

**MAR IVANIOS COLLEGE**  
**THIRUVANANTHAPURAM**  
**(Autonomous)**



**Affiliated to**  
**UNIVERSITY OF KERALA**  
**THIRUVANANTHAPURAM**  
**KERALA**

**SYLLABUS FOR FIRST DEGREE**  
**PROGRAMME IN ZOOLOGY**

**Choice Based Credit and Semester System**

*(With effect from 2021 Admission)*

**CORE COURSES, FOUNDATION COURSE II  
&  
OPEN COURSES**

## First Degree Programme in Zoology

**Table I. Scheme of Instruction and Evaluation**

Seme ster	Course Code	Study Component	Instructional hrs/week		Credit	Duration of ESE	Evaluation		Total Credit
			T	P			CE	ESE	
<b>I</b>	AUEN 111.2	English I-Listening & Speaking Skills	5		4	3hrs	20%	80%	<b>16</b>
	AUFR 111.2 AUHN 111.2 AUML 111.2 AUSY 111.2 AUTM 111.2	Additional Language I	4		3	3hrs	20%	80%	
	AUEN 121.2	Foundation Course I-Writings on Contemporary Issues	4		2	3hrs	20%	80%	
	AUCH131.2e	Complementary Course I Chemistry	2		2	3hrs	20%	80%	
		Complementary Course I Practical		2	--	--	--	--	
	AUBO 131.2e	Complementary Course II Botany	2		2	3hrs	20%	80%	
		Complementary Course II Practical		2	--	--	--	--	
	AUZO 141	Core Course I	3		3	3hrs	20%	80%	
		Core Course Practical I		1					
<b>II</b>	AUEN 211.2	English II-Reading Skills	4		3	3hrs	20%	80%	<b>17</b>
	AUEN 212.2	English III-Modern English Grammer & Usage	5		4	3hrs	20%	80%	
	AUFR 211.2 AUHN 211.2 AUML 211.2 AUSY 211.2 AUTM 211.2	Additional Language II	4		3	3hrs	20%	80%	
	AUZO 241	Core Course II	3	1	3	3hrs	20%	80%	
	AUCH231.2e	Complementary Course III	2		2	3hrs	20%	80%	
		Complementary Course III Practical		2					
	AUBO231.2e	Complementary Course IV	2		2	3hrs	20%	80%	
		Complementary Course IV Practical		2					

Semester	Course Code	Study component	Instructional Hours/week		Credit	Duration of ESE	Evaluation		Total Credits
			T	P			CE	ESE	
III	AUEN 311.2	English IV	5		4	3hrs	20%	80%	22
	AUFR 311.2 AUHN 311.2 AUML311.2 AUSY 311.2 AUTM311.2	Additional Language III	5			4	3hrs	20%	
	AUCH 331.2e	Complementary Course V	3		3	3hrs	20%	80%	
		Complementary Course V Practical		2					
	AUBO331.2e	Complementary Course VI	3		3	3hrs	20%	80%	
		Complementary Course VI Practical		2					
	AUZO 321	Foundation Course II	3		3	3hrs	20%	80%	
		Foundation Course II Practical		2					
IV	AUEN 411.2	English V	5		4	3hrs	20%	80%	23
	AUFR 411.2 AUHN 411.2 AUML 411.2 AUSY 411.2 AUTM411.2	Additional Language IV	5		4	3hrs	20%	80%	
	AUCH 431.2e	Complementary Course VII	3		3	3hrs	20%	80%	
	AUCH43.2ePI	Complementary Course Practical		2	4	3hrs	20%	80%	
	AUBO 431.2e	Complementary Course VIII	3		3	3hrs	20%	80%	
	AUBO 43.2e PI	Complementary Course Practical		2	4	3hrs	20%	80%	
	AUZO 441	Core Course III	3		3	3hrs	20%	80%	
	AUZO4PI	Core Course-practical I of Core I, Core II and Foundation II		2	3	3hrs	20%	80%	

Semester	Course Code	Study component	Instructional Hours/week		Credit	Duration of ESE	Evaluation		Total credits
			T	P			CE	ESE	
V					4	3hrs	20%	80%	22
	AUZO541	Core Course V	5		4	3hrs	20%	80%	

	AUZO542	Core Course VI	4		4	3hrs	20%	80%	
	AUZO543	Core Course VII	4		4	3hrs	20%	80%	
	AUZO54 PII	Core Course VIII Practical II		5	4	3hrs	20%	80%	
	AUZO581b	Open Course	3		2	3hrs	20%	80%	
		Project		3	--				
		Field Study		1	--				
<b>VI</b>	AUZO641	Core Course IX	5		4	3hrs	20%	80%	<b>23</b>
	AUZO642	Core Course X	4		4	3hrs	20%	80%	
	AUZO643	Core Course XI	4		3	3hrs	20%	80%	
	AUZO64 PIII	Core Course XII Practical III		3	3	3hrs	20%	80%	
	AUZO64 PIV	Core Course XIII Practical IV		3	3	3hrs	20%	80%	
	AUZO691.a	Elective Course	3		2	3hrs	20%	80%	
	AUZO644	Project and Field Study		3	4	Viva voce	--	100%	

**T-Theory, P -Practical, CE-Continuous Evaluation, ESE-End Semester Evaluation**

## First Degree Programme in Zoology

**Table II. Scheme of Instruction of Core Courses, Foundation Course II and Open Courses**

Course number	Course Code	Course Title	Semester I		Semester II		Semester III		Semester IV		Semester V		Semester VI		Total			
			Contact Hours	Credit	Contact Hours	Credit	Contact Hours	Credit	Contact Hours	Credit	Contact Hours	Credit	Contact Hours	Credit	Contact Hours	Credit	Contact Hours	Credit
			T	P	T	P	T	P	T	P	T	P	T	P	T	P		
C.C. I	AUZO 141	Animal Diversity I	3	3												3	3	
C.C. II	AUZO 241	Animal Diversity II			3	1	3									4	3	
F.C. II	AUZO 321	Methodology, Perspectives of Science and Bioinformatics					3	3								3	3	
C.C. III	AUZO 441	Ecology, Toxicology and Disaster management							3	3						3	3	
C.C. IV	AUZO 44 PI	Practical I of CC I, C C II and F.C II		1				2		2			4			5	4	
C.C. V	AUZO 541	Cell and Molecular Biology									5	4				5	4	
C.C. VI	AUZO 542	Genetics and Biotechnology									4	4				4	4	
C.C. VII	AUZO 543	Immunology & Microbiology									4	4				4	4	
C.C. VIII	AUZO 54 PII	Practical II of CC V, C C VI and C.C VII										5	4			5	4	
O.C. I	AUZO 581.b	Human Health and Sex education (Offered to other disciplines)									3	2				3	2	
C.C. IX	AUZO 641	Human Anatomy, Physiology and Biochemistry											5	4	5	4	4	
C.C. X	AUZO 642	Developmental Biology & Experimental Embryology											4	4	4	4	4	

C.C. XI	AUZO 643	Evolution, Ethology, Zoogeography and Pest management																		4		3	4	3		
C.C. XII	AUZO 64PIII	Practical III of C.C IX																				3	3	3	3	
C.C. XIII	AUZO 64PIV	Practical IV of C.C.III and CC XI																				3	3	3	3	
E.C. II	AUZO69 1.a	Economic Zoology;vermiculture and apiculture																			3		2	3	2	
C.C.XIV	AUZO644	Project																			3		3		7	4
		Field study																				1				

**C.C. - Core Course, F.C.-Foundation Course, O.P.-Open Course, T -Theory,  
E.C.-Elective Course  
P- Practical**

## **First Degree Programme**

### **Semester V**

#### **Zoology Open Course**

**Offered to students of other disciplines**

**Table III. Scheme of Instruction of Open Course**

<b>Semester</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Instructional hours/week</b>	<b>Credits</b>
V	AUZO581.a	Public Health and Hygiene	3	2
	AUZO581.b	Human Health and Sex education		
	AUZO581.c	Human diseases and their management		

## **First Degree Programme in Zoology**

### **Semester VI**

#### **Zoology Elective course**

**Offered to students of Zoology Programme**

**Table IV. Scheme of Instruction of Elective course**

<b>Semester</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Instructional hours/week</b>	<b>Credits</b>
VI	AUZO691.a	Economic Zoology: Vermiculture and Apiculture	3	2
	AUZO691.b	Ornamental Fish Production and Management.		
	AUZO691.c	Dairy farming and Broiler farming		



## First Degree Programme in Zoology

Table V. Scheme of question paper – Theory Courses

Type of Questions	Question No.	No. of questions to be answered	Marks
I. Objective	1 - 10	10 out of 10	1 x 10 = 10
II. Short Answer	11 - 25	10 out of 15	2 x 10 = 20
III. Short Essay	26 - 34	6 out of 9	5 x 6 = 30
IV. Long Essay	35 - 38	2 out of 4	10 x 2 = 20
<b>Total</b>			<b>80</b>

## First Degree Programme in Zoology

Table VI. Scheme of question paper - Practical

Type of Questions	Marks
I. Major Practical	25
II. Minor Practical I	10
III. Minor Practical II	10
IV. Spotters	15
V. Record	20
<b>Total</b>	<b>80</b>

## **First Degree Programme in Zoology**

### **Choice Based Credit and Semester system**

*(With effect from 2021 admission)*

#### **Scheme of Instruction**

First Degree Programme in Zoology is under Choice Based Credit and Semester system (CBCS). The duration of the Programme is three years consisting of six semesters. The duration of each semester is five months (18 weeks) inclusive of the days of examinations. There will be 90 working days and a minimum of 450 hours of instruction in a semester. An academic year will have two semesters. Odd semesters are from June to October and even semesters from November to March and two months semester break in April and May. The total number of credits of the Programme is 120. The total number of courses is 37.

The language courses are distributed over the first four semesters. Foundation course I (English) is in the first semester and Foundation course II in the third semester.

Core courses - Zoology courses – are offered in all the semesters except in the third semester. Hours for Project are distributed over the fifth and sixth semesters and that for the Field study on fifth semester. Students of First Degree Programme in Zoology can choose Open course offered by any department other than Zoology in the fifth semester while Elective course, offered by the Department of Zoology is in the sixth semester. Complementary courses on allied subjects are in the first four semesters.

The scheme of Instruction and Evaluation of study components of First Degree Programme in Zoology is given in the Table I.

Course number, Course Code, Course title and scheme of instruction of Core Courses, Foundation Courses, Open Courses and Project is given in Table II.

## **Foundation course II (Course Code: AUZO321)**

Foundation Course II – Methodology, Perspectives of Science and Bioinformatics - is in the third semester. It has 72 instructional hours. 54 hours are for theory (3hours/ week) and 18 hours for practical (1hour/ week). Credit is 3. (No ESE for the practical).

**Core Courses:** Core courses are offered by the parent department. The total number of core courses is fourteen- nine theory courses, four practical courses and one Project and Field Study Course. The Core Course I (Course Code: AUZO141) is prescribed for the first semester and Core Course II (Course code:AUZO241) for fourth semester are theory courses, each having 54 hours of instruction (3 hours/ week) and 3 credits. The Core Course IV (Course Code: AUZO44PI) is Practical I of theory courses AUZO141, AUZO241 and AUZO341. The practical hours are distributed one in the first and two each in the third and fourth semesters. Total credits allotted for Practical I is 4.ESE of Practical I is at the end of IV semester. Core Course V (Course Code: AUZO541) of fifth semester has 90 hours (5hours/ week) and 4credits. Core Course VI (Course Code: AUZO542) and Core Course VII (Course Code: AUZO543) of fifth semester are of 72hours (4 hours/ week) and with 4 credits each. Core Course VIII (Course code: AUZO54PII) is Practical II of theory Core Courses AUZO541, AUZO542 and AUZO543 has 5 hours in fifth semester. End Semester examination of Practical II is at the end of the sixfth semester and 4 credits. Theory Core Course IX (Course Code: AUZO641) of sixth semester is of 90 hours (5hours/ week) and 4 credits. Theory Core Courses X (Course Code: AUZO642) and XI (Course Code: AUZO643) of sixth semester are of 72 hours in syllabus (4 hours/ week) with 4 and 3 credits respectively. Core Courses XII (Course Code: AUZO64PIII) is Practical III of Core Course AUZO641 and Core Course XIII (Course Code: AUZO64PIV) is Practical IV of Core Courses AUZO441 and AUZO643. Three hours and three credits are allotted for both courses. Core Course XIV (Course Code AUZO644) is the Project and Field study. In the fifth semester 3 hours are allotted for Project and one hour for the Field study. In the sixth semester also 3 hours are there for the Project. ESE for this course is at the end of the sixth semester and four credits.

### **Open Course**

Students of First Degree Programme have the freedom to choose Open Course offered by any disciplines other than the parent department. The students of First Degree Programme in Zoology have to choose Open Course offered by departments other than Zoology. Open Course in the fifth semester offered by the Department of Zoology is for the students of other disciplines. It has 54 hours (3hours/ week) and 2 credits. Three courses are designed for Open Course. As per University regulations, an institution can choose any one of the following courses and the course offered by Department of Zoology is AUZO581.b.

### **Open Course**

<b>Course Code</b>	<b>Title of course</b>
AUZO581.a	Public Health and Hygiene
AUZO581.b	Human Health and Sex Education
AUZO581.c	Human diseases and their management

The scheme of instruction of Open Course is given in Table III.

### **Elective Course**

Elective course is for the students of First Degree Programme in Zoology. Instructional hours are in the sixth semester. 54 hours (3hours/ week) and 2credits are allotted for it. Three courses are prepared for elective Course. As per University regulations, an institution can choose any one of the following courses and the course offered by Department of Zoology is AUZO691.a.

### **Elective Course**

<b>Course Code</b>	<b>Title of the course</b>
AUZO691.a	Economic Zoology - Vermiculture and Apiculture
AUZO691.b	Ornamental Fish Production and management
AUZO691.c	Dairy farming and Broiler farming

The scheme of instruction of elective course is given in Table IV

### **Project and Field study (Course Code: AUZO644)**

Core courses include a compulsory Project and Field study. Three hours each are given for project in the fifth and sixth semesters. One hour for the Field study in the fifth semester. The Course Code is AUZO644 and credits 4. There is no Continuous Evaluation for this course.

### **SCHEME OF EVALUATION**

Evaluation of all theory and practical courses involve Continuous Evaluation (CE) and End Semester Evaluation (ESE). The proportion of the grade of CE and ESE 1:3. CE is for 20% and ESE for 80%. All theory courses have ESE at the end of the corresponding semesters. But practical courses have ESE at the end of fifth semester and the end of sixth semester only. Both Continuous Evaluation and End Semester Evaluation are carried out with direct grading. The system of five point grade scale adopted is given in Table A

**Table A. Seven point scale of direct grading**

<b>Grade</b>	<b>Performance</b>	<b>CCPA</b>	<b>Percentage of Marks</b>
A+	Outstanding	9 and above	90 and above
A	Excellent	8 to < 9	80 to < 90
B	Very Good	7 to < 8	70 to < 80
C	Good	6 to < 7	60 to < 70
D	Satisfactory	5 to < 6	50 to < 60
E	Adequate	4 to < 5	40 to < 50
F	Failure	< 4	Below 40

#### **I. Continuous E valuation (CE)**

Continuous Evaluation of each course will be done by the faculty member who is engaging the course. CE is based on the student's attendance, performance in the class tests, seminars / assignments and records of practical. Assignments and answer scripts are to be returned to the students after evaluation. Tabulated statement of CE must be put up on the department notice board prior being dispatched to the University.

The process of Continuous Evaluation must be transparent. Monitoring of the First Degree Programme is done by committees at three levels – Department Level Monitoring Committee (DLMC), College Level Monitoring Committee (CLMC). DLMC consists of the Head of the Department and all teachers of the Department. They monitor the conduct of courses and CE. The Head of the Department be the Chair person and a teacher selected by the DLMC from among the members is the Convener. College Level Monitoring Committee will consider the complaints not redressed by the DLMC.

### **CE of Theory courses (Weightage 20)**

The different components considering for CE of theory courses and corresponding weightage are given in the Table B.

**Table B. Components and weightage for CE of theory course**

Sl.No.	Component	Marks
1.	Attendance	5
2.	1 Class test	10
3.	Seminar/Assignment	5
<b>Total</b>		<b>20</b>

### **Attendance**

The allotment of grades for attendance is given in Table C.

**Table C. Grading of attendance**

Attendance	Mark
Above 90%	5
86 to 90%	4
81 to 85 %	3
76 to 80%	2
75%	1

A student with attendance below 75% cannot appear for the ESE.

## 2. Class Test

One class test shall be conducted for each course during the semester. The mark obtained in the test (out of 80) is converted to 10 and the same is considered for CE. Question pattern of ESE can be adopted for test papers. Grading process is similar to that of ESE.

## 3. Seminar/ Assignment

Each student is required to do one seminar or one assignment for each course. Certain topics for seminars/ assignments are given after the syllabus of each course. These topics are denoted for CE only. Seminar is to be graded based on the way of presentation, matter content, etc.

### CE of Practical courses: (Weightage 4)

The different components considering for CE of Practical courses and corresponding weightage are given in the Table D.

**Table D. Components and weightage for CE of Practical course**

Sl. No.	Component	Marks
1	Attendance	5
2	Performance	5
3	One Class test	5
4	Record	5
<b>Total</b>		<b>20</b>

**Attendance:** same as given for theory CE in Table C.

**Performance in laboratory:** Grade the students in the seven-point scale as given for theory (Table A).

**Class test:** One class test shall be conducted for a practical course during a semester. Grading process is similar to that of ESE.

**Record:** Record is to be assessed taking into account the following points – timely presentation, content, accuracy of diagrams and neatness. Record grading is also on the seven-point scale as given for theory (Table A).

