



**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**

## **ACKNOWLEDGEMENT**

The unstinted support provided by some profound personalities and their guidance has immensely contributed to the successful completion of this syllabus restructuring venture.

The initiative taken by the Hon. Vice Chancellor of Mahatma Gandhi University towards restructuring the curriculum of the undergraduate courses of this university is gratefully acknowledged here. Under his leadership, this restructuring effort by a team of Professors has been successfully completed.

The relentless support by the Hon. Pro Vice Chancellor and the Registrar of M. G. University, for the successful completion of the syllabus restructuring is also gratefully acknowledged.

The gratitude felt towards the Syndicate members for their encouragement and continuous support right through the entire exercise is to be mentioned here with gratitude.

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Any venture of this magnitude requires the whole hearted support of several individuals in their official capacity or otherwise, directly or indirectly associated with the process. The magnanimity of each and every such person is being etched here in golden words.

**Dean – Faculty of Science  
M G University, Kottayam.**

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## 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%
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### **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 1<sup>st</sup> to 4<sup>th</sup> 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
<b>Total</b>				<b>25 hrs</b>	<b>17</b>		

**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
<b>Total</b>				<b>25 hrs</b>	<b>23</b>		

### 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
<b>Total</b>				<b>25 hrs</b>	<b>17</b>		

#### 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
<b>Total</b>				<b>25 hrs</b>	<b>23</b>		

**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 <sup>th</sup> semester with investigatory project).	Project	1	0		
<b>Total</b>				<b>25 hrs</b>	<b>15</b>		

### 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		
<b>Total</b>				<b>25 hrs</b>	<b>25</b>		

## 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	
<b>Total</b>	<b>44</b>	<b>24</b>

### 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 (Select any 1 from 3)	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 (Select any 1 from the four)	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.

Semester	Code	Practical No.	Course Title	Duration	Marks ratio		Credits
				Hrs	Internal (I)	External (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**

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

**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	<b>20</b>	<p><b>Project report – 50 marks</b></p> <p>Title- 2 Marks</p> <p>Abstract- 3 Marks</p> <p>Introduction &amp; Review of literature- 10 Marks</p> <p>Methodology- 10 Marks</p> <p>Results- 10 Marks</p> <p>Discussion &amp; Conclusion - 10 Marks</p> <p>Neat presentation and Novelty- 5 Marks</p> <p><b>Presentation &amp; Viva- 30Marks</b></p> <p>(Student can present the project using OHP or LCD, in 7 Minutes) Viva Voce.</p>
<b>Total</b>	<b>20</b>	<b>80</b>

**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)**

<b>Semester</b>	<b>Code</b>	<b>Title of the Course</b>	<b>Hrs</b>	<b>Inst Hrs/week</b>	<b>Credit</b>
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	<b>Practical 1</b> 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	<b>Practical 2</b> 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 .

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## **SEMESTER 1**

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

**36 Hrs  
2 Credits**

1. Taxa, identification techniques  
Bird body parts  
Butterfly/ dragonfly body parts
2. Identification using keys  
Insect, Fish, Snake (Poisonous & Non Poisonous )  
(Any 3 specimens from each category)
3. General identification - The students are expected to identify any 6 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. *Trycoplax adherens*

**2. Phylum Porifera** – Classification upto classes; Mention gemmules

Class I- Calcarea. Eg. *Sycon*.,

Class II – Hexactinellida .Eg. *Euplectella*.

Class III - Demospongia Eg. *Cliona*.

**General Topics**

1. Canal system in sponges.

**Phylum Coelenterata** -Classification upto classes

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

Class II- Scyphozoa Eg. *Rhizostoma*.

Class III- Anthozoa Eg. *Metridium*.

**General Topics:**

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

2. Polymorphism in Coelenterates

**Phylum Ctenophora** - Eg. *Pleurobrachia*.

## MODULE II

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

Class I - Turbellaria. Eg. *Planaria*.

Class II –Trematoda Eg. *Fasciola*

Class III- Cestoda Eg. *Taenia saginata*.

**General Topics:**

1. Life history of *Fasciola hepatica*.

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

**Phylum Nematelminthes(Nematoda)**

**2 Hrs**

**Salient** features, classification up to classes

Class: Phasmdia            Eg. *Enterobius*,  
 Class: Aphasmdia        Eg. *Trichinella*

### General Topic

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

### Phylum Annelida:

2 Hrs

Salient features, Classification upto classes.

