

# **VIMALA COLLEGE (AUTONOMOUS)**

(NAAC Re-accredited(3<sup>rd</sup> Cycle): A Grade, CGPA-3.50)

**Affiliated to University of Calicut**



**B.Sc. DEGREE PROGRAMME**

**IN**

**ZOOLOGY**

**Choice Based Credit and Semester System  
(CBCSS)**

**SYLLABUS AND SCHEME FOR CORE, ELECTIVE AND OPEN  
COURSES  
(2016 ADMISSION ONWARDS)**

**VIMALA COLLEGE  
ENGINEERING COLLEGE P O, THRISSUR  
KERALA- 680009, INDIA**

## SYLLABUS FOR B.Sc ZOOLOGY PROGRAMME (CORE COURSES)

Pattern of the model question paper, scheme of evaluation for internal examination and credit distribution have been included

### B.Sc ZOOLOGY COURSE STRUCTURE

#### Credit Distribution

Semester	Common Course		Core Course	Complementary Course		Open Course	Total
	English	Additional language		Chemistry	Botany		
II	4+3	4	2	2	2	-	17
III	4	4	3	2	2	-	15
IV	4	4	3+4	2+4*	2+4	-	27
V	-	-	3+3+3+3	-	-	2	14
VI	-	-	2+3+3+3+ 3+3 * * ** +4 +4 +2 +1***+2****	-	-	-	30
<b>Total</b>	<b>22</b>	<b>16</b>	<b>56</b>	<b>12</b>	<b>12</b>	<b>2</b>	<b>120</b>

\* Practical

\*\* Project

\*\*\*field study/ Study Tour

\*\*\*\* Viva- voce

#### Mark Distribution and Indirect Grading System

Mark system is followed instead of direct grading for each question. After external and internal evaluations marks are entered in the answer scripts. Indirect Grading System in 7 point scale will be followed. Each course is evaluated by assigning marks with a letter grade (A<sup>+</sup>, A, B, C, D, E or F) to that course by the method of indirect grading.

## Mark Distribution

Sl.No.	Course	Marks
1	English	600
2	Additional Language	400
3	Core course: Zoology	1750
4	Complementary course: Chemistry	400
5	Complementary course: Botany	400
6	Open Course	50
	<b>Total Marks</b>	3600

## Seven point Indirect Grading System

% of Marks	Grade	Interpretation	Grade Point Average	Range of Grade points	Class
90 and above	A <sup>+</sup>	Outstanding	6	5.5- 6	First Class with distinction
80 to below 90	A	Excellent	5	4.5 - 5.49	
70 to below 80	B	Very good	4	3.5 - 4.49	First Class
60 to below 70	C	Good	3	2.5 - 3.49	
50 to below 60	D	Satisfactory	2	1.5 - 2.49	Second Class
40 to below 50	E	Pass/Adequate	1	0.5 - 1.49	Pass
Below 40	F	Fail	0	0 - 0.49	Fail

## CREDIT AND MARK DISTRIBUTION IN EACH SEMESTERS

**Total credits: 120; Total Marks: 3600**

Semester	Course	Credit	Marks
<b>I</b>	Common course: English	4	100
	Common course: English	3	100
	Common course: Additional Language	4	100
	Core Course I: Animal Diversity-Non-Chordata-Part-I	2	100
	Complementary course: Chemistry	2	80
	Complementary course: Botany	2	80
	<b>Total</b>	<b>17</b>	<b>560</b>
<b>II</b>	Common course: English	4	100
	Common course: English	3	100
	Common course: Additional Language	4	100
	Core Course II: Animal Diversity-Non-Chordata-Part-II	2	100
	Complementary course: Chemistry	2	80
	Complementary course: Botany	2	80
	<b>Total</b>	<b>17</b>	<b>560</b>
<b>III</b>	Common course: English	4	100
	Common course: Additional Language	4	100
	Core Course III: Animal Diversity-Chordata-Part-I	3	100
	Complementary course: Chemistry	2	80
	Complementary course: Botany	2	80
	<b>Total</b>	<b>15</b>	<b>460</b>
<b>IV</b>	Common course: English	4	100
	Common course: Additional Language	4	100
	Core Course IV : Animal Diversity-Chordata-Part-II	3	100
	Core Course Practical-I (I*A, I*B, I*C & I*D)	4	100
	Complementary course: Chemistry	2	80

	Complementary course: Botany	2	80
	Complementary course: Chemistry Practical	4	80
	Complementary course: Botany Practical	4	80
	<b>Total</b>	<b>27</b>	<b>720</b>
<b>V</b>	Core Course V : Environmental Biology, Wild Life Conservation and Toxicology	3	100
	Core Course VI : Ethology, Evolution and Zoogeography	3	100
	Core Course VII: Cell Biology and Genetics	3	100
	Core Course VIII : General Methodology in Science, Biostatistics and Informatics	3	100
	Open Course	2	50
	<b>Total</b>	<b>14</b>	<b>450</b>
<b>VI</b>	Core Course IX: Biochemistry	2	100
	Core Course X: Physiology and Endocrinology	3	100
	Core Course XI: Molecular biology and Bioinformatics	3	100
	Core Course XII: Reproductive Biology, Developmental biology and Teratology	3	100
	Core Course XIII: Biotechnology, Microbiology and Immunology	3	100
	Core Course XIV: Elective Course: Human Genetics/ Aquaculture, Animal Husbandry and Poultry/Applied Entomology (Any one)	3	100
	Core course Practical-II (II*A, II*B & II*C)	4	100
	Core course Practical-III (III*A, III*B, III*C & III*D)	4	100
	Core Course Project Work	2	50
	Field study/Study tour	1	-
	Viva-Voce	2	-
	<b>Total</b>	<b>30</b>	<b>850</b>

## B.Sc ZOOLOGY CORE COURSE STRUCTURE

**Total Credits: 56 (Internal: 20%; External: 80%)**

Semester	Code No	Course Title	Hrs/Week	Total hrs/Sem	Credits	Marks
I	VZO1B01	Core Course I: Animal Diversity Non-Chordata-I	2	36	2	100
	-	Core Course Practical I (related to core course I - Practical-I*A)	2	36	*	-
II	VZO2B02	Core Course II: Animal Diversity Non-Chordata-II	2	36	2	100
	-	Core Course Practical I (related to core course II - Practical-I*B)	2	36	*	-
III	VZO3B03	Core Course III – Animal diversity Chordata -I	3	54	3	100
	-	Core Course Practical I (related to core course III - Practical-I*C)	2	36	*	-
IV	VZO4B04	Core Course IV: Animal diversity Chordata-II	3	54	3	100
	-	Core Course Practical I(related to core course IV- Practical-I*D)	2	36	*	-
	VZO4BPL1	Core Course Practical- I (I*A, I*B, I*C & I*D)	8 (in 4 semesters)	144 (in 4 semesters)	4	100
V	VZO5B05	Core Course V: Environmental Biology, Wild life Conservation & Toxicology	3	54	3	100
	VZO5B06	Core Course VI: Ethology, Evolution & Zoogeography	3	54	3	100
	VZO5B07	Core Course VII: Cell Biology & Genetics	3	54	3	100
	VZO5B08	Core Course VIII: General Methodology in Science, Bio Statistics & Informatics	3	54	3	100

