishes, academy press.
- Farm made aquafeeds. FAO fisheries Technical paper, 343.
- Harisankar J. Alappat& A. Bijukumar, Aquarium Fishes. B. R. Publ. Corporation, Delhi.
- MPEDA, A hand Book on Aquafarming Ornamentalfishes, MPEDA, Kochi.
- Amber Richards. 2014. Aquaponics at home.
- Pradip.V.Jabde. 1993. Text book of applied zoology
- Venkitaraman, P.R,1983, Text book of Economic zoology(SudharsanaPuubl. Kochi)
- Addison Webb, Bee Keepingfor profit and pleasure, Agrobios Ltd.
- Edwards.C.A.&Lafty, J.R.1972 Biology of earthworms(Chapman & Hall Led.London)
- Applied Zoology, Study Material Zoological Society of Kerala , CMS college Campus

George cust& Peter Bird, Tropical Fresh water Aquaria, Hamlyn London.

Verreth J. Fish larval nutrition, Chapman & Hall Publ.

Bone Packer. 2014. Aquaponic system

**PRACTICAL
OCCUPATIONAL ZOOLOGY**

36 Hrs

Credit 1

1. General Identification, Economic importance, Morphology, scientific names and common names of the following

a) Economic important and morphology of culturable fishes (Catla, Rohu, Grass carp, Common carp, Silver carp, *Etrophus suratensis*, *Oreochromis /Tilapia*, *Mugil cephalus* and *Anabas Testudineus*)

b) Identification and morphology of ornamental fishes (gold fish, fighter, Gourami, Angel fish, Guppy

c) Two species of earthworms used in Vermiculture

d) Four species of honey bees

e) Economic importance and morphology of shell fishes (Any three species of prawn, two marine mussels, two oysters one rock oyster - *Crasostria* and pearl oyster - *Pinctada fucata* and freshwater mussel - *Lamellidens marginalis*).

2. Castes of bees

3. Principle & uses of - Aquarium filters, Aquarium aerator, Aquarium plants, Oven, Pelletiser, Screw Press, die plate

4. Identification and study of fish parasites and diseases (five numbers each) using slides/pictures

5. Bee keeping equipments, Beehive, Smoker, honey extractor, Queen Cage,

6. Bees wax, Honey, Vermicompost (Identification-Uses)

7. Formulation of artificial feed for aquarium fishes – demonstration

8. Tests for determining the adulteration in honey.

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

SEMESTER V. OPEN COURSES (FOR OTHER STREAMS)

ZY5OPT01

1. VOCATIONAL ZOOLOGY

72 Hrs

4 Hrs/Week, Credits 3

Objectives of the Course

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

Module 1 Aquarium management

12 Hrs

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

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

Module 2 Ornamental Fish Culture

20 Hrs

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

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

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

Module 3 Quail farming (*Coturnix coturnix*) 10 Hrs

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

Activity: Visit to a quail farm or viewing a quail documentary to familiarize the quail farming practices

Module 5 Vermiculture and composting 12 Hrs

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

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

Module 6 Apiculture 18 Hrs

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

Activity: Identify different types of honey bees and rearing equipments

Field visit and report Submission

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

References

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

3. Alka Prakash (2011), Laboratory Manual of Entomology, New age International, New Delhi.
4. Arumugan N. (2008) Aquaculture, Saras publication.
5. Biju Kumar A and Harishanker J Alappat (1995) A Complete Guide To Aquarium Keeping. Published by Books For All, New Delhi.
6. 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
7. Cowey C. B. Mackie, A.M. and Bell, J. G (1985) Nutrition and feeding in fishes. Academy press.
8. David Alderton (2008). Encyclopedia of Aquarium and Pond fish. Published by Dorling Kindersley, DK Books.
9. Dey, V.K. (1997). A Hand Book on Aquafarming- Ornamental fishes. Manual. MPEDA Cochin.
10. George Cust and & Peter Bird. (1978). Tropical Fresh water Aquaria, Published by Hamlyn London. illustrated by George Thompson.
11. Harisankar J. Alappat and Bijukumar. A. (2011) Aquarium Fishes. B. R. Publ. Corporation, Delhi.
12. Herbert R. and Leonard P. Schultz Axelrod (1955) Handbook of Tropical Aquarium Fishes, McGraw-Hill, 1955.
13. Joy P.J., George Abraham K., Aloysius M. Sebastian and Susan Panicker (Eds) (1998) Animal Diversity, Zoological Society of Kerala, Kottayam
14. Michael B. New; Alber G.J. Tacon (1994) Farm made aquafeeds FAO fisheries technical paper No.343, Rome, FAO. 1994
15. Nalina Sundari, M.S and Santhi, R (2006) Entomology. MJP Publishers
16. NPCS Board of Consultants & Engineers, Chennai.(2015) The complete book on Bee keeping and honey processing, 2nd Edition, NIIR Project consultancy services, 106- E kamala Nagar Delhi – 110007.
17. Ronald j. Roberts (1978) Fish pathology , Cassel Ltd London .
18. Vijayakumaran Nair, K, Manju, K.G. and Minimol, K. C.(2015) Applied Zoology, Academia press, Thiruvananthapuram

