

**SACRED HEART COLLEGE(AUTONOMOUS)
THEVARA, KOCHI – 682013
KERALA**



**CURRICULUM AND SYLLABUS
FOR
B. Sc. ZOOLOGY
(CHOICE BASED COURSE CREDIT SEMESTER SYSTEM)**

Prepared By
**Board of Studies in Zoology
Sacred Heart College (Autonomous)
Thevara, Kochi**

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PREFACE

Science and scientific literacy play a key role in educating citizens of today for the world tomorrow. Critical to succeeding in this endeavour are the core competencies that provide students with the ability to think critically, solve problems, and make ethical decisions; to communicate their questions, express opinions, and challenge ideas in a scientifically literate way; and to exercise an awareness of their role as an ecologically literate citizenry, engaged and competent in meeting the responsibilities of caring for living things and the planet.

Zoology (also known as animal science) is the branch of biology devoted to the study of animal life. It is multidisciplinary in nature, involving study of organisms and their genetic, morphological and physiological attributes, their surrounding environment, and their role in conservation of environment. Zoology is a combination of various disciplines such as Genetics, Physiology, Ecology, Developmental Biology, Microbiology, Entomology, Evolution, Taxonomy, Fisheries, Wildlife Biology, Bioinformatics, Biotechnology, Biostatistics etc. This subject has significant role in human resource development, food security, environmental conservation, sustainable development and alleviation of poverty.

The creation of a scientific thinking and scientific attitude necessitates proper education and guidance. In order to achieve this, one must update the developments in every field of science. An effective science education can be imparted at the undergraduate level only by constantly updating the existing curriculum. The present undergraduate curriculum in Zoology was revised in 2015 after the college was elevated to 'Autonomous' status in 2014. The Board of Studies in Zoology then revised the curriculum in tune with the parent University and the University Grants Commission's model for Under Graduate Curriculum. In this process care has been taken to give emphasis to various aspects such as the creativity of students, knowledge of current developments in the discipline, awareness of environmental impacts due to the development of science and technology, the skills essential for handling equipment and instruments in laboratories and industries, employability and entrepreneur development. Later, consequent of the Hon'ble Supreme Court of India order and the subsequent UGC circular, the Academic Council of the college decided to incorporate Environmental Studies and Human Rights in the UG curriculum, as an additional core course.

The meeting of the Board of Studies in Zoology was held on 10th July 2018 and the BoS recommended the revision of the existing UG Zoology Syllabus in comparison with the parent university (MG University) syllabus with appropriate modifications and also taking into consideration, the inclusion of Environmental Studies and Human Rights that was introduced in the revised university curriculum

The Academic Council of the college decided to implement the revised syllabus (B.Sc. Zoology Core and Complementary programmes) with effect from the academic year 2019-20.

CURRICULUM

1. TITLE

B.Sc. ZOOLOGY PROGRAMME

Graduate Programme under Choice Based Credit Semester System, 2019

2. SCOPE

Applicable to all regular Under Graduate Programmes conducted by the Sacred Heart College (Autonomous) with effect from 2019-20 admissions.

3. OBJECTIVES OF THE PROGRAMME

Objectives:

The B.Sc. Zoology programme is designed to help the students to:

1. Impart basic knowledge of various branches of Zoology and General biology meant both for a graduate terminal course and for higher studies.
2. Inculcate interest in and love of nature with its myriad living creatures.
3. Understand the unity of life with the rich diversity of organisms and their ecological and evolutionary significance
4. Acquire basic skills in the observation and study of nature, biological techniques, experimental skills and scientific investigation
5. Understand different methods of exploration, investigation, organization of data and its utilization in practical life.
6. Acquire basic knowledge and skills in certain applied branches to enable them for self employment
7. Create awareness on the internal harmony of different body systems and the need for maintaining good health through appropriate lifestyle
8. Acquire knowledge and skills for better planning and management of animal resources, environment, health, medicine, agriculture and human population.
9. Acquire basic knowledge and skills in certain applied branches for self employment
10. Impart awareness of the conservation of the biosphere.

PROGRAMME OUTCOMES

PO1 Critical Thinking& Deep Domain Knowledge

PO2 Effective Communication

PO3 Contribute to Nation Building

PO4 Care for the Environment

PO5 Ethical Values

PO6 Global Perspective

PROGRAMME SPECIFIC OUTCOMES

After the completion of the programme the student would

PSO1	Understand faunal diversity through scientific classification to grasp and appreciate the complex interactions among them and the environment and their role in sustainable environment.
PSO2	Understand the principles of aquaculture, sericulture, apiculture, vermiculture, poultry and cattle farming for the economic prosperity of the society.
PSO3	Understand the concepts and principles of biochemistry, animal physiology, cell biology, molecular biology, genetics, biotechnology, general informatics and bioinformatics, endocrinology, developmental biology, evolution, zoogeography, ethology, ecology, disaster management, toxicology, microbiology, immunology, nutrition, community health, sanitation, ecotourism, biostatistics and research methodology and their applications in day-to-day life.
PSO4	Perform laboratory procedures in the areas of morphology, anatomy, taxonomy, applied zoology, biochemistry, animal physiology, cell biology, molecular biology, genetics, biotechnology, general informatics and bioinformatics, endocrinology, developmental biology, evolution, zoogeography, ethology, ecology, microbiology and immunology.

4. DEFINITIONS

- 4.1. Programme** means a three year programme of study and examinations spread over six semesters, according to the regulations of the respective programme, the successful completion of which would lead to the award of a degree.
- 4.2. Semester** means a term consisting of a minimum of 450 contact hours distributed over 90 working days, inclusive of examination days, within 18 five-day academic weeks.
- 4.3. Academic Week** is a unit of five working days in which distribution of work is organized from day-one to day-five, with five contact hours of one hour duration on each day. A sequence of 18 such academic weeks constitutes a semester.
- 4.4. Course** means a complete unit of learning which will be taught and evaluated within a semester.
- 4.5. Common Course I** means a course that comes under the category of courses for English and **Common Course II** means additional language, a selection of both is compulsory for all students undergoing undergraduate programmes.
- 4.6. Core course** means a course in the subject of specialization within a degree programme.
- 4.7. Complementary Course** means a course which would enrich the study of core courses.
- 4.8. Open course** means a course outside the field of his/her specialization, which can be opted by a student.
- 4.9. Choice based core course** means a compulsory course for all undergraduate students (as per the UGC directive) to enrich their general awareness.
- 4.10. Credit** is the numerical value assigned to a course according to the relative importance of the content of the syllabus of the programme.
- 4.11. Additional credit or extra credit** is the numerical value assigned to Club activities, Social service, Internship etc. which is not added with the total academic credits of the students.
- 4.12. Grade** means a letter symbol (e.g., A, B, C, etc.), which indicates the broad level of performance of a student in a course/ semester/programme.
- 4.13. Grade point (GP)** is the numerical indicator of the percentage of marks awarded to a student in a course
- 4.14. Grace Marks** shall be awarded to candidates as per the University Orders issued from time to time.

Words and expressions used and not defined in this regulation shall have the same meaning assigned to them in the Act and Statutes.

5. DURATION OF THE PROGRAMME

The duration of U.G. programmes shall be 6 semesters. The duration of odd semesters shall be from June to October and that of even semesters from November to March. 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.

6. COURSE DESIGN

The UG programme in Zoology consists of the following types of courses:

- a) Common courses.
- b) Core courses.
- c) Complementary courses.
- d) Open courses.
- e) Choice based courses.
- f) Project

The core course is in the discipline of Zoology and two complementary courses, in Chemistry and Botany. No course shall carry more than 4 credits. The student shall select any one open course in Sem V offered by other departments including Department of Physical Education.

A student can earn extra credits as detailed below:

- Service - Learning.
- Courses offered by talent clubs.
- Animal Rearing Programmes organized by the department.
- Course in Virtual Lab Experiments.

7. PROGRAMME STRUCTURE

Programme Duration	6 Semesters
Total Credits required for the successful completion of the programme	120 Credits
Credits required from Common Course I (<i>English</i>)	22 Credits
Credits required from Common Course II (<i>Second Language</i>)	16 Credits
Credits required from Core Course, Complementary Courses and Project	79 Credits
Open Course	3 Credits
Minimum attendance required	75 %

7.1.Course-wise Distribution of Credits:

The B. Sc. Zoology programme consists of common courses with 38 credits, core course, Choice based course and complementary courses with 79 credits and open course with 3 credits.

The number and credits of different types of courses of the programme are listed below.

Type of the Course	No. of Courses	No. of Credits
Common Course I (<i>English</i>)	6	22
Common Course II (<i>Second Language</i>)	4	16
Total	10	38
Core Courses – <i>Theory</i>	12	34
Core Courses – <i>Practical</i>	6	12
Choice Based Course	1	3
Project& Viva – Voce	1	2
Total	20	51
Complementary Courses – <i>Theory</i>	8	20
Complementary Courses – <i>Practical</i>	4	8
Total	12	28
Open Course	1	3
Grand Total	43	120

7.2. Extra-Credit Courses:

The list of extra-credit courses and their corresponding credits are given below:

Course	No. of Credits
Service-Learning (<i>Mandatory</i>)	1
Courses offered by talent clubs	1
Animal Rearing Programmes	1
Virtual lab Experiments	1

7.3. Semester-wise Distribution of Credits and Instructional Hours:

	Sem I		Sem II		Sem III		Sem IV		Sem V		Sem VI	
	Credit	Hrs./Week	Credit	Hrs./Week	Credit	Hrs./Week	Credit	Hrs./Week	Credit	Hrs./Week	Credit	Hrs./Week
Common Course I (<i>English</i>)	7	9	7	9	4	5	4	5	-	-	-	-
Common Course II (<i>Second Language</i>)	4	4	4	4	4	5	4	5	-	-	-	-
Core Course - <i>Theory</i>	2	2	2	2	3	3	3	3	12	12	12	12
Core Course - <i>Practical</i>	-	2	2	2	-	2	2	2	-	8	8	8
Complementary Course – I <i>Chemistry - Theory</i>	2	2	2	2	3	3	3	3	-	-	-	-
Complementary Course – I <i>Chemistry- Practical</i>	-	2	2	2	-	2	2	2	-	-	-	-
Complementary Course – I <i>Botany - Theory</i>	2	2	2	2	3	3	3	3	-	-	-	-
Complementary Course – I <i>Botany - Practical</i>	-	2	2	2	-	2	2	2	-	-	-	-
Group activity/Project	-	-	-	-	-	-	-	-	-	1	2	1
Open Course	-	-	-	-	-	-	-	-	3	4	-	-
Choice Based Core Course	-	-	-	-	-	-	-	-	-	-	3	4
Total	17	25	23	25	17	25	23	25	15	25	25	25

SEMESTER	No. of Credits	No. of Instructional Hours
I	17	25
II	23	25
III	17	25
IV	23	25
V	15	25
VI	25	25
Total	120	150

8. EXAMINATIONS

The evaluation of each course shall contain two parts:

- (i) CONTINUOUS INTERNAL ASSESSMENT (CIA)
- (ii) END-SEMESTER EXAMINATION (ESE)

The internal to external assessment ratio shall be 1:3, for both courses with or without practical. There shall be a maximum of 75 marks for external evaluation and maximum of 25 marks for internal evaluation.

Marks distribution for external and internal assessments and the components for internal evaluation with their marks are shown below:

8.1 Mark Distribution for all Core Theory Papers:

- a) Marks of End Semester Examination : **60**
- b) Marks of Internal Evaluation- : **20**

Different components of theory paper internal evaluation is given below. All three components are mandatory.

Components of Theory – Internal Evaluation	Marks
Attendance	5
Assignment / Seminar/ Viva-Voce	5
Internal Assessment Tests (Two)($2 \times 5 = 10$)	10
Total	20

Note: *Decimal are to be rounded to the next whole number*

8.1.1 Mark Distribution for Open Course & Choice Based Core Course.

- a) Marks of End Semester Examination : 75
- b) Marks of Internal Evaluation- Core Courses : 25

Different components for the open course internal evaluation is given below.

Components of Theory – Internal Evaluation	Marks
Attendance	5
Assignment	5
Seminar/ Viva-Voce	5
Internal Assessment Tests (Two)($2 \times 5 = 10$)	10
Total	25

Note: Decimal are to be rounded to the next whole number

Internal Assessment Tests (IAT):

Two internal assessment tests (IAT) are to be attended in each semester for each paper. The marks for the tests will be converted into a 5 mark scale for the test paper component of internal evaluation.

8.2 Mark Distribution for all Practical Papers:

The practical end-semester examination is conducted only at the end of even semesters.

- a) Marks of Practical - ESE: $15+15=30$ (only in even semesters)
- b) Marks of Practical - CIA: $5+5=10$ (odd and even semesters)

Components of Practical-Continuous internal assessment	Marks
Attendance	2
Record	2
Lab involvement	1
Total	5

Percentage of attendance for Practical	Marks
Above 85 %	2
75-85	1
<75	0

8.3 *Mark Distribution for Project and Viva-Voce:*

Students may choose any Research Topic related with courses of Zoology programme for their investigatory project work in consultation with their supervising teacher.

Project Evaluation: (Max. marks100)

Components of Project-Evaluation	Marks
Dissertation (External)	50
Internal Evaluation	25
Viva-Voce (External)	25
Total	100

8.4 *Attendance Evaluation for Theory Papers:*

Mark distribution for attendance, rules regarding attendance and condonation of shortage of attendance are given below.

8.4.1 *Mark Distribution forAttendance:*

Percentage of Attendance	Marks
90 % and above	5
Between 85 and 90%	4
Between 80 and 85%	3
Between 75 and 80%	2
75%	1

8.4.2 Condonation of Shortage of Attendance:

Candidate can seek condonation of shortage of attendance only once in a 2 year course and twice in other courses of longer duration. Following are the rules regarding attendance requirement:-

- i.) Every candidate is to secure 75% attendance of the total duration of the course.
- ii.) A candidate having a shortage of 10% can apply for condonation of shortage in prescribed form on genuine grounds. Condonation of shortage of attendance if any should be obtained at least 7 days before the commencement of the concerned semester examination.
- iii.) It shall be the discretion of the Principal to consider such applications and condone the shortage on the merit of each case in consultation with the concerned course teacher and HoD.
- iv.) Unless the shortage of attendance is condoned, a candidate is not eligible to appear for the examination.

9. COMPUTATION OF GRADE AND GRADE POINTS

For all courses (theory & practical), grades are given on a 08-point scale based on the total percentage of marks (*CIA+ESE*) as given below:

9.1

% of Marks for a course	Grade	Grade Point
95% and above	O - Outstanding	10
85 to below 95%	A ⁺ - Excellent	9
75 to below 85%	A - Very Good	8
65 to below 75%	B ⁺ - Good	7
55 to below 65%	B - Satisfactory	6
45 to below 55%	C - Average	5
35 to below 45%	D - Pass	4
Below 35	F - Failure	0
	Ab – Absent	0

Computation of SGPA (*Semester Grade Point Average*)

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses and the total number of credits of all the courses undergone by a student in a semester.

$$\text{SGPA } (S_i) = \frac{\sum (C_i \times G_i)}{\sum C_i}$$

Where, S_i is the SGPA of the i^{th} semester, C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.

The SGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration for SGPA:

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit \times Grade Point)
Course 1	3	B	6	$3 \times 6 = 18$
Course 2	4	A	8	$4 \times 8 = 32$
Course 3	3	A ⁺	9	$3 \times 9 = 27$
Course 4	3	B ⁺	7	$3 \times 7 = 21$
Course 5	3	C	5	$3 \times 5 = 15$
Course 6	4	O	10	$4 \times 10 = 40$
	$\Sigma C_i = 20$			$\Sigma (C_i \times G_i) = 153$

$$\text{SGPA } (S_i) = \frac{\sum (C_i \times G_i)}{\sum C_i} = \frac{153}{20} = 7.65$$

9.2 Computation of CGPA (Cumulative Grade Point Average)

The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, *i.e.*

$$\text{CGPA} = \frac{\sum (C_i \times S_i)}{\sum C_i}$$

Where, S_i is the SGPA of the i^{th} semester and C_i is the number of credits in that semester.

Note: The CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration for CGPA:

Semester	SGPA (S_i)	Credits (C_i)	$S_i \times C_i$
I	9.69	18	174.42
II	9.12	22	200.64
III	8.50	18	153.00

IV	8.75	22	192.50
V	9.13	15	136.95
VI	9.50	25	237.50
		Σ Ci = 120	Σ (Si × Ci) = 1095.01

$$\text{CGPA} = \frac{\sum (S_i \times C_i)}{\sum C_i} = \frac{1095.01}{120} = 9.13$$

Grades for the different semesters and overall programme are given based on the corresponding SGPA/ CGPA as shown below:

SGPA/CGPA	Grade
9.50 to 10.00	<i>O - Outstanding</i>
8.50 to 9.49	<i>A+ - Excellent</i>
7.50 to 8.49	<i>A - Very Good</i>
6.50 to 7.49	<i>B+ – Good</i>
5.50 to 6.49	<i>B – Satisfactory</i>
4.50 to 5.49	<i>C – Adequate</i>
3.5 to 4.49	<i>D - Pass</i>
Below 3.5	<i>F – Failure</i>

Note: A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 35% are required for a pass for a course.

For a pass in a programme, a separate minimum of Grade **D** is required for all the individual courses. If a candidate secures **F** Grade for any one of the courses offered in a Semester/Programme only **F** grade will be awarded for that Semester/Programme until he/she improves this to **D** grade or above within the permitted period. Candidate secure **D** grade and above will be eligible for higher studies.

10. SCHEME OF CORE AND COMPLEMENTARY COURSES

10.1 SCHEME OF ZOOLOGY CORE COURSES (*Semester-wise Distribution*)

Course Code	Course Title	Credits	Hours / Week	Hour / Sem.	Examination		
					ESE Duration	ESE Max. Marks	CIA Max. Marks
SEMESTER I							
19U1CRZOO01	Animal Diversity - Non-Chordata I	2	2	36	3 Hrs.	60	20
19U2PRZOO01	Practical 1 -Animal Diversity - Non-Chordata I & II	-	2	36	Examination at the end of Sem II		
SEMESTER II							
19U2CRZOO02	Animal Diversity - Non-Chordata II	2	2	36	3 Hrs.	60	20
19U2PRZOO01	Practical 1 -Animal Diversity - Non-Chordata I & II	2	2	36	3 Hrs.	30	10
SEMESTER III							
19U3CRZOO03	Animal Diversity - Chordata	3	3	54	3 Hrs.	60	20
19U4PRZOO02	Practical 2 -Animal Diversity - Chordata + Applied Zoology	-	2	36	Examination at the end of Sem IV		
SEMESTER IV							
19U4CRZOO04	Applied Zoology	3	3	54	3 Hrs.	60	20
19U4PRZOO02	Practical 2 -Animal Diversity - Chordata + Applied Zoology	2	2	36	3 Hrs.	30	10
SEMESTER V							
19U5CRZOO05	Cell and Molecular Biology	3	3	54	3 Hrs.	60	20
19U5CRZOO06	Environmental Biology	3	3	54	3 Hrs.	60	20
19U5CRZOO07	Evolution, Zoogeography and Ethology	3	3	36	3 Hrs.	60	20
19U5CRZOO08	Biochemistry, Human Physiology and Endocrinology	3	3	36	3 Hrs.	60	20
19U6PRZOO03	Practical 3 – Environmental Biology, Toxicology and Disaster Management + Evolution, Zoogeography and Ethology	2	2	36	Examination at the end of Sem VI		
19U6PRZOO04	Practical 4 – Cell and Molecular Biology + Biochemistry, Human Physiology and Endocrinology	2	2	36	"		
19U6PJZOO01	Project and Viva (6th Semester) Visit to research institutes (6th Semester) Study tour/Field study , Group activity (5th Semester)	-	1	18	Project evaluation and viva-voce at the end of Sem VI.		

OPEN COURSE FOR OTHER STREAMS							
19U5OCZOO01	Human Genetics, Nutrition, Community health and Sanitation	3	4	72	3 Hrs.	75	25
SEMESTER VI							
19U6CRZOO09	Reproductive and Developmental Biology	3	3	54	3 Hrs.	60	20
19U6CRZOO10	Genetics and Biotechnology	3	3	54	3 Hrs.	60	20
19U6CRZOO11	Microbiology and Immunology	3	3	54	3 Hrs.	60	20
19U6CRZOO12	General Informatics, Bioinformatics, Biostatistics and Research Methodology	3	3	54	3 Hrs.	60	20
19U6CRZOO13	Ecotourism and Ecotourism Entrepreneurship (<i>Elective Course</i>)	3	4	72	3 Hrs.	75	25
19U6PRZOO05	Reproductive and Developmental Biology + Genetics and Biotechnology	2	2	36	3 Hrs.	30	10
19U6PRZOO06	Microbiology and Immunology + General Informatics, Bioinformatics, Biostatistics and Research Methodology	2	2	36	3 Hrs.	30	10
19U6PJZOO01	Project and Viva (6th Semester) Visit to research institutes (6th Semester) Study tour/Field study , Group activity (5th Semester)	2	1	18	<i>Project evaluation and viva-voce at the end of Sem VI</i>		

10.2 SCHEME OF ZOOLOGY COMPLEMENTARY COURSES FOR B.Sc. BOTANY (*Semester-wise Distribution*)

Course Code	Course Title	Credits	Hours / Week	Hour / Sem.	Examination		
					ESE Duration	ESE Max. Marks	CIA Max. Marks
SEMESTER I							
19U1CPZOO01	Animal Diversity – Non-Chordata	2	2	36	3 Hrs.	60	20
19U2PCZOO01	Practical 1 - Animal Diversity – Non-Chordata + Chordata	-	2	36	Examination at the end of Sem II		
SEMESTER II							
19U2CPZOO02	Animal Diversity – Chordata	2	2	36	3 Hrs.	60	20
19U2PCZOO01	Practical 1 - Animal Diversity – Non-Chordata + Chordata	2	2	36	3 Hrs.	30	10
SEMESTER III							
19U3CPZOO03	Human Physiology and Immunology	3	3	54	3 Hrs.	60	20
19U4PCZOO02	Practical 2 - Human Physiology and Immunology + Applied Zoology	-	2	36	Examination at the end of Sem IV		

SEMESTER IV							
19U4CPZOO04	Applied Zoology	3	3	54	3 Hrs.	60	20
19U4PCZOO02	Practical 2 - Human Physiology and Immunology + Applied Zoology	-	2	36	3 Hrs.	30	10

11. B. Sc. ZOOLOGY PROGRAMME - *CONSOLIDATED SCHEME*

The programme structure with detailed semester-wise distribution of common courses, core courses, complementary courses, open course, choice based course and project are listed below.