## **II. End Semester Evaluation (ESE)**

### **A. Theory**

All theory courses have End Semester Examination at the end of the corresponding semester. The duration of examination is 3 hours per course. Marks of theory ESE is 80. Grading is according to the seven point scale. The question paper for ESE of theory courses will be prepared by the Board of External Examiners. The Scheme of Instruction and Evaluation of First Degree Programme in Zoology are given in Table I.

### **B. Practical:**

End Semester Examination of Practical I (Course Code: AUZO44PI) at the end of fourth semester and Practical II (Course Code: AUZO64PII) will be held at the end of the sixth semester. Practical III (Course Code: AUZO64PIII) and Practical IV Course Code: AUZO64PIV) will be held at the end of the sixth semester. The duration of examination is 3 hours. Practical examination is to be conducted by a team of two external examiners. A batch may contain a maximum of 15 candidates per session of the exam.

### **C. Record**

Each Practical Course has a record book. Candidates must submit the certified record of the corresponding Practical Course on the day of the end semester examination before the External Examiners for ESE. Candidates without certified record book are not allowed to appear for the examination.

### **D. Project and Field study**

Reports related to project work and Field study are evaluated by the Practical Examiners on the next day after the End Semester Examination of Practical IV at the end of sixth semester.

### **Viva-Voce**

Viva-Voce includes presentation of the Project report and testing of the student's knowledge on the project work and general biological topics based on questions asked. Maximum time of ten minutes can be taken for evaluating a candidate.



The distribution of marks is given below.

Project Report	20
Viva-voce	10
Field study Report	20
<b>Total</b>	<b>50</b>

## PROGRAMME OUTCOMES (PO)

At the completion of the First Degree Programme, the student will be able to accomplish the following programme outcomes:

<b>PO No.</b>	
<b>PO.1</b>	Critical thinking and problem-solving ability to face the future challenges.
<b>PO.2</b>	Become competent for any job that require undergraduate degree as a basic qualification.
<b>PO.3</b>	Develop the confidence to become good entrepreneurs.
<b>PO.4</b>	Acquire language and communication skills.
<b>PO.5</b>	Become responsible citizens with awareness on the need for sustainable development.

## PROGRAMME SPECIFIC OUTCOMES (PSO)

At the completion of the First Degree Programme in Zoology, the student will be able to accomplish the following programme specific outcomes:

<b>PSO No.</b>	
<b>PSO.1</b>	Develop the students into a good Biologist and Naturalist.
<b>PSO.2</b>	Develop awareness about the interactions of organisms and environment and the need for conservation of environment.
<b>PSO.3</b>	Develop knowledge about different vital biological processes.
<b>PSO.4</b>	Appreciate the precision, complexity and diversity of life.
<b>PSO.5</b>	Become resourceful so that they can contribute to other branches of science like medicine, agriculture, veterinary science, fisheries, poultry, apiculture, sericulture etc.
<b>PSO.6</b>	Develop confidence and knowledge so that they can specialise in branches related to Zoology.

# SEMESTER I

## ZOOLOGY CORE COURSE I

### Animal Diversity I

Course Code – AUZO141

Total hours 54

CO No.	Expected course outcomes <i>Upon completion of this course, the students will be able to:</i>
1	Analyse the various branches of Zoology and their scope.
2	Explain basics of systematics and the hierarchy of different categories
3	Explain the diagnostic characters and classification of each phyla through brief studies of typical examples.
4	Describe the anatomical features of non-chordates through type study of Phylum Arthropoda
5	Evaluate the pathogenicity and economic importance of various invertebrates.

MODULE	COURSE DESCRIPTION	Hrs	CO No.
<b>1</b>	<b>Introduction</b>	<b>5</b>	
1.1	Two kingdom classification and Whittaker's five kingdom classification. Advantages and disadvantages of five kingdom classification. (self study), mention modern classifications.	1	2
1.1	Introduction to Zoology, Nature and scope of Zoology: branches of Zoology, opportunities for further studies in Zoology	1	1
1.2	Taxonomy-definition, history, new trends and importance, mention molecular taxonomy. Components of classification, Taxonomic hierarchy-taxon, category and rank. Linnaean hierarchy, nomenclature, principles of nomenclature. International Code of Zoological Nomenclature	3	2

	(ICZN), rules of nomenclature, requisites – uni, bi and trinomialism. Species, species concept and approach, taxonomic aids.		
<b>2</b>	<b>Kingdom Protista:</b>	<b>7</b>	
	general characters (self-study), structure and zoological importance and systematic position of <i>Actinophrys</i> , <i>Noctiluca</i> , <i>Paramecium</i> and <i>Opalina</i> . Parasitic protozoans-morphology, life history, pathogenicity and prophylaxis of <i>Entamoeba histolytica</i> , <i>Trypanosoma gambiense</i> and <i>Plasmodium vivax</i> .	7	3,5
<b>3</b>	<b>Kingdom Animalia, Sub kingdom Mesozoa, Sub kingdom Parazoa</b>	<b>8</b>	
3.1	Outlines of classification (self-study– Subkingdom Mesozoa, Subkingdom Parazoa, Subkingdom Eumetazoa. Levels of organization– cellular, tissue, organ(self-study). Divisions of Eumetazoa- Radiata, Bilateria, coelome(self study), metamerism(self-study),cephalisation(self-study), Protostomia, Deuterostomia.	3	2
3.2	Sub kingdom Mesozoa- general charactors, eg. <i>Rhopalura</i> .	2	3
3.3	Sub kingdom Parazoa- general characters and mention the classes of Porifera-Calcispongia, eg. <i>Sycon</i> ; Hydrospongia, eg. <i>Euplectella</i> ; Desmospongia, eg. <i>Spongilla</i> .	3	3
<b>4</b>	<b>Phylum Coelenterata:</b>	<b>4</b>	
	General characters (self-study). Classes-Hydrozoa eg. <i>Obelia</i> (structural organisation and life cycle),mention metagenesis, <i>Physalia</i> ; Scyphozoa eg. <i>Aurelia</i> , <i>Rhizostoma</i> ; Anthozoa eg. Sea anemone, <i>Madrepora</i> , Polymorphism in coelenterates, types of coral reefs.	4	3
<b>5</b>	<b>Phylum Platyhelminthes, Phylum Nematoda, Phylum Annelida</b>	<b>8</b>	
5.1	Phylum Platyhelminthes: General characters (self-study). Classes- Turbellaria eg. <i>Planaria</i> ;mention regeneration ,Trematoda eg. <i>Fasciola</i> (life cycle and	3	3

	pathogenicity); Cestoda, eg. <i>Teania solium</i> (life cycle and pathogenicity).		
5.2	Phylum Nematoda: general characters (self-study), eg. <i>Ascaris</i> , <i>Ancylostoma</i> , <i>Enterobius</i> , <i>Wuchereria</i> , <i>coenorhabditis elegans</i> (mention the pathogenicity).	2	3
5.3	Phylum Annelida: General characters (self study).Earthworm (Mention nephridia). Classes Polychaeta eg. <i>Aphrodite</i> , <i>Arenicola</i> ; Oligochaeta eg. <i>Nereis</i> , mention Heteroneries; Hirudinaria eg. Leech, haemadipsa.	3	3
<b>6</b>	<b>Phylum Arthropoda, Phylum Onychophora</b>	<b>12</b>	
6.1	Phylum Arthropoda: General characters (self-study), Type- <i>Penaeus</i> (Mention larval stages of penaeus). Mention the classes. eg. cockroach, <i>Limulus</i> (evolutionary significance), <i>Eeupagurus</i> , <i>Sacculina</i> (Parasitic adaptations and castration), termite, honey bee, scorpion. Economic importance of insects. Mention sericulture.	11	3,4,5
6.2	Phylum Onychophora: general characters, eg. <i>Peripatus</i> (Mention affinities).	1	3
<b>7</b>	<b>Phylum Mollusca</b>	<b>5</b>	
	General characters (self-study), Classes- Monoplacophora, eg. <i>Neopilina</i> ; Amphineura, eg. <i>Chiton</i> ; Aplecophora, eg. <i>Neomenia</i> , Gastropoda eg. <i>Pila</i> ; Scaphopoda, eg. <i>Dentalium</i> ; Pelicypoda eg. <i>Perna</i> , <i>Terido</i> ; Cephalopoda, eg. <i>Sepia</i> , <i>Octopus</i> . Economic importance of mollusca - pearl culture and mussel culture.	5	3,5
<b>8</b>	<b>Phylum Echinodermata</b>	<b>4</b>	
	General characters (self study) Classes- Asteroidea, eg. <i>Asterias</i> ; Ophiuroidea, eg. <i>Ophiothrix</i> ; Echinoidea, eg. <i>Echinus</i> ; Holothuroidea, eg. Sea cucumber, Crinoidea, eg. Sea lily. Water vascular system in asteroidean.	4	3
<b>9</b>	<b>Phylum Hemichordata: Eg: Balanoglossus.</b>	<b>1</b>	<b>3</b>

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**SEMESTER II**  
**ZOOLOGY CORE COURSE II**  
**Animal Diversity II**  
**Course Code – AUZO241**  
**Total hours 54**

CO No.	Expected course outcomes
	<i>Upon completion of this course, the students will be able to:</i>
1	Identify the Animal diversity around us.
2	Describe the general characters and classification of Protochordates
3	Explain the diagnostic characters and classification of different classes of vertebrates through brief studies of typical examples.
4	Explain the Accessory respiratory organs in fishes.
5	Identify poisonous and non-poisonous snakes
6	Understand the morphological, anatomical and physiological features of chordates through type study of class mammalia

MODULE	COURSE DESCRIPTION	Hrs	CO No.
<b>1</b>	<b>Introduction, Phylum Chordata, Subphylum Urochordata Subphylum Cephalochordata</b>	<b>6</b>	
1.1	Introduction, Phylum Chordata: general characters and their classification into three subphyla (self study).	2	1
1.2	Subphylum Urochordata- general characters, Class Larvacea eg. <i>Oikopleura</i> ; Class Ascidiacea eg. <i>Ascidia</i> (Mention retrogressive metamorphosis) and Class Thaliacea eg. <i>Salpa</i> .	2	2

1.3	Subphylum Cephalochordata-general characters, eg. <i>Amphioxus</i>	2	2
<b>2</b>	<b>Subphylum Vertebrata, Super class Pisces</b>	<b>10</b>	
2.1	Subphylum Vertebrata: general characters, Division 1 Agnatha -general characters, Class Cyclostomata eg. <i>Petromyzon</i> , Class Ostracodermi; Division 2 Gnathostomata general characters, Classification into Super class Pisces and Tetrapoda.	4	3
2.2	Super class Pisces- general characters and classification, Class Placodermi, Class Chondrichthyes, Sub class Elasmobranchii eg. <i>Narcine</i> , Sub class Holocephali eg. <i>Chimaera</i> ; Class Osteichthyes-Sub class Choanichthyes- Order1 Crossoptergii eg <i>Latimeria</i> , Order 2 Dipnoi eg. <i>Protopterus</i> , Subclass Actinopterygii-Super order Chondrostei eg <i>Acipenser</i> . Super order Holostei eg <i>Lepidosteus</i> , Super order Teleostei eg <i>Anabas</i> , <i>Clarius</i> , <i>Saccobranchnus</i> , <i>Ophiocephalus</i> , <i>Echeneis</i> . General topic: Accessory respiratory organs in fishes.	6	3,4
<b>3</b>	<b>Super class Tetrapoda: Salient features, Class Amphibia</b>	<b>5</b>	
	Super class Tetrapoda: Salient features, Class Amphibia - general characters (self study). Classification- Order Urodela eg. <i>Amblystoma</i> , Order Anura eg. <i>Hyla</i> , <i>Bufo</i> , <i>Rana</i> , Order Apoda eg. <i>Ichthyophis</i> . General topic: Parental care in amphibia.		
<b>4</b>	<b>Class Reptilia</b>	<b>9</b>	
	General characters (self study). Classification - Subclass Anapsida -Order Chelonia eg. <i>Chelone</i> ; Subclass Parapsida eg <i>Ichthyosaurus</i> ; Subclass Diapsida- Order Rhynchocephalia eg. <i>Sphenodon</i> , Order Squamata-Suborder Lacertilia eg. <i>Calotes</i> , <i>Chamaeleon</i> , <i>Draco</i> , <i>Hemidactylus</i> , Suborder Ophidia eg. <i>Naja naja</i> , <i>Vipera</i> , <i>Bungarus</i> , <i>Enhydrina</i> , <i>Ptyas</i> , <i>Lycodon</i> , <i>Tropidonotus</i> , <i>Dryophis</i> , <i>Typhlops</i> and <i>Eryx johni</i> , Suborder Crocodilia eg. <i>Crocodylus</i> , <i>Alligator</i> ; Subclass Synapsida eg <i>Cynognathus</i> . General topic: Identification of poisonous and non-poisonous snakes.	9	3,5
<b>5</b>	<b>Class Aves</b>	<b>5</b>	



5	General characters (self study). Classification- Subclass Archeornithes eg . <i>Archeopteryx</i> ; Subclass Neornithes- Super order Paleognathae eg. <i>Sruthio</i> and <i>Emu</i> , Super order Neognathae eg .Grey heron, Vulture, Kite, <i>Pavo</i> , Koel, Owl, Woodpecker, Crow. General topic: flight adaptations of birds.	5	3
6	<b>Class Mammalia-</b>	<b>19</b>	
6.1	General characters and classification - Subclass Prototheria eg. <i>Tachyglossus</i> ; Subclass Metatheria eg. <i>Macropus</i> ; Subclass Eutheria - Order Insectivora eg. <i>Paraechinus</i> , Order Dermoptera eg. <i>Galeopithecus</i> , Order Chiroptera eg. <i>Pteropus</i> , Order Primates eg. <i>Loris</i> , Orangutan, Order Carnivora eg. <i>Leo</i> sps, <i>Felis domesticus</i> , <i>Canis familiaris</i> , <i>Herpestus</i> , Order Cetacea eg. <i>Delphinus</i> , Order Perissodactyla eg. <i>Equus</i> , Order Artiodactyla eg . <i>Camelus</i> , <i>Hippopotamus</i> , Order Proboscidea eg. <i>Elephas</i> . Order 10 Sirenia eg. <i>Dugong</i> , Order Hyracoidea eg. <i>Procavia</i> , Order Rodentia eg. <i>Rattus</i> , Order Lagomorpha eg. <i>Oryctolagus</i> , Order Edentata eg. <i>Dasypus novemcinctus</i> (Armadillo), Order Pholidota eg. <i>Manis</i> , Order Tubilidentata eg. <i>Orycteropus</i> .	9	5
6.2	<b>Type: Rabbit (<i>Oryctolagus cuniculus</i>):</b> External features (Self study), Digestive system, Skeletal System, Vertebral column: Atlas, Axis, Lumbar, Pectoral and Pelvic girdles, Respiratory system, Circulatory system, Heart (Self study) Arterial system and Venous system, Nervous system: Brain – Dorsal and ventral View and Urinogenital system	10	5
	<b>Topics for assignments / seminars (not for ESE)</b> 1. Migration in fishes. 2. Parental care in fishes. 3. Caudal fin in fishes 4. Snake venom and its uses. 6. Adaptations of feet and beak of birds. 7. Economic importance of mammals. 8. Mammalian resources of the forests of Kerala. 9. Flying mammals. 10. Endangered mammals. 11.Migration of birds		

	12.Adaptations of aquatic mammals		
	13. Dentition in mammals		

### References

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# SEMESTER III

## ZOOLOGY FOUNDATION COURSE II

### Methodology, Perspectives of Science and Bioinformatics

Course code – AUZO321

Total hours 54

CO No.	Expected course outcomes
	<i>Upon completion of this course, the students will be able to:</i>
1	Explain the basis of research design
2	Explain the principle, working and applications of different instruments used in biological studies.
3	Describe histological staining techniques
4	Use statistical theory in biological data analysis
5	Recognize the ethical aspects in scientific research
6	Describe the scope and applications of bioinformatics and the various biological databases
7	Describe bioinformatics tools for sequence alignment, data retrieval and phylogenetic tree construction.