OPEN COURSE (FOR OTHER STREAMS)

ZY5OPT02

2. PUBLIC HEALTH AND NUTR

72 Hrs

4hrs/Week

Credits 3

Objectives:

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

PART I HEALTH, EXERCISE & NUTRITION

Module 1 Definition and Meaning of Health

10 Hrs

Dimensions and Determination of Health

Physical Activity and Health benefits

Effect of exercise on body systems – Circulatory, Respiratory, Endocrine, Skeletal and Muscular

Programmes on Community health promotion (Individual, Family and Society) Dangers of alcoholic and drug abuse, medico-legal implications

Module 2 Nutrition and Health

10 Hrs

Concept of Food and Nutrition, Balanced diet

Vitamins, Malnutrition, Deficiency Disease

Determining Caloric intake and expenditure

Obesity, causes and preventing measures

Role of Diet and Exercise, BMI

Module 3 Safety Education in Health promotion

8 Hrs

Principles of Accident prevention

Health and Safety in daily life.

Health and Safety at work.

First aid and emergency care.

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

Module 4 Life Skill Education 8 Hrs

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

PART II PUBLIC HEALTH AND SANITATION

Module 5 Public health and water quality. 11 Hrs

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

Module 6 Public health and diseases 15 Hrs

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

Food borne diseases and Prevention

Botulinum, Salmenellosis, Hepatitis A

Vector borne diseases & Control measures

Chikungunya , Filariasis and Dengu fever

Zoonotic disease-Leptospirosis & its control

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

Re-emerging diseases –TB, Malaria

Health Centre visit & Report Presentation 10 Hrs

References:

1. Gladys Francis & Mini K.D., (Editors) (2012), Microbiology, Zoological Society of Kerala, Kottayam.
2. Greenberg, Jerol S and Dintiman George B (1997) Wellness Creating a life of Health and Fitness , London Allyn and Bacon Inc.
3. K Park, (2008) Park's Text Book of Preventive and Social Mediine 18th Edition. Banarasidass Bhenot Publication
4. Norman Bezzaant HELP First Aid for everyday emergencies. Jaico Publishing House, Bombay, Delhi

18. Speight, M.R., Hunter, M.D. & Watt, A.D. 1999. Ecology of Insects- Concepts and Applications. Blackwell Science Ltd., London.
19. Wall, R., Shearer, D. 2001. Veterinary ectoparasites: biology, pathology and control. Blackwell Science.
20. Wall, R., Shearer, D. 1997. Adult flies (Diptera). In: Wall, R., Shearer, D. (eds.): Veterinary Entomology. Chapman & Hall, London.
21. Ward, J.V. 1992. Aquatic Insect Ecology. John Wiley & Sons, Inc., USA.
22. Williams, D.D. & Feltmate, B.W. 1992. Aquatic Insects. C.A.B. International, UK.
23. R Bonita R Beaglehole T Kjellström Basic epidemiology 2nd edition WHO Library Cataloguing-in-Publication Data Bonita ISBN 92 4 154707 3 (NLM classification: WA 105) ISBN 978 92 4 154707 9 © World Health Organization 2006.