Sl. No.	Type of Course	Course Title	Credits	Hrs./ Week	Hrs./ Sem.
SEMESTER I					
1.	Common	English - I	4	5	90
2.	Common	English Common Course - I	3	4	72
3.	Common	Second Language - I (<i>Mal / Hin / San / Fre</i>)	4	4	72
4.	Core	Animal Diversity – Non-Chordata I	2	2	36
5.	Core	Practicals 1	-	2	36
6.	Complementary	Chemistry - I	2	2	36
7.	Complementary	Chemistry Practicals - I	-	2	36
8.	Complementary	Botany - I	2	2	36
9.	Complementary	Botany Practicals - I	-	2	36
Total			17	25	450
SEMESTER II					
1.	Common	English - II	4	5	90
2.	Common	English Common Course - II	3	4	72
3.	Common	Second Language - II (<i>Mal / Hin / San / Fre</i>)	4	4	72
4.	Core	Animal Diversity – Non-Chordata II	2	2	36
5.	Core	Practicals 1	2	2	36
6.	Complementary	Chemistry - 2	2	2	36
7.	Complementary	Chemistry Practicals - I	2	2	36
8.	Complementary	Botany - 2	2	2	36
9.	Complementary	Botany Practicals - I	2	2	36
Total			23	25	450

SEMESTER III					
1.	Common	English - III	4	5	90
2.	Common	Second Language - III (<i>Mal / Hin / San / Fre</i>)	4	5	90
3.	Core	Animal Diversity – Chordata	3	3	54
4.	Core	Practicals 2	-	2	36
5.	Complementary	Chemistry – III	3	3	54
6.	Complementary	Chemistry Practicals – II	-	2	36
7.	Complementary	Botany - III	3	3	54
8.	Complementary	BotanyPracticals – II	-	2	36
Total			17	25	450
SEMESTER IV					
1.	Common	English - IV	4	5	90
2.	Common	Second Language - IV (<i>Mal / Hin / San / Fre</i>)	4	5	90
3.	Core	Animal Diversity – Applied Zoology	3	3	54
4.	Core	Practicals 2	2	2	36
5.	Complementary	Chemistry – IV	3	3	54
6.	Complementary	Chemistry Practicals – II	2	2	36
7.	Complementary	Botany - IV	3	3	54
8.	Complementary	BotanyPracticals – II	2	2	36
Total			23	25	450
SEMESTER V					
1.	Core	Cell and Molecular Biology	3	3	54
2.	Core	Environmental Biology	3	3	54
3.	Core	Evolution, Zoogeography and Ethology	3	3	54
4.	Core	Biochemistry, Human Physiology and Endocrinology	3	3	54
5.	Open	Open courses offered in other core subject areas	3	4	72
6.	Core	Practicals III	-	4	72
7.	Core	Practicals IV	-	4	72
8.	Core	Project/Group Activity	-	1	18
Total			15	25	450

SEMESTER VI					
1.	Core	Reproductive and Developmental Biology	3	3	54
2.	Core	Genetics and Biotechnology	3	3	54
3.	Core	Microbiology and Immunology	3	3	54
4.	Core	General Informatics, Bioinformatics, Biostatistics and Research Methodology	3	3	54
5.	Choice Based	Ecotourism and Ecotourism Entrepreneurship (Elective Course)	3	4	72
6.	Core	Practicals III	2	-	-
7.	Core	Practicals IV	2	-	-
6.	Core	Practicals - V	2	4	72
7.	Core	Practicals - VI	2	4	72
8.	Core	Project/Group Activity	2	1	18
Total			25	25	450

GRIEVANCE REDRESSAL MECHANISM

In order to address the grievance of students regarding Continuous internal assessment (CIA) a three-level Grievance Redressal mechanism is envisaged. A student can approach the upper level only if grievance is not addressed at the lower level.

Level 1:

At the level of the concerned course teacher

Level 2:

At the level of a department committee consisting of the Head of the Department, a coordinator of internal assessment for each programme nominated by the HoD and the course teacher concerned.

Level 3:

A committee with the Principal as Chairman, Dean of concerned Faculty, HODs of concerned departments and one member of the Academic council nominated by the principal every year as members.

PATTERN OF QUESTION PAPERS

Pattern of questions for ESE for theory papers with practical

Total no. of questions	Number of questions to be answered	Marks of each question	Total marks
8	8	1	8
8	6	2	12
6	4	5	20
4	2	10	20
26	20		60

Pattern of questions for ESE for papers without practical (Open Course and Elective Course)

Total no. of questions	Number of questions to be answered	Marks of each question	Total marks
10	10	1	10
10	8	2	16
7	5	5	25
4	2	12	24
31	25		75

SYLLABUS

B.Sc. ZOOLOGY Core Course

SEMESTER I

19U1CRZOO01 Core Course I

Animal Diversity - Non Chordata I

36 hrs

Credits 2

Course Code	19U1CRZOO01
Title of the course	Animal Diversity - Non Chordata I
Semester in which the course is to be taught	1
No. of credits	2
No. of contact hours	36

Objectives

1. To make aware of the basic philosophy of science, its history, concepts and scope
2. To develop proper scientific mind, culture and work habits
3. To study the scientific classification invertebrate fauna

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understand the history, branches and the scope of Biology	PSO1	U	C	2
CO2	Understand the concept of Symmetry and Coelom	PSO1	U	C	1

CO3	Understand the principles, nomenclature, classification, approaches and modern trends in taxonomy.	PSO1	U	C	7
CO4	Understand the concept of Two kingdom and Five kingdom classification in taxonomy	PSO1	U	C	14
CO5	Differentiate the animals in to phyla based on their characters.	PSO1	A	C	4
CO6	Analyze the life cycle and reproduction of Kingdom Protista and Animalia.	PSO1	A	C	8

Pre-requisite:

- Basic knowledge on various sciences and definitions of scientific terms
- An awareness on basic classification of animals

PART – I BIOLOGY - THE LIFE SCIENCE

Module I. What is Biology?

2 hrs

History of Biology(Brief)

Branches of biology and its scopes.

What is science? Method of science.

Core Readings

Bowler Peter J. and Iwan Rhys Morus. 2005 *Making Modern Science: A Historical Survey*. College of Chicago Press, Chicago, IL:

Ernst Mayr 1982. *The Growth of Biological Thought: Diversity, Evolution and Inheritance*. Published by Harvard College Press.

Ervin Schrodinger 1944. *What is life? Mind and Matter*. Cambridge College Press.

Jacques Monod 1971. *Chance and Necessity: An Essay on the Natural Philosophy of Modern Biology*. Vintage Pub. NY

Kuhn, Thomas. 1996 *The Structure of Scientific Revolutions* 3rd ed.: College of Chicago Press, Chicago, IL

Taylor, Green, Stout (2008) *Biological Science*, Cambridge College, Press, p 951.

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

Module II.

Symmetry and Coelom

1 hr

Symmetry - Asymmetry, Spherical, Radial, Biradial and Bilateral

Coelom – Acoelomates, Pseudocoelomates and Eucoelomates

Schizocoelom, Enterocoelom., Protostomia and Deuterostomia

Core Readings

Zoological Society of Kerala Study material. *Animal Diversity* 2002.

EkambaranathaAyyar M. 1990. *A Manual of Zoology*. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.

Module III. Taxonomy

7

hrs

Principles of taxonomy.

Nomenclature.

Zoological nomenclature.(ICZN)

Law of Priority.(Brief)

Homonymy and Synonymy. (Brief)

Classification – Keys and principles

Two kingdom and Five kingdom classification.

Concepts and definition of classification.

Approches of taxonomy.

Modern trends in taxonomy. (Molecular taxonomy)

Phylogeny and taxonomy.

Core readings

Zoological Society of Kerala Study material. *Animal Diversity* 2002.

EkambaranathaAyyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.

Module IV :Kingdom Protista

Type: Paramecium

14hrs

Salient features and classification up to phyla

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

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

General Topics : (1) Parasitic Protozoans (2). Life cycle of Plasmodium

Module V : Kingdom Animalia

1 hr

Outline classification of Kingdom Animalia.

Three branches - Mesozoa, parazoa, Eumetazoa.

Core Readings

Dhami.P.S. and Dhami J.K. 1979 Invertebrate Zoology. R. Chand and Co. Delhi.

Ekambaranatha Ayyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.

Zoological Society of Kerala Study material. *Animal Diversity* 2002.

MODULE VI

3 hrs

Mesozoa - Eg. Rhopalura.

Phylum Porifera.

Classification upto classes.

Class I- Calcarea. Eg. Sycon., Class II – Hexactinellida . Eg. Euplectella.

Class III – Demospongia Eg. Cliona.

General Topics

1. Reproduction in sponges 2. Canal system in sponges.

Phylum Coelenterata

Type: Obelia

7 hrs

Classification upto classes.

Class I - Hydrozoa Eg. Halistemma. Class II – Scyphozoa Eg. Rhizostoma. Class III- Anthozoa Eg. Fungia.

General Topics: Coral and coral reefs with special reference to conservation of reef fauna.

2. Polymorphism in Coelenterates

Core Readings

Zoological Society of Kerala Study material. *Animal Diversity* 2002.

Ekambaranatha Ayyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.

MODULE VII

Phylum Ctenophora.

1 hr

Eg. Pleurobrachia.

Core Readings

EkambaranathaAyyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.

19U2PRZOO01 Practical 1

Animal diversity – Non Chordata I

36 hours

Credit 1

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understand the structure and function of simple and compound light microscopes	PSO1	U	P	4
CO2	Understand the structure and function of Camera Lucida	PSO1	U	P	4
CO3	Analyze the specimens by their generic names	PSO1	A	C	4
CO4	Apply the principles in Scientific Drawing	PSO1	A	P	10
CO5	Understand the anatomy of Hydra	PSO1	A	F	2
CO6	Understand the larval forms	PSO1	U	C	4
CO7	Analyze the specimens of insects	PSO1	A	C	8

1. Study of simple and compound light microscopes
2. Camera Lucida (Demonstration)
3. Simple identification. (Minimum 10 specimens. All specimens by their generic names and 50% of these by their species name.)
4. Scientific drawing. (Minimum 5 specimens)
5. Anatomy – Study of section (Hydra)
6. Study of larval forms. (Minimum four)
7. Insect identification using key. (Up to Order)

SEMESTER II

19U2CRZOO02Core Course 2

ANIMAL DIVERSITY – Non Chordata II

36 hrs

Credits 2

Course Code	19U2CRZOO02
Title of the course	Animal Diversity - Non Chordata II
Semester in which the course is to be taught	2
No. of credits	2
No. of contact hours	36

Objectives:

1. To create appreciation on diversity of life on earth
2. To study the scientific classification of invertebrate fauna.
3. To learn the physiological and anatomical peculiarities of some invertebrate phyla through type study.
4. learn the evolutionary significance of various invertebrate fauna
5. To stimulate the curiosity in living things around them.

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understand the classification of phylum Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca and Hemichordata	PSO1	U	C	18
CO2	Understand the Life history of platyhelminth parasites	PSO1	U	C	4
CO3	Understand the pathogenic nematodes	PSO1	U	C	4

CO4	Understand the vectoral arthropods	PSO1	U	C	4
CO5	Understand the larval forms of <i>Penaeus</i>	PSO1	U	C	2
CO6	Understand the pearl formation and culture	PSO1	U	C	2
CO7	Understand the water vascular system in Echinodermata	PSO1	U	C	2

Pre requisite:

- Basic knowledge on the living world, plant and animal kingdom
- Knowledge on biodiversity and its conservation
- Knowledge on biological classification and representative organism of major taxa

Module I

Phylum Platyhelminthes

3hrs

Classification upto classes.

Class I - Turbellaria. Eg. Planaria.

Class II – TrematodaEg. Fasciola

Class III- CestodaEg. *Taenia saginata*.

General Topics-

1. Life history of *Fasciola hepatica*.
2. Platyhelminth parasites of Man and Dog (*Schistosoma*, *Taenia solium*, *Echinococcus*).

Module II

Phylum Aschelminthes.

2 hrsEg.

Enterobius.

General Topic-

Pathogenic nematodes.

Module III

Phylum Annelida

7 hrs

Classification upto classes.

Class I- Archiannelida Eg. Polygordius

Class II – Polychaeta Eg. Chaetopterus

Class III- Oligochaeta Eg. Megascolex.

Class IV - Hirudinea Eg. Ozobranchus

Type - Earthworm

Core Readings

Zoological Society of Kerala Study material. *Animal Diversity* 2002.

Ekambaranatha Ayyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.

MODULE IV

Phylum Arthropoda

12 hrs

Type: Panaeus

Classification upto classes.

Divided into 4 subphyla.

1. Sub Phylum - Trilobitomorpha

Class - Trilobita (mention salient features).

2. Sub Phylum- Onychophora

Class – Onychophora . Eg. Peripatus (Mention its affinities).

3. Sub Phylum- Mandibulata

Class I – Crustacea Eg. Sacculina

Class II- Chilopoda Eg. Centipede

Class III – Diplopoda Eg. Millipede

Class IV - Insecta Eg. Dragon fly

4. Sub Phylum - Chelicerata

Class - Merostomata Eg. Limulus

Class II – Arachnida Eg. Scorpion

General Topics

1. Vectorial Arthropods
2. Larval forms of Penaeus

Core Readings

Zoological Society of Kerala Study material. *Animal Diversity* 2002.

EkambaranathaAyyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.

MODULE V

Phylum Mollusca

5 hrs

Classification upto classes

Class I- MonoplacophoraEg.Neopilina

Class II- Amphineura Eg. Chiton

Class III- GastropodaEg. Aplysia

Class IV- Scaphopoda Eg. Dentalium

Class V- PelecypodaEg.Pinctada

Class VI- CephalopodaEg. Sepia

General Topic-

Pearl formation and culture

Module VI

Phylum Echinodermata

4 hrs

Classification upto classes

Class I- Asteroidea Eg.Astropecten

Class II- Ophiuroidea Eg.Ophiothrix

Class III- EchinoideaEg. Echinus

Class IV- Holothuroidea Eg.Holothuria

Class V – Crinoidea Eg. Antedon

Brief account on larval forms.

General Topics

1. Water vascular system.

Module VII

Minor Phyla

2 hrs

1. General account and examples

Module VIII

Phylum Hemichordata (1 hr)

Eg. Balanoglossus (Affinities)

Core Readings

Zoological Society of Kerala Study material. *Animal Diversity* 2002.

Ekambaranatha Ayyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.

Selected Further Readings

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

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

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

Ekambaranatha Ayyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.

Hyman L. H. The Invertebrate Volumes. Mc Graw Hill.

Jordan. E. L., and Verma P.S. 2000. Invertebrate zoology. S. Chand and Co. Ltd., New Delhi.

Kotpal R. L, Agarwal S. K. and R. P. Khetharpal 2002. Modern Textbook of Zoology.

19U2PRZOO01: Practical 1

Animal Diversity - Non Chordata II

36 hrs

Credit 1

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understand the classification of phylum Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca and Hemichordata	PSO1	U	C	18
CO2	Understand the Life history of platyhelminth parasites	PSO1	U	C	4
CO3	Understand the pathogenic nematodes	PSO1	U	C	4
CO4	Understand the vectoral arthropods	PSO1	U	C	4
CO5	Understand the larval forms of Penaeus	PSO1	U	C	2
CO6	Understand the pearl formation and culture	PSO1	U	C	2
CO7	Understand the water vascular system in Echinodermata	PSO1	U	C	2

Anatomy:-

Study of sections. (Any two)

- A. Ascaris
- B. Earthworm
- C. Fasciola

1. Dissections

- A. Prawn - Nervous system

B. Cockroach - Nervous system

2. Mounting:-

A. Cockroach - Salivary glands

B. Mouth parts - Plant bug/House fly/Mosquito/Cockroach/Honey bee (Any Two)

C. Prawn appendages.

D. Earthworm setae

3. General identification

A. Minimum twenty specimens. (Taxonomic classification and Ecological/Morphological/Evolutionary/Economic importance)

SEMESTER III

19U3CRZOO03: CORE COURSE 3 ANIMAL DIVERSITY – CHORDATA

**54 Hrs
3 Credits**

Course Code	19U3CRZOO03
Title of the course	Animal Diversity - Chordata
Semester in which the course is to be taught	3
No. of credits	3
No. of contact hours	54

Objectives

1. To make the student observe the diversity in chordates and their systematic position.
2. To make them aware of the economic importance of some classes.

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understand the general classification of Phylum Chordata, sub phyla Urochordata and Cephalochordata their classes and specific examples	PO1 PSO1	U	C	6
CO2	Understand the classification of Sub phylum Vertebrata, divisions Agnatha and Gnathostomata, super class Pisces and its various classes with typical examples	PO1 PSO1	U	C	8
CO3	Understand the accessory respiratory organs in fish, parental care, scales in fishes, migration, common culture fishes and lung fishes	PO1 and PO4 PSO1	U	C	4
CO4	Understand super class Tetrapoda, class Amphibia, elaborate study of type – frog, various orders under class Amphibia	PO1 PSO1	U	C	10
CO5	Understand the class Reptilia, its various subclasses with examples, identifying poisonous and non poisonous snakes	PO1 and PO4 PSO1	U	C	4
CO6	Understand the class Aves, its various subclasses, migration in birds and flight adaptations in birds	PO1 and PO4 PSO1	U	C	4
CO7	Understand the characteristics of Class Mammalia and detailed study of type - Rabbit	PO1 PSO1	U	C	10
CO8	Understand the various sub classes under Mammalia, their orders and examples and dentition in mammals and aquatic mammals	PO1 and PO4 PSO1	U	C	8

MODULE I

Introduction

1 Hr

Phylum Chordata - General classification

(Classification up to order – Sub phylum, Super class, Class, Subclass, Order)

1. Sub phylum : Urochordata

3Hrs

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**

Core Readings

EkambaranathaIyer 2000 A Manual of Zoology Vol. II .S. Viswanathan and Co.

Young J.Z, 1981, The Life of Vertebrates Oxford University Press.

Young J.Z. 2006 The life of Vertebrates Oxford University Press (Third Ed.) India Ed.

MODULE II

3. Sub phylum: Vertebrata

4. Division 1– Agnatha 2 Hrs

Class I Ostracodermi Eg: Cephalaspis

Class II Cyclostomata Eg: Petromyzon

Division 2 – Gnathostomata 10 Hrs

Super class Pisces

Class: Chondrichthyes

Sub class - Elasmobranchi Eg: Narcine

Sub class Holocephali Eg: Chimaera

Class: Osteichthyes

Sub class – Choanichthyes

Order 1 Crossopterygii Eg: Latimeria

Order 2 Dipnoi Eg: Lepidosiren

Sub class: - Actinopterygii

Super order 1. Chondrostei Eg: Acipencer

Super order 2. Holostei Eg: Amia

Super order 3. Teleostei Eg: Sardine

General topics

1. Accessory respiratory organs in fish.
2. Parental care in fishes.
3. Scales in fishes.
4. Migration in fishes
5. Common culture fishes of Kerala
6. Lung fishes

Core Readings

EkambaranathaIyer 2000 A Manual of Zoology Vol. !!.S. Viswanathan and Co.

Young J.Z. 2006 The life of Vertebrates Oxford University Press (Third Ed.) India Ed.

Jhingran 1977, Fish and Fisheries of India, Hindustan Publishing Co.

MODULE III

Super class: Tetrapoda

10 Hrs

Class Amphibia

Type Frog

Order I Anura

Eg: Hyla

Order II Urodela

Eg: Amblystoma (Mention
axolotl larva and 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

Sub class IV: Synapsida

Eg: Cynognathus

General topic

Identification of poisonous and non poisonous snakes

Class Aves

4 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

Core Readings

Jordan E L and .P.S. Verma, 2002 Chordate Zoology S. Chand and Co.
New Delhi.

EkambaranathaIyer 2000 A Manual of Zoology Vol.II S. Viswanathan and
Co.

MODULE IV**Class Mammalia****18Hrs****Type: Rabbit**

Sub class I: Prototheria	Eg: Echidna
Sub class II: Metatheria	Eg: Macropus
Sub class III: Eutheria	
Order 1. Insectivora	Eg: Talpa
Order 2 Dermoptera	Eg:Galeopithecus
Order 3. Chiroptera	Eg: Pteropus
Order 4. Primates	Eg: Loris
Order 5 Carnivora	Eg: Panthera
Order 6 Edentata	Eg: Armadillo
Order 7 Pholibota	Eg: Manis
Order 8 Proboscidea	Eg: Elephas
Order 9 Hydracoidea	Eg: Procavia
Order 10 Sirenia	Eg: Dugong
Order 11 Perissodactyla	Eg: Zebra
Order 12 Artiodactyla	Eg: Cameleus
Order 13 Lagomorpha	Eg: Oryctolagus
Order 14 Rodentia	Eg: Porcupine
Order 15 Tubulidentata	Eg: Orycteropus
Order 16 Cetacea	Eg: Delphinus

General topics

1. Dentition in Mammals
2. Aquatic Mammals

Core Readings

Jordan E L and .P.S. Verma, 2002 Chordate Zoology S. Chand and Co. New Delhi.

EkambaranathaIyer 2000 A Manual of Zoology Vol. !!.S. Viswanathan and Co.

Thomas A P (Editor) 2010 Chordata .Green leaf publications Kottayam Zoological Society of Kerala Study material. *Animal Diversity* 2002&2011

Selected Further Readings

EkambaranathaIyer 2000 A Manual of Zoology Vol. !!.S. Viswanathan and Co.

Jhingran 1977, Fish and Fisheries of India, Hindustan Publishing Co.

Jordan E L and .P.S. Verma, 2002 Chordate Zoology S. Chand and Co. New Delhi.

Kotpal R.L. 2000, Modern Text Book of zoology, Vertebrates, Rastogi Publications, Meerut.

Nigam and Sobti 2000, Functional Organization of Chordates. Shoban Lal Nagin Chand and Co. New Delhi.

Young J.Z, 1981, The Life of Vertebrates Oxford University Press.

Young J.Z. 2006 The life of Vertebrates Oxford University Press (Third Ed.) India Ed.

19U4PRZOO02:PRACTICAL 2
ANIMAL DIVERSITY - CHORDATA

36 hrs
Credit 1

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Apply taxonomic principles and identify animals belonging to various phyla and classes by their scientific names	PO1 and PO4 PSO4	A	P	6
CO2	Apply scientific principles and draw vertebrate specimens belonging to different classes	PO1 and PO4 PSO4	A	P	6
CO3	Analyse the viscera, digestive system, arterial system, spinal nerves, sciatic plexus and brain of frog	PO1 and PO4 PSO4	A	P	6
CO4	Examine, draw and describe the scales in fishes	PO1 PSO4	A	P	2
CO5	Analyse and examine the vertebrae and girdles of frog and rabbit, skull of rabbit and turtle - plastron and carapace	PO1 and PO4 PSO4	A	P	2
CO6	Analyze the morphology and cross-sections of Amphioxus	PO1 and PO4 PSO4	A	P	2
CO7	Apply taxonomic principles to identify fishes upto order level	PO1 and PO4 PSO4	A	P	6
CO8	Apply taxonomic principles to identify snakes upto order level	PO1 and PO4 PSO4	A	P	6

1. Morphology: Scientific Drawing

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

2. Dissections

Frog: Photographs/diagrams/Virtual lab/models may be used for study.

1. Frog Digestive System
2. Frog Arterial System
3. Frog Sciatic Plexus
4. Frog Brain

3. Mounting of placoid scales/cycloid/ctenoid scales

4. Osteology

Frog vertebrae
Pectoral and pelvic girdles of Frog and Rabbit
Skull of Rabbit (Diastema -dentition)

Turtle – plastron and carapace

5. Study of sections.

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

6. Identification:-

General identification-

Identify all the animals by their generic names and 25 % of them by their specific names.