MODULE	COURSE DESCRIPTION	Hrs	CO No.
<b>1</b>	<b>Scientific instruments and techniques: Principle, working and applications</b>	<b>10</b>	
1.1	Microscopy- Light microscopes, Dark-field, Fluorescent microscope and Phase-contrast microscope, Electron microscopes - TEM and SEM.	5	2

1.2	Centrifuges, Colorimeter, Spectrophotometer, pH meter, Chromatography, Electrophoresis; X-ray Crystallography, Autoradiography.	5	2
<b>2</b>	<b>Histological staining techniques and Robotics</b>	<b>4</b>	
2.1	Histological staining techniques- fixation, dehydration, clearing, infiltration, embedding, sectioning, staining, mounting; Microtome.	3	3
2.2	Robotics –components and types.	1	2
<b>3</b>	<b>Data handling in Science</b>	<b>5</b>	
	Types of Research (Descriptive/Analytical, Applied/Fundamental, Quantitative/ Qualitative). Research Process (Brief account only) - formulating research problem, literature survey, development of hypothesis-Null and alternative, deductive and inductive methods of reasoning, collection of data, analysis of data, testing of hypothesis using statistical tools (mention its significance only), interpretation, scientific documentation.	5	1
<b>4</b>	<b>Introduction to Biostatistics</b>	<b>10</b>	
4.1	Population, Sample, Sampling Methods (Random, Cluster, Stratified and Geographical) and Sampling Errors/Bias	1	4
4.2	Measures of central tendency and dispersion: Arithmetic mean, Median and Mode, Variance, Standard deviation, Standard error of mean.	2	4
4.3	Data presentation: Tables, graphs (line graphs, frequencies polygon, frequency curve and ogives) and diagrams (bar and pie)	2	4
4.4	Testing of Hypothesis: Level of significance, Types of errors, statistics based acceptance or rejection of a hypothesis – (chi-square, t-test); deduction of scientific correlation	5	4
<b>5</b>	<b>Ethics in science</b>	<b>2</b>	

	Ethics in science: (brief account only), sharing of knowledge, transparency and honesty; IPR- Copy right, Patents, Trademarks, Geographical indications, publications, Plagiarism.	2	5
<b>6</b>	<b>General Informatics</b>	<b>3</b>	
	Internet as a knowledge repository, academic search techniques, introduction to use of IT in teaching and learning, Academic services – INFLIBNET, NICNET, BRNET.		6
<b>7</b>	<b>Introduction to Bioinformatics</b>	<b>6</b>	
	Nature & Scope of Bioinformatics - Contrast between Bioinformatics and Computational Biology; Key Bio-sequences in Molecular Biology - DNA, RNA and Aminoacid sequences -Popular Databases in Bioinformatics - NCBI, DDJB, PDB, OMIM	<b>6</b>	6
<b>8</b>	<b>Sequence alignment and Molecular Phylogenetics</b>	<b>7</b>	
8.1	Sequence alignment –pair wise and multiple; BLAST & FASTA, CLUSTALw	4	7
8.2	Molecular Phylogenetics - advantages and computational procedure (only description of use of a package such as Phylip)	3	7
<b>9</b>	<b>Computer Aided Drug Discovery (CADD), Proteomics, Molecular Visualization Software</b>	<b>7</b>	
9.1	Computer Aided Drug Discovery (CADD) - Basic concepts, General description of drug discovery pipeline-concept of personalized medicine	2	7
9.2	Proteomics: Basic ideas of Protein Structure prediction-Concept of Homology Modelling.	3	7
9.3	Molecular Visualization Software - Rasmol (Basic features only)	2	7
	<b>Suggested topics for assignments / seminars (not for ESE)</b>		

	<ol style="list-style-type: none"> <li>1. Different types of microscopes,</li> <li>2. Different types of centrifuges,</li> <li>3. Collection of different local fauna and analysis of data,</li> <li>4. Designing of an experiment of own interest</li> <li>5. Construction of bar diagram, histogram, pie diagram, frequency curve, frequency polygon</li> <li>6. Collect and identify five local fauna with systematic position.</li> </ol>		
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## References

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- Graeme. D. Ruxton and Nick Colegrave. (2006) Experimental design for the life sciences, 2nd edition. Oxford University press.
- Gurumani, Research Methodology. M.J.P.Publishers, Chennai, 600 005
- Keith Wilson and John Walera. (2008) Principles and techniques of biochemistry and Molecular Biology. Cambridge University press.
- Norman, T.J. Bailey (2007) Statistical methods in biology, 3rd edition. Cambridge university press.
- Veerbala Rastogi. (2008) Fundamentals of biostatistics. Ane books India, Chennai.
- Veerakumary, L. (2006) Bioinstrumentation. MJP Publishers, Chennai, 600 005

## Bioinformatics

### Suggested topics for assignments/ seminars (not for ESE)

1. Conduct of an experiment to demonstrate the use of BLAST
2. Visit KEGG data base and retrieve the list of completed genome project
3. Compare the traditional Phylogenetic methods with the Molecular Phylogenetics
4. Visit NCBI, EMBL, DDBJ, PDB. List out the salient features of them.
5. Write a report on various phases of Computer Aided Drug Discovery.
6. From internet locate some success stories of Computer Aided Drug Discovery
7. Write brief note on recent development of System Biology and Synthetic Biology.
8. Down load the human chromosome I in fasta format and cut a portion of the
9. sequence, using gene finding tool predict the gene present.
10. Write a brief note on different Phylogenetic tree building methods.

## References

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- George Beekman, Eugene Rathswohl, Computer Confluence, Pearson Education, ISBN 0-13-066185-6
- Greg Perry, SAMS Teach Yourself Open Office. Org, SAMS , ISBN 0672326183
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## Web Resources

- [www.fgcu.edu/support/office2000](http://www.fgcu.edu/support/office2000)
- [www.openoffice.org](http://www.openoffice.org) *Open Office Official* web site
- [www.microsoft.com/office](http://www.microsoft.com/office) *MS Office* web site
- [www.lgta.org](http://www.lgta.org) *Office* on-line lessons
- [www.learnthenet.com](http://www.learnthenet.com) *Web Primer*
- [www.computer.org/history/timeline](http://www.computer.org/history/timeline)
- [www.computerhistory.org](http://www.computerhistory.org)
- [www.keralaitmisson.org](http://www.keralaitmisson.org) *Kerala Govt. IT Dept.*
- [www.technopark.org](http://www.technopark.org)
- <http://ezinearticles.com/?Understanding-The-IOperation-Of-Mobile-Phone-Networks&id=68259>
- <http://www.scribd.com/doc/259538/All-about-mobile-phones>
- <http://www.studentworkzone.com>

**SEMESTER IV**  
**ZOOLOGY CORE COURSE III**  
**ECOLOGY, TOXICOLOGY & DISASTER MANAGEMENT**

Course code – AUZO441

Total hours 54

CO No.	Expected course outcomes <i>Upon completion of this course, the students will be able to:</i>
1	Describe the characteristics of ecosystems and ecosystem function
2	Explain the biogeochemical cycles
3	Describe the basic principles of habitat ecology, including population ecology and community ecology
4	Discuss the role that humans play in affecting the characteristics of the environment
5	Evaluate current environmental issues and problems including the solutions and management practices that have been used or offered to address these issues and problems
6	Explain the Biotechnological methods for pollution detection, and abatement
7	Explain the general principles of toxicology
8	Discuss the concept of disaster, disaster phenomenon and events and different disaster management mechanisms

MODULE	COURSE DESCRIPTION	Hrs	CO No.
	<b>Ecology</b>	<b>36 hrs</b>	
1	<b>Components of ecosystem:</b> Environmental factors - abiotic factors, light, temperature, soil, water, air; biotic factors- autotrophs, phagotrophs and saprotrophs; ecosystem interaction and inter-	<b>3 hrs</b>	1



	relationship between biotic and abiotic factors, the cybernetic nature and the stability of the ecosystem. Pond as an ecosystem (self study)		
2	<b>Biogeochemical cycles:</b> Basic types of biogeochemical cycles - gaseous cycle-carbon and nitrogen cycles, mention sedimentary cycles (P and S), recycling pathways and recycle index. <b>Limiting Factors-</b> basic concepts- Leibig's law of minimum, Shelford's law of tolerance, combined concept of limiting factors, Light and temperature as limiting factors.	6 hrs	2
3	<b>Habitat Ecology:</b> Biosphere classification- lithosphere, hydrosphere and atmosphere physical features, fauna and their adaptations of aquatic, terrestrial and marine habitats (self study) <b>Population ecology:</b> Properties of population- density, natality, mortality, age distribution, biotic potential, environmental resistance and carrying capacity, population growth forms, J and S shaped curves, emigration, immigration and migration, population fluctuation. <b>Community ecology:</b> Definition and characters, species diversity; stratification; dominance; ecotone and edge effect; ecological indicators; community periodicity, succession (self study)	5hrs	3
4	<b>Anthropogenic impact on ecosystem:</b> Ionizing radiation and radioisotopes, ionizing radiation and human health, radiation accidents and other exposures, disposal of radioactive wastes, pesticides like DDT, endosulfan, furadan, insect repellants , e-wastes. Monitoring of pollutants – physical, chemical and biological.	5hrs	4
5	<b>Global environmental changes</b> -Global warming, Green house effect, Ozone depletion, Climate change. Kyoto protocol, IPCC/UNFCCC, Carbon credit, Carbon sequestration, Carbon trading	3 hrs	5
6	<b>Wild life conservation and management:</b> Significance, causes of extinction, concepts of threatened species, red data book, IUCN, WWF, CITES, Green Environment and Green peace; protected areas, biosphere reserves, national parks and sanctuaries in India, forests in India, desertification, deforestation, carbon trading; importance of mangroves in coastal ecosystems- conservation and management (self study).	5 hrs	5
7	<b>Environmental biotechnology:</b> Biotechnological methods of pollution detection, biotechnological methods in pollution	9hrs	6

	abatement, bioremediation, biotechnology and biodegradation, genetically engineered microbes in bio-treatment of waste, eco-friendly bioproducts for environmental health, bio-piracy, bio-pesticides and bio-fertilizers, organic farming and its merits. Green chemistry – designing a Green synthesis, basic principles of Green chemistry.		
	<b>TOXICOLOGY</b>		
8	<b>General Principles of Toxicology:</b> Definition, Scope of Toxicology, Different areas of Toxicology. Classification of Toxic Agents, Route and Site of Exposure, Duration and Frequency of Exposure – Dose Response.	<b>3hrs</b>	7
9	<b>Disposition of Toxicants:</b> Introduction- Absorption, Distribution, Excretion, Bio-transformation, Bioactivation.	<b>3hrs</b>	7
10	<b>Target Organs and Testing Procedures:</b> Bioassay – LC 50/LD 50 Determination - Acute Toxicity –Short-term and long term Studies – Experimental Design – Selection of Species.	<b>4hrs</b>	7
	<b>DISASTER MANAGEMENT</b>		
11	Concept of disaster, Concept of risk, Levels of disaster, Disaster phenomenon and events (global, national and regional). Disaster management mechanism- Concept of risk management and crisis management, Disaster management cycle, Response and recovery, Development, Prevention, Mitigation and preparedness, planning of relief.	<b>8 hrs</b>	8
	<b>Suggested topics for Assignments (not for ESE)</b> 1. First aid in burning 2. Protective measures to be taken for environmental hazards 3. Management of contagious diseases		

## Reference

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## **DISASTER MANAGEMENT**

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**ZOOLOGY CORE COURSE IV**  
**PRACTICAL I - Methodology and Perspectives of Science and**  
**Zoology, Animal Diversity I and Animal Diversity II**  
**Course Code – AUZO44PI**

CO No.	Expected course outcomes <i>Upon completion of this course, the students will be able to:</i>
1	Identify and classify the various groups of animals
2	Recognize the adaptations and taxonomic significance of non-chordates and chordates
3	Compare the anatomy and morphology of non-chordates through transverse or longitudinal sections, dissections and mountings
4	Explain working principle of different scientific instruments
5	Compute basic statistical problems

<b><u>Methodology and Perspectives of Zoology</u></b>	4
<b>Study of the following instruments</b> 1. Compound microscope 2. Centrifuge 3. Colorimeter 4. Microtome 5. pH Meter	
<b>Biostatistics</b> Graphs, Tables, Histogram, Pie diagram. Mean median, mode, standard deviation and standard error students't- test and chi - square test	5

## **Animal Diversity I**

### **Minor Practicals - any four.**

1. Nereis – parapodium
2. Earthworm – body setae
3. Cockroach – salivary apparatus in situ
4. Cockroach – mouth parts
5. Honey bee – mouth parts / mosquito - mouth parts
6. Prawn – appendages

3

### **Major Practical – any two**

1. Earthworm – nervous system
2. Cockroach – nervous system
3. Prawn – nervous system

### **Taxonomy**

Identification and classification of the following specimens

1. Protista – *Actinophrys*, *Noctiluca*, *Pramecium*, *Opalina* – any 2
2. Phylum Porifera – *Euplectella*, *Spongilla*- any 1
3. Phylum Cnidaria – *Hydra*, *Obelia*, *Physalia*, *Aurelia*, Sea anemone, *Madrepora* – any 3
4. Phylum Nematoda – *Ascaris* male and female (entire)
5. Phylum Platyhelminthes – *Bipalium*, *Fasciola*, *Teania solium* – any 1
6. Phylum Annelida – Earthworm, *Nereis*, Leech, *Aphrodite*, *Arenicola* – any 1
7. Phylum Onychophora – *Peripatus*
8. Phylum Arthropoda – Cockroach, *Limulus*, *Eupagurus*, *Sacculina*, Honey bee, *Lepisma*, Scorpion – any 3
9. Phylum Mollusca – Chiton, *Pila*, *Xancus*, *Dentalium*, *Perna*, *Mytilus*, *Teredo*, *Sepia*, *Octopus*. – any 2
10. Phylum Echinodermata – Starfish, Brittle star, Sea urchin, Sea cucumber, Sea lily – any 2

1,2

## **Animal Diversity II**

### **Minor practical**

Fishes - placoid scales of *Scoliodon* and cycloid and ctenoid scales of *Anabas*

### **Osteology**

Rabbit limb bones, girdles, typical vertebra, atlas, axis, thoracic and lumbar vertebrae and lower jaw.

Turtle - carapace and plastron.

### **Taxonomy**

Prochordates –*Amphioxus* (entire)

Pisces - 2 cartilaginous fishes, 2 fishes with accessory respiratory organs, 2 edible fishes and 2 culture fishes.

Amphibia - any 3 (representing the three orders).

Reptilia - 2 poisonous and 2 non -poisonous snakes, *Draco*, *Chamaelon*

Aves - Different feathers, Pigeon.

Mammals - Bat

### **Compulsory assignment for practical**

#### **Animal Diversity I (5% of practical CE)**

Students shall collect any 2 invertebrates/parasites/pests specimens and prepare a brief note including taxonomy and submit for evaluation.

#### **Animal Diversity II (5% of practical CE)**

Students shall collect any two local fish and prepare a brief note including taxonomy and submit for evaluation.

3

3

1,2

**SEMESTER V**  
**ZOOLOGY CORE COURSE IV**  
**Cell and Molecular Biology**  
**Course code – AUZO541**  
**Total hours 90**

CO No.	Expected course outcomes <i>Upon completion of this course, the students will be able to:</i>
1	Describe the ultra-structural organization and functions of cell and cell organelles
2	Explain the process of cell division and the biology of cancer and aging
3	Describe the nature, structure and replication process of the genetic material
4	Get awareness on the mechanism of gene expression and gene regulation
5	Explain bacterial recombination

MODULE	COURSE DESCRIPTION	Hrs	CO No.
	<b>Cell Biology</b>	<b>50 hrs</b>	
<b>1</b>	<b>Structure and functions of cell and organelles</b>	<b>38</b>	
<b>1.1</b>	<b>History, development and scope of cell biology</b> , discovery of cells; cell theory and its modern version (self study). Cell and its components: basic types of cells- prokaryotic and eukaryotic, nature and comparison (self study) Ultra structural organization and functions:  <b>Plasma membrane</b> - ultra structure- fluid mosaic model , functions of plasma membrane, trans-membrane transport.	<b>6</b>	<b>1</b>



	Cell communication- cell signaling and signal transduction, basic elements involved.		
<b>1.2</b>	<b>Mitochondria</b> - structure, functions, mention oxidative phosphorylation and electron transport chain. Endoplasmic reticulum - morphology, types, functions and formation.	<b>6</b>	
<b>1.3</b>	<b>Golgi bodies</b> - morphology, types, functions (role in secretion) and formation. Lysosomes morphology, mention major groups of enzymes, classification, polymorphism and functions. Microbodies - morphology, major enzymes, peroxisomes and glyoxisomes functions. Ribosomes - different types, subunits, functions. Proteosomes - structure, ubiquitin - tagged protein degradation. Centrioles and basal bodies- structure and functions. Cytoskeleton- microtubules, microfilaments and intermediate filaments- examples and functions.	<b>10</b>	
<b>1.4</b>	<b>Interphase nucleus</b> - gross structure and functions; nuclear envelope- pores and pore complexes; nuclear lamina, formation of NE; nucleoplasm- nature and importance. <b>Nucleolus</b> - structure, nucleolar cycle, nucleolar organizer and functions.	<b>6</b>	
<b>1.5</b>	<b>Chromatin</b> - euchromatin and heterochromatin, nucleosomes, unit fibre, solenoid fibre, and higher order of organization, condensation and coiling.	<b>5</b>	
<b>1.6</b>	<b>Chromosome</b> - structure of a typical metaphase chromosome; giant chromosomes- polytene chromosomes, lamp brush chromosomes; endomitosis.	<b>5</b>	
<b>2</b>	<b>Cell Division:</b> cell cycle- G1, S, G2, and M phases (mention G0, and D0 stages and their significances); amitosis (brief account only). Mitosis (self study). Meiosis: description of all stages, synaptonemal complex, significance	<b>8</b>	<b>2</b>
<b>3</b>	<b>Biology of cancer:</b> characteristics of cancer cells, dedifferentiation of cancer cells, theories of cancer, carcinogenesis, oncogenes and tumor suppressor genes	<b>2</b>	<b>2</b>

4	<b>Aging:</b> cellular and other changes, apoptosis, causes of aging, mention free radicals and superoxide dismutase (SOD), theories of aging.	2	2
	<b>Molecular Biology</b>	<b>40</b>	
5	<p><b>Introduction:</b> history, development and scope.</p> <p><b>Nature of genetic material:</b> search for the genetic material, Griffith's experiment, transformation, contributions of Avery, MacLeod and McCarty, Conrat &amp; Stern's experiment with TMV, Hershey &amp; Chase's experiment, and transduction.</p> <p><b>Composition and structure of nucleic acids</b> - Watson - Crick model of DNA, clover leaf model of tRNA, different types of DNA and RNA; DNA replication in prokaryotes and eukaryotes - Semi-conservative method, Messelson &amp; Stahl experiment, replication machinery and mechanism; modification and repair of DNA.</p>	<b>16hrs</b>	3
6	<p><b>Gene Expression:</b> contributions of Garrod, one gene – one enzyme hypothesis, one gene one polypeptide hypothesis, central dogma of Molecular Biology, central dogma reverse, colinearity of genes and gene products.</p> <p><b>Genetic code</b> - deciphering / cracking the GC, characteristics of GC, codon assignment and wobble hypothesis.</p> <p>Mention contributions of Nirenberg and his associates, Khorana and his associates.</p> <p>Transcription of RNAs - RNA polymerases, transcription factors, mechanism of transcription, post-transcriptional modifications of mRNA, rRNA and tRNA, reverse transcription, translation – machinery and mechanism; post translational modification of proteins; role of chaperones in protein normal folding and protection</p>	<b>15hrs</b>	4
7	<b>Gene regulation:</b> in prokaryotes (inducible and repressive systems); operon concept – Lac operon and Trp operon	<b>5hrs</b>	4
8	<b>Bacterial Recombination:</b> transformation, conjugation and transduction (general and specialized transduction)	<b>4hrs</b>	5