ELECTIVE COURSE. ZY6CBT04

4. NUTRITION, HEALTH AND LIFESTYLE MANAGEMENT

72 Hrs.

3 Credits

Objectives:

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

Module I

15 Hrs

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

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

Module II

18 Hrs

Understanding of health: Define health, basic concepts, dimensions of health, basic parameters of health care. (Health Parameters: Individual normal standards, devices. 1. Blood pressure, 2. Brain activities and sleep, 3. Focus or attention, 4. Pulse, 5. Body temperature, 6. Daily physical activities, 7. Electrocardiogram (ECG), 8. Cardiac fitness 9. Stress, 10. Haematological parameters, 11. BMI

Module III

15 Hrs

Introduction to Life style diseases

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

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

Module IV

10 Hrs

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

disturbed biological clock, stressful environmental conditions

Module V

14 Hrs

Prevention and control of life style diseases:

Healthy life style habits and practices, healthy eating habits, exercise and fitness, good sleep patterns, a strict no to alcohol, drugs, and other illegal drugs. Uncontrollable factors like age, gender, heredity and race.

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

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

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

References

1. AAPHERD (1980). Health Related Physical Fitness Test Manual. Published by Association drive Reston Virginia.
2. ACSM (2005). Health Related Physical Fitness Assessment Manual Lippincott Williams and Wilkins USA, 3. Begum, M.R. (2006).A Text Book of Foods, Nutrition and Dietetics. 2nd Edn. Sterling Low Price Edition.Sterling Publishers Private Ltd., New Delhi.
4. Bucher, C.A., (1979). Foundation of Physical Education (5th ed.). Missouri: C.V.Mosby co.
5. Charles B.C.,et.al, C.A., (2004). Concepts of Fitness and Wellness. Boston: McGraw Hill.
6. Delvin, T.M (1997). Text Book of Biochemistry with clinical correlation. 4th Edn. John Wiley and Sons Inc.Ltd.U.K.
7. Evert, A.B. and Boucher J.L., (2014). New Diabetes Nutrition Therapy Recommendations:

- What You Need to Know Diabetes Spectr. 2014 May; 27(2): 121– 130. Pubmed Published online 2014 May 14. doi: 10.2337/diaspect.27.2.121 8. Fahey, T.P. Insel, M, and W. Roth (2005) Fit and Well New York: McGraw Hill Inc.
9. Greenberg, and Dintiman B 1997. Wellness Creating a life of Health and Fitness, London Allyn and Bacon Inc.
 10. Kumar, M and Kumar R. 2003 Guide to Healthy Living: Role of food and exercise. Deep and Deep Publications.
 11. Kumar, M. and Kumar R. 2004. Guide to Prevention of Lifestyle Diseases. Deep and Deep Publications. Curriculum for B.Sc. Zoology Programme. 108
 12. Les Snowdan. ,(2002). Maggie Humphrey's Fitness walking, Maggie Humphery Orient Paper Backs 2002 New Delhi.
 13. Puri, K., and Chandra.S.S., (2005). Health and Physical Education. New Delhi: Surjeet Publications
 14. Rai, B.C., (2005). Health Education and Hygiene Published by Prakashan Kendra, Lucknow.
 15. Ralph, S., Barger P., Jr. and Leolson E. (1999) Life Fit, 1999 Human Kinetics USA
 16. Schlenker, E. and J.A.Gilbert. (2014) Essentials of Nutrition and Diet Therapy, Edt. RDWilliams. 11e Paperback – Import, 4 Nov 2014
 17. Sing.MD. (2008). Textbook of Nutritional Health and First Ed:2008 Academic excellence.

**13. COMPLEMENTARY ZOOLOGY COURSES OFFERED BY ZOOLOGY DEPARTMENT FOR - MODEL I – BSc BOTANY / BSc HOME SCIENCE
MODEL II – BSc BOTANY, BSc (AQUACULTURE)
MODEL III – BSc (BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION)**

Semester	Code	Title of the Course	Hrs	Inst Hrs/week	Credit
1	ZY1CMT01	Non Chordate Diversity	36	2	2
1		Non Chordate Diversity (Practicals)	36	2	0
2	ZY2CMT02	Chordate Diversity	36	2	2
2		Chordate Diversity (Practicals)	36	2	0
2	ZY2CMP01	Practical 1 Non Chordate Diversity + Chordate Diversity (Practicals)			2
3	ZY3CMT03	Physiology and Immunology	54	3	3
3		Physiology and Immunology (Practicals)	36	2	0
4	ZY4CMT04	Applied Zoology	54	3	3
		Applied Zoology (Practicals)	36	2	
4	ZY4CMPO2	Practical 2 Physiology and Immunology + Applied Zoology (Practical)			2

COMPLEMENTARY COURSE : ZOOLOGY –MODEL I

SEMESTER I. ZY1CMT01.