Protochordata-1, Pisces-4, Amphibia-3, Reptilia- 4, Aves-1,
Mammalia-2.

7. Taxonomic identification with key:-

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

SEMESTER IV

19U4CRZOO04: CORE COURSE 4

APPLIED ZOOLOGY

3hrs/week

54 hrs

Credits 3

Course Code	15U4CRZOO04
Title of the course	Applied Zoology
Semester in which the course is to be taught	4
No. of credits	3
No. of contact hours	54

OBJECTIVES

Equip the students interested in the applied branches of zoology with skills and knowledge which can lead to self employment opportunities.

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understanding of traditional methods of aquaculture and different cultivable fishes of Kerala and management practices for developing entrepreneurial skills.	PSO2	U	C	10
CO2	Understanding of fish culture techniques, fish diseases, fish preservation and processing aquarium fish management practices for developing entrepreneurial skills.	PSO2	U	C	8

C03	Understanding of prawn culture, mussel culture and pearl culture	PSO2	U	C	6
C04	Understanding of sericulture, species of silkworms, life history of silkworms, diseases and pests and management practices for developing entrepreneurial skills.	PSO2	U	C	12
C05	Understanding of vermiculture and various species of earthworms	PSO2	U	C	4
C06	Understanding of vermicomposting	PSO2	U	C	2
C07	Understanding of Honey bee species, apiary, bee keeping methods, bee pasturage	PSO2	U	C	8
C08	Understanding of diseases and pests of honey bees and apiculture management	PSO2	U	C	4

Module 1: Aquaculture

18 hrs

Traditional methods of aquaculture, Advantages and salient features of aquaculture, Types of aquaculture, Biotic and abiotic factors of water.

Pond culture, Brief Description of Carp culture, Composite fish culture. Integrated Fish Culture, Induced breeding in fishes.

Important Fish Diseases. Fish preservation and processing.

Aquarium management, Setting up of an Aquarium, Common species of Aquarium fishes.

Prawn culture, Mussel culture , Pearl culture

Core Readings:

Applied Zoology; (2002) Published by Zoological Society Of Kerala

Module 2 Sericulture

8 hrs

Types of silk, Four species of silkworms, Life history of *Bombyx mori*, Silkworm Rearing Techniques-Mounting of worms, harvesting and extraction of silk.Silkworm diseases, Preventive and control measures.

Core Readings:

Applied Zoology; (2002) Published by Zoological Society Of Kerala

Sudheeran, M.S. & John P.C., 1989 Economic Zoology (Prathibha Publ., Kottayam)

Module 3 Vermiculture**5hrs**

Species of Earthworms suitable for vermiculture. Reproduction and Life Cycle. Factors affecting vermiculture, Vermicomposting, Site Selection, Preparation of pit, Maintenance and Monitoring

Core Readings:

Applied Zoology; (2002) Published by Zoological Society Of Kerala

Venkitaraman, P.R., 1983, Text Book of Economic Zoology (Sudarsana Publ. Cochin)

Module 4 Apiculture**10hrs**

Species of Honey bees. Organization of honeybee colony. Bee keeping methods and equipments, Apiary management and maintenance. Bee pasturage, Byproducts of honey bees and their uses. Diseases and pests of honey bees, control measures.

Core Readings:

Applied Zoology; (2002) Published by Zoological Society Of Kerala

Shukla G.S., & Updhyay V.B., Economic Zoology (Rastogi Publ. Meerut)

Module 5 Poultry Science**8hrs**

Introduction, Importance of egg production, Nutritive value of eggs.

Breeds of fowl: a) Exotic breeds: Rhode Island Red, Plymouth Rock, New Hampshire. b) Indigenous breeds: Chittagong, Gangus

Poultry breeding: meat production

Quail culture (Briefly)

Core Readings:

Sastry, N.S.R. Farm Animal Management & Poultry Production.

Sastry N.S.R.: Farm Animal Management & Poultry Production. Vikas.

Singh H & Mossa: Livestock & Poultry Production, PHI.

Module 6 Animal Husbandry

5 hrs

Introduction, Live stock husbandry - origin, domestication of cattle.

Breeds of cattle.

Common diseases- Anthrax, Foot and Mouth disease, Rinderpest

Biogas production.

Core Readings:

Campbell, J.R. & Lasley, J.R: The Science of Animals that serve Mankind. TMH. Eckles, C.R.

Combs, W.B. & Macy, H.: Milk & Milk Products. Tata MGH. ICARD: Handbook of Animal Husbandry, 1990/97, ICAR, Pusa, N.d.

Selected Further Readings

Alikunhi, K.h., Fish Culture in India (ICAR, New Delhi)

Bhosh, C.C., 1949, Silk Production and Weaving in India (CSIR), New Delhi) Director. Zoological Survey of India, 1994, earthworms Resources and Vermiculture

Edwards, C.A. & Lafty, J.R. 1972 Biology of Earthworms (Chapman and Hall Ltd. London)

Jhingran, V.G., 1985 Fish and Fisheries of India (Hindustan Publ. Corporation, New Delhi)

Kurien, C.V. & Sebastian V.C., Prawn Fisheries in India (Hindustan Publ. Corporation, New Delhi)

Krishnaswami, S., 1986 Improved Method of Rearing Young age Silk worms (Central Silk board Bangalore)

Krishnaswami, S., 1986, New Technology of Silkworm Rearing (Central Silk Board Bangalore)

Lee, K. E., 1985 Earthworms, Their Ecology and relationships with Soils and Land use. Academics Press.

Menon, K.N., 1970 Malsyakrishi (State Institute of language, Trivandrum)

Mysore Silk Association, 1986, Silkworm rearing and Diseases of Silkworms

PadmanabhaAiyer, K.S., 1992, Records of the Indian Museum Vol. XXXI, Part I, PP. 13-76 An Account of the Oligochacta of the Travancore

Shiggene, K., 1969, Problems in Prawn Culture (American publ. Co., New Delhi)

Shukla G.S., & Updhyay V.B., Economic Zoology (Rastogi Publ. Meerut)
Andhra Pradesh Agricultural University, Hyderabad)

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

Singh, S., 1962 Bee keeping in India (ICAR, New Delhi)

Singh, V.P.P. and Ramachandran, V., 1985 Freshwater Fish Culture (ICAR, New Delhi)

Sudheeran, M.S. & John P.C., 1989 Economic Zoology (Prathibha Publ., Kottayam)

Ullal, S. R. and Narasimahanna, M.N., Handbook of Practical Sericulture (Central Silk Board Bombay.)

Venkitaraman, P.R., 1983, Text Book of Economic Zoology (Sudarsana Publ. Cochin)

SEMESTER IV

19U4PRZOO02:PRACTICAL 2

APPLIED ZOOLOGY

2 hrs/week

1 credit

36 hrs

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
C01	Analyse, identify and examine the culturable species of fishes	PO1, PO4 PSO4	E	P	6
C02	Analyse, identify and examine culturable species of earthworms, castes of honey bees and silkworm	PO1, PO4 PSO4	E	P	6
C03	Analyse the bee keeping equipments and chandrike and develop entrepreneurial skills	PO1, PO4 PSO4	E	P	6
C04	Examine the products and by-products of apiculture, sericulture and vermicomposting	PO1 PSO4	E	P	6
C05	Analyse and study the different types of fish diseases and fish parasites	PO1, PO4 PSO4	E	P	6
C06	Analysis of the gut content of fish and determine its feeding habits	PO1 PSO4	E	P	6
C07	Hands on training in maintenance of aquarium, aquaculture farms, apiary, sericulture, poultry farms	PO1 PO2, PO4 PSO4	E	P	1 week

1. General Identification, Economic importance, Morphology, scientific names and common names of the following
 - a. Economic importance and morphology of culturable species
(Catla, Rohu, Etroplus, Tilapia)

Penaeus indicus,/ *P.monodon*,/ *Macrobrachium*

Pernaviridis/P.indicus

Pinctada fucata

- b. 2 species of earthworms used in Vermiculture
 - c. Two species of honey bees
 - d. Silkworm. Cocoon/Adult
2. Castes of bees
 3. Bee keeping equipments Beehive, Smoker, honey extractor
 4. Beeswax, Honey, Silk, Vermicompost (Identification-Uses)
 5. Chandrike used in sericulture
 6. Poultry breeds (picture identification)
 7. Cattle breeds (picture identification)
 8. Fish – Gut content analysis to determine feeding habits.

SEMESTER V

19U5CRZOO05: CORE COURSE 5

CELL AND MOLECULAR BIOLOGY

54 Hrs

Credits 3

Course Code	19U5CRZOO05
Title of the course	Cell and Molecular Biology
Semester in which the course is to be taught	5
No. of credits	3
No. of contact hours	54

Objectives:

1. To emphasize the central role of Cell biology and Molecular biology, being the most developing areas of biological science.
2. To make aware of different cell organelles, their structure and role in living organisms.
3. To introduce the nature of genetic materials at molecular level, their expression and regulation.
4. To develop critical thinking, skill and research aptitudes.

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understand the history and scope of cell and molecular biology, cell theory, prokaryotes, eukaryotes, Actinomycetes, Mycoplasmas, virus, virion and viroids and prions	PO1 PSO3	U	C	2
CO2	Understand plasma membrane, the various models of plasma membrane and its modifications, cell permeability and functions	PO1 PSO3	U	C	6
CO3	Understand the ultrastructure of the cytoplasm and the various cell organelles and their functions	PO1 PSO3	U	C	7
CO4	Understand the structure and functions of the nucleus and a basic understanding of chromosomes and its structure	PO1 PSO3	U	C	6
CO5	Understand cell division both mitosis and meiosis and the various cell signalling mechanisms	PO1 PSO3	U	C	6
CO6	Understand the basic nature of the genetic material, DNA structure, types, replication, modern concept of gene, prokaryotic and eukaryotic genome	PO1 PSO3	U	C	7
CO7	Understand the central dogma of molecular biology, genetic code and protein synthesis in prokaryotes and eukaryotes	PO1 PSO3	U	C	12
CO8	Understand gene regulatory mechanisms, operon concept both lac operon and typtophan operon	PO1 PSO3	U	C	8

PART I - CELL BIOLOGY

27 Hrs

Module I History of cell and molecular biology

2 hrs

Cell theory, Prokaryotes, Eukaryotes, Actinomycetes, Mycoplasmas, Virus, Virion and Viroids, Prions,

Core Readings

Thomas AP (Editor) 2011 Cell & Molecular Biology

Zoological Society of Kerala Study material. 2002. *Cell Biology, Genetics and Biotechnology*
Chapter – 1

Zoological Society of Kerala Study material. 2008. *Microbiology and Immunology* Chapter
– 1

Module II Cell membrane & Permeability

6hrs

Molecular models of cell membrane

(Sandwich model, Unit membrane model, Fluid mosaic model)

Modifications of plasma membrane. (Microvilli, tight junction, gap junction, desmosomes)

Cell permeability - Diffusion, Osmosis, Passive transport, Active transport, Cell coat and Cell recognition.

Core Readings

Thomas AP(Editor) 2011 Cell & Molecular Biology The Fundamentals. Green leaf publications .TIES Kottayam.

Zoological Society of Kerala Study material. 2002. *Cell Biology, Genetics and Biotechnology*
Chapter – 4

Gupta M.L. & M.L. Gangir. (1998) Cell Biology. Agrobotanica

James Darnell. (1998) Molecular Biology. Scientific American Books Inc.

Module III Ultrastructure of Cytoplasm

7 hrs

Cytoskeleton - Microtubules, microfilaments, intermediate filaments.

Endoplasmic reticulum - Structure and functions

Ribosomes (Prokaryotic and Eukaryotic)

Golgi complex - Structure and functions.

Lysosomes Polymorphism - GERL concept, functions

Mitochondria - Structure and functions

Symbiont hypothesis.

Core Readings

Zoological Society of Kerala Study material. 2002. *Cell Biology, Genetics and Biotechnology*
Chapter – 4

Module IV Nucleus 6 hrs

Structure and functions of interphase nucleus, Nuclear membrane, pore complex, structure and functions of nucleolus Chromosomes – Structure; Heterochromatin, Euchromatin, Nucleosomes, Polytene chromosomes-Balbiani rings, Endomitosis, Lamp brush chromosomes.

Core Readings

Zoological Society of Kerala Study material. 2002. *Cell Biology, Genetics and Biotechnology*
Chapter – 4

Powar C.B. (1983) Cell Biology (Himalaya Pub. Company)

Rastogi S. C. (1998) Cell Biology, TataMc.Graw Hill Publishing Co. NewDelhi

Module V Cell Division 3 Hrs

Cell cycle - G₁, S, G₂ and M phases
Mitosis and Meiosis

Core Readings

Zoological Society of Kerala Study material. 2002. *Cell Biology, Genetics and Biotechnology*
Chapter – 6

Powar C.B. (1983) Cell Biology (Himalaya Pub. Company)

Rastogi S. C. (1998) Cell Biology. Tata Mc.Graw Hill Publishing Co., New Delhi

Module VI Cell Communication

3Hrs

Cell signalling- Signalling molecules (neuro- transmitters, hormones, growth factors, cytokines, vitamin A and D derivatives) Role of cyclic AMP

Core Readings

Karp. G., 1996 *Cell and Molecular Biology, Concepts and Experiments*

John Wiley and Sons New York.

PART II - MOLECULAR BIOLOGY

27 Hrs

Module VII Nature of Genetic Materials

7 Hrs

Discovery of DNA as genetic material – Griffith's transformation experiments. Hershey Chase Experiment of Bacteriophage infection. Messelson and Stahl experiment. Structure and types of DNA & RNA. DNA replication.

Modern concept of gene (Cistron, muton, recon, viral genes). Prokaryotic genome, Eukaryotic genome

Brief account of the following-- Split genes (introns and exons), Junk genes, Pseudogenes, Overlapping genes, Transposons

Core Readings

Thomas AP (Editors) 2011 Cell & Molecular Biology The Fundamentals. Green leaf publications TIES Kottayam

Veer Bala Rastogi. (2008). Fundamental of Molecular Biology, Ane's Books, India Chapter -5 pp. 124-138.

Zoological Society of Kerala Study material. 2002. *Cell Biology, Genetics and Biotechnology* Chapter – 9

Module VIII Gene Expressions

12 hrs

Central Dogma of molecular biology, One gene-one enzyme hypothesis, One gene-one polypeptide hypothesis. Characteristics of genetic code, Contributions of Hargobind Khorana. Protein synthesis in Prokaryotes

Reverse transcription

Eukaryotic - Post transcriptional modifications and Post translational modifications.

Core Readings

Veer Bala Rastogi. (2008). *Fundamental of Molecular Biology*, Ane's Books, India Chapter - 12 pp. 282-292, Chapter 13, pp293-318.

Sobti R.C. & G. Obe. (2000) *Eukaryotic Chromosomes*. Narosa Publishing House.

Taylor D.J. Green N.P.O and stout *Biological Science* 2009 3rd edition Chapter 23 pp.802-807.

Module IX Gene regulations

8 hrs

Prokaryotic (inducible, repressible systems), Operon concept -Lac operon and Tryptophan operon. Brief account of Eukaryotic gene regulation, Definitions- Global control – Stimulon and modulon, Catabolite repression (Glucose effect).

Core Readings

Madigan, Martinko and Parker 2002. *Biology of Microorganisms 8th edition Prentice Hall, Chapter 7 pages 226-245.*

Veer Bala Rastogi. (2008). *Fundamentals of Molecular Biology*, Ane's Books, India Chapter 15, pp343--378.

Zoological Society of Kerala Study material. 2002. *Cell Biology, Genetics and Biotechnology* Chapter – 9

Selected Further Readings

Ariel G Loewy Philip Sickevitz, John R. Menninger and Jonathan A.N. Gallants (1991)

- Cell structure and function. Saunder's College Publication
- Arthur & Tania. (1991) DNA Replication. W.H. Freeman & Co. New York.
- Arthur M Lesk. (1990) Introduction to Genomics. Oxford University Press
- Carraway K.L. & C.A.C. Carraway. (2002) Cyto skeleton signalling, Oxford University Press
- Charlotte J Avers. (1986) Molecular Cell Biology. The Benjamin / Cummings Publishing Company Inc.
- Cohn N.S. 1979 Elements of Cytology (Freeman Book Company).
- Daniel & Elizabeth. (1996) Genetics-Principle and Analysis. Jones & Bartlett Publishers
- David A Micklos & Greg A Freyer. (2006) DNA Science. Cold Spring Harbor Laboratory Press
- David Latchman. (2006) Gene Regulation. London Unwin Hyman
- David M. J. Lilley. (2003) DNA-Protein Structural Interactions. Frontiers in Molecular Biology.
- De- Robertis E.D. and De Robertis Jr.E.M.F (2002) Cell and Molecular Biology (Lea &Febiger/Info-Med)
- Earl R Stadtman & P. Boon Chock. (2000) Current Topics in Cellular Regulation. Academic Press
- Edwards & Hassall. Mc.Graw Hill Publishing Co.Ltd., U.K.
- Finean & Michell. (1998) Membrane Structure. Holland Bio-Medical Press, Netherland.
- Gardner E.J. and Snustand D.P. Principles of Genetics. John Wiley & Sons, New York.
- Gupta M.L. & M.L. Gangir. (1998) Cell Biology. Agrobotanica
- James Darnell. (1998) Molecular Biology. Scientific American Books Inc.

- Karp G. (1996) Cell and Molecular Biology: Concepts and Experiments John Wiley and Sons
m, New York
- Kimball J.W. 1984 Cell Biology (Addison - Wesley Pub. Co.)
- Kwang W Jeon. (1997) A Survey of Cell Biology. Academic Press
- Malcolm N. Jones & Dennis Chapman. (1991) Micelles, Monolayers and Biomembranes.
John Willey & Sons Inc. Publication
- Michael T.A. Michael, E.R. and Toya S.K. (1975) Electron Microscopy and Cell Structure.
Cambridge University Press
- Mitchison J.M. (1991) The Biology of the Cell Cycle, Cambridge University Press
- Powar C.B. (1983) Cell Biology (Himalaya Pub. Company)
- Rastogi S. C. (1998) Cell Biology. Tata Mc.Graw Hill Publishing Co., New Delhi
- Sinnot Dunn & Dobzhanasky. (1991) Principles of Genetics. T.M.H. New Delhi.
- Sobti R.C. & G. Obe. (2000) Eukaryotic Chromosomes. Narosa Publishing House.
- Stanley G. Schultz. (2002) Basic Principles of Membrane Transport. Cambridge University
Press
- Stephen L Wolfe. (1981) Biology of the Cell. Wadsworth Publishing Co. Inc.
- Swanson Metz and Young (1983) Cytology and Cytogenetics (Macmillan and Co. Ltd.)
- Samuel J M, Lilly Chacko, Abraham Samuel and Punnen Kurian 2011 Cell and Molecular
Biology The Fundamentals -Green leaf publications TIES Kottayam
- Varma P.S. and Agarwal V.K. (1988) Cytology (S.Chand & Co., New Delhi)
- Varma P.S. and Agerwal V.K. (2008) Genetics (S.Chand & Co., New Delhi)
- Veer Bala Rastogi. (2008). Fundamental of Molecular Biology, Ani Books, India
- West I.C. (2002) Biochemistry of membrane transport. Chapman & Hall, London
- William & Daphne. (2008) Biochemistry & Molecular Biology. Oxford University Press

19U6PRZOO04:PRACTICAL 4**CELL AND MOLECULAR BIOLOGY**

36 hrs
Credit 1

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Examine and evaluate the mitotic stages of onion root tip	PO1 PSO4	A and E	P	4
CO2	Apply scientific principles and analyse the polytene chromosome of Chironomous larva	PO1 PSO4	A	P	6
CO3	Analyse the slides of various tissues and distinguish them on the basis of various cellular features	PO1 PSO4	A	P	6
CO4	Examine, draw and identify the meiotic stages	PO1 PSO4	A	P	2
CO5	Identify and analyse cell organelles	PO1 PSO4	A	P	2
CO6	Analyze the structure of DNA, RNA and DNA replication models	PO1 PSO4	A	P	2
CO7	Apply the staining techniques to prepare temporary and permanent whole mounts of specimens	PO1 PSO4	A	P	6
CO8	Analyze the human blood cell configuration and structurally differentiate the leucocytes	PO1 PSO4	A	P	6

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 meiotic stages (slide/figure)
5. Identification of cell organelles
6. Models (DNA, DNA replication, RNA – Different types.)
7. Preparation of temporary whole mount.
8. Preparation of permanent whole mount (demonstration)
9. Preparation of human blood smear and identification of Leucocytes

19U5CRZOO06: CORE COURSE 6

ENVIRONMENTAL BIOLOGY

54 hrs

Credits 3

Course Code	19U5CRZOO06
Title of the course	Environmental Biology
Semester in which the course is to be taught	5
No. of credits	3
No. of contact hours	54

Objectives

- To impart basic knowledge on ecosystems and their functioning
- 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 create a consciousness regarding Biodiversity, environmental issues & conservation strategies
- To create awareness about disasters, prevention and mitigation measures

Pre-requisite:

- Basic knowledge on ecosystem, food chain, food web and energy flow
- General awareness on pollution and their impacts

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understand the history, development, branches and scopes of Environmental Biology, Toxicology and Disaster Management	PSO3	U	C	2
CO2	Understand the basics of ecosystems and the classification of ecosystems	PSO1 & PSO3	U	F	1
CO3	Understand the structure and functioning of different types of ecosystems	PSO1 & PSO3	U	C	17
CO4	Understand the conservational aspects of wetlands	PSO3	U	C	2
CO5	Understand the importance of natural resources for the survival of humankind and evaluate the environmental issues caused by the misuse or overexploitation of these resources	PSO3	U, E	C	8
CO6	Understand the changes in the environment, their consequences and mitigation efforts by UN	PSO3	U	C	11
CO7	Understand the harmful effects of waste materials, toxic materials, chemicals and minerals to the organisms and human health	PSO3	U	C	8
CO8	Understand the nature of possible natural and anthropogenic disasters, hazard preparedness and mitigation of disaster consequences	PSO3	U	C	5

Module I – Introduction

2 hrs

History, development

Scope, branches

Core Readings

Bharucha, E. 2005. *Textbook of Environmental Studies for Undergraduate Courses*.
University Grants commission

Miller, Tyler. G. (Jr) 2005. *Essentials of Ecology*. Thomson Brooks/cole.

Nambiar, K.R. 2008. *Textbook of Environmental Studies (For Undergraduate Courses as per the UGC Model Syllabus)*. Scitech Publications (India) Pvt. Ltd. Chennai, India.

Odum, E.P. 1971. *Fundamentals of Ecology*. W.B. Saunders College Publishing, Philadelphia.

Rajagopalan, R. 2005. *Environmental Studies from Crisis to Cure*. Oxford University Press, New Delhi.