	<p><b>Suggested topics for assignments / seminars (not for ESE)</b></p> <ol style="list-style-type: none"> <li>1. Basic properties of cells</li> <li>2. A brief history of studies on plasma membrane structure</li> <li>3. Role of Ca<sup>++</sup> in signal transduction</li> <li>4. Chemical components of: a) Endoplasmic reticulum b) Golgi bodies c) Lysosomes d) Ribosomes</li> <li>5. Models of ribosome structure</li> <li>6. Lysosomes and storage diseases</li> <li>7. Phenylketonuria</li> <li>8. Alkaptonuria</li> <li>9. Albinism</li> </ol>		
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- Vijg J. *Aging of the Genome*, Oxford University Press
- Watson, J.D. *et al., Molecular Biology of the Gene*, 4e, Benjamin Cummings

**SEMESTER V**  
**ZOOLOGY CORE COURSE VI**  
**Genetics and Biotechnology**

**Course Code – AUZO542**

**Total hours 72**

CO No.	Expected course outcomes <i>Upon completion of this course, the students will be able to:</i>
1	Analyse the basic principles of inheritance
2	Describe the mechanisms of genes interactions
3	Explain the concept of linkage, crossing over and recombination
4	Describe the mechanism sex determination and cytoplasmic inheritance
5	Evaluate different Types of mutations and genetic syndromes
6	Get awareness of the principles and techniques involved in Biotechnology-DNA technology, PCR, Blotting, Hybridoma technology, gene therapy and human cloning

MODULE	COURSE DESCRIPTION	Hrs	CO No.
	<b>Genetics</b>	<b>37hrs</b>	
<b>1</b>	<p><b>Introduction,</b> Mendel and his experiments, relevance of Mendel’s principles in modern genetics (self study); genetic terminology-gene, allele, genotype, phenotype, genome; wild type and mutant type , test cross, back cross and reciprocal cross.</p> <p>Interaction of genes: Allelic, incomplete dominance, lethal and co-dominance,non- allelic, complementary gene action (self study); Co-epistasis, dominant (feather coat) and recessive (coat colour), polygenic</p>	<b>8hrs</b>	1,2

	action (skin colour), pleiotropism(one example). Multiple alleles- ABO Blood group system, Rh group and its inheritance.		
2	<b>Linkage, crossing over and recombination:</b> Linked genes, linkage groups, chromosome theory of linkage, factors affecting linkage, crossing over and recombination, mechanism, kinds and factors affecting crossing over and its significance. Chromosome mapping (brief account only);  <b>Sex Linkage:</b> Characteristics of sex linked inheritance, sex linked inheritance of man (colour blindness and haemophilia), incompletely sex linked genes, holandric genes, sex limited genes and sex influenced genes.	8hrs	3
3	<b>Sex Determination:</b> Environmental factors on sex determination, mention genic balance theory, chromosome theory of sex determination, chromosomal mechanism of sex determination, (XX-XY, XX-XO, ZZ-ZW), sex determination in man, role of Y chromosome, Barr bodies, dosage compensation and Lyon hypothesis. Chromosome mosaicism; Mention inter sex, gynandromorph and hermaphrodite.	8hrs	4
4	<b>Mutation:</b> Types of mutations - somatic, germinal, spontaneous, induced, autosomal and allosomal, euploidy and aneuploidy. Gene mutation, molecular basis of mutation, induced mutation- chemical, ionizing and non ionizing.	6hrs	4
5	<b>Cytoplasmic inheritance:</b> Mitochondrial DNA, kappa particles in paramecium, maternal effects in Drosophila.	3hrs	5
6	<b>Human Genetics:</b> Karyotyping, normal chromosome compliment, pedigree analysis, chromosomal anomalies in man, autosomal (eg. Down syndrome, Edwards syndrome), allosomal (eg. Klinefelters syndrome, Turner's syndrome) <b>Biochemical genetics:</b> Human biochemical genetics,	4hrs	5

	biochemical pathway of phenyl alanine, tyrosine metabolism in normal man. Disorders- Phenylketonuria, Alkaptonuria, Tyrosinosis and Albinism.		
	<b>Biotechnology</b>	<b>35 hrs</b>	
<b>7</b>	<b>Introduction</b> -Scope of biotechnology, emerging branches of biotechnology. Genetic engineering and recombinant DNA technology, techniques in gene cloning, restriction endonucleases, ligases, major steps in cutting and joining of DNA, tools used in recombinant DNA technology, vectors, plasmids, probes, linkers, host cells, transformation and detection of recombinant molecules.	<b>9hrs</b>	6
<b>8</b>	<b>Genomic library</b> , construction of genomic library and cDNA library, Polymerase Chain Reaction-basic steps and applications of PCR, DNA sequencing (Sanger method, Automated sequencing), patenting DNA sequences.	<b>6hrs</b>	6
<b>9</b>	<b>Blotting Techniques:</b> Southern, Northern and Western blotting, DNA fingerprinting.	<b>5hrs</b>	6
<b>10</b>	<b>Human Genome Project</b> , hybridoma technology and monoclonal antibodies; gene transfer techniques (chemical treatment, electroporation, lipofection, microinjection, retro viral vector method, embryonic stem cell method and shot gun method); transgenic microbes, plants and animals.	<b>6hrs</b>	6
<b>11</b>	<b>Gene therapy:</b> somatic gene therapy and germ line gene therapy; gene doping and its implications; DNA vaccines; Human cloning –therapeutic and reproductive cloning.	<b>4hrs</b>	6
<b>12</b>	<b>Practical applications</b> of biotechnology-in medicine, agriculture, industry, pollution control, forensics and judiciary. Potential hazards of biotechnology.	<b>5hrs</b>	6

	Bio-ethics - problems and solutions. Biotechnology in future.		
	<p><b>Suggested topics for assignments / seminars (not for ESE)</b></p> <ol style="list-style-type: none"> <li>1. Mendel's laws.</li> <li>2. Blood groups.</li> <li>3. Intersexes, hermaphrodites, and gynandromorphs.</li> <li>4. Genetic counseling</li> <li>5. Human Genome Project.</li> <li>6. Applications of DNA fingerprinting.</li> <li>7. Ethical and social issues of Biotechnology.</li> <li>8. Complimentary gene action.</li> <li>9. Incomplete dominance.</li> <li>10. Chemical mutagens in food.</li> </ol>		

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### Genetics

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### Biotechnology

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# SEMESTER V

## ZOOLOGY CORE COURSE VII

### Immunology and Microbiology

Course code – AUZO543

Total hours 72

CO No.	Expected course outcomes <i>Upon completion of this course, the students will be able to:</i>
1	Understand the scope and basics of immunology
2	Describe which cell types and organs present in the immune response.
3	Identify the cellular and molecular basis of immune responsiveness
4	Explain transplantation immunity and the mechanism of Graft rejection and allergy
5	Understand the classification of microbes
6	Understand the positive as well as negative aspects of microbes in various fields

MODULE	COURSE DESCRIPTION	Hrs	CO No.
	<b>Immunology</b>	<b>37hrs</b>	
<b>1</b>	Introduction, history, development and scope.	<b>2hrs</b>	1
<b>2</b>	<b>Immunity:</b> definition, classification of immunity. Innate (non-specific) – species, racial and individual IM with examples, acquired (specific) – active IM (natural and artificial) with examples, passive IM (natural and artificial) examples.	<b>3hrs</b>	1
<b>3</b>	<b>Immune system:</b> organs and tissues of the immune system. Primary (central) - thymus, bone marrow, bursa of Fabricii; secondary (peripheral) - spleen, lymph nodes,	<b>6hrs</b>	2

	MALT etc. Cells lymphocytes – T cells and B cells – formation, development and maturation; plasma cells and null cells – natural killer cells, killer cells, lymphokine - activated killer cells; phagocytes / macrophages; antigen presenting cells – macrophages, B-lymphocytes, dendrite cells, Langerhans cells; follicular dendrite cells, neutrophils, eosinophils, basophils, mast cells. Mitogens – mention only		
4	<p><b>Antigens</b> (immunogens) (Ag): definition, complete antigens, haptens, antigenic determinants or epitopes.</p> <p><b>Antibodies</b> (Immoglobulins)- definition, general structure of Ig, Ig determinants, physico-chemical properties of Ig, classes of Ig- G, M, A, D, E; mention abnormal Igs; antigen – antibody reactions- mechanism (mention zone phenomenon), precipitation reactions, agglutination reactions, complement fixation, neutralization, opsonisation (brief accounts only)</p> <p><b>Complement system:</b> definition, general features, major histocompatibility complex (MHC) (brief account only). Immune response- definition, types of immune responses- humoral immune response (antigen mediated immunity - AMI) and cellular immune response (cell mediated immunity - CMI) in detail, induction of CMI, mention cytokines, define immunological memory, immunological tolerance and immune suppression</p>	14hrs	3
5	<p><b>Hyper sensitivity / allergy:</b> definitions, classification- types I, II and III (Brief accounts only);</p> <p><b>Immuno deficiency diseases (ID)-</b> definition, primary IDs, disorders of immune mechanism (humoral, cellular and combined IDs), disorders of complements, disorders of phagocytosis, mention one example each, secondary IDs - mention example, an account of Acquired Immune Deficiency Syndrome (AIDS);</p> <p><b>Auto immunity-</b>definition, mechanism, mention AI diseases.</p> <p><b>Transplantation immunology-</b>definition, classification of transplants, graft versus host reactions, graft rejection,</p>	12hrs	4

	<p>mechanism of graft rejection, factors affecting graft survival;</p> <p><b>Immunisation and vaccination-</b> definitions, vaccines; types of immunization- active immunization- killed and live attenuated vaccines, microbial extracts, vaccine conjugates, toxoids, recombinant vaccines, DNA vaccines; passive immunization- pooled normal human Igs, specific Igs (hyper antisera); combined immunization</p>		
	<b>Microbiology</b>	<b>35hrs</b>	
<b>6</b>	<p><b>Introduction:</b> history, development and scope Importance of microbes in various ways beneficial, harmful, ecological and others.</p> <p><b>Classification of microbes/ particles:</b> broad classification- viruses- different groups, examples; mention viroids and prions, <i>Mycoplasmas</i>, <i>Rickettsiae</i> and <i>Chlamydiae</i>; Bacteria: 1. Archaea – significance of extreme life forms(<i>Methanoarchaea</i> , extreme halophiles and thermophiles); Eubacteria (=Bacteria) Major groups of Eubacteria: Bergey’s system of classification; modern methods classification of Eubacteria (outline only with familiar examples)- Nonphotosynthetic proteobacteria:- (Fermentative Rods and Vibrios) ex. <i>Vibrio</i>, <i>Pasteurella</i> (oxidative rods and cocci) eg. <i>Pseudomonas</i>, <i>Azotobacter</i>, <i>Rhizobium</i>; Chemo-lithotrophic bacteria:- eg. nitrifying, sulphur and iron bacteria; Firmicutes (eg. <i>Staphylococcus</i>) and Actinobacteria (Coryneform bacteria); Phototrophic bacteria (Cyanobacteria); Algae-( details not expected) Protista- different groups- examples: <i>Plasmodium</i>, <i>Giardia</i>; Fungi- Mention different groups – example <i>Candida</i>. Structure of a bacteriophage and a typical bacterium</p>	<b>14hrs</b>	<b>5</b>
<b>7</b>	<b>Applied microbiology:</b> various fields: emphasis on environmental, agricultural, medical, biotechnological, industrial and strategic fields	<b>9hrs</b>	<b>6</b>
<b>8</b>	<b>Symbiotic microbes:</b> microbes with other microbes, microbes with plants microbes with animals; microbe –	<b>12hrs</b>	<b>6</b>

	<p>human host interactions, normal human microbiota of various organs- mention any 3 examples,</p> <p><b>Pathogenic microbes</b> – mention any 3 examples, microbial toxins – mention any 2 examples. Microbial diseases in man (of skin, respiratory system etc.)- viral – chicken pox, measles, cold, herpes, hepatitis, poliomyelitis; bacterial – diphtheria, pneumonia, leprosy, ornithosis; fungal – aspergillosis, candidiasis and others – malaria</p>		
	<p><b>Suggested topics for assignments / seminars (not for ESE)</b></p> <ol style="list-style-type: none"> <li>1. Factors affecting innate immunity</li> <li>2. Defence mechanisms of the body against infections</li> <li>3. Factors affecting antibody production</li> <li>4. Theories of antibody production</li> <li>5. Organ transplantation</li> <li>6. Immunization and vaccination</li> <li>7. Antiseptics and antibiotics</li> <li>8. Sterilisation and disinfection</li> <li>9. Inflammation and fever</li> <li>10. Blood transfusion and safety</li> <li>11. Timing of vaccination: National Immunization Schedule</li> </ol>		

## References

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**ZOOLOGY CORE COURSE VIII**  
**PRACTICAL II - Cell and Molecular Biology, Genetics and**  
**Biotechnology and Immunology and Microbiology**  
**Course Code – AUZO64PII**

CO No.	Expected course outcomes <i>Upon completion of this course, the students will be able to:</i>
1	Identify cell organelles, barr body, mitotic stages, blood cells and polytene chromosome
2	Conduct pedigree analysis, karyotyping
3	Get expertise to carry out routine hematological and microbiological techniques
4	Prepare whole mounts, blood smear, squash preparation of root tip
5	Familiarise Mendelian genetics and Biotechnology techniques

COURSE DESCRIPTION	CO No.
<p><b>Cell Biology and Molecular Biology</b></p> <p>1. Staining of prokaryotic cells: (a) <i>Lactobacillus</i> from curd (b) Nitrogen fixing bacteria (<i>Rhizobium</i>) from root nodules of legumes</p> <p>2. Staining of eukaryotic cells: buccal epithelial cells (observe Barr body)</p> <p>3. Study of cell organelles</p> <p>4. Mitosis: stages in onion (<i>Allium cepa</i>) root meristem (squash preparation)</p> <p>5. Calculation of mitotic index and metaphase index in root meristem of <i>Allium cepa</i></p> <p>6. Meiosis: stages in testis of grass hopper (demonstration only)</p> <p>7. Giant chromosomes in Diptera: (<i>Drosophila Chironomus</i> larvae) salivary gland cells. (Demonstration only)</p>	1,3

<p><b>Genetics</b></p> <ol style="list-style-type: none"> <li>1. Study of monohybrid cross using coloured beads.</li> <li>2. Study of normal chromosome compliment and karyotype of man.</li> <li>3. Study of genetic syndromes and abnormal karyotypes of man (Klinefelter's syndrome, Turner's syndrome, Down syndrome and Edward syndrome).</li> <li>4. Study of Barr body and its significance (in stained buccal epithelial cells).</li> <li>5. Construction of Pedigree chart.</li> <li>6. Study of phenotypic characters of male and female Drosophila.</li> </ol>	2,5
<p><b>Biotechnology</b></p> <ol style="list-style-type: none"> <li>1. DNA extraction</li> <li>2. Polymerase Chain Reaction</li> <li>3. Southern blotting and Northern blotting</li> <li>4. Gene cloning (Demonstration in the Department / Visit to research institute / CD display)</li> </ol>	5
<p><b>Immunology and Microbiology</b></p> <ol style="list-style-type: none"> <li>1. Collection of blood, and study of the effect of anticoagulant.</li> <li>2. Total and differential count of blood cells.</li> <li>3. ABO and Rh systems of blood grouping.</li> <li>4. Microscopic observation and study of stained preparations of any two microbes.</li> </ol>	3,4

# SEMESTER VI

## ZOOLOGY CORE COURSE IX

### Human Anatomy, Physiology and Biochemistry

Course Code – AUZO641

Total hours 90

CO No.	Expected course outcomes <i>Upon completion of this course, the students will be able to:</i>
1	Analyze the structure and physiology of various organ systems and diseases associated with its function
2	Describe the structure and classification of major bio molecules
3	Describe the metabolism of different types of biomolecules
4	Explain the biochemical reactions involved in enzymes action