COMPLEMENTARY COURSE 1
NON CHORDATE DIVERSITY

36 hrs
Credits 2

Objectives:

1. To study the scientific classification of invertebrate fauna.
2. To learn the physiological and anatomical peculiarities of some invertebrate phyla through type study.
3. To learn the unity of life with rich diversity of organisms & evolutionary significance of certain invertebrate fauna
4. To stimulate the curiosity of students' in the biota living around them.

Module I

10 Hrs

Introduction: Five kingdom classification

Kingdom Protista: Salient features (any five important salient features) of each phylum with one example each (detailed account of example is not necessary).

Phylum Rhizopoda	(eg: Amoeba)
Phylum Actinopoda	(eg: Actinophrys)
Phylum Dinoflagellata	(eg: Noctiluca)
Phylum Parabasalia	(eg: Trypanosoma)
Phylum Metamonada	(eg: Giardia)
Phylum Kinetoplasta	(eg: Trypanosoma)
Phylum Euglenophyta	(eg: Euglena)
Phylum Cryptophyta	(eg: Cryptomonas)
Phylum Opalinata	(eg: Opalina)
Phylum Bacillariophyta	(eg: Diatoms)
Phylum Chlorophyta	(eg: Volvox)
Phylum Choanoflagellata	(eg: Proterospongia)
Phylum Ciliophora	(eg: Paramecium)
Phylum Sporozoa	(eg: Plasmodium)
Phylum Microsporidia	(eg: Nosema)
Phylum Rhodophyta	(eg: Red algae)

General Topic: Pathogenic Protists – Plasmodium, Entamoeba

Module II

3 Hrs

Phylum Porifera: Salient features (eg: Leucosolenia)

Phylum Coelenterata: Salient features and classification upto class.

Class 1: Hydrozoa (eg: Physalia)

Class 2: Schyphozoa (eg: Aurelia)

Class 3: Anthozoa (eg: Adamsia)

General Topic: Corals and Coral reefs.

Module III

6 Hrs

Phylum Platyhelminthes: Salient features and classification up to class.

Class 1: Turbellaria (eg: Planaria)

Class 2: Trematoda (eg: Fasciola)

Class 3: Cestoda (eg: *Taenia solium*)

Phylum Nematoda: Salient features and classification up to class.

Class 1: Phasmida (eg: Wuchereria)

Class 2: Aphasmida (eg: Trichinella)

Phylum Annelida: Salient features and classification up to class.

Class 1: Polychaeta (eg: Nereis)

Class 2: Oligochaeta (eg: Pheretima)

Class 3: Hirudinomorpha (eg: Hirudinaria)

Module IV

11 Hrs

Phylum Arthropoda: Salient features. Type study – *Fenneropenaeus* (Penaeus) - habitat, morphology, appendages, sexual dimorphism, digestive system, respiratory system, circulatory system, excretory system, nervous system, sense organs, reproductive system, larval stages.

Classification up to class with one example each

Subphylum Trilobitomorpha

Class 1: Trilobita (Extinct) (eg: Dalmanites)

Subphylum: Chelicerata

Class 1: Merostoma (eg: Limulus)

Class 2: Arachnida (eg: Spider)

Class 3: Pycnogonida (eg: Nymphon)

Subphylum Mandibulata

Class 1: Crustacea (eg: Daphnia)

Class 2: Chilopoda (eg: Centipede)

Class 3: Symphyla (eg: Scutigera)

Class 4: Diplopoda (eg: Millipede)

Class 5: Pauropoda (eg: Pauropus)

Class 6: Insecta (eg: Butterfly)

Module V

6 Hrs

Phylum Mollusca: Salient features and classification up to class

Class 1: Aplousobranchia (eg: Neomenia)

Class 2: Monoplacophora (eg: Neopilina)

Class 3: Polyplacophora (eg: Chiton)

Class 4: Bivalvia (eg: Perna)

Class 5: Gastropoda (eg: Xancus)

Class 6: Cephalopoda (eg: Sepia)

Class 7: Scaphopoda (eg: Dentalium)

Phylum Echinodermata : Salient features and classification up to class.