Module II – Ecosystems

20 hrs

Concept, classification

Terrestrial ecosystem

Abiotic/ biotic components (Brief description only)

Interactions

Classification (Types)

Forest

Desert

Grassland

Causes of land degradation with special reference to Kerala

Freshwater ecosystem

Physico chemical nature (Brief description only)

Types

Lentic

Lotic

Ground water

Threat to freshwater resources of Kerala

Watershed management

Marine ecosystem

Physico chemical nature (Brief description only)

Intertidal zone

Rocky shore

Muddy shore

Sandy shore

Coral reefs

Wetland and mangroves

Estuaries

Convention on wetlands (Ramsar, 1971)

Ramsar sites in Kerala –threats and conservation aspects

Core Readings

Bharucha, E. 2005. *Textbook of Environmental Studies for Undergraduate Courses*.
University Grants commission

Miller, Tyler. G. (Jr) 2005. *Essentials of Ecology*. Thomson Brooks/cole.

Nambiar, K.R. 2008. *Textbook of Environmental Studies (For Undergraduate Courses as per the UGC Model Syllabus)*. Scitech Publications (India) Pvt. Ltd. Chennai, India.

Odum, E.P. 1971. *Fundamentals of Ecology*. W.B. Saunders College Publishing, Philadelphia.

Rajagopalan, R. 2005. *Environmental Studies from Crisis to Cure*. Oxford University Press, New Delhi.

Zoological Society of Kerala Study material. 2002. *Environmental Biology and Ethology*
Published by Zoological Society of Kerala.

Module III – Concepts of Population and Community

4 hrs

(Brief account only)

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

Ecological indicators

Ecotone and Edge effect

Keystone species

Concepts of Ecological Niche and Guild

Ecological succession

Community evolution-climax.

Core Readings

Bharucha, E. 2005. *Textbook of Environmental Studies for Undergraduate Courses*.
University Grants commission

Zoological Society of Kerala Study material. 2002. *Environmental Biology and Ethology*
Published by Zoological Society of Kerala.

Module IV – Biodiversity

5 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

Protected area concept

Sanctuary

National Park

Biosphere reserve

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 Data Book

Green Data Book.

Core Readings

Bharucha, E. 2005. *Textbook of Environmental Studies for Undergraduate Courses*.
University Grants commission

Zoological Society of Kerala Study material. 2002. *Environmental Biology and Ethology*
Published by Zoological Society of Kerala.

Module V – Man and Environment

5 hrs

Natural resources -Introduction (concept)

Energy resources

Conventional

Non-conventional

Inexhaustible

Energy conservation measures

Core Readings

Andrew S. Pullin 2002 *Conservation Biology*. Cambridge University Press, Cambridge, UK

Bharucha, E. 2005. *Textbook of Environmental Studies for Undergraduate Courses*.
University Grants commission

Kaufman G.Donald and Cecilia M. Franz. 2000. *Biosphere 2000 Protecting Our Global Environment*. Kendall/Hunt Publishing Company. Iowa, US

Module VI –Environmental Pollution

4 hrs

(Brief account only)

Air pollution

Water pollution

Soil pollution

Marine pollution

Noise pollution

Thermal pollution

Nuclear pollution

Core Readings

Bharucha, E. 2005. *Textbook of Environmental Studies for Undergraduate Courses*.
University Grants commission

Nambiar, K.R. 2008. *Textbook of Environmental Studies (For Undergraduate Courses as per the UGC Model Syllabus)*. Scitech Publications (India) Pvt. Ltd. Chennai, India.

Meera Asthana and Astana D.K.1990 Environmental pollution and Toxicology Alka printers.
Lutgens, F.K. and Tarbuek, J.E.1992.The Atmosphere. Prentice Hall, New Jersey.

Module VII – Global environmental changes

7 hrs

- Global warming
 - Green house effect
 - Ozone depletion
- Climate change (Brief description only)
 - Definition- recent developments
 - Kyoto protocol
 - IPCC/UNFCC
 - Carbon credit
 - Carbon sequestration
 - Carbon trading

Core Readings

Bharucha, E. 2005. *Textbook of Environmental Studies for Undergraduate Courses*.
University Grants commission

Miller, Tyler. G. (Jr) 2005. *Essentials of Ecology*. Thomson Brooks/cole.

Nambiar, K.R. 2008.*Textbook of Environmental Studies (For Undergraduate Courses as per the UGC Model Syllabus*. Scitech Publications (India) Pvt. Ltd. Chennai, India.

Module VIII – Municipal Solid Waste

3 hrs

- Plastic pollution
 - Types of plastics
 - Problems of plastics
 - Management strategies
- Biowastes and their management. –aerobic and anaerobic systems.
- e-waste

Major types and sources

Toxic ingredients

Effects on environment and human health (Brief description only)

Management strategies

Core Readings

Nambiar, K.R. 2008. *Textbook of Environmental Studies (For Undergraduate Courses as per the UGC Model Syllabus)*. Scitech Publications (India) Pvt. Ltd. Chennai, India.

Odum, E.P. 1971. *Fundamentals of Ecology*. W.B. Saunders College Publishing, Philadelphia.

Module IX – Disaster Management

4 hrs

Definition and Classification

Natural

Anthropogenic

Hybrid

Earthquake

Landslide

Flood

Drought

Cyclone

Tsunami

Mitigation measures for disaster management

Core Readings

Singh, S.R., 2008 *Disaster Management*. A.P.H Publishers

Selected Further Readings

Ahuwalie V.K., Sunita Malhotra, 2009 *Environmental science*, Ane Books Pvt. Ltd.

Alan Beeby, 2006 Anne – Maria Brennan *First Ecology, Ecological principles and Environmental issues*. International students edition Sec. edition Oxford University Press.

- Andrew S. Pullin 2002 *Conservation Biology*. Cambridge University Press, Cambridge, UK
- Banerjee, L.K., Sastry, A.R.K. and Nayar, M.P. 1989. Mangroves in India: Identification manual. Botanical Survey of India.
- Bharucha, E. 2005. *Textbook of Environmental Studies for Undergraduate Courses*. University Grants commission
- ErachBharucha 2008 (UGC).Test Book of Environmental Studies of Undergraduate course. University Press
- Kaufman G.Donald and Cecilia M. Franz. 2000. *Biosphere 2000 Protecting Our Global Environment*. Kendall/Hunt Publishing Company. Iowa, US
- Miller, Tyler. G. (Jr) 2005. *Essentials of Ecology*. Thomson Brooks/cole.
- Misra S.P., Pandey S.N. 2009 *Essential Environmental Studies*, Ane books Pvt. Ltd.
- Nambiar, K.R. 2008. *Textbook of Environmental Studies (For Undergraduate Courses as per the UGC Model Syllabus)*. Scitech Publications (India) Pvt. Ltd. Chennai, India.
- Odum, E.P. 1971. *Fundamentals of Ecology*. W.B. Saunders College Publishing, Philadelphia.
- Pandey Kamleshwar , J.P.Shukla and S.P.Trivedi.2005. *Fundamentals of Toxicology*. New Central Book Agency (P) Ltd. Kolkata, India
- Rajagopalan,R. 2005. *Environmental Studies from Crisis to Cure*. Oxford University Press, New Delhi.
- Robert May & Angela Mc Lean 2007 *Theoretical Ecology. Principles and Application* , Oxford University press (India Ed.)
- Santra ,S.C. 1994. *Ecology Basic and Applied*. M.D. Publications Pvt. Ltd. New Delhi.
- Sharma, P.D. 2007. *Ecology and Environment*. Rastogi Publishers
- Stern, Nicholas. 2006. *The Economics of Climate Change: The Stern Review*, Cambridge University Press, Cambridge, UK.
- Stiling Peter, 2002. *Ecology: Theories and applications*. Prentice Hall of India pvt. Ltd. New Delhi

19U6PRZOO03: PRACTICAL 3

ENVIRONMENTAL BIOLOGY

36 hrs

Credit 1

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understand the methodology for examining ecological parameters of freshwater habitats	PO1/PSO4	P	A	4
CO2	Analyze the amount of dissolved Oxygen and Dissolved Carbon Dioxide in water sample	PO1/PSO4	P	A/An	6
CO3	Understand the technique for identifying planktonic materials in a water sample	PO1/PSO4	P	A	6
CO4	Analyze Zooplankton in a water sample qualitatively and quantitatively	PO1/PSO4	P	An	6
CO5	Understand the methodology for analyzing soil fauna	PO1/PSO4	P	An	2
CO6	Understand the mineral composition and ecological importance of rocks and minerals	PO1/PSO4	P	An	2
CO7	Understand the technique of studying the water turbidity using Secchi's Disc and plankton net	PO1/PSO4	P	A	2
CO8	Understand the structure and function of a terrestrial, freshwater or marine ecosystems	PO1/PSO4	P	A	8

1. Estimation of dissolved oxygen
2. Estimation of dissolved carbon dioxide
3. Estimation of Soil Organic Carbon(Demonstration only)
4. Plankton count

5. Identification of freshwater/ marine plankton
6. Extraction of soil organisms(Demonstration only)
7. Identification of minerals and rocks
8. Secchi disc, Plankton Net
9. Compulsory Field Study report on one Terrestrial/Marine/Fresh water ecosystem

19U5CRZOO07: CORE COURSE 7

EVOLUTION, ZOOGEOGRAPHY AND ETHOLOGY

54 hrs

Credits 3

Course Code	19U5CRZOO07
Title of the course	Evolution, Zoogeography and Ethology
Semester in which the course is to be taught	5
No. of credits	3
No. of contact hours	54

Objectives:

- To acquire knowledge about the evolutionary history of earth (living and non living)
- To learn various tools and techniques for evolutionary studies
- 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, Evidences of Evolution.

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understand origin of life on earth - origin of universe, chemical evolution, Miller-Urey experiment&Haldane and Oparin theory	PO1, PO4 PSO3	U	C	5
CO2	Differentiate various theories of organic evolution – Lamarckism, Weisman’s germplasm theory, Mutation theory, Modern Synthetic theory(Neo Darwinism) and Neutral theory of molecular evolution	PO1, PO4 PSO3	A	C	7
CO3	Understand the concepts of population genetics and evolution - Genetic basis of variation, Hardy Weinberg equilibrium and gene frequencies	PO1 PSO3	U	C	6
CO4	Understand the basics of evolution above species level including adaptive radiation, microevolution, macroevolution, evolution of horse, mega evolution, punctuated equilibrium, speciation and evolution of horse& geological time scale	PO1 PSO3	U	C	12
CO5	Understand the basic concepts of oorigin of oceans and continents, zoogeographical realms, insular fauna, biogeography of India with special reference to Western Ghats and the types, means and barriers of animal distribution	PO1, PO4 PSO3	U	C	10
CO6	Understand the definition, history and scope of Ethology	PO1 PSO3	U	C	1
CO7	Differentiate different types of learning	PO1 PSO3	A	C	8
CO8	Understand the basic concepts of sociobiology and evolution of humanbehavior, primates and human socio groups& human pheromones	PO1 PSO3	U	C	5

PART I – EVOLUTION

30 hrs

Module I – Origin of life

5 hrs

Introduction

Origin of universe

Chemical evolution

Miller-Urey experiment

Haldane and Oparin theory

Module II – Theories of organic evolution

7 hrs

Lamarckism

Critical analysis of Lamarck's propositions

Weisman's germplasm theory

Mutation theory.

Darwinism.

Critical analysis of Darwinism

Modern Synthetic theory(Neo Darwinism)

Neutral theory of molecular evolution

Module III – Population genetics and evolution

6 hrs

Genetic basis of variation

Hardy Weinberg equilibrium

Change in gene frequencies

Factors affecting gene frequencies (brief account only)

Module IV – Evolution above species level

8 hrs

Adaptive radiation

Microevolution

Macroevolution

Evolution of horse

Mega evolution

Punctuated equilibrium

Speciation -Phyletic and True- Sympatric and Allopatric.

Evolution of horse.

Module V – Geological time scale

4 hrs

Geological dating with radioactive elements

Mass extinction

Core Readings (Modules 1-5)

Barnes, C.W. 1988. *Earth, Time and Life*. John Wiley & Sons, New York (Module 2 & 3)

Bendall, D. S. (ed.) 1983. *Evolution from Molecules to Man*. Cambridge University Press, U.K. (Module 2, 3 and 5)

Bull J.J. and H.A. Wichman. 2001. Applied Evolution. *Annu. Rev. Ecol. Syst.* 32:183-217 (Visit the Annual Reviews home page at www.AnnualReviews.org.)

Chattopadhyay Sajib. 2002. *Life Origin, Evolution and Adaptation*. Books and Allied (P) Ltd. Kolkata, India.

Goodwin, B. 1996. *How the Leopard Changed its Spots: The Evolution of Complexity*. Simon & Schuster, NY, USA. (Module 4 & 5)

Jerry A. Coyne and H. Allen Orr. 2004. *Speciation*. Sinauer Associates (Module 4)

Rob Desalle and Ian Tattersall 2008. *Human Origins: What Bones and Genomes Tell Us about Ourselves*. Texas A&M University Press, USA. (Module 3 & 4)

Sean B. Carroll and David M. Kingsley .2005 *Evolution: Constant Change and Common Threads*. Holiday Hrs on Science. Webcast or DVD available at www.hhmi.org/biointeractive/evolution. (Module 3 & 4)

Strickberger, M.W.2000. *Evolution*. Jones and Bartlett, Boston. (Module 1-5)

Verma P.S. and Agarwal V.K 2007 *Cell biology, Genetics, Molecular Biology, Evalution and Ecology*, S. Chand & Company New Delhi (Moldule 1-5)

PART II – ZOOGEOGRAPHYAND ETHOLOGY

24 hrs

Module VI – Zoogeography: Introduction

5 hrs

Origin of oceans and continents

Platetectonics – continental drift

Zoogeographical realms

Insular fauna-Continental Islands egMedagascar.

Oceanic Islands egGalapagoes.

Biogeography of India – with special reference to Western Ghats

Module VII – Animal distribution

5 hrs

Types and means of animal distribution

Barriers in animal distribution.

Core Readings

Zoogeography

Andrews. M.I and Joy, K.P. 2003. *Environmental biology, evolution, ethology and Zoogeography*. St.Mary's press and book dept. (Module Vi, VII, VIII and IX)

Briggs, J.C. 1996. *Global Biogeography*. Elsevier Publishers. (Module VI and VII).

- Chandran, Subash M .D.1997. On the ecological history of the Western Ghats. *Current Science*, Vol.73, No.2.146-155.
- Chundamannil , Mammen.1993. *History of Forest management in Kerala*. Report number 89. Kerala Forest Research Institute, Peechi, India.
- Daniels, R.J.R and J.Vencatesan .2008. *Western Ghats Biodiversity.People.Conservation*. Rupa &Co.NewDelhi.India.
- Mani, M.S. 1974.*Ecology and Biogeography of India*. Dr. W. Junk b..v. Publishers , The Hague.
- Nair, C.S.1991. *The Southern Western Ghats : A Biodiversity Conservation Plan*. INTACH, New Delhi.
- Ramesh,B.R and RajanGurukkal., 2007.*Forest Landscapes of the Southern Western Ghats, India Biodiversity, Human Ecology and management Strategies*. French Institute of Pondicherry, India.
- Tiwari, S. 1985. *Readings in Indian Zoogeography*, (Module VI)

Module VIII – Ethology

1 hr

Definition

History and scope of ethology

Module IX – Learning and imprinting

8 hrs

Types of learning with examples

Experiments by K. Lorenz

Module X – Ethology of man

5 hrs

Sociobiology and evolution of human behaviour

Primates and human socio groups

Human pheromones

Core Readings

- Bonner, J.T. 1980. *The Evolution of Culture in Animals*. Princeton University Press..NJ,USA. (Module 10)
- David McFarland. 1999. *Animal Behaviour*. Pearson Education Ltd . Essex, England. (Module 8 and 9)
- Dawkins, M.S. 1995.*Unravelling Animal Behaviour*. Harlow:Longman. (Module 8, 9 and 10)
- Dunbar,R. 1988. *Primate Social Systems*.CroomHelm,London. (Module 10 & 11)
- Manning Aubrey and Marian Stamp Dawkins 1998. *An Introduction to Animal Behaviour*.Cambridge University Press,UK. (Module 8, 9 & 10)
- Paul W. Sherman and John Alcock.,2001 Exploring Animal Behaviour- Readings from American Scientist 3rdEdn. Sinauer Associates Inc. MA,USA. (Module 10 & 11)
- Wilson, E.O. 1975. Sociobiology. Harvard University Press, Cambridge, Mass. USA. (Module 9)
- Zoological Society of Kerala Study material. 2002. *Environmental Biology and Ethology* Published by Zoological Society of Kerala (Module 6, 7, 8 & 9)

Selected Further Readings

Evolution

- Barnes, C.W. 1988. *Earth, Time and Life*.John Wiley &Sons, NewYork
- Bendall , D. S. (ed.)1983.*Evolution from Molecules to Man*. Cambridge University Press,U.K.
- Bull J.J and H.A.Wichman.2001.Applied Evolution. *Annu.Rev.Ecol.Syst.* 32:183-217 (Visit the Annual Reviews home page at www.AnnulReviews.org.)
- Chattopadhyay Sajib.2002. *Life Origin, Evolution and Adaptation*. Books and Allied (P) Ltd.Kolkata,India.
- Goodwin,B. 1996. *How the Leopard Changed its Spots: The Evolution of Complexity*. Simon &Schuster, NY,USA.
- Jerry A.Coyne and H.Allen Orr.2004. *Speciation*. Sinauer Associates

Rob Desalle and Ian Tattersall 2008.*Human Origins: What Bones and Genomes Tell Us about Ourselves*. Texas A&M University Press, USA.

Sean B. Carroll and David M. Kingsley .2005 *Evolution: Constant Change and Common Threads*. Holiday Hrs on Science. Webcast or DVD available at www.hhmi.org/biointeractive/evolution.

Strickberger, M.W.2000. *Evolution*. Jones and Bartlett, Boston.

Ethology

Bonner, J.T. 1980. *The Evolution of Culture in Animals*. Princeton University Press.NJ, USA.

David McFarland. 1999. *Animal Behaviour*. Pearson Education Ltd. Essex, England.

Dawkins, M.S. 1995.*Unravelling Animal Behaviour*. Harlow: Longman.

Dunbar, R. 1988. *Primate Social Systems*.Croom Helm, London.

Manning Aubrey and Marian Stamp Dawkins 1998. *An Introduction to Animal Behaviour*.Cambridge University Press,UK.

Paul W. Sherman and John Alcock.,2001 Exploring Animal Behaviour- Readings from American Scientist 3rdEdn. Sinauer Associates Inc. MA,USA.

Thomas A P (Editor)2011 Evolution, Zoogeography and Ethology. Green leaf publications TIES Kottayam.

Wilson, E.O. 1975. Sociobiology. Harvard University Press, Cambridge, Mass. USA.

19U6PRZOO03: PRACTICAL 3

EVOLUTION, ZOOGEOGRAPHY AND ETHOLOGY

36 hrs

Credit 1

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Differentiate zoogeographical realms using map	PO1, PO4 PSO4	A	P	4
CO2	Differentiate endemic species of each realm	PO1, PO4 PSO4	A	P	4
CO3	Differentiatedifferent stages of horse evolution	PO1, PO4 PSO4	A	P	4
CO4	Differentiate Homologous and Analogous organs	PO1, PO4 PSO4	A	P	4
CO5	Analyse various connecting links	PO1, PO4 PSO4	A	P	4
CO6	Analyse pheromone traps	PO1, PO4 PSO4	A	P	4
CO7	Differentiate Skinner box and T Maze& different types of behaviour	PO1, PO4 PSO4	A	P	6
CO8	Analyse phototaxis and chemotaxis in Drosophila/Housefly	PO1, PO4 PSO4	A	P	6

1. Identification of Zoogeographical realms using map
2. Study on endemic species of each realm
3. Identification of different stages of horse evolution
4. Study on Homology / Analogy
5. Study on connecting links
6. Pheromone traps
7. Skinner box/T Maze
8. Identification of behaviour showing pictures
9. Experiment to demonstrate phototaxis using *Drosophila*/House fly
10. Experiment to demonstrate chemotaxis using *Drosophila*/House fly

SEMESTER V

19U5CRZOO08: CORE COURSE 8

BIOCHEMISTRY, HUMAN PHYSIOLOGY AND ENDOCRINOLOGY

54 hrs

Credits 3

Course Code	19U5CRZOO08
Title of the course	Biochemistry, Human Physiology and Endocrinology
Semester in which the course is to be taught	5
No. of credits	4
No. of contact hours	54

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.

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understand the structure, biological importance and metabolism of important carbohydrates, protein and lipids	PO1 PSO3	U	C	14
CO2	Understand the mechanism of enzyme action and role of enzymes in metabolism.	PO1 PSO3	U	C	4
CO3	Understand the importance of balanced diet, role of vitamins and minerals in diet and nutritional disorders	PO1 PSO3	U	C	5
CO4	Understand the functional aspects of respiration and respiratory disorders	PO1 PSO3	U	C	5
CO5	Understand the functional aspects of cardiovascular circulation, disorders related to it and the clinical aspects	PO1 PSO3	U	C	4
CO6	Understand the structure and function of human nitrogenous excretory organs and renal disorders	PO1 PSO3	U	C	4
CO7	Understand structure and functional facets of neuro muscular system and physiological features of sports and exercise	PO1 PSO3	U	C	8
CO8	Understand the functional aspects of endocrine glands and the disorders associated with it	PO1 PSO3	U	C	11

Part I. BIOCHEMISTRY

18 Hours

Module 1 - GENERAL BIOCHEMISTRY, BIOELEMENTS AND BIOMOLECULES

4 hrs

Carbohydrates, protein and lipids – structure of basic compounds, classifications with examples and its biological importance.

Core Readings

Harper's Illustrated Biochemistry, 27th Ed, Mc Graw Hill

Module -2 METABOLISM

9 hrs

Carbohydrate metabolism- Glycolysis, glycogenolysis, gluconeogenesis, glycolysis –citric acid cycle, ATP synthesis,

Lipid metabolism- Biosynthesis and oxidation of fatty acids- Beta oxidation, Physiologically important compounds synthesized from cholesterol.

Protein metabolism- Deamination, transamination, transmethylation, decarboxylation.

Core Readings

Harper's Illustrated Biochemistry, 27th Ed, Mc Graw Hill

Module 3- ENZYMES

4 hrs

Chemical nature of enzymes, mechanism of enzyme action, factors influencing enzyme action (temperature, pH, enzyme concentration, substrate concentration), enzyme activation, enzyme inhibition, allosteric enzyme, isoenzymes, co-enzyme.

Core Readings

Harper's Illustrated Biochemistry, 27th Ed, Mc Graw Hill

Part II. HUMAN PHYSIOLOGY 26 Hrs

Module 4- NUTRITION

5 hrs

Nutrients,classification,RDA,Balanced diet.