	-	Core Course Practical II (related to core course V & VI- Practical-II*A )	3	54	*	-
	-	Core Course Practical II (related to core course VII- Practical-II*B )	3	54	*	-
	-	Core Course Practical II (related to core course VII- Practical-II*C)	2	36	*	-
	-	Project Work	2	36	**	-
	-	Field Study	1	18	***	-
VI	<b>VZO6B09</b>	Core Course IX: Bio Chemistry	2	36	2	100
	<b>VZO6B10</b>	Core Course X: Physiology & Endocrinology	3	54	3	100
	<b>VZO6B11</b>	Core Course XI: Molecular Biology & Bioinformatics	3	54	3	100
	<b>VZO6B12</b>	Core Course XII: Reproductive Biology, Developmental Biology & Teratology	3	54	3	100
	<b>VZO6B13</b>	Core Course XIII : Biotechnology, Microbiology & Immunology	3	54	3	100
	<b>VZO6E01</b> Elective (Any one)	Core Course XIV: Aquaculture, Animal husbandry & Poultry (Offered by the Department)	3	54	3	100
	<b>VZO6E02</b> Elective	Core Course XIV: Human Genetics	3	54	3	100
	<b>VZO6E03</b> Elective	Core Course XIV: Applied Entomology	3	54	3	100
	-	Core Course Practical III (related to core course IX & X- Practical-III*A)	2	36	*	-
	-	Core Course Practical III ( related to core course XII -Practical-III*B )	2	36	*	-

-	Core Course Practical III (related to core course XIII -Practical-III*C)	2	36	*	-
-	Core Course Practical III (related to core course XIV -Practical-III*D)	2	36	*	-
<b>VZO6B PL2</b>	Practical-II (II*A, II*B & II*C)	8	144	4*	100 (90+10 tour report )
<b>VZO6B PL3</b>	Practical-III (III*A, III*B, III*C & III*D)	8	144	4*	100 (90+10 general Viva)
<b>VZO6PR</b>	Project Work	-	-	2**	50
-	Field Study	1	18	1***	-
-	Viva voce	-	-	2****	-
<b>Total</b>				<b>56</b>	<b>1750</b>

\* Practical      \*\* Project      \*\*\*field study/ Study Tour      \*\*\*\* Viva- voce

Core course Practical- I exam will be conducted at the end of 4<sup>th</sup> semester and Core course practical II and III exams will be at the end of 6<sup>th</sup> semester.

Practical II includes Field Study report submission. (Marks: 90 + 10 for field study report).  
Field report should be submitted on the day of Practical II.  
Practical III includes general Viva voce. (Marks: 90 + 10 for General viva voce).  
Practical examinations are of **4 hrs** duration.

Project presentation and related Viva will be conducted on a separate day after practical III.  
Project report (one copy for each group) should be submitted on this day.

## CORE COURSE THEORY: EVALUATION SCHEME

The evaluation scheme for each course contains two parts: viz., internal evaluation and external evaluation.

### 1. INTERNAL EVALUATION

20% of the total marks in each course are for internal evaluation.

**Table 1: Components of Evaluation**

Sl. No.	Components	Marks
1	Attendance	5
2	Test papers: I & II	5+5
3	Assignment	2
4	Seminar	3
<b>Total Marks</b>		<b>20</b>

**Table 2: Percentage of attendance and Eligible Marks**

<b>% of attendance</b>	<b>Marks</b>
Above 90%	5
85-89%	4
80-84%	3
76-79%	2
75%	1
Below 75%	0

**Table 3: Pattern of test papers**

<b>Duration</b>	<b>Pattern</b>	<b>Total number of questions</b>	<b>Number of questions to be answered</b>	<b>Marks for each question</b>	<b>Marks</b>
1.5 hrs	One word	4	4	1	4
	Short answer	5	4	2	8
	Paragraph	5	3	6	18
	Essay	2	1	10	10
<b>Total marks *</b>					<b>40</b>

\*90% and above = 5, 80 to below 90% = 4.5, 70 to below 80% = 4, 60 to below 70% = 3.5, 50 to below 60% = 3, 40 to below 50% = 2, 35 to below 40% = 1, below 35% = 0.

## 2. EXTERNAL EVALUATION

External evaluation carries 80% marks. Theory examinations will be conducted at the end of respective semesters.

**Table 1: Pattern of test papers**

<b>Duration</b>	<b>Pattern</b>	<b>Total number of questions</b>	<b>Number of questions to be answered</b>	<b>Marks for each question</b>	<b>Marks</b>
3 hrs	One word	10	10	1	10
	Short answer	12	10	2	20
	Paragraph	8	5	6	30
	Essay	4	2	10	20
<b>Total marks</b>					<b>80</b>

## CORE COURSE PRACTICAL: EVALUATION SCHEME

The evaluation scheme includes internal evaluation (20% marks) and external evaluation (80% marks).

## 1. INTERNAL EVALUATION

**Table 1:- Components of Evaluation for Practical I (I \*A, I\*B, I\*C ,I\*D)**

Sl. No.	Components	Marks
1	Attendance	5
2	Performance & Punctuality	5
3	Test Papers	4
4	Record	6
<b>Total Marks</b>		<b>20</b>

**Table 2:- Percentage of Attendance and Eligible Marks**

% of attendance	Marks
Above 90%	5
85-89%	4
80-84%	3
76-79%	2
75%	1

**Table 3:- Percentage of Eligible Marks for Performance & Punctuality**

Criteria	Marks
Excellent	5
V.Good	4
Good	3
Satisfactory	2
Adequate	1

**Table 4:- Percentage of Eligible Marks for Test Papers**

Criteria	Marks
85% and above	4
70 - 84%	3
55 - 69%	2
35-54%	1

**Table 5:- Percentage of Eligible Marks for Record**

Criteria	Marks
Outstanding	6
Excellent	5
V.Good	4
Good	3
Satisfactory	2
Adequate	1

**Table 6:- Components of Evaluation for Practical II (II \*A, II\*B, II\*C) and Practical III (III \*A, III\*B, III\*C, III \*D)**