Class 1: Asterozoa (eg: Astropecten)

Class 2: Ophiurozoa (eg: Ophiothrix)

Class 3: Echinozoa (eg: Echinus)

Class 4: Holothurozoa (eg: Holothuria)

Class 5: Crinozoa (eg: Antedon)

Phylum Hemichordata : Salient features (eg: Balanoglossus.)

References:

Animal Diversity (2002). Published by Zoological Society of Kerala.

Barnes, R D, (1987). Invertebrate Zoology (W.B. Saunders, New York).

Barrington, E.J.W., (1967). Invertebrate Structure and function (ELBS and Nelson , London).

Dhami, P.S. and Dhami, J.K. (1979). Invertebrate Zoology (R. Chand and Co. New Delhi).

Ekambaranatha Ayyer M (1990) A Manual of Zoology, Volume 1. Invertebrate Part I and Part II S
Viswanathan printers 7 Publishers Pvt.Ltd.

Groove, A.J. and Newell, G.E. (1974). Animal Biology – Indian Reprint (University Book Stall, New Delhi).

Hyman, L.H. The Invertebrate vols. (McGraw-Hill) 1942. Comparative vertebrate Anatomy (The University of Chicago Press).

James R.D. (1987). Invertebrate Zoology, W.B. Saunders, New York.

Kapoor, V.C. 1994. Theory and Practice of Animal Taxonomy (Oxford and IBH Publishing Co., New Delhi.)

Kotpal R.L. Agarwal S.K. and R.P. Khetharpal (2002). Modern Text Book of Zoology.

Parker T.J and Haswell W.A. (1962). Text Book of Zoology Vol. I. Invertebrate (ELBS &

Macmillan, London).

Vijayakumaran Nair, Jayakumar J & Paul P I (2007) Protista & Animal Diversity Academica Publications

SEMESTER I

COMPLEMENTARY COURSE 1 - PRACTICAL

NON CHORDATE DIVERSITY

36 Hrs

Credit 1

1. Scientific drawing - 5 specimens
2. Simple identification - 10 invertebrates, out of which 5 by their scientific names
3. T.S - Earthworm, T.S Fasciola
4. Dissection - Nervous system of Prawn
5. Dissection - Nervous system of Cockroach
6. Mounting - Prawn Appendages

SEMESTER II. ZY2CMTO2.

COMPLEMENTARY COURSE 2 CHORDATE DIVERSITY

36 Hrs
Credits 2

Objectives

1. To make the student observe the diversity in chordates and their systematic position.
2. To make the a student ware of the economic importance of some chordates.
3. To learn the physiological and anatomical peculiarities of some vertebrate species through type study.
4. To stimulate the students' curiosity in vertebrates living associated with them.

Module I

4 Hrs

Phylum Chordata: Fundamental characters and outline classification upto class.

Sub phylum Urochordata: General characters,

Classification:

Class 1: Larvacea (eg: Oikopleura)

Class 2: Ascidiacea (eg: Ascidia) , Retrogressive metamorphosis.

Class 3: Thaliacea (eg: Salpa)

Sub phylum Cephalochordata: Salient features (eg: Branchiostoma)

Module II

6 Hrs

Sub phylum Vertebrata: Salient features

Division Agnatha : salient features and classification

Class 1: Cyclostoma (eg: Petromyzon)

Class 2: Class Ostracodermi (eg: Cephalopsis)

Division Gnathostomata: Salient features

Super class Pisces

Super class Tetrapoda.

Super class Pisces: Salient features and classification

Class 1: Chondrichthyes (eg: N
arcine)

Class 2: Osteichthyes (eg: Latimeria)

General Topic: Accessory respiratory organs in fishes.

Module III

14 Hrs

Super class Tetrapoda: Salient features

Class 1: Amphibia : Salient features. **Type study:** *Euphlyctis hexadactyla* - Habitat, morphology, sexual dimorphism, coelom and viscera, skeletal system, digestive system, respiratory system, circulatory system, excretory system, nervous system, sense organs, reproductive system, development..