Class I- Archiannelida            Eg. *Polygordius*  
 Class II -Polychaeta            Eg. *Chaetopterus*  
 ClassIII- Oligochaeta            Eg. *Megascolex*.  
 Class IV- Hirudinea            Eg. *Ozobranchus*, *Hirudinaria*

### 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. *Scutigera* – (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*

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## **PRACTICAL**

### **ANIMAL DIVERSITY- NON CHORDATA**

**36 Hrs.**

**Credit 1**

**Scientific Drawing:-**

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

**Anatomy:-**

**Study of sections. (Any two)**

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

**Dissections**

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

**Mounting:-**

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

**Identification:-**

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

Identification of (a) Parasitic protest – 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 Crossopeterigii(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>Procavia</i>
Order 10 Sirenia	Eg: <i>Dugong</i>
Order 11 Perissodactyla	Eg: <i>Rhinoceros</i>
Order 12 Artiodactyla	Eg: <i>Camelus</i> -mention ruminant stomach
Order 13 Lagomorpha	Eg: <i>Oryctolagus</i>
Order 14 Rodentia	Eg: <i>Hystrix</i> (Porcupine)
Order 15 Tubulidentata	Eg: <i>Orycteropus</i>
Order 16 Cetacea	Eg: <i>Delphinus</i>

### General topics

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

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## **PRACTICAL**

### **ANIMAL DIVERSITY - CHORDATA**

**36 Hrs**

**Credit 1**

#### **1. Scientific Drawing**

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

#### **2. Dissections**

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

1. Frog Viscera
2. Frog Digestive System
3. Frog Arterial System
4. Frog 9<sup>th</sup>& 1<sup>st</sup> 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 9<sup>th</sup>

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.

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#### **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' - 3<sup>rd</sup>Ed. University science Press
3. Misra S.P., Pandey S.N. 2009 Essential Environmental Students, Ane books Pvt. Ltd.
4. P.D Sharma (2012), Ecology and Environment' - 11<sup>th</sup> 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-ho Yu, 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 - G<sub>1</sub>, S, G<sub>2</sub> 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 (Ed
4. itors) (2011) *Cell Biology and Molecular Biology*.
5. 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.
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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.
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7. Vijayakumaran Nair K. (2012). *Genetics and Biotechnology*. Academica, Trivandrum.

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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.
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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 allogenous 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**

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

## **References:**

### **EVOLUTION**

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2. Barnes, C.W. (1988). Earth, Time and Life. John Wiley & Sons, New York
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10. Coyne J.A. and Allen Orr H. (2004). Speciation, Sinauer Associates
11. Ridley, M. (2004), Evolution 3<sup>rd</sup> 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.
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- 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.
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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.

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29th edition (Lange basic science.)

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## **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 R<sub>f</sub> 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**

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Majumdar N. N -1985 Vetebrate 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

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**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.
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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.
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7. Darla J. Wise & Gordon R. Carter: (2004): Immunology A Comprehensive Review Iowa state University Press. A Blackwell science company,
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10. Heritage, J, E.G.V. Evaus and R.A.Killungten (2007): Introductory Microbiology Cambridge University Press
6. Ivan Roitt I (2002) Essentials of Immunology ELBS.

## **PRACTICAL**

### **MICROBIOLOGY AND IMMUNOLOGY**

**72 Hrs**

**2 Credits**

1. Instruments –Autoclave, Hot air oven, Bacteriological incubator – Laminar air flow
2. Preparation of solid and liquid media for microbial cultures.  
(Ingradients, 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 Bjorn Kristiansesn, 2008. Basic Biotechnology 3 rd ed. Cambridge University.
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5. John E. Smith. Biotechnology Cambridge Low priced ed. (Third Ed) 2005 Madingan, Martinko and Parker 2002, Biology of Microorganisms, Brock Eighth Ed. Prentice Hall.
6. Singh B.D. Biotechnolgy 2002, Kalyan Publishers New Delhi.
7. Sudha Gangal 2007. Biotechnology Principles and & practice of Animal Tissue culture, Universities Press.

## BIOINFORMATICS

**14 Hrs**

### Module III

**8 Hrs**

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

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

### Module IV

**6 Hrs**

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

## **MOLECULAR BIOLOGY**

**20 Hrs**

### **Module V**

**8 Hrs**

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

### **Module VI**

**12 Hrs**

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

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

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

### **References**

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

## **PRACTICAL .**

### **BIOTECHNOLOGY, BIOINFORMATICS & MOLECULAR BIOLOGY**

#### **BIOTECHNOLOGY**

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

#### **BIOINFORMATICS**

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

#### **MOLECULAR BIOLOGY**

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

### **V1 SEMESTER. 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

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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.

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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, *Etiropus 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.

**ELECTIVE COURSE. ZY6CBT04**

**1. 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**

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- 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
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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 Humphrey 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
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