Sl. No.	Components	Marks
1	Attendance	5
2	Performance & Punctuality	4
3	Test Papers: I & II	4
4	Record	5
<b>Total Marks</b>		<b>18</b>

**Table 7:- Percentage of Attendance and Eligible Marks**

% of attendance	Marks
Above 90%	5
85-89%	4
80-84%	3
76-79%	2
75%	1

**Table 8:- Percentage of Eligible Marks for Performance & Punctuality**

Criteria	Marks
Excellent	4
V.Good	3
Good	2
Satisfactory	1
Adequate	0.5

**Table 9:- Percentage of Eligible Marks for Test Papers**

Criteria	Marks
85% and above	4
70 - 84%	3
55 - 69%	2
35-54%	1

**Table 10:- Percentage of Eligible Marks for Record**

Criteria	Marks
Outstanding	5
Excellent	4
V.Good	3
Good	2
Satisfactory	1
Adequate	0.5

## 2. EXTERNAL EVALUATION

The Practical Examination I (I\*A, I\*B, I\*C, I\*D) will be held at the end of 4<sup>th</sup> semester. The Practical Examination II (II\*A, II\*B, II\*C) and III (III \*A, III\*B, III\*C, III\*D) will be held at the end of 6<sup>th</sup> semester. The duration for the conduct of examination is **4 hours**.

**Table 1: Pattern of Examination for Practical I (I \*A, I\*B, I\*C, I\*D)**

Duration	Pattern	Total number of questions	Marks for each question	Marks
4 hrs	Spotters	4	3	12
	Short answer	1	8	8
	Minor question/Experiment	1	15	15
	Major question	1	35	35
	Record	-	-	10
	<b>Total</b>			<b>80</b>

**Table 2: Pattern of Examination - Practical II (II\*A, II\*B, II\*C) and III (III\*A, III\*B, III\*C, III\*D)**

Duration	Pattern	Total number of questions	Marks for each question	Marks
4 hrs	Spotters	4	3	12
	Short answer/Problem	1	5	5
	Minor question	1 or 2	-	10
	Major question	1	35	35
	Record	-	-	10
	<b>Total</b>			<b>72</b>

## CORE COURSE PROJECT: EVALUATION SCHEME

Project evaluation will be conducted at the end of sixth semester

**Table 1: Internal evaluation**

Sl.No.	Criteria	Marks
1	Punctuality	2
2	Skill in doing project work	2
3	Project presentation	3
4	Viva-Voce	3
<b>Total Marks</b>		<b>10</b>

**Table 2: External Evaluation**

Sl.No.	Criteria	Marks
1	Content and relevance of the project	10
2	Project report	10
3	Project presentation	10
4	Viva-Voce	10
<b>Total Marks</b>		<b>40</b>

## OPEN COURSE STRUCTURE

(For students other than B.Sc Zoology)

Total Credits: 2 (Internal 20%; External 80%)

Semester	Code No	Course Title	Hrs/Week	Total Hrs	Marks
V  (Any one)	VZO5D01	Reproductive Health and Sex Education <i>(Offered by Department)</i>	2	36	50
	VZO5D02	Nutrition, Health & Hygiene	2	36	50
	VZO5D03	Applied Zoology	2	36	50

## OPEN COURSE: EVALUATION SCHEME

The evaluation scheme contains two parts: internal evaluation and external evaluation.

### 1. INTERNAL EVALUATION

20% of the total marks are for internal evaluation.

**Table1: Components of Evaluation**

Sl.No.	Components	Marks
1	Attendance	2.5
2	Test papers: I & II	2.5 + 2.5
3	Assignment	2.5
<b>Total Marks</b>		<b>10</b>

**Table 2: Percentage of Attendance and Eligible Marks`**

Sl.No.	% of attendance	Mark
1	Above 90%	2.5
2	85-89%	2
3	80-84%	1.5
4	76-79%	1
5	75%	0.5

**Table 3: Pattern of Test Papers**

Duration	Pattern	Total number of questions	Number of questions to be answered	Marks for each question	Marks
1 Hour	One word	3	3	1	3
	Short answer	1	1	2	2
	Paragraph	2	1	5	5
	Essay	2	1	10	10
<b>Total Marks</b>					<b>20</b>

\*Marks: 80% and above = 2.5, 60 to below 80% = 2, 50 to below 60% = 1.5, 40 to below 50% = 1, 35 to below 40% = 0.5, below 35% = 0.

## 2. EXTERNAL EVALUATION

External evaluation carries 80% marks. Examination will be conducted at the end of 5<sup>th</sup> semester.

**Table 1: Pattern of Question Paper**

Duration	Pattern	Total number of questions	Number of questions to be answered	Marks for each question	Mark s
2 Hours	One word	10	10	1	10
	Short answer	7	5	2	10
	Paragraph	3	2	5	10
	Essay	2	1	10	10
<b>Total Marks</b>					<b>40</b>

**FIRST SEMESTER B.Sc DEGREE PROGRAMME (Theory)**  
**ZOOLOGY CORE COURSE- I**  
**ANIMAL DIVERSITY: NON-CHORDATA PART- I**  
**Code: VZO1B01**  
(DIVERSITY, ADAPTATIONS AND FUNCTIONAL ANATOMY OF  
PROTOZOANS AND NON-CHORDATES)  
[36 hours] [2 hours per week] [2 Credits]

**Section A (11 hrs)**

**Principles of classification and nomenclature (5 hrs)**

Systematics: Natural and classical. Nomenclature: Binomial and Trinomial nomenclature; International rules of Zoological nomenclature (brief account), Mention new trends in systematics like Chemotaxonomy, Serotaxonomy, Cytotaxonomy, Numerical taxonomy (Phenetics), Cladistics (Phylogenetic systematics), Molecular systematics.

**Five kingdom classification of living organisms (1 hr)**

Mention Cavaller-Smith's eight kingdom classification.

**Concepts of classification of animals (brief account) (5 hrs)**

Classification based on number of cells, tissue or organ system level of organization, development of germ layers, development of symmetry, development of coelom, segmentation in the somite, homology and analogy of organs and their origin, development of mouth and digestive tract.