MODULE	COURSE DESCRIPTION	Hrs	CO No.
	<b>Physiology</b>	<b>60hrs</b>	
<b>1</b>	<b>Nutritional Physiology:</b> Structure of digestive system (self study). General introduction, types of nutrition, mechanical and chemical changes of food in the alimentary canal, balanced diet, nutritional disorders – PEM, vitamin deficiency, deficiency of iron, iodine and calcium, lifestyle diseases, role of fibres, nervous and hormonal control of digestion	<b>6hrs</b>	1
<b>2</b>	<b>Circulatory Physiology:</b> Structure of Heart. (self study). Blood- Composition and functions of blood plasma and formed elements, blood groups, mechanism of blood clotting, intrinsic and extrinsic pathways, disorders of blood clotting, anticoagulants, heartbeat, conducting system and pace maker, pulse and blood pressure, clinical	<b>8hrs</b>	1



	significance, control of cardiac activity, common cardiovascular diseases – arteriosclerosis, atherosclerosis, Myocardial infarction, electrocardiogram, angiogram, angioplasty. Lymph and lymphatic system (brief account)		
<b>3</b>	<b>Respiratory Physiology:</b> Structure of lungs (self study). Gas exchange, respiratory pigments- structure of haemoglobin, transport of O <sub>2</sub> - Oxyhaemoglobin curve, Bohr effect, transport of CO <sub>2</sub> -carbonic acid, carbamino haemoglobin, bicarbonate and chloride shift, regulation of respiration – neural and chemical; respiratory disturbances – apnoea, dyspnoea, hypoxia, hypo and hyper capnia, asphyxia, carbon monoxide poisoning, bronchitis, asthma. Physiological effects of smoking.	<b>8hrs</b>	<b>1</b>
<b>4</b>	<b>Renal Physiology:</b> Structure of Kidney. (self study). Nephron – structure, urine formation, counter-current multiplier system, role of kidney in osmoregulation, composition of urine, abnormal constituents of urine, regulation of kidney functions, renal disorders – nephritis, haematuria, renal calculi, acidosis and alkalosis – Dialysis and kidney transplantation.	<b>8hrs</b>	<b>1</b>
<b>5</b>	<b>Muscle Physiology:</b> Brief account of types of muscles, fast and slow twitch muscles, red and white muscles. Ultra structure of striated muscle fibre, muscle proteins, simple muscle twitch, summation, tetanus, tonus, All or None law, fatigue, oxygen debt, rigor mortis. Physiological and biochemical events in muscle contraction.	<b>8 hrs</b>	<b>1</b>
<b>6</b>	<b>Nerve Physiology:</b> Structure of Brain. (self study). Neurons – structure, types of neuron (self study). Synapse and types of synapse, nerve impulse propagation, synaptic transmission. Reflex action, refractory period, neuro transmitters, electro encephalogram. Nerve disorders – epilepsy, Alzheimer’s disease, Parkinson’s disease.	<b>6 hrs</b>	<b>1</b>
<b>7</b>	<b>Sensory Physiology:</b> Structure of eye and ear (self study). Physiology of vision, visual elements and pigments, photo chemistry of vision. Eye defects – myopia, hyperopia, presbyopia, astigmatism, cataract. Structure of ear and mechanism of hearing, hearing impairments – deafness,	<b>5 hrs</b>	<b>1</b>

	labyrinthine disease. Olfactory, gustatory and tactile sense organs		
8	<b>Reproductive physiology:</b> Male and female reproductive organs (self study). Reproductive cycles, puberty, adolescence, pregnancy, parturition, lactation and birth control.	3hrs	1
9	<b>Endocrinology:</b> Endocrine glands in man, hormones and disorders, feed-back mechanism, mechanism of hormonal activity.	8hrs	1
	<b>Biochemistry</b>	30hrs	
10	<b>Biomolecules:</b> micromolecules, macromolecules, water, buffer systems and importance; <b>Carbohydrates-</b> structure, classification- monosaccharides (trioses, tetroses, pentoses, hexoses, aldoses, ketoses), disaccharides and polysaccharides (homo and hetero polysaccharides); biological functions of carbohydrates. <b>Lipids-</b> classification- simple lipids, (neutral fats and waxes), conjugated lipids (phosphor lipids, sphingo lipids, glyco lipids, lecithins, cephalins, cerebrosides, gangliosides), derived lipids (fatty acids, steroids, prostaglandins), biological functions of lipids. <b>Proteins</b> - classification of proteins, amino acids- basic structure, structure of protein primary, secondary tertiary and quaternary structures, haemoglobin as atypical protein, biological functions of proteins.	8hrs	2
11	<b>Metabolism: Carbohydrate metabolism</b> – glycogenesis, glycogenolysis, hexose monophosphate shunt, metabolic pathway of glucose- glycolysis, Kreb’s cycle, electron transport series, chemi-osmotic theory, energetic; hormonal control of carbohydrate metabolism. <b>Lipid metabolism</b> – hydrolysis of lipid, beta oxidation, mention alpha and omega oxidation of fatty acids, hormonal control of lipid metabolism, hormonal control of lipid metabolism.	16hrs	3

	<b>Protein metabolism</b> – deamination, transamination, formation of urea, hormonal control of protein metabolism.		
<b>12</b>	Enzymes: Chemical nature, mechanism of enzyme action, factors affecting enzyme activity, kinetics of enzyme action, Michaelis – Menten equation, iso enzymes, co-enzyme, co-factors, enzyme activation and inhibition.	<b>6hrs</b>	<b>4</b>
	<p><b>Topics for assignments / seminars (not for ESE)</b></p> <ol style="list-style-type: none"> <li>1. Amino Acids</li> <li>2. Nucleic Acids</li> <li>3. Enzymes and their Classification</li> <li>4. Nutrients</li> <li>5. Vitamin deficiency diseases – symptoms and diagnosis</li> <li>6. Hormone deficiency diseases – symptoms and diagnosis</li> <li>7. Body temperature and its osmoregulation.</li> <li>8. Human brain</li> <li>9. Instruments used for the diagnosis of circulatory disorders.</li> <li>10. Kidney related diseases and their diagnostic instruments.</li> <li>11. Brain related diseases and their diagnostic tools.</li> <li>12. Submission of endocrine glands of mammals (goat, cow, buffalo, pig) description.</li> <li>13. Submission of models of diagnostic instruments with description.</li> </ol>		

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### **Biochemistry**

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# Semester VI

## ZOOLOGY CORE COURSE X

### Developmental Biology and Experimental Embryology

Course code – AUZO642

Total hours 72

CO No.	Expected course outcomes <i>Upon completion of this course, the students will be able to:</i>
1	Describe the main stages of fertilization and development common to most multicellular organisms.
2	Describe the main anatomical changes that occur during development
3	Explain the initial developmental procedures involved in Amphioxus, Frog and chick
4	Familiarise with information on state- of- the art experimental procedures in embryology

MODULE	COURSE DESCRIPTION	Hrs	CO No.
	<b>Developmental biology</b>	<b>57hrs</b>	
<b>1</b>	<b>Introduction</b> , historical perspective (brief account), theories- Preformation, Epigenesis, Recapitulation and Germplasm. Subdivisions of Developmental biology. Spermatogenesis and oogenesis, structure of Graafian follicle, typical egg and sperm. Polarity of egg, egg envelopes; classification of eggs based on different criteria.	<b>6 hrs</b>	1
<b>2</b>	<b>Fertilization:</b> Agglutination, sperm penetration, activation of egg, amphimixis; physiological and biochemical changes during and after fertilization. Parthenogenesis- introduction, natural and artificial parthenogenesis,	<b>5hrs</b>	1

	arrhenotoky and thelytoky, obligatory and facultative, significance of parthenogenesis.		
<b>3</b>	<b>Cleavage:</b> types of cleavage - holoblastic and meroblastic; patterns of cleavage – radial, bilateral, spiral, rotational; cell lineage in Planocera (brief account only). Morula formation in microlecithal, mesolecithal, macrolecithal eggs; blastulation - introduction, different types of blastula – stereo blastula, coeloblastula, discoblastula, periblastula, blastocyst. Presumptive organ forming areas and fate maps, eg. amphioxus, frog, construction of fate maps.	<b>7hrs</b>	<b>2</b>
<b>4</b>	<b>Gastrulation:</b> introduction, brief account of morphogenetic movements – epiboly and emboly (invagination, involution, infiltration, ingression, delamination, convergence, divergence) concept of germ layers, derivatives of germ layers.	<b>3hrs</b>	<b>2</b>
<b>5</b>	<b>Cell differentiation:</b> totipotency, pluripotency and unipotency of embryonic cells. Determination and differentiation in embryonic development. Gene action, Drosophila as a model organism (brief account only), Homeotic genes and Hox genes.	<b>5 hrs</b>	<b>2</b>
<b>6</b>	<b>Development: Amphioxus</b> - cleavage, blastulation, gastrulation, neurogenesis, notogenesis, mesoderm and coelom formation. <b>Frog</b> -cleavage, blastulation, gastrulation, organogeny – development of brain, eye, heart; metamorphosis - ecological, morphological and physiological changes and hormonal control. <b>Chick</b> - cleavage, blastulation, gastrulation, study of 24 hrs chick embryo; development of extra- embryonic membranes in chick. <b>Man</b> - implantation, pregnancy, parturition. Placentation in mammals – different types of placenta, functions.	<b>28hrs</b>	<b>3</b>
<b>7</b>	<b>Teratology:</b> definition, causes, infections, drugs and chemicals, metabolic imbalance, ionizing radiation, malnutrition, autoimmunization.	<b>3 hrs</b>	<b>4</b>
	<b>Experimental embryology</b>		

8	Spemann's constriction experiments, organizers and embryonic induction, transplantation experiments involving optic cup, nuclear transplantation experiments in amphibians. In vitro fertilization and embryo transfer experiments in farm animals, In vitro fertilization and embryo transfer experiments in man and test tube babies; cloning experiments in animals (mammals); prenatal diagnosis and sex determination methods – amniocentesis chorionic villus sampling, ultra sound scanning. Embryonic and adult stem cell research and stem cell therapy.	15hrs	4
	<p><b>Suggested topics for assignments / seminars (not for ESE).</b></p> <ol style="list-style-type: none"> <li>1. Human male and female reproductive organs.</li> <li>2. Larval forms of invertebrates.</li> <li>3. Metamorphosis in insects.</li> <li>4. Regeneration in animals</li> <li>5. Cloning experiments in animals.</li> <li>6. Transgenic animals.</li> <li>7. Stem cell research.</li> <li>8. Comparative account on cleavage, blastulation, gastrulation in different animals.</li> <li>9. Embryonic development of an invertebrate.</li> </ol>		

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**SEMESTER VI**  
**ZOOLOGY CORE COURSE XI**  
**Evolution, Ethology, Zoogeography & Pest Management**  
**Course Code – AUZO643**  
**Total hours 72**

CO No.	Expected course outcomes <i>Upon completion of this course, the students will be able to:</i>
1	Explain the concept on the origin of life, theories on organic evolution and its evidences
2	Describe the concept of speciation, types and causes
3	Analyze the science of animal behavior and on the concept of learning
4	State the origin of continents, factors affecting animal distribution and zoogeographical realms
5	Evaluate the methods of Integrated Pest Management and its applications

MODULE	COURSE DESCRIPTION	Hrs	CO No.
	<b>Evolution</b>		
<b>1</b>	Origin of universe, Origin of life, Chemical evolution, Urey-Miller experiment, Oparin and Haldane hypothesis	<b>(5 hrs)</b>	1
<b>2</b>	<b>Theories of organic evolution:</b> Lamarck's theory, it's criticism (Weisman's germplasm theory) Darwin's theory of natural selection (mention the contributions of Wallace) (self-study). Mutation theory, sexual selection theory.	<b>(1hrs)</b>	1

3	Geological timescale, fossils, fossilization, paleontological evidences of evolution, fossil dating and significance of fossils.	(4hrs)	1
4	<p><b>Modern concept of organic evolution:</b> (Neo Darwinism) - genetic basis of evolution- gene pool, gene frequency, mutation, role of mutation in evolution, neutral mutation (Kimura), genetic drift, genetic equilibrium; factors affecting genetic equilibrium and Hardy –Weinberg law.</p> <p><b>Natural selection:</b> types of selection (brief account of the observation in <i>Biston betularia</i>), isolation and isolating mechanisms; speciation- sympatric speciation and allopatric speciation.</p>	(12hrs)	1,2
5	Evolution above species level: Adaptive radiation, Microevolution, Macroevolution, Mega evolution	(8 hrs)	1,2
6	<p><b>Tempo of Evolution:</b> Gradualism vs Punctuated equilibrium, rates of evolution- Bradytely and Tachytely, Gould's and Eldridge's contributions, orthogenesis and orthoselection, anagenesis and cladogenesis.</p> <p><b>Evolution of man:</b> Organic and cultural, examples of trends in human evolution, brief accounts of Parapithecus, Propliopithecus, Dryopithecus, Ramapithecus, Australopithecus, Neanderthal, Cromagnon and Modern man.</p>	(10hrs)	1,2
	<b>Ethology</b>	12hrs	
7	<p><b>History and scope of ethology:</b> Motivation- models of motivation (Lorenz's psychohydraulic model and Deutsch's model). Learning- types of learning (imprinting, habituation, conditioned reflex, unconditioned reflex, latent learning, insight learning). Neural mechanisms in behaviour: role of hypothalamus and other brain centres. Hormones and behaviour; Sociobiology- social groups –merits and demerits, properties of organized societies,</p>	(12hrs)	3

	social groups in mammals, social stress. Pheromones and chemical communication; human pheromones.		
	<b>Zoogeography</b>	<b>10 hrs</b>	
<b>8</b>	<b>Animal Distribution:</b> Geographic distribution of animals-cosmopolitan distribution, discontinuous distribution, bipolar distribution and isolated distribution, factors affecting animal distribution, barriers to animal distribution- physical and biological barriers.	<b>4hrs</b>	4
<b>9</b>	<b>Zoogeographical Realms:</b> (brief account of each realm mention the areas included, physical features and fauna) Palaearctic region, Australian region, Ethiopian region, Nearctic region, Oriental region and Neotropical region. Biogeographical classification of India- Western Ghats, Eastern Ghats and Himalayas. <b>Insular Fauna:</b> Brief account of oceanic islands and continental islands (with one example each).	<b>6hrs</b>	4
	<b>Pest Management</b>		
<b>10</b>	<b>Pest Management:</b> Introduction. Types of pesticides. Its impact on environment. Components of Biological control, Biodiversity of biocontrol agents: Parasitoids, Predators and microbial agents, Advances in Integrated Pest Management, Insect parasitism, Insect host parasite relation and crop pest biocontrol agents their interactions, pest resistance	<b>10hrs</b>	5
	<b>Suggested topics for assignments / seminar (not for ESE).</b> 1. Biodiversity of sacred groves of Kerala. 2. Mangroves of Kerala and their importance. 3. Wild life sanctuaries of Kerala. 4. Depleting water resources of Kerala 5. Sand mining and related problems. 6. Threatened animals of India.		

	7. Pheromones and behaviour.		
	8. Origin of life.		
	9. Mesozoic reptiles.		

## References

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**ZOOLOGY CORE COURSE XII**  
**PRACTICAL III - Physiology and Biochemistry**  
**Course Code - AUZO64PIII**  
**No. of credits – 3**

CO No.	Expected course outcomes
	<i>Upon completion of this course, the students will be able to:</i>
1	Understand the clinical procedures for blood & urine analysis.
2	Analyze the biomolecules in the sample provided
3	Explain the working of different instruments used in physiological studies
4	Use chromatographic technique for separation of mixtures

Physiology	CO No.
1. Preparation of blood smear and study of blood cells of man. 2. Kymograph apparatus and explanation of simple muscle twitch. 3. Measurement of oxygen consumption of cockroach using Fen's respirometer. 4. Study of tonicity of blood cells 5. Effect of temperature / pH on salivary amylase activity 6. Digestion of starch and separation of maltose by dialysis.	1,3
Biochemistry	

<p>7. Urine analysis for the detection of abnormal constituents – glucose, albumin</p> <p>8. Detection of excretory products – ammonia (Nessler's test), urea (Ammonia generation/ Biuret test) and uric acid (Phosphotungstic acid test)</p> <p>9. Estimation of haemoglobin of blood using Haemoglobinometer.</p> <p>10. Paper chromatographic separation of amino acids</p> <p>11. Isolation of casein from milk.</p>	<p>2,3,4</p>
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**ZOOLOGY CORE COURSE XIII**

**PRACTICAL IV - Developmental Biology and Experimental Embryology and Ecology, Ethology, Evolution and Zoogeography**

Course Code –AUZO64PIV

<b>CO No.</b>	<b>Expected course outcomes</b> <i>Upon completion of this course, the students will be able to:</i>
1	Identify different types of eggs
2	Identify the developmental stages of embryo
3	Analyse the different parameters of and water
4	Identify zoogeographical realms

<b>COURSE DESCRIPTION</b>	<b>CO No.</b>
<b>Developmental Biology and Experimental Embryology</b>	
1. Study of different types of eggs-Amphioxus, frog, chick, man- based on models/charts. 2. Study of blastula- Amphioxus, frog- slide / model 3. Study of gastrula – frog-yolk plug stage - slide / model. 4. Mounting of 24hrs/48hrs chick blastoderm. 5. Study of placenta – any two types. 6. Sperm motility in fish (zebra fish) 7. Embryonic development of the egg of zebra fish (demonstration only)	1,2
<b>Ecology, Ethology, Evolution and Zoogeography</b>	



<ol style="list-style-type: none"> <li>1. Estimation of dissolved oxygen</li> <li>2. Estimation of CO<sub>2</sub></li> <li>3. Estimation of primary productivity using dark and light bottle</li> <li>4. Turbidity using Secchi disc</li> <li>5. Estimation of hardness of three different water samples.</li> <li>6. Measurement of pH of different water samples using pH meter, pH paper and indicator solution.</li> <li>7. Extraction of soil organisms using Berlese funnel and Baerman's funnel</li> <li>8. Construction of food web</li> <li>9. Study of ecological adaptations – any three</li> <li>10. Study of marine plankton – any three</li> <li>11. Alarm pheromones in ants.</li> <li>12. Write up on the contribution of Darwin and Lamark.</li> <li>13. Study different zoogeographical realms with fauna.</li> </ol>	<p>3,4</p>
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# OPEN & ELECTIVE COURSES

## SEMESTER V

### ZOOLOGY OPEN COURSE

#### Public Health and Hygiene

Course Code – AUZO581.a

Total hours 54

CO No.	Expected course outcomes
	<i>Upon completion of this course, the students will be able to:</i>
1	Make aware of the essentials of public health and sanitation.
2	Get awareness of Adulteration of food and diseases
3	Learn the principles of nutrition and dietetics
4	Describe the ill effects of modern lifestyle
5	Study the advantages of being hygienic