Classification up to order:

Order 1: Urodela (eg: Amblystoma)

Order 2: Anura (eg: Bufo)

Order 3: Apoda (eg: Ichthyophis)

Module IV

6 Hrs

Class Reptilia: Salient features and classification up to subclass

Sub class 1: Anapsida (eg: Chelone)

Sub class 2: Diapsida (eg: Chamaeleon)

Sub class 3: Parapsida (eg: Ichthyosaurus)

General Topics: Poisonous and non poisonous snakes of Kerala.

Class Aves: Salient features and classification up to subclass

Sub class Archeornithes (eg: Archaeopteryx)

Sub class Neornithes (eg: Struthio)

General Topics: Flight adaptation of birds

Module V

6 Hrs

Class Mammalia: Salient features and classification up to subclass

Sub class 1: Protheria (eg: Echidna)

Sub class 2: Metatheria (eg: Macropus)

Sub class 3: Eutheria (eg: Elephas)

General Topic: General adaptation of aquatic mammals with example.

References

Animal Diversity (2002). Zoological Society Of Kerala Study Material Series. Published by

Zoological Society of Kerala

Deoras, P.J. (1981). Snakes of India (National Book Trust of India.)

Ekamberanatha Ayyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S.

Viswanathan Printers & Publishers Pvt. Ltd.

Ekamberanatha Ayyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S.

Viswanathan Printers & Publishers Pvt. Ltd.

- Groove, A.J. and Newell, G.E. (1974). *Animal Biology - Indian Reprint Universal Book Stall, New Delhi.*
- Induchoodan, (1986), *Kweralathile Pakshikal (Kerala Sahitya Academy, Trichur).*
- Kapoor, V.C. 1994, *Theory and Practice of Animal Taxonomy (Oxford and IBM Publishing Co. New Delhi.*
- Lagler, K.F. , Bardach, J.E. , Miller, R.R. Passino, D.R.M. 1977 *Ichthyology (John Wiley and Sons).*
- Mayer, E. (1980). *Principles of Systematic Zoology (Tata McGraw Hill Publishing Co. New Delhi.*
- Newman, H.H. (1939). *Phylum Chordata, (Macmillan Pub. Co. New York)*
- Nigam H.C. (1978) , *Zoology of Chordata (S. Chand and Co. New Delhi).*
- Parker, T.J. and Haswell W.A. (1962). *Text Book of Zoology Col. II Vertebrates (ELBS and Macmillan , London).*
- Parter S.H. (1971). *The Book of Indian Animals (Bombay Natural History Society).*
- Salim Ali, (1969). *Birds of Kerala (Oxford University Press).*
- Sinha A.K. , Adhikari S. Ganguly, B.B. (1988). *Biology of Animals Vol. II (New Central Book Agency, Calcutta.)*
- Whitaker, R. (1978) *Common Indian Snakes – A field Guide Macmillan and Co. of India Ltd.)*
- Young J.Z. (1981). *The life of Vertebrate s (Oxford University Press).*

SEMESTER II

COMPLEMENTARY COURSE 2- PRACTICAL CHORDATE DIVERSITY

**36 Hrs
Credit I**

1. Simple identification of 10 chordates, out of which 5 by their scientific names
2. Osteology - Vertebrae and girdles of Frog
3. Snake identification - 3 poisonous and 3 non poisonous snakes with key
4. Mounting of placoid scales of shark
5. Dissections: Frog: Photographs/Diagrams/ models may be used for the study.
 1. Frog - Viscera
 2. Frog - Digestive System
 3. Frog - Arterial System
 4. Frog - Brain

SEMESTER III. ZY3CMT03.

COMPLEMENTARY COURSE -3

PHYSIOLOGY AND IMMUNOLOGY

54 hrs
Credits 3

Objectives

- 1 To appreciate the correlation between structure and function of organisms
- 2 To make the student aware of the health related problems, their origin and treatment.
- 3 To understand how efficiently our immune system work in our body.
- 4 To acquire knowledge about preventing common diseases rather than curing.

Module I

14 Hrs

Nutrition: Types of nutrition – autotrophy, heterotrophy. Nutritional requirements – carbohydrates, proteins, lipids, minerals (Ca, Fe, I), vitamins (sources and deficiency disorders), nutritional disorders

Respiration: Transport of respiratory gases in blood - transport of oxygen, transport of carbon dioxide, chloride shift. Respiratory disturbances – Hypoxia, Hypercapnia, Asphyxia, physiological effect of smoking, carbon monoxide poisoning.