**Section B (5 hrs)**

**KINGDOM PROTISTA**

Characteristic features and classification of Kingdom Protista down to phyla (Salient features of the following phyla with note on the examples cited)

Phylum Rhizopoda. Example: *Amoeba*

Phylum. Dinoflagellata. Example: *Noctiluca*

Phylum. Parabasalia. Example: *Trichonympha*

Phylum Apicomplexa [=Sporozoa]. Example: *Plasmodium*

Phylum Ciliophora. Example: *Vorticella*, *Ephelota*

Parasitic Protozoans of man

Nutrition in Protozoans

Reproduction in Protozoans

**Section C (20 hours)**

**KINGDOM ANIMALIA**

Salient features of the major phyla of animals and their diversity

[Habits, habitat, morphology, functional anatomy and life history of representative types (wherever specified) and classification of each phylum down to classes, except otherwise mentioned, and examples thereof: Study of animal diversity with typical examples from each class, with emphasis on ecological and adaptive features, economic importance and such other points of biological interest expected. Only very brief account of each example is to be studied.]

## **MESOZOA (1hr)**

A brief account of dicyemid and orthonectid mesozoans Examples: *Dicyema*, *Rhopalura*

## **METAZOA**

### **Phylum PORIFERA (3 hrs)**

Classification down to classes; salient features of the classes

Class Calcispongiae. Example: *Leucosolenia*

Class Demospongiae. Example: *Spongilla*

Class Hyalospongiae. Example: *Euplectella*

Canal system in sponges

Larval forms and gemmule of sponges

### **Phylum CNIDARIA [COELENTERATA] (7 hrs)**

Type: *Obelia* (Morphology and life cycle only)

Classification down to classes; salient features of the classes

Class Anthozoa. Example: *Adamsia*, *Madrepora*

Class Hydrozoa. Example: *Halitemma*, *Physalia*

Class Scyphozoa. Example: *Rhizostoma*

Polymorphism in Cnidarians

Corals and coral reefs

### **Phylum CTENOPHORA [ACNIDARIA] (1 hr)**

Unique features as exemplified by *Pleurobrachia*

Mention cydippid larva

## **ACOELOMATA**

### **Phylum PLATYHELMINTHES (3 hrs)**

Classification down to classes, give salient features of the following classes

Mention the life cycle and host of examples

Class Turbellaria. Example: *Dugesia*

Class Cestoda. Example: *Fasciola*

Class Trematoda. Example: *Schistosoma*

## **PSEUDOCOELOMATA**

### **Super phylum ASCHELMINTHES (3 hrs)**

Highlight the heterogeneous nature of animals of this group, classification down to phyla

### **Phylum NEMATODA**

Characteristic features of *Ascaris*

Examples: *Ancylostoma*, *Enterobius*, *Wuchereria*

Mention the life cycle, host and pathogenicity of examples

## **MINOR PHYLA (2hrs)**

Salient features of the following

Phylum **GASTROTRICHA** Example: *Chaetonotus*

Phylum **ROTIFERA** Example: *Brachionus*

**SECOND SEMESTER B.Sc DEGREE PROGRAMME (Theory)**  
**ZOOLOGY CORE COURSE- II**  
**ANIMAL DIVERSITY: NON-CHORDATA PART- II**  
**Code: VZO2B02**  
(DIVERSITY, ADAPTATIONS AND FUNCTIONAL ANATOMY OF  
NON-CHORDATE COELOMATES)  
[36 hours] [2 hours per week] [2 Credits]

**Section A (31 hrs)**

**COELOMATA**

**Phylum ANNELIDA (7 hrs)**

Type: *Neanthes* or *Nereis*

Classification down to classes, salient features of the following classes

Class Polychaeta. Example: *Arenicola*

Class Oligochaeta. Example: *Megascolex*

Class Hirudinea. Example: *Hirudinaria*

**Phylum ARTHROPODA (11 hrs)**

Type: *Penaeus* (larval stages included)

Classification down to classes, salient features of the following classes

Class Trilobita (brief account only)

Class Merostomata. Example: *Limulus*

Class Arachnida. Example: *Palamnaeus*, spider, mention ticks and mites

Class Myriapoda. Examples: *Scolopendra*, *Spirostreptus*

Class Crustacea. Example: *Sacculina*, *Eupagurus*

Class Insecta. Examples: *Lepisma*, *Mantis*, *Tabanus*, *Troides minos*

Useful and harmful insects

Economic importance of crustaceans

Social organisation and caste system in honey bee

**Phylum MOLLUSCA (7 hrs)**

Classification down to classes; salient features of the following classes

Class Placophora. Example: *Chiton*

Class Bivalvia. Example: *Perna*

Class Scaphopoda. Example: *Dentalium*

Class Gastropoda. Example: *Pila*

Class Cephalopoda. Example: *Sepia*

Economic importance of Molluscs

**Phylum ECHINODERMATA (4 hrs)**

Classification down to classes (extant forms only)

Salient features of the following classes

Class Crinoidea. Example: *Antedon*

Class Asteroidea. Example: *Asterias*

Class Ophiuroidea. Example: *Ophiothrix*

Class Holothuroidea. Example: *Holothuria*

Class Echinoidea. Example: *Echinus*

**Phylum HEMICHORDATA (2 hr)**

Salient features. Example: *Balanoglossus*

### Section B (3 hrs)

#### COELOMATE MINOR PHYLA (3 hrs)

Salient features of the following minor phyla, mention examples specified  
(Structure and life history not required)

**Phylum PHORONIDA** Example: *Phoronis*

**Phylum ECTOPROCTA [=Bryozoa]** Example: *Bugula*

**Phylum ECHIURA** Example: *Bonellia*

### Section C (2 hrs)

#### Phylum ONYCHOPHORA (2 hrs)

*Peripatus* (Distribution, peculiarities and affinities)

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- <http://www.mbl.edu>
- <http://phylogeny.corne>

**THIRD SEMESTER B.Sc DEGREE PROGRAMME (Theory)**  
**ZOOLOGY CORE COURSE-III**  
**ANIMAL DIVERSITY CHORDATA PART-I**  
**Code: VZO3B03**  
(TAXONOMY, DIVERSITY, STRUCTURAL ANATOMY AND  
ADAPTATIONS OF CHORDATES)  
[54 hours] [3 hours per week] [3 credits]

**Section A (13 hrs)**

**Introduction (6 hrs)**

Chordate characters (fundamental, general and advanced)  
Diversity of chordates, classification down to subphyla, salient features of each subphylum

**Subphylum 1. UROCHORDATA (Tunicata) (3 hrs)**

Affinities, add a note on neoteny

Classification down to classes.