Antioxidants and functions, Mineral metabolism, Role of Ca, Fe, Na, K, and P. Role of vitamins

Food adulteration, Defects of modern food habits (importance of fibers in food), weight control, nutrition during pregnancy, breast feeding, anorexia, acidity and ulcers, flatulence, fasting and its significance, malfunctions of gastro intestinal tract.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.718-833

Prosser & Brown 2006 : Comparative Animal Physiology

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Module 5 -RESPIRATION

5 hrs

Gas transport, Factors affecting transport of respiratory gases through blood, oxy-hemoglobin curve, Bohr effect, reverse Bohr effect, Haldane effect, neural (voluntary and automatic) and chemical control (mention the role of carotid and aortic bodies) of respiration, smoking and its physiological effects, carbon monoxide poisoning, oxygen toxicity, nitrogen narcosis, dysbarism, oxygen therapy, artificial respiration, respiratory disorders –hypoxia, hypocapnia, hypercapnia, asphyxia.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp432-509 Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Module 6–CIRCULATION

4 hrs

Cerebral circulation, blood brain barrier and cerebrospinal fluid, Haemo dynamic principles, formation and fate of blood cells, Blood composition, blood clotting mechanism – intrinsic and extrinsic pathways, clotting factors, anticoagulants, blood transfusion (safety and security problems), mention haemostasis, haemolysis, jaundice, thrombosis, ESR.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.144-262, 382-429, 711-715.

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Module 7 –EXCRETION

4 hrs

Urea cycle (in detail), renal handling of individual substances eg. glucose, sodium, urea, water, factors affecting GFR, concept of plasma clearance, acid base balance and homeostasis, kidney disorders – acute renal failure, chronic renal failure- glomerular nephritis, pyelonephritis, nephrotic syndrome and kidney stones.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.264-379

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Module 8-MUSCLE PHYSIOLOGY

4 hrs

Ultra structure of striated muscle.Mechanism of muscle contraction.Biochemistry of muscle contraction,isotonic and isometric contraction.

Electrical, chemical and morphological changes and ionic fluxes during contraction of striated muscle fibre, Cori cycle, electrophysiology of muscle, threshold and spike potentials, simple muscle twitch, whole muscle contraction, isotonic and isometric contraction, latent and refractory periods, summation, beneficial effect, superposition curve, tetanus, tonus, staircase phenomenon, fatigue, oxygen debt, rigor mortis.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.52-86

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Module 9 –NEUROPHYSIOLOGY

4hrs

Synaptic transmission (in detail)& properties of synapses, neurotransmitters, role of

dopamine and serotonin. EEG, memory, short term and long term sleep, dream, Neural disorders- dyslexia, Parkinson's disease, epilepsy, Alzheimer's disease, schizophrenia.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.512-715

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Part III ENDOCRINOLOGY

11 hrs

Module 11

5 hrs

Hormones as messengers, classification and types of hormones. General principles of hormone action, Concept of hormone receptors, hormonal control of homeostasis.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.836-966

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Module 12

6 hrs

Secretion, Regulation, Functions and Disorders of hormones of Hypothalamus, Hypophysis, Pineal, Thyroid, Parathyroid, Thymus, Islets of Langerhans, Adrenal, Gonads, Placenta, Gastro intestinal hormones.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.836-966

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Selected Further Readings

Human Physiology

Best and Taylor: Physiological basis of Medical practice

Chakrabarti, Ghosh &: Human Physiology, the New Book Stall Schana.

Chatterjee C.C.: Human Physiology, Vol I & II Medical Allied Agency

Eckert & Randall : Animal Physiology, Mechanism & Adaptations , CBS pub, N. Delhi.

Ganong W F : Review of Medical Physiology, Mc Graw Hill, New Delhi.

Guyton : Text Book of Medical Physiology Saunders

Joshi : Nutrition and Dietetics , Tata Mc. Graw Hill

Knut Schmidt Nilesen 2007 Animal Physiology – Adaptation and environment. Cambridge University press 5th ed.

Mackenna & Callander : Illustrated Physiology, Churchill Livingstone

Powar Human Physiology

Prosser & Brown : Comparative Animal Physiology

Sarada Subramanyam & K. Madhavankutty : Textbook of human physiology, S. Chand & Co Ltd, New Delhi.

Endocrinology

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

Bentley, P.J. Comparative Vertebrate Endocrinology, Cambridge University Press.

David O. Norris Vertebrate Endocrinology 3rd Edition,

Gorbman, *Aet. al.* Comparative endocrinology, John Wiley & Sons.

Hadley, M.E. 2000. Endocrinology, 5th ed. Prentice Hall, Upper Saddle River, NJ. Martin, C.R. Endocrine Physiology, Oxford University Press

Norris, D.O. 1997. Vertebrate Endocrinology, 3rd ed. Academic Press, Sand Diego, CA.

Williams, R.H. Textbook of Endocrinology, W.B. Saunders

Biochemistry

Ackerman E, Biophysical Science, Prentice Hall Inc.

Awapara J, Introduction to Biological chemistry, Prentice-Hall of India

Cohn E E and Stumpf P K, outlines of Biochemistry, Wiley Eastern

Foster, R.L. Nature of Enzymology

Garett and Grisham. Biochemistry.

Harper's Illustrated Biochemistry, 27th Ed, Mc Graw Hill

Lehninger, Biochemistry , Kalyani Publications

Lodish et. al. Molecular Cell Biology

Rangnatha Rao K, Text Book of Biochemistry, Prentice-Hall of India

Roy K N, A Text Book of Biophysics, New Central Book Agency

Stryer, Biochemistry, W.H Freeman and Co., Newyork

Voet, D. and J.G. Voet. Biochemistry. J. Wiley & Sons

19U6PRZOO04:PRACTICAL4

BIOCHEMISTRY, HUMAN PHYSIOLOGY AND ENDOCRINOLOGY

36 hrs

Credit1

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Analyse the haemoglobin content of human blood	PO1 PSO4	An	P	4
CO2	Analyse the RBC and WBC count using haemocytometer	PO1 PSO4	An	P	8
CO3	Analyse the Packed cell volume of the given blood sample	PO1 PSO4	An	P	4
CO4	Analyse the effect of hypertonic, hypotonic and isotonic solutions on the diameter of RBC	PO1 PSO4	An	P	4
CO5	Application of sphygmomanometer, stethoscope and kymograph	PO1 PSO4	A	P	4
CO6	Analyse the brain of cockroach	PO1 PSO4	An	P	4
CO7	Analyse the human endocrine disorders	PO1 PSO4	An	U	4
CO8	Analyse the chemical nature of biological fluids	PO1 PSO4	An	P	4

PHYSIOLOGY

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

- 3) Total WBC count using Haemocytometer
- 4) Estimation of PCV
- 5) Effect of hypertonic, hypotonic and isotonic solutions on the diameter of RBC.
- 6) Instruments: Kymograph, Sphygmomanometer and Stethoscope (principle and use)
Measurement of blood pressure using a sphygmomanometer (demonstration)

ENDOCRINOLOGY

1. Cockroach – Corpora cardiaca & Corpora allata (Demonstration)
2. Human hormonal disorders (Diagrams/Photographs)

BIOCHEMISTRY

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

SEMESTER VI

19U6CRZOO09: Core course 9

REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY

54 hrs

Credits 3

Course Code	19U6CRZOO09
Title of the course	Reproductive and Devolepmental Biology
Semester in which the course is to be taught	6
No. of credits	3
No. of contact hours	54

Objectives

1. This will provide a basic understanding of the experimental methods and designs that can be used for further study and research.
2. 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.

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understand the definition, sub-divisions, terms, early history, applications and scope of embryology	PO1/PSO3	U	C	16
CO2	Understand the concepts of gametogenesis, fertilization, cleavage, blastulation, gastrulation, fate maps and egg types	PO1/PSO3	U	C	14
CO3	Understand the embryology of human, chick, frog and drosophila	PO1/PSO3	U	C	15
CO4	Understand the sexual cycle	PO1/PSO3	U	C	4
CO5	Understand the experimental embryology and regeneration in animals	PO1/PSO3	U	C	4
CO6	Understand the concept of teratology	PO1/PSO3	U	C	1
CO7	Understand the birth and developmental defects	PO1/PSO3	U	C	2

Module I

10 hrs

Introduction

Scope of developmental biology, definition, sub-divisions (Descriptive, Comparative, Experimental). Early history of embryology. (Preformation and Epigenesis, Recapitulation theory or Biogenetic law, Germplasm theory (Weisman)

Gametogenesis.

Spermatogenesis (brief account), Structure of sperm, different types. Oogenesis (brief account), significance of gametogenesis

Egg types.

Classification of eggs, based on the amount, distribution and position of yolk. Mosaic, regulative and cleidoic eggs. Influence of yolk on development. Polarity, symmetry and egg content.

Fertilization

Approach and binding of spermatozoa, activation of the egg, amphimixis. Parthenogenesis (brief account) natural and artificial. Arrhenotoky, Thelytoky, Obligatory and Facultative, Significance

Module II

12 hrs

Cleavage

Types, planes of cleavage (radial and spiral with examples) Cell lineage (brief account). Holoblastic (equal, unequal) and Meroblastic cleavage (discoidal and superficial). Patterns of cleavage (radial , bilateral and rotative). Influence of yolk on cleavage.

Blastulation

Blastula formation, Types of blastula (coeloblastula, stereoblastula, Discoblastula, Blastocyst with examples).

Fate maps

Concept of fate maps, construction of fate maps. (artificial and natural). A typical vertebrate fate maps. Significance of fate map.

Gastrulation

Definition, Morphogenetic cell movements (brief account). Epiboly, Emboly (invagination, involution , delamination , convergence, divergence infiltration). Concept of germ layers (brief account) and its derivatives.

Module III

4 hrs

Embryology of Frog - Gametes, Fertilization, cleavage, blastulation, fate map, gastrulation, notogenesis ,neurulation, development of nervous system and sense organs (eye only)

Module IV**4 hrs****Embryology of chick**

Structure of egg, fertilization, cleavage, blastulation, gastrulation. Mention brief account of 18 hour chick embryo and 24 hour chick embryo. Extra embryonic membranes in chick.

Module V**10 hrs****Human development**

Human reproductive organs (brief account only)

Sexual cycle

Estrus cycle (non-primate) and menstrual cycle (primate cycle). Hormonal control of menstrual cycle. Gametes, Blastocyst, Morula, Implantation, foetal membranes and placenta formation. Types of placenta (brief account). Classification of placenta based on, Nature of contact, Mode of implantation, Histological intimacy of foetal and maternal tissue. Functions of placenta.

Module VI**2 hrs****Embryonic development of Drosophila**

Early embryonic development (brief account only), control of genes over developmental process

Module VII Post Embryonic development**3 hrs**

Metamorphosis – Types in insects, Amphibian metamorphosis (brief account only) – Regeneration in animals - General survey of regeneration among animals, different types of regeneration

Module VIII 2 hrs**Experimental embryology.**

Spemann's constriction experiments, Organizer and embryonic induction.

Applications of embryology

Cryopreservation of semen and embryo

3hrs

Teratology / Dysmorphology.

Definition, Teratogen / Teratogenic agents. Ionizing radiation, infection (herpes virus, parvo virus-B 19, rubella virus, syphilis, cytomegalovirus, toxoplasmosis), Chemicals, drugs, hormones and vitamins.

Core Readings

Majumdar N. N - Vertebrate embryology

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

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Selected Further Readings

Berry A. K - An introduction to embryology.

Gibbs (2006). Practical guide to developmental biology.

Gilbert S. F - Developmental biology

Harrison, Harriosns Book of Internal Medicine Chrch Livingston 17th Ed.

Jain P. C - Elements of developmental biology.

John Rigo Fundamental Genetics Cambridge University Press. 2009

Julio Collado Vides & Relf Hofestadt Gene Regulation and Metabolism Post genomic
Computated Approaches, Ane Book 2004

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

Pattern M.B. and Carlson B.C. 1974 Foundations of Embryology, TMH, New Delhi.

Sobte R.C., Sharma V.L. Essentials of Modern Biology Press Book India 2008

Werne A Muller. Dev. Biology, Springer Verlay New York 2008

Web Resources

www.Wikipedia.com. (Module IV)

www.medpedia.com. (Module IV)

19U6PRZOO05:PRACTICAL 5**REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY****36 hrs****Credit 1**

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Analyze the development of frog, chick and Drosophilla	PO1/PSO4	An	P	8
CO2	Analyse the developmental stages of Drosophila and the life cycle from fruit fly stock culture	PO1/PSO4	An	P	6
CO3	Analyse Mammalian Development	PO1/PSO4	An	P	4
CO4	Analyse the placenta of pig and man	PO1/PSO4	An	P	2
CO5	Analyse the embryological techniques	PO1/PSO4	An	P	4
CO6	Candling of chick egg–Analyse whether the egg is fertilised or not	PO1/PSO4	An	P	4
CO7	Analyse the male and female reproductive system of a teleost fish / cockroach	PO1/PSO4	An	P	8

Practical

1. Development of Frog - cleavage stages, blastula, gastrula, neurula, tadpole (Charts/ permanent slides may be used for study).
2. Development of Chick - primitive streak stage, 24th hour, 33 hour and 48 hour chick embryo (Charts/ permanent slides may be used for study)

3. Development of *Drosophila* - Study the developmental stages and the life cycle from fruit fly stock culture
4. Mammalian development - Sections of Testis and Ovary (Mammalian), Study of placenta- pig and man
5. Study of the following embryological techniques - Amniocentesis, Embryo transfer, IVF, cloning (models/charts/ pictures may be used)
6. Candling of chick egg.
7. Study of male and female reproductive system of a teleost fish/cockroach (Dissect and display, sketch and label)

SEMESTER VI

19U6CRZOO10: CORE COURSE 10

GENETICS AND BIOTECHNOLOGY

54 hrs

Credits 3

Course Code	19U6CRZOO10
Title of the course	Genetics and Biotechnology
Semester in which the course is to be taught	6
No. of credits	3
No. of contact hours	54

Objectives of the Course

1. To emphasize the central role that genetics and biotechnology plays in the life of all organisms.
2. To introduce the student to some of the present and future applications of bio-sciences
3. To develop critical thinking skill and research aptitude among students, by introducing the frontier areas of the biological science.

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understanding of scope and importance of genetics, brief explanation of terms and laws of genetics	PSO2	U	C	2
CO2	Understanding of gene interactions. Linkage and recombination of genes	PSO2	U	C	8

C03	Understanding of sex determination in man, honey bees, hormonal influence and environmental influence on sex and study of mutations, its types and molecular basis of mutations and understanding the concept of extra nuclear inheritance	PSO2	U	C	10
C04	Understanding of bacterial genetics, bacterial gene transfer, drug resistance, transposons, transposable genetic elements	PSO2	U	C	5
C05	Understanding of Human genetics, genetic disorders in man, autosomal and sex chromosomal anomalies,	PSO2	U	C	9
C06	Understanding of biotechnology, scope, importance, basic aspects of genetic engineering,, tools, vectors, DNA isolation, techniques in gene transfer	PSO2	U	C	7
C07	Understanding of general techniques in biotechnology, gene cloning, blotting techniques, hybridization techniques, stem cultures	PSO2	U	C	5
C08	Understanding of practical applications of biotechnology and problems and hazards of genetic engineering	PSO2	U	C	8

PART I GENETICS

33hrs

Module I

2hrs

Introduction: Scope and importance of genetics, Brief explanation of the following terms- gene, alleles, genotype, phenotype, genome, homozygous and heterozygous, wild type and mutant alleles, dominant and recessive traits, test cross and back cross, reciprocal cross, Mendelism – Mendel's laws , Mendelian traits in man
Chromosome theory of heredity.

Core Readings

Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology Chapter 1 &2.

Module II**5 hrs**

Interaction of genes: Allelic and non Allelic. Allelic- incomplete dominance Co-dominance Non allelic interactions, – complementary, supplementary, epistasis – dominant (feather colour in fowl) and recessive (coat colour in mice) Polygenes (Skin colour inheritance in man) pleiotropism, modifying genes, lethal genes (Brief account with one example each) Multiple alleles(eg) Coat Colour in rabbits. Man ABO blood group Rh factor, Blood group and its inheritance (Genetic problems related to this topic are included in practicals)

Core Readings

Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology Chapter 3 &4.

Module III**3 hrs**

Linkage and recombination of genes based on Morgan's work in *Drosophila* (Complete and incomplete linkage) .Linkage map Chromosome mapping ./.

Core Readings

Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology Chapter 5

Module IV**3 hrs**

Sex determination: Chromosome theory of sex determination (sex chromosomes and autosomes) chromosomal mechanism (XX-XO, XX-XY, ZW-ZZ) Barr bodies and Lyon hypotheses : Sex determination in man- role of Y chromosome. Sex determination in honey bees. Genic balance theory. *Drosophila*- intersex, gynandromorphs. Hormonal Influence on sex determination Environmental influence - Hermaphroditism

Core Readings

Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology Chapter 6

Module V

5 hrs

Mutations, Types of Mutations. Germinal, Sex linked mutations. Chromosomal mutations - structural and numerical changes. Gene mutation (point mutation) Molecular basis of gene mutations – tautomerism- Induced mutations Physical and chemical mutagens

Core Readings

Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology

Gardner E.J. & Snustand D.P 1984. *Principles of Genetics* (John Wiley & Sons) New York

Module VI

2 hrs

Extra nuclear inheritance (Cytoplasmic inheritance Characteristics: Organelle DNA (Mitochondrial and plastid DNA) Kappa particles in paramecium.

Core Readings

Vijayakumaran Nair 2006, *Genetics and Molecular Biology*. Continental Publications, Trivandrum.

Module VII

5 hrs

Bacterial genetics: Bacterial genome Recombination in Bacteria – Bacterial transformation. Transduction, conjugation F mediated sexduction. Resistance transfer factor (RTF) Mechanism of drug resistance in bacteria Transposable genetic elements in bacteria, basic components and mechanisms of transposition in bacteria.

Core Readings

Panicker S. Abraham G and Francis G. 2008. *Microbiology and Immunology* Published by Zoological Society of Kerala Chapter 10

Ananthanarayanan & Jayaram Panicker, 2006. *A textbook of Microbiology*. Orient Longman pvt. Ltd

Module VIII

8 hrs

Human Genetics: Karyotyping- Normal human chromosome complement. Pedigree Analysis Aneuploidy and Non disjunction. Genetic disorders in Man. Chromosomal anomalies

Autosomal (eg. Down syndrome, Edward's syndrome and Cri du chat syndrome) Sex chromosomal anomalies (Klinefelter's syndrome, and Turner's syndrome) Single gene disorders Gene mutation and disorders (Brief mention) Autosomal single gene disorders (Sickle cell anaemia, brachydactyly; inborn errors of metabolism such as phenylketonuria, alkaptonuria). Sex linked inheritance. Definition - characteristics criss-cross inheritance. Haemophilia and colour blindness. Pseudoautosomal genes (incompletely sex-linked genes and holandric genes. Multifactorial disorders - Polygenic traits - Cleft lip and cleft palate. Sex limited and sex influenced traits in man with examples. Genetic counselling, Eugenics and Euthenics.

Core Readings

Stern C. 1973. Principles of Human Genetics (W.H. Freeman and Co.)

Veer Bala Rastogi – Fundamental of Mol. Biology Ane students Education 2008

Verma P.S. and Agarwal V.K. 1988 Genetics (S. Chand and Co. New Delhi)

Winchester A.M. 1966. Genetics (Oxford & IBH Publications).

PART II BIOTECHNOLOGY

21hrs

Module IX

1 hr

Definition and scope of Biotechnology

Core Readings

Sudha Gangal- Principles & Practice of Animal Tissue Culture. University Press. Pp- 128-135

Module X

6 hrs

Basic aspects of Genetic Engineering.

Tools-Enzymes-Restriction enzymes and DNA ligases.

Vectors-Plasmids and Phage vectors.

Isolation of gene/DNA.

Techniques-Production of recombinant DNA. Briefly mention

rDNA transfer and screening methods. Cloning in host cells. Virus mediated gene transfer, DNA mediated gene transfer.

Module XI

6hrs

General Techniques in Biotechnology.

Techniques in gene cloning; PCR technique and DNA Amplification.

Blotting Techniques- Southern Blotting

Northern Blotting

Western Blotting

Identification of DNA, mRNA, and Protein.

DNA hybridization, Fluorescence *insitu* Hybridization (FISH), Colony hybridization.

DNA finger printing and its applications.

RFLP- markers Applications. Gene libraries, Genomic and cDNA libraries Human DNA library, Construction of genomic library and cDNA library.

Stem cells (Totipotency, Pluripotency, Unipotency) and human ES cell cultures, Human EG cell cultures and Human EC cell cultures and stem cell research. Therapeutic cloning. Potential uses of stem cells. Ethical issues related to embryological experiments.

Animal cell and tissue culture.

Core Readings

John Ringo 2009 *Fundamental Genetics* Cambridge University Press, Chapter 29.

Sobti & Sharma 2008 *Essentials of Modern Biology* Ane's Student Edition Chapter 2 p. 89

Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology , Published by Zoological Society of Kerala

Wilson & Walker 2008 *Biochemistry and Molecular Biology* 6th edition, Cambridge University Press. Chapter -5

Veer Bala Rastogi – Fundamental of Mol. Biology Ane students Education 2008 Chapter 16
p. 379-424.

Module XII

5 hrs

Practical Applications of Biotechnology (Brief account only)

Bioremediation.

Tissue culture – Principle and uses

Technology of mammalian and plant cell culture.

Single cell protein (SCP) The economic implications of SCP. Biotechnology and Medicine:

Gene therapy

Monoclonal antibodies,

Pharmaceuticals and Biopharmaceuticals –Hormones(insulin, somatostatin, interferon, Lymphokines, Cytokines) Antibiotics, Vaccines

Biotechnology in agriculture and forestry – Microbial insecticides, Resistance of plants to weedicides, insect pest and microbial diseases. Production of transgenic plants

Animal biotechnology – Genetic Engineering for transgenic animals.

Fermentation technolog in food and beverages

Core Readings

Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology ,
Published by Zoological Socieyt of Kerala

John E. Smith Biotechnology Cambridge Low priced ed. (Third Ed) 2005

Singh B. D Biotechnology 2002, Kalyan Publishers New Delhi

Module XIII

3 hrs

Problems in Biotechnology

Hazards of genetic engineering Problems of biologically active biotechnology products. Problems of biotechnological inventions: Patenting and Patent protection – Trade secrets Plant breeder's rights. Biowar and biopiracy

Core Readings

John E. Smith Biotechnology Cambridge Low priced ed. (Third Ed) 2005

Singh B.D. Biotechnology 2002, Kalyan Publishers Nw Delhi.

Selected Further Readings

Bala Subramanian D., C.F & Bryle & K. Dharmarajan J. Green Kunthala Jayaraman, Concept in Biotechnology. University Press 2007

Benjamin Lewin 2004 Gene VIII Oxford University Press

Brown C.H., Campbell I & Priest F, G. 1987. Introduction of Biotechnology (Blackwell scientific publishers Oxford)

C.W. Fox, J.B. Wolf Evolutionary Genetics Concept of Case Studies, Oxford university Press 2006

Colin Ratledge & Bjorn Kristiansen, Basic Biotechnology 3rd ed. Cambridge University (2008)

De Robertis E.D. and De. Robertis E.M. 1987 cell & Molecular Biology (Lea & Febya / Info- Med)

Desmand S.T. Nicholi An introduction to Genetic Engineering Cambridge Sec, Ed. 2007.

Frank H, Stephenson Calculation for Molecular Biology and Biotechnology . Academic press 2006

Gardner E.J. and Snustand D.P. 1984. Principles of Genetcis (John Wiley & Sons New York.)