MODULE	COURSE DESCRIPTION	Hrs	CO No.
1	<b>Introduction:</b> Scope and importance of the study; balanced diet, diet control for diabetics, cholesterol etc., concept of energy, calories, daily food intake as per occupation, pregnancy and lactation, probiotics and nutraceuticals.  Dietary requirements of infants, pre-school children, school children, adults and geriatric care. Malnutrition and over nutrition – obesity and weight control;	6hrs	3

	defects of modern food habits – fast food, soft drinks, ice-creams and broiler chicken.		
2	<b>Adulteration of food:</b> food hygiene – hygiene of milk, meat, fish, eggs, fruits and vegetables, common food adulterants – harmful effects and their detection, food additives, fortification of food; Food Adulteration Act and its stringent implementation	4hrs	2
3	<b>Health Hazards:</b> Health dynamicity – definition, spectrum, factors influencing health, health as a medium of socio-economic development. Diseases – concept, terminologies, disease cycle, mode of transmission. Preventive methods including vaccination and its schedule.  Common food borne and water borne diseases (gastroenteritis, jaundice, cholera, salmonellosis, travellers’ diarrhoea and <i>Escherichia coli</i> infection, typhoid) – causative agents, symptoms, prevention and control. Emerging diseases, sexually transmitted infections – AIDS, genital herpes, hepatitis B, syphilis, gonorrhoea – causative agents, symptoms, modes of transmission and prevention. Dengue, chikunguniya, rat fever (general methods of mosquito control and the need to prevent mosquito breeding in and around our homes).  <b>Lifestyle habits</b> – excessive usage of T.V., computer, mobile phones, two wheelers, and their impacts on health. Lack of physical exercise and its deleterious effects on the body and mind	18hrs	1,2,4
4	<b>Health Education:</b> Definition, objectives, principles and methods of health education, ill effects of	6hrs	5

	<p>smoking, alcoholism and drug abuse (emphasis should be given to pan masala, amphetamines, hashish, opium, brown sugar, pethedine).</p> <p><b>Population control and family welfare</b>, use of contraceptives. Blood donation –basics of ABO, blood grouping including Rh factor. Genetic incompatibility and consanguineous marriages.</p>		
5	<p><b>Mental Health:</b> Definition by WHO and necessity of mental well being, major depressive disorders, substance abuse, schizophrenia, obsessive compulsive disorders, domestic violence, causes for lost years of healthy life, strategies for prevention and possible interventions, childhood mental disorders and illnesses, gulf widow syndrome, stress reduction and management (importance of yoga)</p>	12hrs	1,5
6	<p><b>Hygiene:</b> Definition, personal hygiene- body odour, oral hygiene, grooming, feminine hygiene, sleep hygiene, hand washing, toiletry. Social hygiene – clean living movements, occupational hygiene, food and cooking hygiene, medical hygiene, excessive hygiene.</p>	8hrs	1,5
	<p><b>Suggested topics for assignments / seminars (not for ESE).</b></p> <p>1. Medical camps maybe conducted in colleges and students can have routine blood tests and grouping done.</p> <p>2. Extension activities – Community programmes may be arranged for alcoholics and students may form self-help groups for extending social support.</p>		

	<p>3. Awareness programmes – Drinking water sources may be tested for possible contamination and classes on sanitation may be arranged for the local people.</p> <p>4. Case studies based on public hygiene.</p> <p>5. Survey of mental illness and symptoms among children of mentally retarded schools.</p> <p>6. Effect of alcoholism on the social life in a community</p> <p>7. Impact of tobacco addiction on the life of farmers</p>		
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### References

- Jatin V. Modi and Renjith S. Chawan. Essentials of Public Health and Sanitation, Part IV
- Murray, C. J. L. and A.D. Lopez. (1996). The Global Burden Of Disease. W H O.
- Park, J.E. and Park, K. Textbook of Community Health for Nurses.
- Swaminathan S. Principles of Nutrition and Dietetics.

**SEMESTER V**  
**ZOOLOGY OPEN COURSE**  
**Human Health and Sex Education**  
**Course Code –AUZO581.b**  
**Total hours 54**

	<b>Course Outcomes</b>
1	Address problem associated with health thereby promoting fitness and wellbeing.
2	Explain human reproductive system and assisted reproductive techniques
3	Educate the student on clean sexual habits thereby warding off sexually transmitted diseases.

<b>MODULE</b>	<b>COURSE DESCRIPTION</b>	<b>Hrs</b>	<b>CO No.</b>
<b>1</b>	<b>Introduction to health:</b> health as a state of wellbeing, health awareness, Immunity immunization and vaccination, factors affecting health- food, balanced diet, food supplements, pathogens, pollution, sleep, exercise and stress. Physical health, reproductive health, adolescence, senescence. Mental health- mental illness and disabilities, symptoms and prevention of mental illness; alcoholism, tobacco addiction, de-addiction, lifestyle diseases. Community health- health centres, role of health centres. Spiritual health, yoga and meditation.	<b>14hrs</b>	<b>1</b>

2	<p><b>Human reproductive system:</b> Male reproductive system- structural details of testis and accessory structures, functions of testis, semen, hormonal control. Female reproductive system- structure of ovary, accessory structures, puberty, reproductive cycles and hormonal control, menstrual cycle, gestation period, hysterectomy, menopause.</p>	8hrs	2
3	<p><b>Events of human reproduction:</b> Gametogenesis- spermatogenesis and oogenesis, ovulation, fertilization, embryonic development, parturition</p>	7hrs	2
4	<p><b>Human intervention in reproduction:</b> Contraception and birth control-barrier method, hormonal methods, natural methods, sterilization, termination of pregnancy. Infertility-male and female infertility, causes and treatment for infertility. Assisted Reproductive Techniques- IVF, GIFT, ZIFT, Donor Insemination (DI). Artificial Insemination by Donor (AID), Artificial Insemination by Husband or partner (AIH). Surrogacy, SUZI (sub-zonal insemination), MIST (micro insemination sperm transfer)</p>	12hrs	2
5	<p><b>Sexually transmitted diseases:</b> Syphilis, genital warts, chlamydia, chancroid, trichomoniasis, gonorrhea, genital herpes, AIDS</p>	6hrs	3
6	<p><b>Sex education:</b> Adolescent sexual activity, teenage pregnancy, sexual harassment, sexual awareness and policies (legal aspects), lesbian and gay sex, bisexual, transgender youth, adolescent stress management</p>	7hrs	3

	<p><b>Suggested topics for assignments / seminars (not for ESE0).</b></p> <ol style="list-style-type: none"> <li>1. A survey of lifestyle diseases in a locality</li> <li>2. A study on sexually transmitted diseases registered in a hospital</li> <li>3. A survey of vaccination in village, town and city</li> <li>4. Impact of yoga and meditation on health</li> <li>5. A survey of contraceptive methods prevalent among village and city people.</li> <li>6. A comparison of the affects of sexual harassment among school and college students.</li> <li>7. A survey of adolescent sexual activities in a city or town.</li> </ol>		
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## References

- Common sexual problems and solutions by Dr. Prakash Kothari, UBS Publishers and Distributors Ltd.
- Mac E. Hadley. Endocrinology. Pearson Education, Singapore.
- Taylor, D.J., Green, N.P.O., Stout G. W. Biological Science. (Editor R. Soper) 3<sup>rd</sup> Edition, Cambridge University Press.
- The Complete Manual of Fitness and Well-being. The Reader's Digest Association, Inc. Pleasantville, New York / Montreal.
- Guyton & Hall. Textbook of Medical Physiology.



# SEMESTER V

## ZOOLOGY OPEN COURSE

### Human diseases and their management

Course Code – AUZO581.c

Total hours 54

	Course Outcomes
1	Explain the need to create a healthy society
2	Learn the various modes and agents of disease transmission.
3	Describe the causative factors of non communicable diseases
4	Describe different diagnostic techniques

MODULE	COURSE DESCRIPTION	Hrs	CO No.
1	<b>Introduction:</b> Health-WHO definition, individual and community health, importance of individual health, history of human diseases, human diseases, cultural and social factors in health and diseases, differences in health and diseases.	4hrs	1
2	<b>Environment and health:</b> Basic health requirements in the environment. Water – sources and uses of water, water pollution, water-borne diseases and purification of water. Housing- basic human requirement- sanitation- nature and methods of purification of water. Air- composition and cause of discomfort- need for proper ventilation, removal of refuse- disposal and utilization of excreta (biogas).	6hrs	1

3	<b>Lifestyle choice for healthier life:</b> Diet and health, exercise and health, alcohol, tobacco and drugs, sex and health, computers and health, mobile phone and health, psychological health	4hrs	1
4	<b>Communicable diseases:</b> Classification of communicable diseases. Defense mechanism – immunity (natural, acquired)	3hrs	2
5	<b>Viral Infections:</b> Brief account of virus, chickenpox, poliomyelitis, rabies, yellow fever, dengue fever, mumps, influenza, measles, encephalitis, hepatitis, HIV infection and AIDS – causes, symptoms, prevention and cure.	4hrs	2
6	<b>Bacterial Infections:</b> Brief account of bacteria, dysentery, cholera, tuberculosis, tetanus, diphtheria, septicemia, scarlet fever, typhoid, plague; STD and leprosy – causes, symptoms, prevention and cure.	4hrs	2
7	<b>Protozoan Infections:</b> Brief account of protozoans - amoebiasis, leishmaniasis, trichomonosis, malaria - causes, symptoms, prevention and cure.	4hrs	2
8	<b>Worm Infections:</b> Brief account of platyhelminthes and nematods, cysticercosis, taeniasis, ascariasis, ancylostomiasis, encephalitis, enterobiasis and dracunculosis – causes, symptoms, prevention and cure.	4hrs	2
9	<b>Vector borne diseases:</b> Vector – identification of vectors – dengue, filaria, kala azar, Japanese encephalitis, chikungunya- causes, symptoms, prevention and cure.	3hrs	2
10	<b>Non-communicable diseases:</b> Hereditary and congenital diseases – haemophilia, diabetes mellitus, hypertension,	4hrs	3

	muscular dystrophia, some types of cancer. Immunological diseases – allergy, autoimmune diseases. Deficiency diseases – scurvy, pellagra, beriberi, xerophthalmia, rickets. Cardiovascular diseases-causes, symptoms, prevention and treatment.		
<b>11</b>	<b>Mental health:</b> Meaning, definition, history, characteristics of a mentally healthy person. Types of mental illness – causes, symptoms and prevention – major mental illness (schizophrenia, paranoia), minor mental illnesses (anxiety, phobia, obsessive compulsive neuroses)	<b>4hrs</b>	<b>1</b>
<b>12</b>	<b>Basic viewing techniques-</b> endoscopy examination techniques: Blood- total count, differential count, ESR, immune function tests, blood clotting test, routine blood chemistry, blood cholesterol test, hormone tests; urine-routine urine chemistry; cell and tissue test- pap test, sputum test, biopsy, histopathology; genetic tests- amniocentesis, chorionic villi sampling; imaging techniques- X – ray, ultrasound scanning, CT scan, MRI scan, SPECT scanning, PET scanning.	<b>8hrs</b>	<b>4</b>
<b>13</b>	Role of yoga in management of common diseases.	<b>2 hrs</b>	<b>1</b>
	<p><b>Suggested topics for assignments/ seminars (not for ESE).</b></p> <p>1. Epidemiological study of the above diseases. Questionnaire has to be prepared. Students have to be grouped in 10. Each student will have to visit 25 houses and record the observations. The data of 10 students (250 Houses) has to be tabulated, studied and interpreted. Every year the study, if possible, has to carry out in the same</p>		

	houses or to the same locality. This follow up survey will be very useful		
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## References

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- Anderson, G. M. Communicable Disease Control,. Macmillan, New York.
- Bajpee. (1995). Textbook of Preventive and Social Medicine. Jaypee Brothers Medical publishers, New Delhi.
- Chauhan, S. S. Mental Hygiene – A Science of Adjustment, Allied Publishers.
- Carol. D. Tampo. Diseases of Human body
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- Mangal, S., K. (2004). Introduction to Abnormal Psychology. Sterling Publishers.
- Mary L M, Mark Zelman, Paul Holdway; Human Diseases – A Systematic Approach.
- Park, K. (2005). Textbook of Prevention and Social Medicine, Jebelpur, Banarids.
- Park, J., E., and Park, K. Textbook of Preventive and Social Medicine.
- Swami Satyananda Saraswathi Swami Karam: Yogic Management of Common Diseases.

**SEMESTER VI**  
**ZOOLOGY ELECTIVE COURSE**  
**Economic Zoology - Vermiculture and Apiculture**  
**Course Code – AUZO691.a**  
**Total hours 54**

	<b>Course Outcomes</b>
1	Promote self employment and self reliance among educated youth
2	Describe the basic procedure and methodology of vermiculture
3	Explain the scope and methodology of apiculture.`

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<b>MODULE</b>	<b>COURSE DESCRIPTION</b>	<b>Hrs</b>	<b>CO No.</b>
	<b>Vermiculture</b>	<b>24hrs</b>	
<b>1</b>	<b>Introduction:</b> definition and scope of vermiculture. Nature and species of earthworms: habit categories – epigeic, endogeic and anecic, indigenous and exotic species ( <i>Eudrillus eugeniae/Eisenia foetidae/Perionyx excavatus/ Lampito mauritii</i> ), identification of the above four species based on morphological characters.	<b>6hrs</b>	1,2
<b>2</b>	<b>Methodology of vermicomposting:</b> step by step methodology – containers for culturing, raw materials required, preparation of bed, environmental pre-requisites, feeding, harvesting, and storage of vermicompost. Advantages of composting, precautions to be taken to prevent attack by pests and pathogens.	<b>10hrs</b>	1,2

3	<p><b>Vermicompost profile and applied aspects:</b> physical, chemical and biological parameters of vermicast, vermin enrichment, economic uses of vermiculture (biofertilizer, waste disposal, vermiwash, poultry feed, vermi-remediation etc.</p>	8hrs	1,2
	<p><b>Apiculture</b></p>	30hrs	
4	<p><b>Introduction and Scope:</b> Definition and significance of the study. Caste system and Social behaviour; common species of honeybees used, organization of bee colony, social life and adaptations of honeybees.</p>	8hrs	1,3
5	<p><b>Bee keeping methods and equipments:</b> indigenous methods, extraction appliances, extraction of honey from the comb and processing, management and maintenance of an apiary, bee pastures</p>	12hrs	1,3
6	<p><b>Diseases and economics:</b> diseases (bacterial, fungal, protozoan, acarine, brood diseases), preventive and curative measures. Use of honey, bees wax, bee venom, nutrient profile of honey, marketing strategies.</p>	10hrs	1,3
	<p><b>Suggested topics for assignments / seminars (not for ESE).</b></p> <p><b>Vermiculture</b></p> <ol style="list-style-type: none"> <li>1. Report of field visits to commercial/professional units</li> <li>2. Feasibility of maintaining a vermin-composting plant in the College maybe worked out</li> </ol>		

	<p>3. Awareness programmes on waste management through vermin-composting may be conducted for the local residence associations</p> <p><b>Apiculture</b></p> <p>1. Report of field visits</p>		
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### References

1. Cherian & Ramachandran Bee keeping in *South Indian* Govt. Press, Madras.
2. Gupta, K.C. Romance of bee keeping. Khadi Paristhan, Calicut.
3. Mary Appelhof. Worms eat my Garbage.
4. Mishra R.C. Perspectives in Indian Apiculture
5. Sathe, T.V. Vermiculture and Organic farming.

# SEMESTER VI

## ZOOLOGY ELECTIVE COURSE

### Ornamental fish production and management

Course Code – AUZO691.b

Total hours 54

	Course Outcomes
1	Aware of the vast potentials involved in ornamental fish farming and trading
2	Describe the scientific method of setting an aquarium
3	Learn the culture breeding and marketing techniques of common ornamental fishes

MODULE	COURSE DESCRIPTION	Hrs	CO No.
1	Importance and history of aquarium fish keeping. Design and construction of aquaria: aquarium fabrication- shape, size, volume, type of glass tank, cutting of glass, preparation of glass tank, strengthening and supporting of tank, fitting of tanks into room settings; aquarium floor setting – type and size of pebbles, gravels, granites used for bed setting and its advantages. Filters- biological, chemical and mechanical. Aquarium accessories like aerators, decorative, lighting, heating and feeding trays.	6hrs	1,2
2	Water quality management in aquarium systems – sources of water, containers, storage, temperature, pH, dissolved carbon dioxide, ammonia, hardness, turbidity and ozone in aquarium.	3hrs	1,2



3	<p>Aquarium plants: Uses of aquarium plants, different varieties of plants like submerged plants (tubers, rooted plants, cutting plants) and emerged plants , indoor plants and outdoor plants , selection of plants, planting techniques, propagation and maintenance of aquarium plants. Advantages of natural plants over artificial plants.</p>	5hrs	2
4	<p>Fresh water ornamental fishes: Common ornamental fishes- indigenous and exotic species; Identification and biology of the common ornamental fishes. <i>Cyprinus carpio</i> (koi carp), <i>Molliensia sphenops</i> (black molly lyre tail), <i>Poecilia reticulata</i> (guppy), <i>Poecilia latipinna</i>, <i>Xiphophorous helleri</i> (red sword tail) <i>Xiphophorous maculatus</i> (red platy) <i>Pterophyllum scalare altum</i> (angel fish) <i>Carassius auratus</i> (red oranda) <i>Betta splendens</i> (Siamese fighting fish) <i>Trichogaster leeri</i> (pearl gourami). Live bearers and egg layers. Sexual dimorphism in ornamental fishes.</p>	9hrs	3
5	<p>Breeding and rearing of common ornamental fishes. Conditions for breeding- pH, temperature and sex ratio. Brood stock management- selection of brooders, maintenance and management of brood stocks. Selective breeding and hybridization techniques. Induced breeding. Colour enhancement techniques.</p>	6hrs	3
6	<p>Aquarium maintenance- Setting up of a freshwater community tank and its maintenance. Food and feeding - live feed and formulated feed. Preparation and culture of live feed ( Artemia, Infusoria, Spirulina). Control of algal growth, snails and other</p>	6hrs	2,3

	predators. Common disease of ornamental aquarium fishes - their causative agents - virus, bacteria, fungi, protozoa and nematode; symptoms, treatment and prophylactic measures.		
7	Indigenous ornamental fishes - Common indigenous ornamental fishes. Identification and biology of the common ornamental fishes. Cyprinids : <i>Puntius denisonii</i> (red line torpedo fish), <i>Puntius fasciatus</i> (melan barb), <i>Puntius filamentosus</i> (Indian tiger barb), <i>Puntius curmuca</i> (red tailed silver shark) , <i>Danio malabaricus</i> (Malabar danio) ;Loaches ( <i>Nemacheilus triangularis</i> (Zodiac loach), <i>Lepidocephalus thermalis</i> ( Malabar loach) ; Cichlids: <i>Etoplus maculatus</i> (yellow and orange chromides), <i>E . suratensis</i> (pearl spot), Anabantids: <i>Anabas testudineus</i> (climbing perch)and Catfishes : <i>Horabagrus brachysoma</i> (Yellowish catfish), <i>H . nigricollaris</i> (White collared imperial catfish).	10hrs	3
8	Marine aquarium: preparation and maintenance of common marine ornamentals (Fishes, Crustaceans, Mollusks and Echinoderms). Collection, packing and transportation and marketing of indigenous ornamental fishes. Post harvest technology	4hrs	2
9	Constraints of farming and export of ornamental fishes: Convention on biodiversity; procedures for starting an export firm; training methods and entrepreneurship; funding agencies.	5hrs	1
	<b>Suggested topics for assignments / seminars (not for ESE).</b>		