Class: Ascidiacea Type: *Ascidia* (morphology and retrogressive metamorphosis)

Class Larvacea. Example: *Oikopleura*

Class Thaliacea. Example: *Doliolum*

**Subphylum 2. CEPHALOCHORDATA (4 hrs)**

Example: *Branchiostoma (Amphioxus)* morphology, primitive, degenerate and specialized features (affinities and systematic position to be emphasized)

**Section B (19 hrs)**

**Subphylum 3. VERTEBRATA (3 hrs)**

**Division 1. AGNATHA**

Characters. Examples: *Myxine*, *Petromyzon* (mention Ammocoete larva)

**Division 2. GNATHOSTOMATA (16 hrs)**

**Superclass PISCES**

Type: Mullet

Classification of Pisces down to orders; salient features of the following groups

**Class Chondrichthyes** (cartilagenous fishes)

Order Selachii. Examples: *Scoliodon*, *Trygon*

Order Holocephali. Example: *Chimaera*

**Class Osteichthyes** (bony fishes)

Order Crossopterygii (coelacanth). Example: *Latimeria*

Order Dipnoi (lung fishes). Examples: *Neoceratodus*, *Protopterus*, *Lepidosiren*

(Add a note on distribution of lung fishes)

Order Acanthopterygii (spiny-rayed fishes). Example: *Rastrelliger*

Parental care in fishes

Migration in fishes

Accessory respiratory organs in fishes

**Section C (15 hrs)**

**Superclass TETRAPODA**

**Class Amphibia (15 hrs)**

Type: Frog

Classification of Amphibia down to orders with examples (extant forms only)

Order Apoda. Example: *Ichthyophis*

Order Caudata. Examples: *Necturus*, *Ambystoma*, mention Axolotl larva

Order Anura. Examples: *Bufo*, *Rhacophorus*

Mention discovery of *Nasikabatrachus sahyadrensis*

Parental care in Amphibians

### Section D (7 hrs)

#### Class Reptilia (7 hrs)

Classification of Reptilia down to subclasses and salient features of the following subclasses.

Mention the given orders with examples

#### Subclass Anapsida

Order Cotylosauria (stem reptiles) example: *Hylonomus*

Order Chelonia (common turtles, tortoises etc.) example: *Chelone*

#### Subclass Diapsida

#### Super order Lepidosauria

Order Rhynchocephalia example: *Sphenodon*

Order Squamata example: *Chamaeleon*,

Common poisonous and non-poisonous snakes of Kerala - *Ptyas*, *Typhlops*, *Naja*, *Daboia*, *Bungarus*

Super order Archosauria

Order Crocodylia examples: *Crocodylus*, *Gavialis*, *Alligator*

#### Subclass Euryapsida (Parapsida)

#### Subclass Synapsida

Identification key for snakes

Poison apparatus and snake venom

Mesozoic reptiles

**FOURTH SEMESTER B.Sc DEGREE PROGRAMME (Theory)**  
**ZOOLOGY CORE COURSE-IV**  
**ANIMAL DIVERSITY CHORDATA PART-II**

**Code: VZO4B04**

(TAXONOMY, DIVERSITY, STRUCTURAL ANATOMY AND  
ADAPTATIONS OF CHORDATES – AVES AND MAMMALS)

**[54 hours] [3 hours per week] [3 credits]**

**Section A (16 hrs)**

**Class AVES (16 hrs)**

Classification of Aves down to the orders specified with examples

**Subclass Archaeornithes**

Order Archaeopterygiformes. Example: *Archaeopteryx* – brief account

**Subclass Neornithes**

**Super order Palaeognathae (Ratitae)**

Order Casuariiformes. Example: *Casuarius* (cassowary)

Order Dinornithiformes (Apterygiformes). Example: *Apteryx* (kiwi)

Order Rheiformes. Example: *Rhea*

Order Struthiorniformes. Example: *Struthio* (ostrich)

**Super order Neognathae (Carinatae)**

Order Galliformes (pheasants, quail, turkeys, grouse). Example: *Pavo cristatus*

Order Anseriformes (screamers, water fowls). Example: *Anas*

Order Passeriformes (perching birds). Example: *Passer domesticus*

Order Piciformes (wood peckers, barbets, honey guides). Example: *Dinopium*

Order Coraciiformes (kingfishers). Example: *Alcedo*

Order Apodiformes (swifts, humming birds). Example: *Micropodus*

Order Strugiformes (owls). Example: *Bubo*

Order Cuculiformes (cuckoos, roadrunners, turacos). Example: *Eudynamys*

Order Psittaciformes (parrots, lorries, cockatoos). Example: *Psittacula krameri*

Order Gruiformes (cranes, rails, coots, bustards). Example: *Choriotis*

Order Charadriiformes (plovers, gulls, terns, auks, sand pipers). Example: *Tringa*

Order Columbiformes (pigeons, doves, dodos, sand grouse). Example: *Columba*

Order Falconiformes (diurnal birds of prey- falcons, hawks). Example: *Mylvus*

Order Ciconiiformes (herons, storks, ibis, spoon bills). Example: *Ardea*

Order Pelecaniformes (pelicans, cormorants). Example: *Pelecanus*

Order Sphenisciformes (Impennae). Example: *Aptenodytes* (penguin)

Order Phoenicopteriformes (flamingos). Example: *Phoenicopterus*

**Extinct birds**

Passenger pigeon (*Ectopistes migratorius*), Dodo (*Raphus cucullatus*), Pink-headed duck (*Rhodonessa caryophyllacea*), Elephant bird (*Aepyornis*)

Rediscovery of Jerdon's courser (*Cursorius bitorquatus*)

Migration in birds (mention local movements of birds, trans himalayan, trans continental migrations)

Flight adaptations in birds

Flightless birds

Nesting behaviour and parental care in birds

**Section B (38 hrs)**

**Class MAMMALIA**

Type: *Oryctolagus* (16 hrs)

Classification of Mammalia down to the orders cited with examples (22 hrs)

**Subclass Prototheria**

**Infraclass Ornithodelphia** (egg-laying mammals)

Order Monotremata. Examples: *Ornithorhynchus* (platypus), *Tachyglossus* (*Echidna*)

**Subclass Theria**

**Infraclass Metatheria** (marsupials)

Order Marsupialia. Examples: *Didelphis* (opossum), *Macropus* (kangaroo)

**Infraclass Eutheria** (true placental mammals)

Order Edentata. Examples: *Dasypus* (armadillo) *Myrmecophaga* (spiny ant eater)

Order Pholidota. Example: *Manis* (pangolin / scaly ant eater)

Order Lagomorpha (rabbits and hares)

Order Rodentia. Examples: *Funambulus*, *Ratufa*

Order Insectivora. Examples: *Paraechinus* (hedgehog), *Suncus* (*Crocidura*)

Order Dermoptera. Examples: *Cynocephalus* (*Galeopterus* - flying lemur)

Order Chiroptera. Examples: *Pteropus*, *Pipistrellus*

Order Primates. Examples: *Loris*, *Macaca*, *Gorilla*, *Pongo*, *Hylobates*

Order Carnivora. Examples: *Phoca* (seal), *Odobenus* (walrus), *Panthera* sps

Order Cetacea. Examples: *Physeter* (sperm whale), *Delphinus*, *Balaenoptera* (baleen whale)