Gerhard Fuchs. Biotechnology & in Corporative Perspective. Study in global Competition series, Ane Book 2003

Jan Vijay Aging of the Genome The dual role of DNA in life and Deaths. Oxford university Press 2008

Janarthanan S & Vincent S., Practical Biotechnology, Method of Protocols. University Press .
2007

John E. Smith Biotechnology Cambridge Low priced ed. (Third Ed) 2005

Madingan , Martinko and Parker 2002, Biology of Microorganisms , Brock Eighth Ed.
Prentice Hall

Powar. C.B. 1983. Cell biology (Himalaya Publishing company)

Prave D. Faustu and Sitting W and Subasten D.A (Eds) 1987 Fundamentals of
Biotechnology (VCH publishers. Germany)

R.C. Sobte and Suparna. S. Pachauri. Essentials of Biotechnology Ane Book Pvt. Ltd. 2009

Singh B.D. Biotechnology 2002, Kalyan Publishers New Delhi.

Sinnat Dunn & Dobzhansky 1959. Principles of Genetics (T.M.H. New Delhi)

Stern C. 1973. Principles of Human Genetics (W.H. Freeman and Co.)

Strickberger W.M. 1990. Genetics (Mac Millan Publishing Co.)

Sudha Gangal Biotechnology Principles And & practice of Animal Tissue culture, Universities
Press 2007

Susantha Gosnalibke – Merged Evolution (Long term implication of Biotechnology and
Information Technology) Gordon & Breech Pub. 2005

Veer Bala Rastogi – Fundamental of Mol. Biology Ane students Education 2008

Verma P.S. and Agarwal V.K. 1988 Genetics (S. Chand and Co. New Delhi)

Winchester A.M. 1966. Genetics (Oxford & IBH Publications.

19U6PRZOO05:PRACTICAL5**GENETICS AND BIOTECHNOLOGY****36 hrs****Credit 1**

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Evaluating genetic problems – mono and dihybrid ratio, back cross and multiple alleles	PO1 PSO4	A	P	4
CO2	Analysis of human buccal epithelium	PO1 PSO4	A	P	2
CO3	Analyse the chromosomal anomalies in man	PO1, PO5 PSO4	A	P	4
CO4	Examine the karyotype and idiogram of somatic metaphase chromosome in human	PO1, PO5 PSO4	A	P	4
CO5	Analysing the sex in Drosophila	PO1, PO4 PSO4	A	P	4
CO6	Isolation of DNA	PO1 PSO4	A	P	4
CO7	Analysis of polymerase chain reaction	PO1 PSO4	A	P	6
CO8	Analysis and study of the blotting techniques	PO1 PSO4	A	P	8

1. Genetic problems – (Problems from each type)
(a) Mono and Dihybrid ratio (b) Back cross (c) Multiple alleles.
2. Study of barrbody in human buccal epithelium
3. Study through photographs of the Karyotype- Turner's Syndrome , Klinefelters and Down's Syndrome
4. Study of the karyotype and idiogram from the given photograph of somatic metaphase chromosome-(Human)
5. Sexing of *Drosophila melanogaster*
6. Isolation of DNA (Demonstration)
7. Study of Polymerase Chain Reaction (Demonstration)
8. Western blotting of proteins from SDS-polyacrylamide gel (Demonstration)
9. Southern blotting of DNA fragments from agarose gel (Demonstration)
10. Northern Blotting of RNA molecules (Demonstration)

(Students are expected to visit the near by research institution / Biotechnology departments/ research centre, and see the demonstration of practicals 5, 6 7, and 8,/Video show if they do not have such facility in their institution)

Core Reading

S. Janardhanan and Vincent S. 2008 *Practical Biotechnology Methods and protocols*
Cambridge University Press.

SEMESTER VI
19U6CRZOO11: CORE COURSE 11
MICROBIOLOGY AND IMMUNOLOGY

54 hrs

Credits 3

Course Code	19U6CRZOO11
Title of the course	Microbiology and Immunology
Semester in which the course is to be taught	6
No. of credits	3
No. of contact hours	54

Objectives of the course

1. To inspire the students in learning the frontier areas of biological sciences
2. To make them aware of the pathogens , health related problems, their origin and treatment.
3. To equip the students with the knowledge of modern developments and recent trends in biological sciences

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understand the history and scope of microbiology and outline classification of bacteria, fungi and viruses	PO1; PSO3	U	C	2
CO2	Understand the methods in microbiology	PO1; PSO3	U	C	6

CO3	Understand basic bacteriology.	PO1; PSO3	U	C	7
CO4	Understand basic virology	PO1; PSO3	U	C	3
CO5	Differentiate the types and carriers of microbial infections and the diseases caused.	PO1; PSO3	U	C	9
CO6	Understand the basics of immunology, antigens and antibodies.	PO1; PSO3	U	C	11
CO7	Understand the clinical applications of antigen-antibody reaction.	PO1; PSO3	U	C	7
CO8	Understand immune response system and their disorders.	PO1; PSO3	U	C	9

PART I MICROBIOLOGY

27hrs

Module1 Introduction and Scope of Microbiology
Outline classification of bacteria, fungi, viruses,

2 hr

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala

Anthanarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd.

Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed. Ane's student Editions 2009

Module 2 Methods in Microbiology

6 hrs

Sterilization and disinfection. Different methods, physical and chemical. Sterilization by moist and dry heat, by filtration, by irradiation, preparation of culture media (aerobic and anaerobic cultivation) Selective media, enrichment media and differential media, Plating techniques and isolation of pure colonies, culture preservation techniques – refrigeration, deep

freezing, freezing under liquid nitrogen and lyophilization.

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 5 p. 107-137

Anthanarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd.

Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed. Ane's student Editions 2009

Module 3 Morphology and fine structure of bacteria, size, shape and arrangements. **5 hrs**
Flagella, Pili, Capsule, cell wall and its composition, Cytoplasmic membrane, protoplast, spheroplast, , nuclear material , cell inclusions, Bacterial spores

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 1 p. 1-36

Anthanarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd.

Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed. Ane's student Editions 2009

Module 4 Bacterial Growth, Effect of various factors on bacterial growth. **2 hrs**
cell division., Nutritional requirements.Enumeration of bacteria ;Total count & viable count Bacterial growth curve

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 3

Anthanarayan R & C.K. Jayaram Paniker. Textbook of Microbiology (2008) Orient Longman Private Ltd.

Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed. Ane's student Editions 2009

Module 5 Basic Virology **3 hrs**

Viruses -Structure of Viruses Human, Animal, Plant and Bacterial Viruses.

Replication of viruses.

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 2

Anthanarayan R & C.K. Jayaram Paniker. Textbook of Microbiology (2008)
Orient Longman Private Ltd.

Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed. Ane's
student Editions 2009

Module 6

Infections

2 hrs

Types, Primary and secondary infections. Cross infection , nosocomial infection

Infection, endogenous and exogenous infections, different sources of transmission of diseases (by food, water, air, vectors, and carriers. Mention different types infections, contagious diseases (Epidemic, endemic and pandemic) modes of of carriers, healthy carriers, convalescent carriers, temporary and chronic carriers, contact carriers, paradoxical carriers , bacteraemia, Septicaemia

Core Readings

Anthanarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008)
Orient Longman Private Ltd

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 8.

Park K., Park's Text Book of Preventive and Social Medicine – 2002, 17t Ed.
BanarasidassBhenot Publications

Module 7

Diseases caused by different pathogens, epidemiology, symptomology, principles of laboratory diagnosis of Bacterial,viral and fungal diseases: A brief study of two examples from each category bacterial:Tuberculosis& Typhoid

7 hrs

Viral : Influenza& Polio

Fungal: Dermatophytoses& Candidiasis

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 7

Anthanarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd.

Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed. Ane's student Editions 2009

PART II IMMUNOLOGY

27 rs

Module 8 Introduction to immunology

4 hrs

Types of immunity, innate immunity, Mechanism of innate immunity (eg. Barriers, Phagocytosis, inflammation.) acquired - passive & active Vaccines types of vaccines , live, killed , toxoids, recombinant DNA

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 1

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Module 9 Antigens Antibodies Complements

6 hrs

Types of Antigens, haptens, antigenic determinants. Basic structure of immunoglobulins. Different classes of immunoglobulins and functions

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 4

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Module 10 Antigen-antibody reactions, Precipitation test, Agglutination Test, Clinical applications of antigen antibody reaction : Eg: Widal , VDRL , HIV test (ELISA) **4 hrs**

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Module 11 Immune Response system **6 hrs**

Primary and secondary lymphoid organs. Cells of the immune system – Leucocytes, Lymphocytes T & B cells, Macrophages, Plasma cells, Memory cells, MHC Antibody synthesis, primary and secondary responses,

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 10.

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Module 12 Immunopathology- immune disorders **7hrs**

(Hypersensitivity, autoimmunity and immunodeficiency)

Different types of hypersensitivity reactions

Autoimmunity, mechanisms of autoimmunization

A brief study on autoimmune diseases eg. Thyrotoxicosis, rheumatid arthritis

Immunodeficiency diseases- eg. AIDS

Transplantation Immunity - Graft rejection , major histocompatibility,
Human leukocyte antigen system - (HLA)

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Selected Further Readings

Anthanarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd.

Coleman: 2002 Fundamentals of Immunology

Darla J. Wise & Gordon R. Carter: 2004:Immunology A Comprehensive Review Iowa state University Press. A Blackwell science company,

Hans G. Sch Legel General Microbiology Seventh Ed. Cambridge Low Price Ed.

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

Heritage, J ., E.G.V. Evaus&R.A.Killungten 2007: Introductory Microbiology Cambridge University Press

Ivan Roitt: 2002 Essentials of Immunology ELBS.

K. Park, Park's Text Book of Preventive and Social Medicine – 2002, 17t Ed.
BanarasidassBhenot Publications

Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed. Ane's student Editions 2009

Keith Wilson and John Walker, 2009, Principles and Techniques of Biochemistry and Molecular Biology Sixth Ed. Cambridge University Press

Mangi, E.M.T El. C.F.A Bryca, A.L Demain, A.K. Allman Fermentation Microbiology & Biotechnology Sec. Ed. Taylor Framics London New York 2006

Michael J. PelczarECS,Chan& Noel. R. Kreig, Microbiology, Tata McGraw Hill 5th ed. 1996.

Monica Cheesbrough: Laboratory Manual for Tropical Countries. Vol.II Microbiology, ELBS – Cambridge Ed. 1986.

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala.

Prakesh Arora M. Anes Illustrated Dictionary of Immunology, Ane Book India. 2002

Prescott. Microbiology 2nd edition

19U6PRZOO06:Practical 06**MICROBIOLOGY AND IMMUNOLOGY****36 hrs****Credit 1**

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Apply the principles of instruments used in microbiology lab	PO1 PSO4	A	P	4
CO2	Apply the knowledge for the preparation of different media	PO1 PSO4	A	P	6
CO3	Analyse different types of media and their uses	PO1 PSO4	An	P	8
CO4	Analyse different culture techniques in microbiology	PO1 PSO4	An	P	8
CO5	Analyse the different staining techniques in microbiology	PO1 PSO4	An	P	4
CO6	Analyse the blood samples using ABO and Rh antigen typing	PO1 PSO4	An	P	4
CO7	Analyse the primary and secondary lymphoid organs using photographs	PO1 PSO4	An	U	2

1. Instruments –Autoclave, Hot air oven, Bacteriological incubator – Working and use in Microbiology lab.
2. Cleaning and sterilization of glasswares
3. Preparation of solid and liquid media for microbial cultures. (Ingredients, pH and method of preparation)(Demonstration)

- (a) Solid media (1) Nutrient agar (2) Mac Conkey's agar
 - (b) Liquid Media (1) Nutrient broth (2) Peptone water.
 - (c) Semi solid agar
 - (d) Firm agar
4. Culture methods (Demonstration)
- (a) Streak plate technique and isolation of pure colonies.
 - (b) Lawn culture (c) Stab culture
 - (d) Pour plate culture
 - (e) Liquid culture
5. Serial dilution and Standard Plate Count (SPC) calculation of C fu /ml in well water sample (demonstration).
6. Examination of microbes in living condition
- (a) Wet mount
 - (b) Hanging drop method for demonstrating motility of bacteria.
7. Gram staining – preparation, procedure, identification of Gram + ve and Gram –ve bacteria.
8. Antibiotic sensitivity test (demonstration).
9. Preparation of a fungal smear – Lactophenol cottonblue staining and mounting
10. Determination of ABO blood groups and Rh factor (Antigen –antibody Reaction)
11. Study through photographs/ illustration, the primary immune (Bone marrow and thymus) and secondary immune (spleen and lymph nodes) organs in Rat/Man.

SEMESTER VI

19U6CRZOO12: CORE COURSE 12

GENERAL INFORMATICS, BIOINFORMATICS, BIOSTATISTICS AND RESEARCH METHODOLOGY

54 hrs

Credits 3

Course Code	19U6CRZOO12
Title of the course	General Informatics, Bioinformatics and Biostatistics and Research Methodology
Semester in which the course is to be taught	6
No. of credits	3
No. of contact hours	54

Objectives of the course

1. To inspire the students in learning the frontier areas of biological sciences
2. To update and expand basic informatics skills and attitudes relevant to the emerging knowledge of society and also to equip the students to effectively utilize the digital knowledge resources in learning.
3. To equip the students with the knowledge of modern developments and recent trends in biological sciences
4. To familiarize with the basic tools and techniques of scientific study with emphasis on biological sciences

Pre-requisite:

- An awareness on role of research in science

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understand the basic principles of human genetics, the disorders associated with it and awareness on pre natal diagnosis	PO1 PSO3	U	c	9
CO2	Understand the genetic principle of blood group inheritance, importance of blood donation, causes of infertility, DNA fingerprinting and its applications	PO5 PSO3	U	c	9
CO3	Understand psychoneuroimmunology of physical activity, exercise, yoga and programmes related to community health promotion	PO5 PSO3	U	c	8
CO4	Understand the importance of balanced diet, and awareness on nutritional disorders	PO1 PSO3	U	c	5
CO5	Understand the principles of accident prevention and first aid	PO5 PSO3	U	c	5
CO6	Understand the pathology of water borne diseases and their prevention; waste water and solid waste management	PO4 PSO3	U	c	12
CO7	Understand the microbiology of food borne diseases and their prevention	PO4 PSO3	U	c	12
CO8	Understand the pathology and control measures of emerging diseases, vector borne and life style diseases	PO4 PSO3	U	c	12

Part I GENERAL INFORMATICS

6 hrs

Module 1. Introduction

2 hrs

Microprocessors – RAM, ROM, EPROM, Memory systems, input, output devices. Disk operating systems, booting, formatting.

Core Readings

Sinha, Pradeep K. and Sinha, Priti. [2003], *Computer Fundamentals – concepts systems and applications*, Third Edition, BPB publications, New Delhi.

Module 2.Operating systems:

4hrs

DOS, Windows, Linux (only basics), MS Office (MS word, Excel, Access and PowerPoint) computer programming, Networking (LAN, WAN), Internet, World Wide Web, Databases and information retrieval.

New technology in Internet

Core Readings

Gupta, Vikas [2002], *Comdex –computer course kit*, Eight Edition, Dreamtech, New Delhi.

Part II BIOINFORMATICS

18 hours

Module

3

6 hrs

Definition, Nature & Scope of Bioinformatics - Contrast between Bioinformatics and Computational Biology; Key Bio-sequences in Molecular Biology - DNA, RNA and Amino-acid sequences -Popular Databases in Bioinformatics - NCBI, DDBJ, PDB, OMIM, EMBL, INSDC; BLAST & FASTA sequence file formats, Approach of Comparative Biology based on sequence comparison - The basic idea of sequence comparison (algorithms not required) - idea of scoring matrices

Core Readings

1. Claverie&Notredame, Bioinformatics - A Beginners Guide, Wiley-Dreamtech India Pvt Ltd, 2003
2. Dan E. Krane and Michael L. Raymer, Fundamental Concepts of Bioinformatics, Pearson Education.
3. Rastogi et. al., Bioinformatics: Methods and Applications, Prentice Hall of India.

Further Readings:

1. Introduction to Bioinformatics, Arthur M. Lesk, OXFORD publishers.
2. D. Mount, Bioinformatics: sequence & Genome Analysis, Cold spring Harbor press, USA.

3. Rashidi, Hooman H. and Buehler, Lukas K. [2001]. *Bioinformatics Basics applications in biological science and medicine*, CRC Press, Washington, D.C.

Module

4

6 hrs.

The Blast search engine - important features - Idea of Multiple sequence alignment - Proteomics: Basic ideas of Protein Structure prediction- Concept of Homology Modeling- Idea of Molecular Phylogenetics - advantages and computational procedure (only description of use of a package such as Phylip)-

Core Readings

1. Claverie&Notredame, Bioinformatics - A Beginners Guide, Wiley-Dreamtech India Pvt Ltd, 2003
2. Dan E. Krane and Michael L. Raymer, Fundamental Concepts of Bioinformatics, Pearson Education.
3. Rastogi et. al., Bioinformatics: Methods and Applications, Prentice Hall of India.

Selected further Readings

1. Introduction to Bioinformatics, Arthur M. Lesk, OXFORD publishers.
2. D. Mount, Bioinformatics: sequence & Genome Analysis, Cold spring Harbor press, USA.
3. Rashidi, Hooman H. and Buehler, Lukas K. [2001]. *Bioinformatics Basics applications in biological science and medicine*, CRC Press, Washington, D.C.

Module 5

6 hrs.

Basic concepts of computer Aided Drug Discovery- General description of drug discovery pipeline- concept of Personalized medicine; Bioinformatics tools: (i)Molecular Visualization Software - Rasmol (Basic features only) - (ii) ORF finding (iii) gene finding, (iii) BLAST (iv) Hydrophobicity Prediction (v) Single Nucleotide Polymorphism (SNP) prediction using GENSNIIP

Core Readings

1. Claverie&Notredame, Bioinformatics - A Beginners Guide, Wiley-Dreamtech India Pvt Ltd, 2003
2. Dan E. Krane and Michael L. Raymer, Fundamental Concepts of Bioinformatics, Pearson Education.
3. Rastogi et. al., Bioinformatics: Methods and Applications, Prentice Hall of India.

Slected further Readings

1. Introduction to Bioinformatics, Arthur M. Lesk, OXFORD publishers.
2. D. Mount, Bioinformatics: sequence & Genome Analysis, Cold spring Harbor press, USA.
3. Xiong, Jin. [2006], *Essential Bioinformatics*, Cambridge University Press, New York.

Module 6 Future Prospects:

2 hrs.

1. Human brain Project
2. Computer simulation and visualization of molecular structure
3. Protein structure prediction.

Core Readings

Rashidi, Hooman H. and Buehler, Lukas K. [2001]. *Bioinformatics Basics applications in biological science and medicine*, CRC Press, Washington, D.C.

Part III BIOSTATISTICS

Total- 18 hrs.

Module7. Sample & Sampling techniques

2 hrs

Collection of data, Classification of data, Frequency distribution tables,

Graphical representation: - Bar diagrams, Histogram, Pie diagram and

Frequency curves.

Core Readings

Dutta, Naren. [2002], *Fundamental of Biostatistics- Practical Approach*, Kanishka Publishers, New Delhi.

Rastogi, V.B .2009. Fundamentals of Biostatistics, Ane Books Pvt. Ltd. New Delhi.

Module 8. Measures of Central Tendency

3hrs

Mean, Median, Mode (Direct method only)

Core Readings

Dutta, Naren. [2002], *Fundamental of Biostatistics- Practical Approach*, Kanishka Publishers, New Delhi.

Rastogi, V.B .2009. Fundamentals of Biostatistics, Ane Books Pvt. Ltd. New Delhi.

Module 9. Measures of dispersion

4 hrs

Range, Quartile Deviation, Mean Deviation, Standard Deviation, Standard error. (Merits & demerits).

Core Readings

Dutta, Naren. [2002], *Fundamental of Biostatistics- Practical Approach*, Kanishka Publishers, New Delhi.

Rastogi, V.B .2009. Fundamentals of Biostatistics, Ane Books Pvt. Ltd. New Delhi.

Module 10. Probability Distributions

3 hrs

Normal, Binomial, Poisson distribution (Brief description only)

Core Readings

Rastogi, V.B .2009. Fundamentals of Biostatistics, Ane Books Pvt. Ltd. New Delhi.

Module 11. Correlation

4 hrs

Definition, Types of correlation.

Core Readings

Campbell, R.C. [2005], *Statistics for Biologists, Cambridge Universtiy Press*, New York.

Rastogi, V.B .2009. Fundamentals of Biostatistics, Ane Books Pvt. Ltd. New Delhi.

Module 12. Test of Hypothesis and Test of Significance 2 hrs

Basic concept, Levels of significance, test of significance, Procedure for testing hypothesis, types of hypothesis- Null hypothesis and Alternate hypothesis. Chi- square test.

Core Readings

Campbell, R.C. [2005], *Statistics for Biologists*, Cambridge University Press, New York.

Rastogi, V.B .2009. Fundamentals of Biostatistics, Ane Books Pvt. Ltd. New Delhi.

Selected Further Readings

Campbell, R. 1990. Statistics for biologists. CBS Publishers and distributors.

Chavali. L.N. 2009 Bioinformatics & Bioprogramming in Cambridge University press

David. G. Kleinbaum and Mitchel Klein 2009 Survival analysis Statistics for Biology & Health 2nd .Ed. Springer International ed.

Jin Xiang 2008 Essential Bioinformatics 1st Ed. Cambridge University Press.

Khan and Khanum, 1990 Fundamentals of biostatistics

Neil C. Jones and Pavel A. Pevzner. 2004 An introduction to Bioinformatics Algorithms. Ane Book Pvt Ltd.

Nikolay Kolchamvov and Ralf Hofstaedt-2008 Bioinformatics of Genome Regulation and structure. Springer international Ed.

Norman T.J. Bailey Statistical methods in biology 2007 Cambridge University press.

Paul.G. Hegg's and Teresa .K. Altwood- 2005., Bioinformatics and Molecular Evolution Blackwell publishers.

Pennington S.R. and M.J. Dunn. Proteomics. 2005 Ane Books.

Rastogi, V.B .2009. Fundamentals of Biostatistics, Ane Books Pvt. Ltd. New Delhi.

Warren J. Ewens, Gregory .R. Grant. 2008. Statistical methods in Bioinformatics an Introduction

Part IV RESEARCH METHODOLOGY

Total- 12 hrs.

Module I. Tools and Techniques in Biological Research

7 hrs

Scientific drawing -Purpose and principle

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

Core readings

Aggarwal S.K, 2009 *Foundation Course in Biology* Ane's Students Edition P- 79-93.

Eldon D. Enger, Frederick C. Ross and David Bailey 2008(Eleventh Edition) *Concepts in Biology*. Tata – McGraw Hill, New Delhi

Taylor, Green, Stout (2008) *Biological Science*, Cambridge University, Press, p 161-163

Wilson & Walkar 2008 *Principles and Techniques of Biochemistry and Molecular Biology* Cambridge University Press. Chapters 9,10,11,15.

Zoological Society of Kerala Study Material 2002 – *Cell Biology, Genetics & Biotechnology*. Chapter- 2 Tools and Techniques.