Circulation: Composition and functions of blood. Plasma and formed elements - WBC, RBC and platelets, Mechanism of blood coagulation – clotting factors, intrinsic and extrinsic pathways, anticoagulants. ECG, Blood pressure, Arteriosclerosis, Hemophilia, cerebral and pulmonary thrombosis.

Module II

14 hrs

Excretion: Structure of a nephron. Urine formation – glomerular filtration, tubular reabsorption, tubular secretion. Urine concentration – counter current mechanism. Composition of urine – normal and abnormal constituents. Hormonal regulation of kidney function. Kidney stone, dialysis.

Neuro physiology: Structure of a neuron. Myelinated and non myelinated nerve fibre, nerve impulse production (resting membrane potential, action potential), Impulse propagation, All or none law, saltatory conduction, synaptic transmission. Neurotransmitters (acetyl choline, adrenalin, dopamine), brain waves, EEG. Neural disorders - Parkinson's disease, Alzheimer's disease.

Muscle physiology: Types of muscles: striated, non striated and cardiac. Ultra structure of striated muscle, Mechanism of muscle contraction, cori cycle and muscle relaxation. Muscle fatigue, oxygen debt, Rigor mortis.

Module III

8 hrs

Endocrinology: Introduction to Endocrine system. Mechanism of hormone action, Endocrine glands - hypothalamus, pituitary gland, pineal gland, thyroid gland, parathyroid gland, endocrine pancreas, adrenal gland, thymus gland, testis and ovary. Physiological role of hormones, Hormonal disorders.

Module IV

12 Hrs

Immunology: Introduction to immunology, types of immunity – innate, acquired, passive, active, mechanism of innate immunity (barriers, inflammation, phagocytosis). Types of antigens. Basic structure of immunoglobulins, Classes of immunoglobulins and functions. Antigen antibody reactions, Precipitation test, agglutination test, WIDAL, VDRL, HIV test (ELISA),

Module V

6 Hrs

Immune response system: (Brief accounts of the followings)

Primary and secondary lymphoid organs, Cells of Immune system - T&B lymphocytes, natural killer cells, macrophages, plasma cells, memory cells, Monoclonal antibodies, Hybridoma technology.

Immune disorders: Hypersensitivity, Auto immunity (rheumatoid arthritis) & Immunodeficiency (AIDS), Vaccines - BCG, DPT, Polio vaccine.

REFERENCES

- Barret K.E et.al.,2009. Ganong's Review of Medical Physiology 23rd edn. by Mc Graw Hill, New Delhi.
- Best, C H, Taylor, N B 1991 Physiological basis of Medical practice 12th edn. edited by John B. West.
- Chakrabarti B K, Ghosh H N & Sahana S N 1984: Human Physiology, the New Book Stall, Calcutta, India
- Chatterjee C.C 1973: Human Physiology, Vol I 8th edn. Medical Allied Agency, Calcutta
- Chatterjee C.C 1975: Human Physiology Vol II 9th edn New Central Book Agency Calcutta.
- Hall J.E and C Guyton 2010 Text Book of Medical Physiology. 12th edn. Publishers Saunders
- Knut Schmidt Nilesen 2007 Animal Physiology – Adaptation and environment. Cambridge University press 5 th ed.
- Prosser C L,Brown J R, Frank A 1962 : Comparative Animal Physiology 2nd edn. Saunders
- Roger Eckert; D Randall; George Augustine 1988: Animal Physiology, Mechanism and Adaptations, W.H Freeman, New York
- Singh H D, Madhavankutty K, Sarada Subrahmanyam 2014: Textbook of Human Physiology, 5th edn. S. Chand & Co Ltd, New Delhi.
- Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

SEMESTER III

**COMPLEMENTARY COURSE - 3 PRACTICAL
PHYSIOLOGY AND IMMUNOLOGY**

36Hrs

Credit 1

1. Preparation of Human Blood smear & identification of leucocytes
2. Qualitative analysis of Reducing Sugar, Protein and Lipid
3. Action of Salivary amylase on Starch (Demonstration Only)
4. Estimation of Haemoglobin (Demonstration only)
5. Identification of human blood groups, A, AB, B and O, Rh factor
6. Instruments (Principle & uses)- Sphygmomanometer , Stethoscope

SEMESTER IV. ZY4CMT04.