Order Artiodactyla. Examples: *Sus scrofa cristatus*, *Hemitragus* (tahr), *Axis axis* (spotted deer), *Antelope cervicapra* (black buck)

Order Perissodactyla. Examples: *Equus caballus* (horse), *Rhinoceros*

Order Sirenia. Examples: *Trichechus* (manatee), *Dugong*

Order Proboscidea. Examples: *Elephas maximus indicus*(Indian elephant), *Loxodont africana* (African savanna elephant), *Loxodonta cyclotis* (African forest elephant)

Aquatic mammals and their adaptations

Dentition in mammals (adaptations related to food)

Social groups in mammals

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<http://www.oit.itd.umich.edu>

**FIFTH SEMESTER B.Sc DEGREE PROGRAMME (Theory)**  
**ZOOLOGY CORE COURSE – V**  
**ENVIRONMENTAL BIOLOGY, WILDLIFE CONSERVATION AND**  
**TOXICOLOGY**  
**Code: VZO5B05**  
**[54 hours] [3 hours per week] [3 credits]**

**Section A: ENVIRONMENTAL BIOLOGY (32 hrs)**

**1. Ecological tools and Techniques (4 hrs)**

Sampling of animal populations

- (a) Trapping and collecting various groups of flying insects (aquatic organisms, soil organisms, birds and mammals)
- (b) Marking of animals
- (c) Determination of home range and territory
- (d) Estimation of number of animals in population
- (e) Indirect method of estimating wild animals by their signs and symptoms
- (f) Remote sensing

**2. Ecosystem and Energetics (5 hrs)**

- (a) Definition, scope and branches of ecology, habitat, niche, community, Autecology and Synecology
- (b) Energy flow and energetics of ecosystem
- (c) Solar energy, photosynthetic and chemosynthetic production
- (d) Energy transformations and energy transfer
- (e) Laws of thermodynamics

**3. Biogeochemical cycles (3 hrs)**

Basic types of biogeochemical cycles - Gaseous cycle - Carbon and Nitrogen cycles, sedimentary cycles

**4. Limiting factors (2 hrs)**

Basic concepts - Leibig's law of minimum - Shelford's law of tolerance, combined concept of limiting factors

**5. Population Ecology (4 hrs)**

Properties of population - density, natality, mortality, age distribution, biotic potential, environmental resistance and carrying capacity, population growth forms- J and S shaped curves, migration, emigration and immigration

**6. Community Ecology (5 hrs)**

Biotic community - definition, characteristics and classification, species diversity, fluctuations, stratification, succession, ecotone and edge effect

**7. Population interactions (2 hrs)**

Intraspecific and interspecific associations - Positive and negative interactions- Mutualism, Commensalism, Parasitism, Predation, Competition

### **8. Aquatic Ecology (3 hrs)**

- (a) Marine ecology- major divisions of marine habitat, pelagic realm, benthic realm
- (b) Freshwater ecology- lentic and lotic environments

### **9. Man and Environment (4 hrs)**

- (a) Sustainable development (in brief)
- (b) Destruction of habitat and its consequences - wetland, paddy fields, mangrove, river encroachment, sand and clay mining, ecological impacts of tourism
- (c) Individual responsibilities – Role of Governmental and Non Governmental Organizations in biodiversity conservation

## **Section B: WILDLIFE CONSERVATION (18 hrs)**

### **1. Biodiversity (12 hrs)**

- (a) Introduction, alpha, beta and gamma diversities, mention Shannon diversity index and Simpson's dominance index
- (b) Hot spots of biodiversity, mention hot spots in Indian region (Western Ghats and Sri Lanka, Eastern Himalayas and Indo Burma)
- (c) Threats to biodiversity (Habitat modification, pollution, poaching, etc.)
- (d) Role of systematics in biodiversity, extinction of species
- (e) Natural resources and conservation-strategies, Natural Reserves, classification of natural resources
- (f) Wildlife conservation, Wildlife protection Act 1972, Conservation projects- Project Tiger, Elephant, Lion, Crocodile, Dolphins, Swamp deer, Black buck and Turtle
- (g) Endangered fauna and flora.
- (h) Sanctuaries-Thattekkad bird sanctuary & Parambikulam wildlife sanctuary  
National parks – Eravikulam NP & Silent Valley NP  
Biosphere Reserves-Nilgiri BR & Agasthyamalai BR
- (i) Mention IUCN categories and Red data book
- (j) Conservation of biodiversity - *in situ* and *ex situ* conservations  
Mention conservation of germplasm

### **2. Global Strategy for Conservation (6 hrs)**

- (a) Stockholm Conference / Declaration (1972)
- (b) Nairobi Conference / Declaration
- (c) Rio Declaration (Earth Summit (1992)
- (d) CITES
- (e) Biodiversity Convention of UNCED
- (f) Kyoto Agreement (1997)
- (g) Johannesburg Conference (2002)
- (h) World Summit on Sustainable Development
- (i) UNEP and its major strategies
- (j) Biodiversity Act (2002)
- (k) Wildlife Act (1972) and its Amendments
- (l) Ramsar Conventions
- (m) Paris Conference (2015)

## Section C: TOXICOLOGY (4 hrs)

### 1. Toxicants and public health hazards

- (a) Toxic chemicals (pesticides, automobile emissions, heavy metals, fertilizers, food additives, xenobiotics, radioactive wastes)
- (b) Indian law of drug and poisons
- (c) Levels of toxicity- acute, sub acute, chronic, LD<sub>50</sub>, LC<sub>50</sub>
- (d) Common bacterial poisoning (botulism)
- (e) Behavioural toxicology

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**FIFTH SEMESTER B.Sc DEGREE PROGRAMME (Theory)**  
**ZOOLOGY CORE COURSE –VI**  
**ETHOLOGY, EVOLUTION AND ZOOGEOGRAPHY**  
**Code:VZO5B06**

[54 hours] [3 hours per week] [3 credits]

**Section A: ETHOLOGY (14 hrs)**

**1. Brief history, scope and branches of Ethology (2 hrs)**

**2. Patterns of behavior (5 hrs)**

Innate behaviour (orientation taxis/ kinesis), simple reflexes and instincts, motivation and categories of behavior. Learned behaviour - habituation, conditioned reflex, trial and error learning, latent learning, imprinting, insight learning, memory and learning

**3. Biological clocks / rhythms (4 hrs)**

Photoperiod, circadian rhythm, migration, navigation and homing instinct, diapause, hibernation and aestivation (in brief)

**4. Sociobiology (3 hrs)**

Social group in common monkey and elephants, pheromones and social behavior, mention human pheromones.