Module II. Research Methodology

4 hrs

Scientific method

Research Projects- Steps and process. Types.

Research Communication

Research report writing (Structure of a scientific paper)

Presentation techniques

Project proposal writing

Assignment, seminar, debate, workshop, colloquium, Conference

- Brief description and major differences

Core Readings

Anderson, J, Durston, B.H. and Poole, M. 1992. *Thesis and assignment writing*. Wiley Eastern Ltd.

Debbies Holmes, Peter Moody and Diana Dine 2006 *Research methods for the Biosciences*. International student Edition: Oxford University Press. Chapters.1-8.

Hawkins C. and Sorgi, M. 1987. *Research: How to plan, speak and write about it*. Narosa Publishing House.

Ruxton, G.D. and Colegrave, N. 2006. *Experimental design for the life sciences*. Oxford University Press. Chapters 1-6.

Module III. Units of measurements

1 hr

Calculations and related conversions of each:

- Metric system- length; surface; weight
- Square measures
- Cubic measures (volumetric)
- Circular or angular measure
- Concentrations- percent volume; ppt; ppm
- Chemical – molarity, normality
- Temperature- Celsius, centigrade, Fahrenheit

Core readings

D.K. Illustrated Oxford Dictionary.2006 Chapter on Measurements p-968.

Knut Schmidt – Nielsen 2007 *Animal Physiology*, 5th Edition, Appendix -A

Taylor D.J. Green N.P.O, Stout G.W. Editor R. S. Oper, 2008 Biological science (Third edition Cambridge University press. P-960

Selected Further Readings

Aggarwal. S.K. 2009 Foundation Course in Biology, 2nd Ed.. Ane's Student Edition. Ane Books Pvt. Ltd.

Anderson, J, Durston, B.H. and Poole, M. 1992. Thesis and assignment writing. Wiley Eastern Ltd.

Bowler Peter J., and Iwan Rhys Morus. 2005 *Making Modern Science: A Historical Survey*. University of Chicago Press, Chicago, IL:

Day, R.A. 1993. How to write and publish a scientific paper. Cambridge University Press. (Module VI)

Day, R.A. 2000. Scientific English: A guide for Scientists and other Professionals. Universities Press. (Module VI)

- Debbies Holmes, Peter Moody and Diana Dine 2006 Research methods for the Biosciences. International student Edition : Oxford University Press .
- Eldon D. Enger ,Frederick C. Ross and David Bailey 2008 (Eleventh Edition) *Concepts in Biology* .Tata-McGraw Hill , New Delhi.(Module VII, II & III)
- Ernst Mayr 1982. *The Growth of Biological Thought: Diversity, Evolution, and Inheritance*. Published by Harvard University Press.
- Ernst Myer .1997. *This is Biology: The Science of the Living World*. Universities Press, Hyderabad, India
- Ervin Schrodinger 1944. What is life? Mind and Matter. Cambridge University Press
- Gupta K.C, Bhamrah, H.S and G.S.Sandhu 2006.Research Techniques in Biological Sciences. Dominant Publishers and Distributors, New Delhi.
- Hawkins C. and Sorgi, M. 1987. Research: How to plan, speak and write about it. Narosa Publishing House.
- Jacques Monod 1971. *Chance and Necessity: An Essay on the Natural Philosophy of Modern Biology*. Vintage Pub. NY
- Kuhn, Thomas. 1996 *The Structure of Scientific Revolutions*. 3rd ed.: University of Chicago Press, Chicago, IL
- Marie, M. 2005. Animal Bioethics: Principles and Teaching Methods Wageningen Academic Publishers
- Michael Roberts,Tim King and Michael Reiss.1994.Practical Biology for Advance Level. Thomas Nelson and Sons Ltd. Surrey, UK.
- Ruxton, G.D. and Colegrave, N. 2006. Experimental design for the life sciences. Oxford University Press.
- Sateesh, M.K. 2008 Bioethics and Biosafety; I.K. International Publishing House (Module V)
- Taylor D.J. Green N.P.O, Stout G.W. Editor R. S. Oper, 2008 Biological science (Third edition Cambridge University press

19U6PRZOO06:Practical 06

General informatics, Bioinformatics, Biostatistics and Research Methodology

36 hrs

Credit 1

CO	CO Statement	POs/ PSOs	CL	KC	Class session s
C01	MS Word, MS Excel, MS Access	PO1 PSO4	A	P	6
C02	Internet: Access a web page on any biological topic. Frequency distribution, Range and standard deviation and Correlation using any biological data.	PO1 PSO4	A	P	4
C03	Download a specified sequence from NCBI and search with it in BLAST, Download molecular structure data files of DNA, Sugar, Water etc and inspect them through Rasmol	PO1, PSO4	A	P	4
C04	Download a specified DNA sequence from NCBI and identify ORF & genes, if any, in it. Download a specified AA sequence from NCBI and plot its hydrophobicity profile.	PO1, PSO4	A	P	4
C05	Download and study at least two samples of genome sequences. Spotters—copies of genome sequences and proteins.	PO1, PSO4	A	P	4
C06	Graphical representation of data. Construction of bar diagrams, Histograms, Pie diagram and Line graphs.	PO1 PSO4	A	P	6
C07	Micrometry –calibration and measurement of microscopic objects –low power Paper chromatography	PO1 PSO4	A	P	4
C08	Instrumentation	PO1 PSO4	A	P	4

1. MS Word: Mail merge—Preparing mark sheet of students
2. MS Excel : To create mean and median
3. MS Access: To create grade of students
4. Internet: Access a web page on any biological topic.
5. Frequency distribution of the given samples to find out arithmetic mean, median, mode.
6. Range and standard deviation for a biological data
7. Correlation using any biological data.
8. Download a specified sequence from NCBI and search with it in BLAST and report results with comments.
9. Download molecular structure data files of DNA, Sugar, Water etc and inspect them through Rasmol. .
10. Download a specified DNA sequence from NCBI and identify ORF & genes, if any, in it.
11. Download a specified AA sequence from NCBI and plot its hydrophobicity profile.
Download and study at least two samples of genome sequences.
12. Spotters—copies of genome sequences and proteins.
13. Graphical representation of data. Construction of bar diagrams, Histograms, Pie diagram and Line graphs.
14. Micrometry –calibration and measurement of microscopic objects –low power
15. Paper chromatography
16. Instrumentation – demonstration (write notes on principle, equipment and its use)
 - pH Meter
 - Colorimeter/ Spectrophotometer
 - Centrifuge
 - Electrophoresis

Model questions of Bioinformatics (Theory and Practicals)

1. Define bioinformatics. How is it different from computational biology?
2. Explain one standard file format for bio-sequences.
3. Explain important features of NCBI or PDB.
4. How does bioinformatics help comparative biology?
5. Explain how two DNA fragments ATTT and TTT can be compared?
6. What are scoring matrices? Why is it essential in sequence comparison?
7. Explain important features of BLAST.
8. What is multiple sequence alignment? Where is it useful?
9. What is the need for protein structure prediction?
10. Explain the concept of homology modeling.
11. Compare molecular phylogenetics with traditional phylogenetics.
12. Explain the process of Tree construction using molecular phylogenetics software.
13. Explain the basic drug discovery pipeline.
14. Explain the features of Rasmol.

SEMESTER VI

19U6CRZOO13:ELECTIVE PAPER

ECOTOURISM AND ECOTOURISM ENTREPRENEURSHIP

72 hrs

4 hrs/week

Credits 3

Course Code	15U6CRZOO13
Title of the course	Ecotourism and Ecotourism Entrepreneurship
Semester in which the course is to be taught	6
No. of credits	3
No. of contact hours	72

Objectives:

- 1.To introduce the concepts, principles and applications of tourism and its sustainability
2. To critically analyse the cost and benefits of ecotourism, including related laws and policies, community involvement and future trends
- 3.To develop an appreciation among students with respect to tourism development from the sustainability perspective
4. To equip the students with basic knowledge for the emerging ecotourism industry
5. To equip the students with basic entrepreneurial skills in ecotourism industry

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Fundamentals of Tourism	PSO3	U	C	12
CO2	Major areas of eco-tourism	PSO3	U	C	10
CO3	Emerging trends in eco-tourism	PSO3	U	C	10
CO4	Problems and prospects of eco-tourism	PSO3	U,A	C	10
CO5	Sustainable tourism	PSO3	U, E	C	12
CO6	Eco-tourism guides	PSO3	U,A	C	6
CO7	Ecotourism Entrepreneurship	PSO3	U,A	C	12

Module I. Fundamentals of Tourism

12 Hrs

Introduction- Tourism, concepts and definitions

History, types, Characteristics

The facilitating sectors

Attractions

Geography, heritage

Wildlife, nature

Quality Control

Module II. Major areas of eco-tourism **10 Hrs**

Concepts, practices and case studies for each: Marine tourism Wildlife tourism Adventure tourism

Module III. Emerging trends in eco-tourism **10Hrs**

Cultural tourism Pilgrimage tourism Farm tourism Backwater tourism Health tourism

Module IV. Problems and prospects of eco-tourism **10 Hrs**

Economics and benefits of ecotourism Cultural issues and negative aspects of ecotourism
Environmental Impacts of Tourism

Module V. Sustainable tourism **12 Hrs**

Quality, Standards

Systems of sustainable tourism: environmental, sociocultural, economical

Environment and conservation: basic principles

Current practices of eco-conservation in tourism industry

Sustainable tourism and society

Community based ecotourism

Eco-development committees (EDC)

Module VI. Eco-tourism guides **6Hrs**

Ecotourism guiding and case studies

Module VII: Ecotourism Entrepreneurship **12 Hrs**

Entrepreneur- meaning, types, qualities, function;

Entrepreneurship – characteristics, importance;

Role of entrepreneur in national development.

Ecotourism Business ideas- sources; Identification of opportunities; Analysis of opportunities.

Feasibility – Marketing feasibility and location feasibility

Establishing ecotourism enterprise- steps, procedures, license, registration, etc.

References

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

Ghimire, K.B. and M. Pimbert. 1997. Social change and conservation: environmental politics and impacts of national parks and protected areas. London: Earthscan Publications.

Karan Singh. 1980. Indian Tourism: Aspects of great adventure. Department of tourism. New Delhi.

Ratandeep Sing. 2003. National Ecotourism and Wildlife tourism: Policies and guidelines. Kanishka Publishers, New Delhi

Whelan, T. 1991. Nature tourism: managing for the environment. Washington, D.C.: Island Press.

Brian Garrod and Julie C. Wilson. 2002. Marine Ecosystem. Channel View Publications.

Ratandeep Sing. 2003. National Ecotourism and Wildlife tourism: Policies and guidelines. Kanishka Publishers, New Delh

Vasant Desai, Entrepreneurship Development, Himalaya Pub

Feroze Banker, Progressive Entrepreneur, Kanishka Publications

Mohanty, SangramKeshari (2005). Fundamentals of entrepreneurship, New Delhi.

Gupta &Srinivasan, Entrepreneurial Development

SYLLABUS OF ZOOLOGY FOR COMPLEMENTARY COURSE (B.Sc. BOTANY PROGRAMME)

SEMESTER I

19U1CPZ001: Animal Diversity – Non Chordata

2 hrs/week

36/hrs

Credit – 2

Course Code	19U1CPZ001
Title of the course	Animal Diversity - Non Chordata
Semester in which the course is to be taught	1
No. of credits	2
No. of contact hours	36

Objectives

1. To acquire knowledge on the taxonomic status of various Invertebrate animals and animal groups.
2. To familiarize the students with the diverse group of organisms around us.
3. To develop an aptitude for understanding nature and its rich bio-diversity.

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understand the basic concepts and principles of invertebrate taxonomy	PO1,PO4 PSO1	U	C	2

CO2	Understand salient features and taxonomy up to phylum of Kingdom Protista	PO1,PO4 PSO1	U	C	7
CO3	Understand the salient features and taxonomy of mesozoa and parazoa.	PO1,PO4 PSO1	U	C	2
CO4	Differentiate the coral reefs and the rich biodiversity of coelenterates	PO1,PO4 PSO1	U	C	3
CO5	Understand the pathogenicity of round worms and flat worms.	PO1,PO4 PSO1	U	C	4
CO6	Understand the salient features and taxonomy of segmented, jointed and shelled invertebrates.	PO1,PO4 PSO1	U	C	5
CO7	Understand the morphological aspects, structural and functional facets of <i>Penaeus</i> .	PO1,PO4 PSO1	U	C	8
CO8	Understand the pests of paddy, coconut and stored grains.	PO1,PO4 PSO1	U	C	5

Module 1

General Introduction

1 hr

5 Kingdom classification, Classification in general

Core Readings

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

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)

Protista & Animal Diversity Academica Publications. Zoological Society of Kerala.

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

Module 2

Kingdom Protista

7 hrs

Salient features and classification up to phyla

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

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

Pathogenic protista – Plasmodium, Entamoeba.

Core Readings

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

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)

Protista & Animal Diversity Academica Publications.

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

Module 3

Mesozoa – eg.Rhopalura (mention 5 salient features)

2 hrs

Parazoa

Phylum Porifera – egLeucosolenia

Phylum Placozoa –e g. Trycoplaxadherens.

Core Readings

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

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)

Protista & Animal Diversity Academica Publications.

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

Module 4

Phylum : Coelenterata

3hrs

Salient features, Classification up to classes

1. Hydrozoa – Physalia
2. Scyphozoa – Aurelia
3. Anthozoa – Adamsia

Corals and coral reefs.

Core Readings

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

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)

Protista & Animal Diversity Academica Publications.

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

Module 5

Phylum - Platyhelminthes

2 hrs

Salient features, classification upto classes

1. Turbellaria – Planaria
2. Trematoda – Fasciola
3. Cestoda – Taenia solium

Core Readings

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

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)

Protista & Animal Diversity Academica Publications.

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

Module 6

Phylum Nematoda

2 hrs

Salient features, classification up to classes

1. Phasmidia - Wuchereria
2. Aphasmidia – Trichinella

Module 7

Phylum - Annelida

2 hrs

Salient features, classification upto classes

1. Polychaeta, - Nereis
2. Oligochaeta – Earthworm – Pheretima
3. Hirudinomorpha – Hirudinaria

Core Readings

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

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)

Protista & Animal Diversity Academica Publications.

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

Module 8

Phylum Arthropoda

10 hrs

Salient features

Type - Prawn - Penaeus

Classification upto classes

Subphylum Chelicerata

Class 1. Merostoma – Limulus

2. Arachnida – Spider

3. Pycnogonida – Nymphon

Subphylum Mandibulata

Class 1. Crustacea – Daphnia

2. Chilopoda - Centepede

3. Symphyla - Scutigereilla

4. Diplopoda - Millipede

5. Pauropoda - Pauropus

6. Insecta - Butterfly

(Detailed account of examples are not necessary)

Phylum Onychophora – eg. Peripatus (Mention its affinities)

Insect pests

1. Pests of coconut – *Oryctes rhinoceros*,
Rhynchophorus ferrugineus, *Nephantisserinopa*, *Eriophid mite*
2. Pests of paddy – *Leptocorisa acuta*, *Spodoptera mauritius*
3. Pests of stored grains - *Trogoderma granarium*,
Tribolium castaneum, *Sitophilus oryzae*

Core Readings

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

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)

Protista & Animal Diversity Academica Publications.

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

Module: - 9

Phylum – Mollusca

3 hrs

Salient features and classification upto classes

1. Aplousobranchia – Neomenia
2. Monoplacophora – Neopalina
3. Bivalvia – Perna
4. Polyplacophora – Chiton
5. Gastropoda – Xancus
6. Cephalopoda – Sepia
7. Scaphopoda – Dentalium

Core Readings

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

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)

Protista & Animal Diversity Academica Publications.

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

Module 10

Phylum - Echinodermata

3 hrs

Salient features , classification upto classes

Class 1. Asterozoa – Astropecten

2. Ophiurozoa - Ophiothrix
3. Echinozoa – Echinus

4. Holothuroidea – Cucumaria

5. Crinoidea – Antedon

Core Readings

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

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)

Protista & Animal Diversity Academica Publications. Zoological Society of Kerala.

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

Module 11

Phylum Hemichordata

1 hr

Salient features eg: Balanoglossus

Core Readings

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

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)

Protista & Animal Diversity Academica Publications.

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

Selected Further Readings

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

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

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

EkamberanathaAyyar M. (1990) A Manual of Zoology, Volume I. Invertebrate Part I and Part
II S. Viswanathan Printers & Publishers Pvt. Ltd.

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

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

- James R.D. (1987). Invertebrate Zoology, W.B. Saunders, New York.
- Kapoor V.C. (1994). Theory and Practice of Animal Taxonomy.
- Kapoor, V.C. 1994. Theory and Practice of Animal Taxonomy (Oxford and IBH Publishing Co., New Delhi.)
- Kotpal R.L. Agarwal S.K. and R.P. Khetharpal (2002). Modern Text Book of Zoology.
- Parker T.J and Haswell W.A. (1962). Text Book of Zoology Vol. I. Invertebrate (ELBS & Macmillan, London).
- Marshall, A.J. and Williams, W.D. 1972. Text Book of Zoology Vol. Invertebrates (ELBS and Macmillan, London).
- Mayer, E. 1980. Principles of Systematic Zoology (Tata McGraw Hill Publishing Co., New Delhi.)
- Nair, K.K. Ananthakrishnan, T.N. David, B.V. 1976. General and Applied Entomology (T.M.H. New Delhi).

Practicals

19U2PCZOO1: ANIMAL DIVERSITY – NON CHORDATA

2 hr/week,
36 hrs
Credit – 1

CO	CO Statement	POs/PS Os	CL	KC	Class sessions
CO1	Application of scientific principles in drawing invertebrates	PO1 PSO4	A	P	8
CO2	Application of taxonomic principles in identification of invertebrates.	PO1,PO4 PSO4	A	P	5
CO3	Analyse Prawn Nervous system.	PO1 PSO4	An	P	6
CO4	Analyse Cockroach Nervous system.	PO1 PSO4	An	P	6
CO5	Analyse Prawn appendages	PO1 PSO4	An	P	4
CO6	Analyse mouthparts of cockroach.	PO1 PSO4	An	P	4
CO7	Application of histological principles in invertebrate systematics.	PO1 PSO4	A	P	3

1. Scientific drawing - 5 specimens
2. Simple identification – 25 invertebrates (Out of which 15 by their scientific names)
3. T.S - Earthworm, T.S Fasciola
4. Dissection - Prawn Nervous system
5. Dissection - Cockroach Nervous system
6. Mounting – Prawn Appendages
7. Mounting – Cockroach Mouth parts

SEMESTER II

19U2CPZ002 - ANIMAL DIVERSITY – CHORDATA

36 hrs
Credits 2

Course Code	19U2CPZ002
Title of the course	Animal Diversity - Chordata
Semester in which the course is to be taught	2
No. of credits	2
No. of contact hours	36

Objectives

1. To acquire knowledge on the taxonomic status of the various vertebrate animals and animal groups.
2. To familiarise the students with the diverse groups of organisms around us.
3. To develop an aptitude for understanding nature and its rich biodiversity.

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understand taxonomy of Phylum Chordata, sub phyla Urochordata and Cephalochordata their classes and specific examples.	PO1 PSO1	U	C	5
CO2	Understand the taxonomy and salient features of Sub phylum Vertebrata, divisions Agnatha and Gnathostomata, super class Pisces and its various classes with typical examples	PO1 PSO1	U	C	3
CO3	Understand the accessory respiratory organs in fish.	PO1 and PO4 PSO1	U	C	2
CO4	Understand the morphological aspects, structural and functional characteristics of frog.	PO1 PSO1	U	C	16
CO5	Understand salient features of class Reptilia, its various subclasses with examples, identifying poisonous and nonpoisonous snakes.	PO1 and PO4 PSO1	U	C	4
CO6	Understand Avian characteristics, its taxonomy and flight adaptations.	PO1 and PO4 PSO1	U	C	3
CO7	Understand the general characteristics of Class Mammalia and its classification.	PO1 PSO1	U	C	2
CO8	Understand adaptations in aquatic mammals.	PO1 and PO4 PSO1	U	C	1

Module I

7hrs

Phylum Chordata

General characters of the Phylum Chordata

Classification upto classes

Sub phylum I Urochordata

General characters

Class 1 Larvaceaeg . Oikopleura

2. Ascidiaceaeg. Ascidia

3. Thaliaceaeg.Salpa

Subphylum II Cephalochordata

General characters eg.Brachiostoma

Subphylum III Vertebrata

General characters

Division I Agnatha

General characters

Class 1 Cyclostomataeg.Petromyzon

Class 2 Ostracodermieg.Cephalapis

Division 2 Gnathostomata

General characters

Super class Pisces and Super class Tetrapoda

Core Readings

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

EkamberanathaAyyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.

Young J.Z. 1981. The life of Vertebrates (Oxford University Press).

Module II

3 hrs

Super class Pisces

General characters

Class 1. Chondrichthyes eg.Narcine

Class 2. Osteichthyes eg.Latimeria

Accessory respiratory organs in fishes.

Core Readings

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

EkamberanathaAyyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.

Young J.Z. 1981. The life of Vertebrate s (Oxford University Press).

Module III

16 hrs

Super Class Tetrapoda

General characters

Class : Amphibia General characters

Type : *Rana hexadactyla*

Order I. Urodelaeg.Amblystoma

II. Anuraeg.Bufo

III . Apodaeg.Icthyophis

Core Readings

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

EkamberanathaAyyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.

Young J.Z. 1981. The life of Vertebrates (Oxford University Press).

Module IV Class Reptilia

4 hrs

General characters

Sub class I: Anapsida Eg. Chelone

Sub class II Diapsida Eg. Chameleon

Subclass III Parapsidaeg. Ichthyosaurus

Poisonous and non-poisonous snakes of India

Core Readings

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

EkamberanathaAyyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.

Young J.Z. 1981. The life of Vertebrates (Oxford University Press).

Module V Class Aves

3 hrs

General characters

Sub class I : Archeornithes Eg: Archaeopteryx

Sub class II. Neornithes Eg: Struthio

Flight adaptations of birds

Core Readings

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

EkamberanathaAyyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.

Young J.Z. 1981. The life of Vertebrates (Oxford University Press).

Module VI Class – Mammalia

3 hrs

General characters

Sub class I Prototheria eg. Echidna

Sub Class II Metatheria eg. Macropus

Sub class III Eutheriaeg. Elephas

Aquatic mammals

Core Readings

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

EkamberanathaAyyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.

Young J.Z. 1981. The life of Vertebrate s (Oxford University Press).

Selected Further Readings

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

EkamberanathaAyyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.

Groove, A.J. and Newell, G.E. 1974. Animal Biology - Indian Reprint Universal Book Stall, New Delhi.

Induchoodan, 1986, KweralthilePakshikal (Kerala Sahitya Academy, Trichur).

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

Lagler, K.F. , Bardach, J.E. , Miller, R.R. Passino, D.R.M. 1977 Ichthyology (John Wiley and Sons).

Mayer, E. 1980. Principles of Systematic Zoology (Tata McGraw Hill Publishing Co. New Delhi.