	<ol style="list-style-type: none"> <li>1. Indigenous fishes of Kerala</li> <li>2. Indigenous ornamental fishes of India</li> <li>3. Feeding habits of fishes</li> <li>4. Nutritional requirement in fishes</li> <li>5. Aquarium plants</li> <li>6. Preparation of Community tank.</li> <li>7. Fish diseases</li> <li>8. Predators in a fish pond.</li> <li>9. Environmentally and genetically induced abnormalities in ornamental fishes.</li> <li>10. Economic importance of ornamental fishes.</li> </ol>		
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## References

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- Tom Lovell (1998). Nutrition and feeding of fish second Ed. Kluwer Academic publishers.
- Talwar.P.K., and Jhingran.A.G.,(1991). Inland fishes Oxford and IBH Publishing Co. PVT LTD, New Delhi.
- Web site: [www. Ornamentalfish.org](http://www.Ornamentalfish.org)

# SEMESTER VI

## ZOOLOGY ELECTIVE COURSE

### Dairy farming and Broiler farming

Course Code – AUZO691.c

Total hours 54

	Course Outcomes
1	Describe Breeds of livestock and know the Nutritive values of common feeds
2	Planning to establish dairy farm and Preparation and marketing of dairy products
3	Aid white revolution by improving the breeds of cattle
4	Learn the proper and scientific methodology behind poultry farming

MODULE	COURSE DESCRIPTION	Hrs	CO No.
	<b>Dairy farming</b>	<b>27hrs</b>	
<b>1</b>	Breeds of livestock and dairy farm: Breeds of Taurus (exotic) dairy cattle, breeds of zebu (Indian) cattle, breeds of dairy buffaloes; present status of dairy farming; planning to establish dairy farm, location of farm, different housing systems, dairy buildings, space requirements, economically setting a small farm.	<b>7hrs</b>	<b>1,2</b>
<b>2</b>	Nutritive values of common feeds, commercial and mixed feeds: Feeding and providing feed - feeds rich in minerals , feeds rich in protein , live stock tonics - hormones , thyroprotein , stilbestrol , urea for dairy cattle, toxic feeds,	<b>5hrs</b>	<b>1</b>

	food-poisoning - Balancing the dairy ration - general rule for feeding dairy herd.		
<b>3</b>	Mechanism of reproduction: Male reproductive organs, female reproductive organs, role of hormones in male reproduction, role of hormones in female reproduction; care and management of newborn animals.	<b>4hrs</b>	<b>2</b>
<b>4</b>	Artificial insemination: Advantages of artificial insemination over natural breeding, limitation of A.I, problems under Indian conditions; collection of semen - electro ejaculation, dilution of semen and cryopreservation, insemination , cleaning and sterilization of apparatus.  Common parasites in India and cure methods - External parasites and pest, reproductive diseases, milk borne diseases.	<b>6hrs</b>	<b>3</b>
<b>5</b>	Preparation and marketing of dairy products: Determining quality of milk, choosing market outlet, assembling dairy products from farms, co-operative action among creameries, hauling  milk to city markets; Marketing fluid milk (i) Specific gravity of milk (ii) determination of specific gravity with a lactometer (iii) pasteurization of milk (iv) advantages of pasteurization; determining cost of distribution.	<b>5hrs</b>	<b>3</b>
	<b>Broiler farming</b>	<b>27hrs</b>	
<b>6</b>	History, contribution to remove protein deficiency, role of broiler farm in urban and rural areas, employment potential, export potential. Poultry breeds, broiler strains	<b>5hrs</b>	<b>4</b>

	available in India, day old chicks and their maintenance, hatchery potential; parental stocks and their maintenance		
<b>7</b>	Poultry house, site, space requirement, types of houses-cage and deep-litter system, equipment for feeding and watering, lighting for poultry houses, ventilation.	<b>5hrs</b>	<b>4</b>
<b>8</b>	Nutrition of poultry birds, nutritional requirements according to age, starter feed, finisher feed, feed formulation. Availability of raw material for feed; use of antibiotics, aminoacids and minerals.	<b>5hrs</b>	<b>4</b>
<b>9</b>	Brooding and rearing baby chicks, types of brooders, vaccination, summer management and monsoon management.	<b>5hrs</b>	<b>4</b>
<b>10</b>	Diseases and health management, common diseases caused by viruses, bacteria and worms, ranikhet, fowl pox, worms and other parasites, toxicosis and account of aspergillus, aflotoxin, Salmonella; deworming and insecticide treatment; machanised dressing methods; cold storage, avoiding aflotoxin.	<b>7hrs</b>	<b>4</b>
	<p><b>Suggested topics for assignments / seminars (not for ESE).</b></p> <p><b>Dairy farming</b></p> <p>Breeds of Taurus (exotic) dairy cattle, Breeds of zebu (Indian) cattle, Breeds of dairy buffaloes.  Planning to establish dairy farm.  Setting a small farm.  Feeding and providing feed to dairy animals.  General rule for feeding dairy herd.  Role of hormones in male reproduction.  Role of hormones in female reproduction.  Care and management of newborn animals.</p>		

	<p>Advantages of Artificial insemination over natural breeding.</p> <p>Common parasites in India and cure methods - External parasites and pest.</p> <p>Reproductive diseases - Milk borne diseases.</p> <p>Determining quality of milk.</p> <p>Marketing fluid milk.</p> <p><b>Broiler farming</b></p> <p>Role of broiler farm to remove protein deficiency.</p> <p>Role of broiler farm in employment potential and export potential.</p> <p>Day old chicks and their maintenance.</p> <p>Parental stocks and their maintenance.</p> <p>Setting up of broiler farming.</p> <p>Feed formulation. Availability of raw material for feed;</p> <p>Use of antibiotics, aminoacids and minerals.</p> <p>Brooding and rearing baby chicks.</p> <p>Summer management and monsoon management.</p> <p>Diseases and health management.</p>		
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## References

### Dairy farming

Banerji, G.C. A text book of Animal husbandry, 1998. Oxford & IBH.

ICAR. Handbook of Animal Husbandry, 1990/97, ICAR, PUSA.

### Broiler farming

Gnanamani. Profitable Poultry Farming.

Banerji, G.C. Poultry. Oxford & IBH.

**SEMESTER VI**  
**ZOOLOGY PROJECT AND FIELD STUDY**  
**Course Code – AUZO644**

	<b>Course Outcomes</b>
1	Develop an aptitude for research in Zoology
2	Inculcate proficiency to identify appropriate research topic and presentation

**Specifications**

Topics of biological interest can be selected for the project.  
Project is to be done by a group not exceeding 10 students.  
Every student should submit typed (A4 paper, 12 Font, 1.5 Space), spirally bind project report in duplicate to the department on the day of the examination of Practical II.

A copy duly attested by the supervising teacher and the Head of the Department must be placed for ESE before a board of two Examiners.

The viva-voce based on the Project is conducted individually.  
Project topic once chosen shall not be repeated by any later batches of students.

**The project report may contain the following sections**

Preliminary (Title page, declaration, Certificate of the supervising teacher, content etc.)

Introduction with relevant literature review and objective

Materials and Methods

Result

Discussion

Conclusion / Summary

References.



**Field study**

A total of eighteen hours (1hour/week) are allotted to field study in the fifth semester. Field study of 4 days is compulsory. Students are directed to visit one research institute and one wild life sanctuary / ecosystem / museum / zoo, preferably with in the state of Kerala. Scientifically prepared hand written study tour report must be submitted by each student for ESE on the day of the examination of Practical II.

**ZOOLOGY COMPLEMENTARY COURSES  
OFFERED TO FDP BOTANY**

*(with effect from 2021 admission)*

**FIRST DEGREE PROGRAMME**  
**ZOOLOGY COMPLEMENTARY COURSES**

Table I. Scheme of Instruction and Evaluation

Semester	Course Code	Course Title	Instructional hours/week		Credits	Duration of ESE	Evaluation		Total Credits
			T	P			CE	ESE	
I	AUZO131.2a	Animal Diversity I	2	2		3hrs	20%	80%	2
		Practical		2					
II	AUZO231.2a	Animal Diversity II	2	2		3hrs	20%	80%	2
		Practical		2					
III	AUZO331.2a	Functional Zoology	3	3		3hrs	20%	80%	3
		Practical		2					
IV	AUZO431.2a	Applied Zoology	3	3		3hrs	20%	80%	3
	AUZO43.2a PI	Practical of s1, s2, s3& s4		2	4	3hrs	20%	80%	4

T – Theory, P – Practical, CE – Continuous Evaluation, ESE – End Semester Evaluation

**ZOOLOGY COMPLEMENTARY COURSE****TABLE II: SCHEME OF QUESTION PAPER – THEORY COURSES**

<b>Type of Questions</b>	<b>Question No.</b>	<b>No. of questions to be answered</b>	<b>Marks</b>
I. One word/sentence	1 - 10	10 out of 10	1 x 10 = 10
II. Short Answer	11 - 25	10 out of 15	2 x 10 = 20
III. Short Essay	26 - 34	6 out of 9	5 x 6 = 30
IV. Long Essay	35 - 38	2 out of 4	10 x 2 = 20
<b>TOTAL</b>			<b>80</b>

**TABLE III. SCHEME OF QUESTION PAPER – PRACTICAL**

<b>Type of Questions</b>	<b>Marks</b>
I. Major Practical	25
II. Minor Practical	15
III. Qualitative analysis	15
IV. Spotters	10
V. Record	15
Total	80

## **First Degree Programme**

### **Zoology Complementary Course**

#### **Scheme of Instruction**

Complementary courses offered by the department of Zoology to the students of other disciplines are distributed over the first four semesters. There are 5 complementary courses – four theory courses and one practical course. Semester I offers Complementary Course I -Animal Diversity I(Course Code (AUZO131.2a) and Semester II offers Course II Animal Diversity II (Course Code AUZO231.2a) both with 36 hours of instruction (2hours/ week) and 2 credits. Semester III offers Complementary Course III Functional Zoology (Course Code AUZO331.2a) and Semester IV offers Complementary Course IV Applied Zoology (Course CodeAUZO431.2a ) both having 54 hours (3hours/week) and 3 credits. Complementary Course V is Practical I(Course Code AUZO43.2aPI) related to the four Complementary Theory Courses. Hours for the practical are allotted during all the four semesters, 2 each in the first and second semesters and 3 each in the third and fourth semesters. A total of 4 credits are given. University level examination of Complementary Course Practical I will be conducted at the end of fourth semester.

The scheme of Instruction Evaluation of Zoology Complementary Courses is given in Table I.

#### **Scheme of Evaluation**

Evaluation of theory and practical courses involve Continuous Evaluation (CE) and End Semester Evaluation (ESE). The proportion of grade of CE and ESE is 1:3. CE is for 20% and ESE for 80%.All theory courses have ESE at the end of the corresponding semesters. But Practical course has ESE at the end of fourth semester. Both Continuous Evaluation and End Semester Evaluation are carried out with marks and then grading. The system of seven point grade scale adopted is given in Table .A

## Criteria for Grading (SCPA/CCPA/Courses)

Table A. seven point scale of grading

Grade	Performance	CCPA	Percentage of Marks
A+	Outstanding	9 and above	90 and above
A	Excellent	8 to < 9	80 to < 90
B	Very Good	7 to < 8	70 to < 80
C	Good	6 to < 7	60 to < 70
D	Satisfactory	5 to < 6	50 to < 60
E	Adequate	4 to < 5	40 to < 50
F	Failure	< 4	Below 40

### I. Continuous Evaluation (CE)

Continuous Evaluation of each course will be done by the faculty member who is engaging the course. CE is based on the student's attendance, performance in the class tests, seminars / assignments and records of practical. Assignments and answer scripts are to be returned to the students after evaluation.

The process of Continuous Evaluation must be transparent. Monitoring of the First Degree Programme is done by committees at three levels – Department Level Monitoring Committee (DLMC) and College Level Monitoring Committee (CLMC). DLMC consists of the Head of the Department and all teachers of the Department. They monitor the conduct of courses and CE. The Head of the Department be the Chair person and a teacher selected by the DLMC from among the members is the Convener. College Level Monitoring Committee will consider the complaints not redressed by the DLMC.

#### CE of Theory courses (Weightage: 20 )

The different components considering for CE of theory courses and corresponding weightage are given in the Table B.

Table B. Components and weightage for CE of theory course.

Sl. No.	Components	Marks
1.	Attendance	5
2.	Class test	10

3.	Seminar/ Assignment	5
Total		20

### 1. Attendance (5)

The allotment of grades for attendance is given in Table C.

Table C. Grading of attendance

Attendance	Marks
Above 90%	5
85% to 90%	4
80% to 85%	3
76% to 80 %	2
Attendance 75%	1

A student with attendance below 75% cannot appear for the ESE

## 2. One Class Test (Weightage 10)

Two class tests must be conducted for each course during the semester. CE is the average grade of the two test papers. Weightage for this is 2. Question pattern of ESE can be adopted for test papers. Grading process is similar to that of ESE.

## 3. Seminar/ Assignment (5)

Each student is required to do one seminar or one assignment for each course. Seminar, with mark 5, is to be graded based on the way of presentation, matter content, etc. These factors can be graded on the seven-point scale as given in Table A.

Each assignment is to be graded based on timely submission, content, etc. on the five-point scale as given in Table A.

### CE of Practical courses: (20 marks)

The different components considering for CE of Practical courses and corresponding marks are given in the Table D.

Table D. Components for CE of Practical course

Sl. No.	Component	Marks
1.	Attendance	5
2.	Performance	5
3.	One Class test	5
4.	Record	5
Total		20

- 1. Attendance:** (5) same as given for theory CE in Table C.
- 2. Performance in Laboratory :** (5) Grade the students in the five-point scale as given for theory (Table A).
- 3. Class test:** (5) One class tests must be conducted for a practical course during a semester. Grading process is similar to that of ESE.
- 4. Record:** (5) Record is to be assessed taking into account the following points – timely presentation, content, accuracy of diagrams and neatness. Record grading is also on the seven-point scale as given for theory (Table A).



**A. Theory**

All theory courses have End Semester Examination at the end of the corresponding semester. The duration of examination is 3 hours per course.

Total marks of Theory ESE is 80. Scheme of Instruction and Evaluation of Complementary Courses is given in Table I. Grading is according to the seven point scale

**B. Practical:**

End Semester Examination of Practical I will be held at the end of the fourth semester. The duration of examination is 3 hours. Weightage of Practical ESE is 80 marks. The question papers for the conduct of ESE of Practical will be prepared by the Board of Examiners appointed by the University. Practical examination is to be conducted by a team of one external examiner and an internal examiner. A batch may contain a maximum of 15 candidates per session of the exam.

The scheme of question paper of practical course along with marks is given in Table III.

**C. Record**

Practical Course has a record book. Candidates must submit the record of the Practical Course on the day of the examination before the External Examiners for ESE. Candidates without certified record book are not allowed to appear for the examination.

# SEMESTER I

## Zoology Complementary Course I

### Animal Diversity I

Course Code – AUZO131.2a

Total hours 36

CO NO.	AIM OF THE COURSE
1	A good attitude is developed in Biology students towards life.
2	Awareness of different Biological processes is developed in students.
3	Zoology helps the students to know precision and complexity of life.

CO No.	Expected course outcomes <i>Upon completion of this course, the students will be able to:</i>
1	Explain basics of systematics and the hierarchy of different categories
2	Explain the diagnostic characters and classification of each phyla through brief studies of typical examples.
3	Describe the anatomical features of non-chordates through type study of Phylum Arthropoda
4	Evaluate the pathogenicity and economic importance of various invertebrates.