**Section B: EVOLUTION (32 hrs)**

**1. Introduction (2 hrs)**

History and concepts of inorganic and organic evolution, History of evolutionary thought: Ideas of evolution during Pre-Darwinian, Darwinian and Post- Darwinian periods. (brief account)

**2. Course of Evolution (6 hrs)**

(a) Origin of life: Theory of abiogenesis, Theory of biogenesis, Theory of special creation, Theory of Panspermia and Biochemical origin of life, Modern hypothesis, Oparin-Haldane Theory, major steps in the biochemical evolution of the life (brief account), Origin of Earth and the primordial atmosphere, formation of organic molecules, formation of macromolecules or polymers, and formation of coacervates, microspheres, protocells and full fledged living cells. Experimental evidence for biochemical origin of life- Urey- Miller experiment. Modern ideas on the origin of life

(b) History of life on Earth - Geological time scale (simple chart), mention Cambrian explosion

(c) Fossils, Fossilization and Dating of fossils (brief account)

(d) Living fossils: mention common features and examples

**3. Evidences of Organic Evolution (5 hrs)**

a) Morphological and anatomical evidences: Homologous, analogous and vestigial structures and their evolution.

Adaptive radiation (Divergent Evolution): cause and significance, adaptive radiation in Darwin's finches.

Convergent Evolution: mention examples

Pre-adaptation: mention examples

b) Physiological and biochemical evidences: examples

c) Embryological evidences: examples, Biogenetic Law

d) Palaeontological evidences: Kinds of fossilization, formation of sedimentary rocks, determination of age of rocks and fossils, conclusion drawn from fossil records (brief account)

e) Taxonomical evidences: evolution based principles of classification, mention phylogenetic tree

#### **4. Theories of Evolution (5 hrs)**

a) Lamarckism: Explanation of the major postulates of the Lamark's theory with examples, Criticism against Lamarckism, Neo-Lamarckism, Present status of Lamarckism

b) Darwinism: Explanation of important postulates of Darwin's theory, Examples for natural selection, Criticism against Darwinism, Neo-Darwinism (Synthetic theory of evolution)

#### **5. Modern Concepts of Evolutionary Process (3 hrs)**

Genetic basis of evolution: Mutations (gene and chromosomal mutations brief account), Variations: somatic or environmental variations and genetic or hereditary variations, Hardy-Weinberg Principle: Hardy-Weinberg Equilibrium, Factors that upset Hardy-Weinberg Equilibrium, Genetic drift: effects on population, Bottleneck effect and Founder effect, genetic drift and natural selection, importance of genetic drift in evolution, Micro and Macro evolution, Theory of Punctuated equilibrium and its relevance

#### **6. Nature of Evolution (3 hrs)**

Species and Speciation: Species concept, morphological and biological species concepts, General characteristics and subdivisions of species (sub species, semispecies, sibling species, cline and deme), Speciation: Types of speciation, Phyletic speciation (autogenous and allogenous transformations), True speciation, Instantaneous and gradual speciation, allopatric and sympatric speciation

#### **7. Isolation and Isolating Mechanisms: (3hrs)**

Types of isolating mechanisms - Geographic isolation (mention examples), Reproductive isolation - Prezygotic isolation (habitat, seasonal, ethological, morphological, physiological and cytological isolation with examples, Postzygotic isolation - hybrid inviability, hybrid sterility and F2 breakdown isolation with examples

#### **8. Evolution of horse (2 hrs)**

Time and place of origin, major evolutionary trends, phylogeny of probable sequence species of horse of Eocene, Oligocene, Miocene, Pliocene, and Pleistocene forms, Orthogenesis

#### **9. Evolution of Modern Man (3 hrs)**

Evolutionary trends in humans, Ancestors of Primates, Apes-the closest relatives of man, Fossil ancestors of man: *Dryopithecus*, *Australopithecus* (The Man-Ape of Africa), *Homo habilis* (The Handy Man), *H. erectus*, *H. neanderthalensis* (Neanderthal man), The Cro-magnon, *Homo sapiens* (Modern man); Socio-cultural evolution (brief account).

### **Section C: ZOOGEOGRAPHY (8 hrs)**

#### **1. Animal Distribution (3 hrs)**

(a) Geographic distribution of animals - cosmopolitan distribution, discontinuous distribution, bipolar distribution and isolated distribution

(b) Factors affecting animal distribution, Barriers to animal distribution – Physical barriers (topographical and climatic); biological barriers

## **2. Zoogeographical realms (3 hrs)**

Zoogeographical regions with specific fauna (fauna regions): Palaearctic region, Oriental region, Australian region, Ethiopian region, Nearctic region and Neotropical region, Insular fauna, mention Continental and Oceanic islands

## **3. Biogeography of India (2 hrs)**

Biogeographical zones of India-Trans Himalayan zone, Himalayan zone, Desert zone, semiarid zone, Western Ghats zone, Deccan plateau zone, Gangetic plain zone, North East zone, Coastal zone, Islands present near the shore line

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**FIFTH SEMESTER B.Sc DEGREE PROGRAMME (Theory)**  
**ZOOLOGY CORE COURSE- VII**  
**CELL BIOLOGY AND GENETICS**  
**Code:VZO5B07**

[54 hours] [3 hours per week] [3 credits]

**Section A: CELL BIOLOGY (27 hours)**

**Scientific instruments and techniques in Cell Biology**

**1. Microscopy (5 hrs)**

Light microscopy: Simple microscope, Compound microscope, Principles and uses, Use of oil immersion objectives, Use of ocular micrometer and stage micrometer for microscopic calibration (Micrometry)

Use of camera lucida, principle and uses. Mention Phase contrast microscope, Fluorescence microscope

Electron microscopy: Principle, applications, advantages and disadvantages

Mention Transmission Electron Microscope (TEM), Scanning Electron Microscope (SEM), Scanning-tunnelling microscope, Atomic force microscope

**2. Histological Techniques (2 hrs)**

Microtomy: Rotatory microtome (brief description), uses, preparation of materials for light microscopy (for temporary and permanent)

Fixation: Common fixatives, such as buffered formalin, ethanol, Bouin's solution and Carnoy's fluid

Common histological stains: Haematoxylin, Eosin and Leishman's

Vital stains: Neutral red and Janus green

Mounting medium: DPX, Canada Balsum

**Structure of eukaryotic cell**

**4. Plasma membrane (3 hrs)**

Unit membrane concept. Structure (fluid-mosaic model) and chemical organization, Glycocalyx

Functions – Transmembrane transport – diffusion, osmosis, active transport, pinocytosis, phagocytosis.