COMPLEMENTARY COURSE - 4

APPLIED ZOOLOGY

54 hrs
Credits 3

Objectives

1. To acquire basic knowledge and skills in applied branches of zoology.
2. To understand the technology for utilising ecofriendly organisms around them for beneficial purpose.
3. To equip the students for self employment opportunities with scientific knowledge to perform profitably & confidently.

Module I

24 Hrs

Aquaculture: Advantages of aquaculture, Traditional methods of aquaculture, Biotic and abiotic factors in water, Pond culture – construction and maintenance. Types of aquaculture, composite fish culture, integrated fish culture, induced breeding of carp & prawn, Importance of algae in aquaculture. Aquarium management - Setting up of an aquarium, biological filter and aeration. Common cultivable fishes of Kerala. Fish diseases, Prawn culture, mussel culture, pearl culture, Fish processing and preservation.

Module II

12 Hrs

Sericulture: Four species of silkworms, life history of silkworm, silk worm rearing techniques, Mounting of silkworm - Chandrika, defective cocoons, harvesting and stifling of cocoons. Silkworm diseases and pest, preventive and control measures.

Module III

6 Hrs

Vermiculture: Species of earthworms, ecological classification of earthworms, life cycle and reproduction of earthworm. Physical & chemical effects of earthworms on soil, Vermicomposting – site selection, preparation of pit, maintenance, monitoring and harvesting of vermicompost.

Module IV

12Hrs

Apiculture: Species of honey bees, organization of honey bee colony. Bee keeping methods and equipments. Apiary management and maintenance. Bee pasturage, byproducts of honey bees and their uses. Diseases, pests of honey bees and control measures.

References:

- Alikunhi, K.. H, Fish Culture in India (ICAR, New Delhi)Andhra Pradesh Agricultural University, Hyderabad)
- Applied Zoology; (2002) Published by Zoological Society Of Kerala
- Bhosh, C.C., 1949, Silk Production and Weaving in India (CSIR), New Delhi) Director. Zoological Survey of India, 1994, earthworms Resources and Vermiculture
- Edwards, C.A. & Lafty, J.R. 1972 Biology of Earthworms (Chapman and Hall Led. London)
- Jhingran, V.G., 1985 Fish and Fisheries of India (Hindustan Publ. Corporation, New Delhi)
- Krishnaswami, S., 1986 Improved Method of Rearing Young age Silk worms (Central Silk board Bangalore)
- Krishnaswami, S., 1986, New Technology of Silkworm Rearing (Central Silk Board Bangalore)
- Kurien, C.V. & Sebastian V.C., Prawn Fisheries in India (Hindustan Publ. Corporation, New Delhi)
- Lee, K. E., 1985 Earthworms, Their Ecology and relationships with Soils and Land use. Academic Press.
- Menon, K.N., 1970 Malsyakrishi (State Institute of language, Trivandrum)
- Mysore Silk Association, 1986, Silkworm rearing and Diseases of Silkworms
- Padmanabha Aiyer, K.S., 1992, Records of the Indian Museum Vol. XXXI, Part I, PP. 13-76 An account of the Oligochacta of the Travancore
- Shiggene, K., 1969, Problems in Prawn Culture (American publ. Co., New Delhi)
- Shukla G.S., & Updhyay V.B., Economic Zoology (Rastogi Publ. Meerut)
- Singh, S., 1962 Bee keeping in India (ICAR, New Delhi)
- Sinhan, V.R.P. & Ramachandran, V., 1985, Fresh water Fish Culture (ICAR, New Delhi)

SEMESTER IV

**COMPLEMENTARY COURSE - 4 PRACTCAL
APPLIED ZOOLOGY**

2 Hrs/week

36 Hrs

Credit 1

1. General identification, economic importance, morphology, scientific names and common names of the following
 - a. Economic importance and morphology of culturable fishes (Catla, Rohu, Grass carp, Common carp, Silver carp, Etroplus, Tilapia)
 - b. Two species of earthworms used in Vermiculture
 - c. Two species of honey bees
 - d. Silkworm. Cocoon/Adult
2. Castes of honey bees
3. Bee keeping equipments - Bee hive, Smoker, honey extractor
4. Identification and uses - Bee wax, Honey, Silk, Vermicompost
5. Chandrika / Natrika used in sericulture