- Newman, H.H. 1939. Phylum Chordata, (Macmillan Pub. Co. New York)
- Nigam H.C. 1978 , Zoology of Chordata (S. Chand and Co. New Delhi).
- Parker, T.J. and Haswell W.A. 1962. Text Book of Zoology Vol. II Vertebrates (ELBS and Macmillan , London).
- Parter S.H. 1971. The Book of Indian Animals (Bombay Natural History Society).
- Salim Ali, 1969. Birds of Kerala (Oxford University Press).
- Sinha A.K. , Adhikari S. Ganguly, B.B. 1988. Biology of Animals Vol. II (New Central Book Agency, Calcutta.)
- Whitaker, R. 1978 Common Indian Snakes – A field Guide Macmillan and Co. of India Ltd.)
- Young J.Z. 1981. The life of Vertebrates (Oxford University Press).
- Young J.Z. Life of mammals) Oxford University Press).

Practicals

19U2PCZOO1 - ANIMAL DIVERSITY – CHORDATA

2 hrs/week

36 hrs

1. Morphology

Scientific drawing – 5 specimens of chordates

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Apply taxonomic principles and identify animals belonging to various phyla and classes by their scientific names	PO1 PSO4	U	C	5
CO2	Apply scientific principles and draw vertebrate specimens belonging to different classes	PO1 PSO4	A	P	10
CO3	Analyse the viscera, digestive system, arterial system, sciatic plexus and brain of frog	PO1 and PO4 PSO4	U	C	5
CO4	Analyse placoid scales in fish.	PO1 PSO4	A	P	5
CO5	Analyse and examine the vertebrae and girdles of frog	PO1 and PO4 PSO4	A	C	5
CO6	Apply taxonomic principles to identify snakes	PO1 and PO4 PSO4	A	P	6

2. Simple identification of 10 chordates (Out of which 5 by their scientific names)

3. Osteology – Vertebrae and girdles of Frog

4. Snake identification - 3 poisonous and
3 non poisonous with key

5. Mounting of placoid scales of shark

6. Dissections:

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

1. Frog – Viscera
2. Frog – Digestive System
3. Frog – Arterial System
4. Frog – Sciatic plexus
5. Frog – Brain

SEMESTER III

19U3CPZOO3- HUMAN PHYSIOLOGY AND IMMUNOLOGY

3 hrs/week

54 hrs

Credits 3

Course Code	19U3CPZOO3
Title of the course	Human Physiology and Immunology
Semester in which the course is to be taught	3
No. of credits	3
No. of contact hours	54

Objectives

- To inspire the students in learning the frontier areas of biological sciences
- To appreciate the correlation between structure and function of organisms
- To make them aware of the health related problems, their origin and treatment.

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understand nutrition and deficiency disorders	PO1 PSO3	U	C	3
CO2	Understand the functional aspects of respiration and respiratory disorders	PO1 PSO3	U	C	5
CO3	Understand functional aspects of cardiovascular circulation, disorders and clinical aspects.	PO1 PSO3	U	C	7

C04	Understand structure and function of human nitrogenous excretory organ and renal disorders.	PO1 PSO3	U	C	6
C05	Understand structural and functional features of neuromuscular system and its disorders.	PO1 PSO3	U	C	10
C06	Understand functional characteristics of hormonal glands and its disorders.	PO1 PSO3	U	C	5
C07	Understand the basics of immunology, antigens and antibodies, antigen antibody reactions and its clinical applications.	PO1 PSO3	U	C	13
C08	Understand the applications, new developments and recent trends in immune research.	PO1 PSO3	U	C	5

Part I HUMAN PHYSIOLOGY

36 hrs

Module 1 : Nutrition

3 hrs

Malnutrition disorders, Vitamin deficiencies, and mineral deficiencies (Iron, Calcium and Iodine)

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.718-833

Prosser & Brown 2006 : Comparative Animal Physiology

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Module 2: Respiration

5 hrs

Transport of O₂ and CO₂ in blood, respiratory disorders – Dyspnoea, Hypoxia, Asphyxia, Hypo and Hypercapnia, CO poisoning, smoking and its physiological effects.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp432-509 Zoological

Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Module 3: Circulation

7 hrs

Blood – Composition and function, Brief account of mechanism of blood clotting; Disorders of blood clotting – Haemophilia, cerebral and pulmonary thrombosis, Cerebral haemorrhage, Blood pressure and factors controlling it; electrocardiogram, Cardiovascular disorders – Arteriosclerosis, Myocardial infraction, Angiogram and Angioplasty.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.144-262, 382-429, 711-715.

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Module 4 Excretion

6 hrs

Structure of human nephron, composition of urine – normal and abnormal constituents, urine formation (ultra filtration , selective reabsorption, tubular secretion and counter current mechanism); Hormonal control of renal function, Kidney disorders – myelonephritis, glomerular nephritis, nephrotic syndrome, Dialysis

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.264-379

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Module 5 Neurophysiology

6 hrs

Structure of typical neuron, myelinated and non myelinated nerve fibres; Nerve impulse – initiation and propagation of nerve impulse, All or none law, Saltatory conduction, Synaptic transmission, Neurotransmitters, Brain waves, Electroencephalogram, Neural disorders – Parkinson's disease, Epilepsy,

Alzheimer's syndrome, Dyslexia.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.512-715

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Module 6 Muscle Physiology

4 hrs

Striated, Non striated and Cardiac muscle, Ultra structure of striated muscle fibre, Mechanism of muscle contraction, Threshold and spike potential, Fatigue, O₂ debt, Rigor mortis.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.52-86

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Module 7 Endocrinology

5 hrs

Endocrine glands and their hormones, mode of action (in brief) , Hypothalamus, Pituitary , Thyroid, Parathyroid, Thymus , Islets of Langerhans, Adrenal, Testis and ovary , Hormonal disorders.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.836-966

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Part II IMMUNOLOGY

18 hrs

Module 8

3 hrs

Introduction to immunology

Types of immunity, innate immunity , acquired, passive , active

Mechanism of innate immunity (eg. Barriers , phagocytosis , inflammation)

Complement System, biological effects of complements.

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 1

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Module 9

5 hrs

Antigens and antibodies

Types of antigens , haptens, antigenic determinants.

Basic structure of immunoglobulins , Different classes of immunoglobulins and functions.

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 4

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Module 10

5 hrs

Antigen antibody reactions

Precipitation test, agglutination test ,

Clinical applications of antigen antibody reaction, Widal, VDRL, HIV test (ELISA), Complement Fixation Test, and Coombs test.

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material; Zoological Society of Kerala

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Module 11

5 hrs

(Brief accounts of the followings)

Immune response system

Primary and secondary lymphoid organs,

Cells of Immune system – Leucocytes, lymphocytes, T&B cells, Macrophages, Plasma cells , Memory cells, MHC, Antibody synthesis, Monoclonal antibodies, Hybridoma technology

Immune disorders – hypersensitivity, Auto immunity & Immunodeficiency, AIDS,

Vaccines - Major types of vaccines (BCG, DPT, Polio vaccine and TAB vaccines). Recent trends in vaccine preparation.

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 10.

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Sobha& Sharma (2008) *Essentials of Modern Biology One's Student edition* PP 463-468.

Selected Further Readings

Anthanarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd.

Colemen: Fundamentals of Immunology

Guyton, Medical Physiology

Ivan Roitt: *Essentials of Immunology ELBS*.

Madhavankutty, Medical Physiology

Mahupathra, Human Physiology, Current Books

Michael J. PelczarECS,Chan& Noel. R. Kreig, Microbiology, Tata McGraw Hill 5th ed.
1996.

Michael J. Gibuay, Ian A. Macdonald and Helen M. Roche, Nutrition and Metabolism.

Monica Cheesbrough: Laboratory Manual for Tropical Countries. Vol.II Microbiology,
ELBS – Cambridge Ed. 1986.

Paniker S., Francis G. and Abraham G.K 2008, Microbiology and Immunology, Study
Material Series published by Zoological Society of Kerala.

Park, K. Park's Text Book of Preventive and Social Medicine – 2002, 17th Ed.
BanarasidassBhenot Publications

Prosser and Brown, Comparative Animal Physiology

Sebastian Prof. M.M., Animal Physiology

William S Hoar, Animal Physiology.

Practicals

19U4PCZOO2: HUMAN PHYSIOLOGY AND IMMUNOLOGY

2Hrs/Week

36Hrs

Credit 1

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Analyse human blood cell configuration	PO1 PSO4	An	P	8
CO2	Analyse chemical nature of biological fluids.	PO1 PSO4	An	P	8
CO3	Application of role of salivary amylase on starch	PO1 PSO4	A	P	6
CO4	Analysis of haemoglobin content in human blood.	PO1 PSO4	An	P	6
CO5	Analyse different types of blood groups and Rh factor	PO1 PSO4	An	P	4
CO6	Application of Sphygmomanometer and stethoscope.	PO1 PSO4	A	P	4

- 1 Preparation of Human Blood smear & identification of leucocytes
- 2 Qualitative analysis of Reducing Sugar, Protein and Lipid
- 3 Action of Salivary amylase on Starch (Demonstration Only)

- 4 Estimation of Haemoglobin (Demonstration only)
- 5 Identification of human blood groups, A, AB, B and O, Rh factor
- 6 Instruments (Principle & use)– Sphygmomanometer , Stethoscope ,
Measurement of blood pressure using Sphygmomanometer (demonstration)

SEMESTER IV

19U4CPZ004 - APPLIED ZOOLOGY

3hrs/week

54 hrs

Credits 3

Course Code	19U4CPZ004
Title of the course	Applied Zoology (Aquaculture, Sericulture, Vermiculture, Apiculture)
Semester in which the course is to be taught	4
No. of credits	3
No. of contact hours	54

OBJECTIVES

Equip the students interested in the applied branches of zoology with skills and knowledge which can lead to self employment opportunities.

CO	CO Statement	POs/PSOs	CL	KC	Class sessions

CO1	Application of aquaculture management practices for developing entrepreneurial skills.	PSO2	A	P	10
CO2	Application of aquarium fish management practices for developing entrepreneurial skills.	PSO2	A	P	10
CO3	Application of sericulture management practices for developing entrepreneurial skills.	PSO2	A	P	12
CO4	Application of apiculture management practices for developing entrepreneurial skills.	PSO2	A	P	6
CO5	Application of vermiculture management practices for developing entrepreneurial skills.	PSO2	A	P	12
CO6	Application of pearl culture management practices for developing entrepreneurial skills.	PSO2	A	P	4

Module 1: Aquaculture

24 hrs

Traditional methods of aquaculture, Advantages and salient features of aquaculture, Types of aquaculture, Biotic and abiotic factors of water, Importance of Alga in aquaculture, Common Cultivable fishes of Kerala
Economic importance and morphology of culturable species *Catla*, *Rohu*, *Mrigal*, *Cyprinus carpio*, *Etropolis*, & *Tilapia* .

Penaeus indicus, *P. monodon*, *Pernaviridis*/*Perna indicus*, *Pinctada fucata*.

Pond culture (Construction and maintenance) Brief Description of Carp culture
Composite fish culture. Integrated Fish Culture, Induced breeding in fishes,
Important Fish Diseases. Fish preservation and processing

Aquarium management, Setting up of an Aquarium, Biological filter and

Aeration . Common species of Aquarium fishes.

Prawn culture, Mussel culture , Pearl culture

Core Readings:

Applied Zoology; (2002) Published by Zoological Society Of Kerala

Module 2 Sericulture

12 hrs

Four species of silkworms, Life history of silkworms, Silkworm Rearing Techniques. Diseases and Pests of silkworms. Mounting of worms. Harvesting and stiffling of cocoons. Silkworm diseases. Preventive and control measures.

Core Readings:

Applied Zoology; (2002) Published by Zoological Society Of Kerala

Sudheeran, M.S. & John P.C., 1989 Economic Zoology (Prathibha Publ., Kottayam)

Module 3 Vermiculture

6 hrs

Species of Earthworms suitable for vermiculture. Reproduction and Life Cycle . Physical and Chemical effects of Vermiculture, Vermicomposting, Site Selection, Cement pit Soil pit . Preparation of pit. Maintenance and Monitoring

Core Readings:

Applied Zoology; (2002) Published by Zoological Society Of Kerala

Venkitaraman, P.R., 1983, Text Book of Economic Zoology (Sudarsana Publ. Cochin)

Module 4 Apiculture

12 hrs

Species of Honey bees. Organization of honeybee colony. Bee keeping methods and equipments Apiary management and maintenance. Bee pasturage, Byproducts of honey bees and their uses. Diseases and pests of honey bees, control measures.

Core Readings:

Applied Zoology; (2002) Published by Zoological Society Of Kerala

Shukla G.S., & Updhyay V.B., Economic Zoology (Rastogi Publ. Meerut)

Selected Further Readings

Alikunhi, K.h., Fish Cluture in India (ICAR, New Delhi)

Bhosh, C.C., 1949, Silk Production and Weaving in India (CSIR), New Delhi) Director.
Zoological Survey of India, 1994, earthworms Resources and Vermiculture

Edwards, C.A. & Lafty, J.R. 1972 Biology of Earthworms (Chapman and Hall Led. London)

Jhingran, V.G., 1985 Fish and Fisheries of India (Hindustan Publ. Corporation, New Delhi)

Kurien, C.V. & Sebastian V.C., Prawn Fisheries in India (Hindustan Publ. Corporation, New Delhi)

Krishnaswami, S., 1986 Improved Method of Rearing Young age Silk worms (Central Silk board Bangalore)

Krishnaswami, S., 1986, New Technology of Silkworm Rearing (Central Silk Board Bangalore)

Lee, K. E., 1985 Earthworms, Their Ecology and relationships with Soils and Land use. Academics Press.

Menon, K.N., 1970 Malsyakrishi (State Institute of language, Trivandrum)

Mysore Silk Association, 1986, Silkworm rearing and Diseases of Silkworms

PadmanabhaAiyer, K.S., 1992, Records of the Indian Museum Vol. XXXI, Part I, PP. 13-76
An Account of the Oligochacta of the Travancore

Shiggene, K., 1969, Problems in Prawn Culture (American publ. Co., New Delhi)

Shukla G.S., & Updhyay V.B., Economic Zoology (Rastogi Publ. Meerut)

Andhra Pradesh Agricultural University, Hydrabad)

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

Singh, S., 1962 Bee keeping in India (ICAR, New Delhi)

Singh, V.P.P. and Ramachandran, V., 1985 Freshwater Fish Culture (ICAR, New Delhi)

Sudheeran, M.S. & John P.C., 1989 Economic Zoology (Prathibha Publ., Kottayam)

Ullal, S. R. and Narasimahanna, M.N., Handbook of Practical Sericulture (Central Silk Board Bombay.)

Venkitaraman, P.R., 1983, Text Book of Economic Zoology (Sudarsana Publ. Cochin)

Practicals

19U4PCZ002 -APPLIED ZOOLOGY

2 hrs/week

1 credit

36 hrs

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Analyse, identify and examine the culturable species of fishes	PO1, PO4 PSO4	E	P	6
CO2	Analyse, identify and examine culturable species of earthworms, castes of honey bees and silkworm	PO1, PO4 PSO4	E	P	6
CO3	Analyse the bee keeping equipments and chandrike and develop entrepreneurial skills	PO1, PO4 PSO4	E	P	6
CO4	Examine the products and by-products of apiculture, sericulture and vermicomposting	PO1 PSO4	E	P	6
CO5	Analyse and study the different types of fish diseases and fish parasites	PO1, PO4 PSO4	E	P	6
CO6	Analysis of the gut content of fish and determine its feeding habits	PO1 PSO4	E	P	6
CO7	Hands on training in maintenance of aquarium, aquaculture farms, apiary, sericulture, poultry farms	PO1 PO2, PO4 PSO4	E	P	1 week

1. General Identification, Economic importance, Morphology, scientific names and common names of the following
 - a. Economic importance and morphology of culturable species
(Catla, Rohu, Mrigal, Grass carp, Common carp, , Etroplus, Tilapia, *Penaeus indicus*, *P.monodon*, *Pernaviridis*/*P.indicus*, *Pinctadafucata*)
 - b. 2 species of earthworms used in Vermiculture
 - c. Two species of honey bees
 - d. Silkworm. Cocoon/Adult
2. Castes of bees
3. Bee keeping equipments Beehive, Smoker, honey extractor
4. Beeswax, Honey, Silk, Vermicompost (Identification-Uses)
5. Chandrika /Natrika used in sericulture
6. Fish diseases (any 2 diagrams/specimens)
7. Fish Parasite (any one)

SYLLABUS OF ZOOLOGY OPEN COURSE FOR OTHER STREAMS

SEMESTER V

19U50CZ0001: HUMAN GENETICS, NUTRITION, COMMUNITY HEALTH AND SANITATION

72 hrs

4hrs/Week

Credits 3

Course Code	15U50CZ001
Title of the course	Human Genetics, Nutrition, Community Health and Sanitation
Semester in which the course is to be taught	5
No. of credits	3
No. of contact hours	72

Objectives of the Course

- To develop critical thinking skill and research aptitude among students, by introducing the frontier areas of the biological science.
- To emphasize the central role that biological sciences plays in the life of all organisms.

To introduce the student to some of the present and future applications of bio-sciences

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understand the basic principles of human genetics, the disorders associated with it and awareness on pre natal diagnosis	PO1 PSO3	U	c	9

CO2	Understand the genetic principle of blood group inheritance, importance of blood donation, causes of infertility, DNA fingerprinting and its applications	PO5 PSO3	U	c	9
CO3	Understand psychoneuroimmunology of physical activity, exercise, yoga and programmes related to community health promotion	PO5 PSO3	U	c	8
CO4	Understand the importance of balanced diet, and awareness on nutritional disorders	PO1 PSO3	U	c	5
CO5	Understand the principles of accident prevention and first aid	PO5 PSO3	U	c	5
CO6	Understand the pathology of water borne diseases and their prevention; waste water and solid waste management	PO4 PSO3	U	c	12
CO7	Understand the microbiology of food borne diseases and their prevention	PO4 PSO3	U	c	12
CO8	Understand the pathology and control measures of emerging diseases, vector borne and life style diseases	PO4 PSO3	U	c	12

PART I HUMAN GENETICS

18 hrs

Module I Human normal chromosome complement. Genetic disorders in man. **9 hrs**
 Chromosomal anomalies. Eg. Down Syndrome and Cri-du chat syndrome. Sex chromosomal anomalies – Syndromes- Klinefelters Syndrome and Turners Syndrome. Pre – natal Diagnosis (Amniocentesis, and Chorionic Villus Sampling) Ultra sound scanning and Fetoscopy Genetic Counselling. Eugenics and Euthenics.

Core Readings

Zoological Society of Kerala Study Material Series 2002– Cell biology
 Genetics & Biotechnology published by Zoological Society of Kerala.

Module II	<p>Human blood groups and their inheritance pattern. Rh factor Blood transfusion – Universal Donor, Universal recipient – Importance of Blood donation.</p> <p>DNA finger printing and applications – Probing for criminals – Method to resolve paternity and maternity disputes.</p> <p>Causes of human infertility – a brief account. Human genome project – a brief account.</p> <p>Core Readings</p> <p>Zoological Society of Kerala Study Material Series 2002– Cell biology Genetics & Biotechnology published by Zoological Society of Kerala.</p>	9 hrs
PART – II	NUTRITION AND COMMUNITY HEALTH	15 hrs
Module III	<p>Health and Nutrition</p> <p>Definition and Meaning of Health, Dimensions and Determination of Health</p> <p>Concept of Food and Nutrition, Food Stuffs – Carbohydrates, Proteins, Lipids - their sources and importance.</p> <p>Vitamins - their sources and importance, Deficiency Disease</p> <p>Minerals – their role in body functions, resources</p> <p>Importance of water and roughage in diet</p> <p>Concept of Balanced diet, Malnutrition and associated problems</p> <p>Determination of Caloric intake and expenditure, Body Mass Index (BMI) and its importance, Lifestyle diseases - Obesity, causes and preventing measures, Diabetese, Cardiovascular disorders - Prevention and Management.</p> <p>Core Readings</p> <p>K Park, (2008) Park’s Text Book of Preventive and Social Medicine 18th Edition. BanarasidassBhenot Publication.</p> <p>Tom Sanders and Peter Emery. (2004) Molecular basis of human nutrition: Taylor & Francis Publishers Ane Book.</p>	10 hrs
Module IV	<p>Physical Activity and Health benefits</p> <p>Physical activity, Effect of exercise on body systems – Circulatory, Respiratory, Endocrine, Skeletal and Muscular</p>	5 hrs

Health and Safety in daily life, Principles of Accident prevention, Common injuries and their management, First aid and emergency care.

Emotional adjustment and well being, Psychoneuroimmunology.

Core Readings

Norman Bezzaant HELP First Aid for everyday emergencies. Jaico Publishing House, Bombay, Delhi.

Fashey , Tomas D, Insel , Paul M and Roth Walt (2005) Fit and Well. New York; Mc Graw Hill Inc

Rai. B.C. Health Education and Hygiene. Published by Prakashan Kendra, Lucknow

PART III COMMUNITY HEALTH AND SANITATION

39 hrs

Module V	Public health and water quality. Prevention of Water borne diseases. Potable water quality monitoring and waste water management. Faecalbacteriae and pathogenic microorganisms transmitted by water. Cholera and Typhoid. Determination of sanitary quality of drinking water, water purification techniques.	12 hrs
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Core Readings

Pelczar M.J. Jr. E.C.S. Chane& N.R. Krieg, Microbiology (Concept & Applications). 5th edition. Tata McGraw Publishing Company Ltd.

Monica Cheesbrough, Laboratory Manual for Tropical Counties Vol.II LBS.

Module VI	Public Health and Food borne diseases and their prevention	12 hrs
	Food poisoning caused by toxins produced by microbes eg Staphylococcal food poisoning, Botulism, Salmonellosis	
	Food infection caused by growth of microorganisms in the human body after the contaminated food has been eaten. Eg Food Infection hepatitis	

(hepatitis A)

Core Readings

Pelczar M.J. Jr. E.C.S. Chane & N.R. Krieg, Microbiology (Concept & Applications). 5th edition. Tata McGraw Publishing Company Ltd.

Panicker S, Franis G And Abraham g. (2008) Microbiology & Immunology. Zoological Society Study Material Series. Published by Zoological Society of Kerala.

Module VII Public health and diseases (a) Emerging pathogens and diseases – **12 hrs**
Swine flue (H1N1), bird flue (H5N1), Reemerging pathogens and diseases – TB

(b) Vector borne diseases (mosquito) and their control measures (Malaria, Filariasis, Chikungunya and Dengu fever)

(c) Leptospirosis and preventive measures – Rodent control measures

(d) Cancer different types, causes of cancer, carcinogens, diet & cancer

(e) HIV, AIDS – causes & preventive measures

Core Readings

Zoological Society of Kerala Study Material Series 2002– Cell biology Genetics & Biotechnology published by Zoological Society of Kerala.

K Park, (2008) Park's Text Book of Preventive and Social Medicine

BanarasidassBhenot Publication.

Community Health Promotion – Definition of community Health, Importance of community Health, Programmes on Community health promotion (Individual, Family and Society), Dangers of alcoholism and drug abuse, medico-legal implications.

Module VIII **3 hrs**

Core Readings

K Park, (2008) Park's Text Book of Preventive and Social Medicine

BanarasidassBhenot Publication.