MODULE	COURSE DESCRIPTION	Hrs	CO No.
<b>1</b>	<b>Introduction, Kingdom Protista</b>	<b>4</b>	
1.1	Introduction: Classification of organisms-kingdom system, five kingdom system.	1	1

1.2	Kingdom Protista- general features and classification: Phylum Rhizopoda e.g., Entamoeba, Phylum Dinoflagellata e.g., Noctiluca, Phylum Parabasalia e.g., Trichonympha, Phylum Ciliophora e.g., Paramecium.	3	2
	Phylum Apicomplexa e.g., <i>Plasmodium</i> - life history and pathogenicity (self-study).		
<b>2</b>	<b>Kingdom Animalia, Phylum Porifera, Phylum Cnidaria</b>	<b>5</b>	
2.1	Kingdom Animalia: Salient features, levels of organization- cellular, tissue, organ and organ system. Branches- Mesozoa, Parazoa and Eumetazoa-radiata and bilateria- Protostomia and Deuterostomia; acoelomata, pseudocoelomate and eucoelomata- schizocoela and enterocoela; body segmentation- metamerism and pseudometamerism.	1	2
2.2	Phylum Porifera: general characters (self-study), classification up to classes- Class Calcarea eg. Sycon, Class Hexactinellida e.g., Euplectella, Class. Desmospongiae e.g., Spongilla.	2	
2.3	Phylum Cnidaria: general Characters (self-study), classification up to classes, Class Hydrozoa e.g., Obelia, Physalia, Class Scyphozoa e.g., Aurelia (mention larval stage), class Anthozoa e.g., Sea anemone	2	
<b>3</b>	<b>Phylum Nematoda, Phylum Annelida, Phylum Mollusca, Phylum Onychophora</b>	<b>9</b>	
3.1	Phylum Nematoda: general characters (self-study), classification up to classes- Class Secernentea (Phasmida) e.g., Ascaris, Class Adenophorea (Aphasmida) e.g., Trichinella.	2	2
3.2	Phylum Annelida: general characters (self-study), classification up to classes- Class Polychaeta e.g., Neris (mention parapodium, heteroneries), Class Oligochaeta e.g., earthworm (mention vermiculture), Class Hirudinea e.g., Hirudinaria.	3	2

3.3	Phylum Mollusca: General characters (self-study), classification up to classes- Class Aplacophora e.g., Neomenia, Class Monoplacophora e.g., Neopilina, Class Bivalvia e.g., pearl oyster, Class Gastropoda e.g., Pila, Class Cephalopoda e.g., Sepia, class Scaphopoda eg. Dentalium.	3	2
3.4	Phylum Onychophora: General characters, e.g., Peripatus.	1	2
4	<b>Phylum Arthropoda</b>	<b>15</b>	
	Phylum Arthropoda: General characters (self-study), classification up to classes- Subphylum Trilobitomorpha- Class Merostomata eg. Limulus, Class Arachnida eg. scorpion, Class Pycnogonida eg. Nymphon; Subphylum Mandibulata- Class Crustacea eg. prawn (detailed study), Sacculina, Class chilopoda eg. Scolopendra, Class Symphyla e.g. Scutigera, Class Diplopoda eg. Spirostreptus, Class Pauropoda eg. Pauropus, Class Insecta eg. Cockroach (self-study- external characters mouth parts, digestive system), mosquitoes- Anopheles, Culex and Aedes - pathogenicity of mosquitoes. Pest of paddy - Leptocorisa and Spodoptera, Coconut palm Oryctes rhinoceros and Eriophid mite, stored food grains -Sitophylus oryzae and Triholium.	15	2,3,4
<b>5</b>	<b>Phylum Echinodermata</b>	<b>3</b>	
	Phylum Echinodermata: General characters (self-study), classification-Class Asteroidea e.g., Sea star, Class Ophiuroidea e.g., brittle star, Class Echinoidea e.g., sea urchin, Class. Holothuroidea e.g., Sea cucumber, Class Crinoidea e.g., sea lily (mention larval stages)	3	2
	<b>Suggested topics for Assignments /Seminars</b>		
	<ol style="list-style-type: none"> <li>1. Life history and Pathogenicity of <i>Plasmodium</i></li> <li>2. Metagenesis with reference to <i>Obelia</i> colony.</li> <li>3. Parasitic flat worms</li> <li>4. Human nematode Parasites</li> </ol>		

	5. Vermiculture		
	6. Economic importance of Molluscs		
	7. Evolutionary Significance of Peripatus		
	8. Insect vectors		
	9. Pest management		

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- Chandler, A.C. and Read. Parasitology.
- Hickman C.P. and Roberts L.S. (1994) Animal Diversity. Wm. C. Brown, Dubuque, IA
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- Ruppert E.E., Fox R and Barnes R.D. (2004) Invertebrate Zoology. Thomson Books.Cole. USA>

**SEMESTER II**  
**Zoology Complementary Course II**  
**Animal Diversity II**

Course Code – AUZO231.2a

Total hours 36

CO No.	Expected course outcomes
	<i>Upon completion of this course, the students will be able to:</i>
1	Identify the Animal diversity around us.
2	Describe the general characters and classification of Protochordates
3	Explain the diagnostic characters and classification of different classes of vertebrates through brief studies of typical examples.

MODULE	COURSE DESCRIPTION	Hrs	CO No.
<b>1</b>	<b>Phylum Chordata, Subphylum Urochordata, Subphylum Cephalochordate</b>	<b>5</b>	
1.1	Phylum Chordata: Salient features of the phylum Chordata (self- study), classification up to classes		1
1.2	Subphylum Urochordata e.g., <i>Ascidia</i> - general characters, external features and retrogressive metamorphosis	3	2
1.3	Subphylum Cephalochordate e.g., <i>Amphioxus</i>	2	2
<b>2</b>	<b>Subphylum Vertebrata, Super class Pisces, Class Amphibia</b>	<b>14</b>	
2.1	Subphylum Vertebrata: General characters (self-study), classification		1,3
2.2	Super class Agnatha eg. <i>Petromyzon</i> ; Super class Pisces eg. <i>Scoliodon</i> , <i>Narcine</i> , <i>Anguilla</i> , <i>Echeneis</i> , <i>Hippocampus</i> , <i>Etroplus</i> , mackerel, sardine, pomfret;	4	1,3

2.3	<p>Super class Tetrapoda- Class Amphibia-general characters eg. <i>Ichthyophis</i>, <i>Rhacophorus</i>, <i>Amblystoma</i>-axolotl larva.</p> <p>Type: frog. External features Digestive system, Respiratory system, Circulatory system- structure and working of heart Skeletal system –skull excluded. Nervous system - structure and function of brain, Urinogenital system, Reproductive system</p> <p>General topic: Parental care in amphibia.</p>	10	1,3
<b>3</b>	<b>Class Reptilia</b>	<b>9</b>	
	<p>Class Reptilia: General characters (self- study), eg. <i>Calotes</i>, <i>Draco</i>, <i>Chaemeleon</i>, <i>Chelone</i>, snakes-general features, non- poisonous snakes eg. <i>Lycodon</i>, <i>Ptyas</i> (external features and peculiarities of examples), poisonous snakes eg. <i>Naja</i>, <del>viper</del> <i>Bungarus</i>, <i>Enhydrina</i> (characteristic features), identification of poisonous and non- poisonous snakes, different types of venom, mode of action.</p>		1,3
<b>4</b>	<b>Class Aves</b>	<b>5</b>	
	<p>Class Aves: General characters (self-study), flightless birds- eg. ostrich and kiwi, flying birds eg. pigeon- mention different types of feathers and pea fowl. Flight adaptations of birds.</p>		1,3
<b>5</b>	<b>Class Mammalia</b>	<b>3</b>	
	<p>Class Mammalia- general characters (self -study), eg. echidna, kangaroo, bat, loris, tiger and whale.</p>		1,3
	<p><b>Suggested topics for assignments / seminars</b></p> <ol style="list-style-type: none"> <li>1. Retrogressive metamorphosis in Ascidia</li> <li>2. Feeding mechanism in Amphioxus</li> <li>3. Common edible fishes of Kerala.</li> <li>4. Metamorphosis of Frog</li> <li>5. Arboreal adaptations of Reptiles</li> <li>6. Identification of poisonous and non-poisonous snakes.</li> <li>7. Snake bite and its first aid</li> </ol>		

	8. Flight adaptations of birds 9. Aquatic adaptation in Mammals 10. Larvivorous fishes 11. Bird migration		
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#### References

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- Ekambaranatha Ayyar, M. and Ananthkrishnan, T.N. A Manual of Zoology. Vol II
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**SEMESTER III**  
**Zoology Complementary Course III**  
**Functional Zoology**  
**Course Code – AUZO331.2a**  
**Total hours 54**

CO No.	Objectives of the course
1	Describe the structure and function of each system in the human body.
2	Analyse the etiology of common physiological disorders, syndromes and diseases.
3	Explain the scope and basics of immunology

MODULE	COURSE DESCRIPTION	Hrs	CO No.
1	<b>Nutrition:</b> Types of nutrition – components. Brief mention of disorders (deficiency diseases).	4	1
2	<b>Respiration:</b> Respiratory pigments and their functions with special emphasis on transport of oxygen and carbon dioxide. Neural and hormonal control of respiration in man. Respiratory disturbances: brief mention of Apnoea, Dyspnoea, Hypoxia, Hypo and Hypercapnia, Asphyxia and Carbon monoxide poisoning. Physiological effects of smoking.	6	1,2
3	<b>Circulation:</b> Blood-composition and functions, blood groups, mechanism of blood clotting (intrinsic and extrinsic pathways), anticoagulants, disorders of blood clotting -haemophilia and thrombosis. Heart - neurogenic and myogenic, peculiarities of cardiac muscle. Heartbeat, pace maker. Blood pressure, ECG, cardiovascular disorders- arteriosclerosis, myocardial infarction, and hypertension; angiogram and angioplasty.	8	1,2
4	<b>Excretion and osmoregulation:</b> Classification of animals based on excretory wastes. Human nephron - structure and urine formation - ultrafiltration,	6	1,2

	selective reabsorption, tubular secretion and counter current mechanism; hormonal control of renal function; composition of urine. Kidney diseases - proteinuria, uremia, acidosis and alkalosis; dialysis.		
<b>5</b>	<b>Neurophysiology:</b> Neurone-structure, nerve impulse latent period; synapse and synaptic transmission--resting potential, action potential and All or none law, refractory period, Neurotransmitters. Saltatory transmission and EEG.	<b>6</b>	1,2
<b>6</b>	<b>Muscle physiology:</b> Ultrastructure of a striated muscle fibre, mechanism of muscle contraction, brief mention of muscle twitch, summation, tetanus and tonus, all or none law, fatigue, oxygen debt and rigor mortis.	<b>8</b>	1,2
<b>7</b>	<b>Endocrinology:</b> List the various endocrine glands and their corresponding hormones, brief description of hormonal influence, action and hormonal disorders- goitre, cretinism exophthalmic goitre, diabetes mellitus, diabetes insipidus, dwarfism, gigantism and acromegaly. Role of Hormones in reproductive cycle.	<b>8</b>	1,2
<b>8</b>	<b>Immunology:</b> Types of immunity-innate, acquired, active, passive, humoral and cell mediated. Cells, tissues and organs of immune system- lymphocytes, lymphoid tissue and organs (Lymph nodes, spleen, bone marrow, thymus and mucosa associated lymphoid tissue). Antigens. Antibodies- structure and function of immunoglobulin, classes of immunoglobulins. Hypersensitivity and allergy; immunization-passive and active; vaccination. AIDS and its etiology.	<b>8</b>	3
	<p><b>Suggested topics for assignments / seminars</b></p> <ol style="list-style-type: none"> <li>1. Vitamins and deficiency diseases</li> <li>2. Health hazards of smoking</li> <li>3. Respiratory disorders</li> <li>4. Cardiac disorders</li> <li>5. Dialysis and Artificial kidney</li> <li>6. Impulse transmission in a nerve</li> <li>7. Physical and Chemical events in muscle contraction</li> <li>8. Hormonal disorders in Man</li> </ol>		

	9. Allergic conditions		
	10. AIDS		
	11. Osmoregulation		
	12. Immune dysfunction		

### References

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- Ganong, W.F. (2002) Lange Review of Medical Physiology. Mc G H.
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**SEMESTER IV**  
**Zoology Complementary Course IV**  
**Applied Zoology**  
**Course Code – AUZO431.2a**  
**Total hours 54**

CO No.	Objectives of the course
1	To learn the basic principles involved in the culture and breeding of common edible and ornamental fishes of Kerala and the art of aquarium keeping and Live Stock Management.
2	To do sericulture and apiculture
3	To get a basic understanding of human genomics and reproductive biology including stem cell research and prenatal diagnostic techniques

MODULE	COURSE DESCRIPTION	Hrs	CO No.
1	<b>Aquaculture:</b> Traditional methods of aquaculture, fishing crafts and gears, common fishes used for culture in Kerala, Catla, Etroplus, Tilapia and Mugil; capture fishes- sardine, mackerel. Pond culture: Construction, maintenance and management; carp culture, shrimp culture, shellfish culture, composite fish culture and pearl culture Ornamental fish culture: Fresh water ornamental fishes – biology, breeding habits, spawning, hatching and rearing techniques. Construction and maintenance of aquarium: Construction of home aquarium, materials used, setting up of freshwater aquaria, aquarium plants, ornamental objects, cleaning the aquarium, maintenance of water quality, control of snail and algal growth.	17	1
2	<b>Sericulture:</b> Brief account of morphology and life history of silkworm, varieties of silkworm, rearing technique, mulberry cultivation, diseases and pests of silkworm. Processing of cocoon, reeling and marketing of silk.  <b>Apiculture:</b> Species of honey bees, social organization of honey bees, apiary management	10	2

	and maintenance, bee keeping equipments, bee pasturage, honey and bees wax and their uses.		
<b>3</b>	<p><b>Live Stock Management:</b> Poultry farming-poultry breeds: mention American, Asiatic, Mediterranean, English and indigenous breeds. Poultry breeding and poultry products; rearing of chicks, growers, layers, broilers, ducks, turkeys and quails; diseases of poultry.</p> <p>Dairy farming: Types, loose housing system and conventional barn system; advantages and limitations of dairy farming; establishment of dairy farm and choosing suitable dairy animals, feed, diseases of dairy animals.</p>	<b>8</b>	<b>1</b>
<b>4</b>	<p><b>Human Genetics:</b> Normal chromosome complements; karyotype study, pedigree analysis. Syndromes- autosomal syndromes (Down's syndrome and Edwards syndromes), sex chromosomal syndromes (Turners syndrome and Klinefelter's syndrome), genetic disorders-single gene disorders (sickle cell anaemia and phenyl ketonuria), multifactorial disorders (cleft lip, and cleft palate), genetic counselling.</p> <p><b>Developmental Biology and Biotechnology:</b> Types of egg; fertilization; types and pattern of cleavages, blastulation different types of blastula, gastrulation-morphogenetic movements (epiboly and emboly). Brief description of organizers and embryonic induction. Cloning experiments in animals and man. Embryonic stem cell research. Parental diagnostic techniques. Amniocentesis. Chronic villus sampling, ultrasound scanning. Test tube babies, human genome project, human genome therapy.</p>	<b>7</b>	<b>3</b>
	<p><b>Suggested topics for assignments / seminars</b></p> <ol style="list-style-type: none"> <li>1. Genetic disorders</li> <li>2. Karyotypes of different types of syndromes</li> <li>3. Prenatal diagnosis</li> <li>4. Gene cloning</li> <li>5. Setting up of freshwater aquarium</li> <li>6. Aquarium fishes</li> <li>7. Ornamental fishes</li> <li>8. Advantages and Limitation of dairy farming</li> </ol>		

### References

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**First Degree Programme Zoology Complementary Course V**  
**Practical I Animal Diversity I &II, Functional Zoology and Applied**  
**Zoology**

**Course Code: AUZO43.2aPI**

CO No.	Expected course outcomes
	<i>Upon completion of this course, the students will be able to:</i>
1	Identify and classify the various groups of animals
2	Evaluate the adaptations and taxonomic significance of non-chordates and chordates
3	Compare the anatomy and morphology of non-chordates through transverse or longitudinal sections, dissections and mountings
4	Carry out routine clinical analysis of blood and urine
5	Describe the economic importance of organisms
6	Explain the concept of karyotypes

COURSE DESCRIPTION	CO No.
<b>Animal Diversity I &amp;II</b>	1,2
<b>Study specimens</b>	
1. Protista: <i>Noctiluca</i> , <i>Paramecium</i> , <i>Entamoeba</i> , <i>Trichonympha</i> [any 3]	
2. Porifera: <i>Sycon</i>	
3. Cnidaria: <i>Obelia</i> , <i>Aurelia</i> , Sea anemone ( <i>Adamsia</i> )	
4. Platyhelminthes: <i>Bipalium</i> , <i>Fasciola</i> , <i>Taenia solium</i>	
5. Nematoda: <i>Ascaris</i> , <i>Ancylostoma</i>	

6 Annelida: <i>Nereis</i> , <i>Hirudinaria</i>	
7 Arthropoda: Limulus, Scorpion, Scolopendra, Sacculina, Leptocorisa, Oryctes, Larval stages of prawn [any 5]	
8. Mollusca: <i>Freshwater mussel</i> , <i>sepia</i> , <i>Pila</i>	
9 Echinodermata: Starfish, Sea urchin, Brittle star, Sea cucumber, sea lily [any 3]	
10. Chordata: Branchiostoma (entire) Ascidia. Petromyzon Scoliodon, Narcine, Echeneis, Hippocampus, Anguilla [any 3] Icthyophis, Amblystoma, Rhacophorus [any 2] Chamaeleon, Bungarus, Naja, Vipera, Chelone [any 4] Pigeon – different types of feathers Pteropus	
<b>Minor Practical (Mounting) – any three</b>	<b>3</b>
1. Earthworm Setae <i>in situ</i>	
2. <i>Panaeus</i> Appendages	
3. Cockroach Mouth parts	
4. Nereis Parapodium	
5. Shark Placoid scales	
<b>Major Practical (Dissection) – any two</b>	<b>3</b>
Earthworm: Alimentary canal and associated glands	
<i>Panaeus</i> : Nervous system	
Cockroach: Alimentary canal	
<b>Osteology</b>	<b>3</b>
Study of the skeleton of frog	
Vertebrae (typical, 8 , 9 <sup>h</sup> and urostyle)	
Limb girdles: pectoral girdle with sternum, pelvic girdle, astragalus & calcaneum.	



<b>Functional and Applied Zoology</b>	
<b>Functional Zoology</b>	4
1. Preparation of human blood smear to study the different types of WBCs. 2. Human blood grouping: ABO and Rh Systems. 3. Urine analysis for abnormal constituents: albumin and glucose. 4. Study of slides/models of different types of eggs, blastula and gastrula of animals.	
<b>Applied Zoology</b>	5
1. Study of beneficial insects Apis (worker, drone and queen), Bombyx (life cycle, silk) 2. Study of the following items of economic importance: Perna, Pinctada, Penaeus, Sardinella, Rastrelliger	
<b>Human Genetics</b>	6
Study of the following using charts/photographs	
1. Study of normal human karyotype. 2. Study of abnormal human karyotypes. [Klinefelter's, Turner, Down's and Edwards syndrome]	