Modifications of plasma membrane

**5. Ribosomes (2 hrs)**

Types of ribosomes in prokaryotes, eukaryotes and mitochondria; Structure and chemical composition of subunits; free and attached ribosomes, monosomes, polysomes; functions of ribosomes; biogenesis of ribosomes

**6. Mitochondria (2 hrs)**

Structure and Functions of mitochondria, mitochondriogenesis

**7. Lysosomes (1 hr)**

Structure and chemistry, kinds of lysosomes, polymorphisms, enzymes in Lysosomes, concept of GERL (Golgi body – Endoplasmic Reticulum – Lysosome complex), functions of lysosomes

### **8. Centrioles and basal bodies (1 hr)**

Structure, chemical composition and functions

### **9. Golgi complex (1 hr)**

Morphology, chemical components, secretory and endocytic pathways, functions, Golgiogenesis

### **10. Interphase nucleus (3 hrs)**

General structure and functions, Nucleo-Cytoplasmic index, Nuclear envelope : Structure, nuclear pores and pore complex formation, Functions, Nucleoplasm

Nucleolus: Structure, composition, nuclear cycle, nucleolar organizer, functions

Chromosomes: Chromatin, euchromatin, heterochromatin

Nucleosomes : chemical composition, nucleosome packing, organization of chromatin

### **11. Giant chromosomes (1 hr)**

Polytene chromosomes: occurrence, structure, puffs and bands, endomitosis, significance in cytological studies

Lamp brush chromosomes: occurrence, structure, loops, significance

### **12. Cell Divisions (3hrs)**

Cell cycle: G<sub>1</sub>, S, G<sub>2</sub> and M phases – Check points

Amitosis: brief account only

Mitosis: description of all stages, cytokinesis and significance.

Meiosis: description of all stages, nature of chromosomes during different stages and significance, mention stage G<sub>0</sub> as an elevated part of cell cycle

### **13. Cytogenetics of cancer (2 hrs)**

Types of cancer, characteristics of cancer cells, Carcinogenesis (theories- brief account)

### **14. Cell ageing (1 hr)**

Apoptosis – Cell death

## **Section-B: GENETICS (27 hrs)**

### **1. Variations from Mendelian ratios (2 hrs)**

Incomplete dominance, Co-dominance, lethal genes, Pleiotropism

### **2. Interaction of genes (3 hrs)**

Allelic and Non allelic interactions, factor hypothesis, inheritance of comb pattern in poultry, Supplementary genes, Complementary genes, Epistasis, Duplicate genes, Polymeric genes, Penetrance, Expressivity, Polygenic (quantitative) inheritance, Skin colour in man

### **3. Multiple alleles (3 hrs)**

Definition, characteristics and examples: coat colour in rabbits, mention isoalleles, blood group alleles, genetics of ABO blood group system, mention other systems of blood grouping; MN blood group, Levin and Bombay phenotype; Rh factor and erythroblastosis foetalis

#### **4. Linkage, crossing over and recombination (3 hrs)**

Morgan's work on *Drosophila*, define chromosome theory of linkage, linkage types with examples- complete and incomplete linkage, linkage groups, crossing over, factors influencing linkage and crossing over, recombination, linkage map (definition and principle)

#### **5. Sex determination (3 hrs)**

Sex determination and sex differentiation, sex chromosomes(X and Y) male heterogametic and female heterogametic chromosome mechanism of sex determinations (XX-XO, XX-XY, ZZ-ZW types) Genic balance (ratio) theory of Bridges, environmental and hormonal influence of sex determination, sex determination in honey-bees and *Bonellia*  
Short notes on intersexes and gynadromorphism

#### **6. Sex-linked, sex-influenced and sex-limited characters (4 hrs)**

Types of sex-linkage – sex linkage in man (colour blindness as an example) holandric genes (hypertrichosis as an example) sex-influenced traits and sex-limited traits (definition and examples), importance of Y, dosage compensation, Barr body, Lyon hypothesis

#### **7. Mutation (3 hrs)**

Definition, kinds of mutations, gene mutations, molecular basis of gene mutations, substitution mutations and frame shift mutations, mechanisms, factors influencing mutations, induced mutations, mutagens, detection of mutations (CIB Method)  
Chromosome mutations: Numerical changes: euploidy and aneuploidy with subdivisions  
Structural changes: deletion, duplication, insertion, inversion, translocation. Mention significance of mutations in speciation and breeding

#### **8. Human Genetics (3 hrs)**

Normal chromosome complement in human beings, classification and grouping of human chromosomes (Patau's scheme)  
Chromosomal anomalies and disorders: Down's, Patau's, Edward's Syndrome  
Sex chromosomal anomalies : Turner's and Klinefelter's syndrome  
Gene mutations: autosomal mutations: albinism, PKU, alkaptonuria, thalassemia, brachydactyli  
Sex chromosomal mutations: haemophilia, dermal hypoplasia, polygenic traits: cleft palate, club foot  
Gene Therapy

#### **9. Genetic counseling (1 hr)**

Eugenics, Euthenics and Euphenics

#### **10. Cytoplasmic inheritance(2 hrs)**

Shell coiling in *Limnaea*, Cytoplasmic organelles- DNA in chloroplast and mitochondria

#### **REFERENCE**

Brooks, R. J.: *Genetics: Analysis and Principles*. 1999, Addison Wesley  
Burns, G. W. & Bottino, P. J.: *The Science of Genetics*. 6/7e, Maxwell McMillan Curt Stein: *Principles of Human Genetics*. 1960, Euresia Pubg.  
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Niel O. Thorpe: *Cell Biology*.

Philip Sheeler and Donald E. Bianchi: *Cell Biology – Structure, Biochemistry and Functions*.

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Ricki, L.: *Human Genetics: Concepts and Applications*. WCB MGH

Robert H. Tamarin, *Principles of Genetics*.

Sharma, A. K. & Sharma, A.: *Chromosome Techniques*. 1990, Butterworth

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Strickberger: *Genetics*, 4e, W.C. Brown Pub., Maxwell Macmillan.

Verma, P.S. & Agarwal, V.K.: *Cytology*. S. Chand & Co.

Vijayakumaran Nair, K. & Jayaprakash, M.: *Cell Biology, Genetics, Molecular Biology*. Academica, TVM.

**FIFTH SEMESTER B.Sc. DEGREE PROGRAMME (Theory)**  
**ZOOLOGY CORE COURSE- VIII**  
**GENERAL METHODOLOGY IN SCIENCE, BIOSTATISTICS**  
**AND INFORMATICS**  
**Code: VZO5B08**  
**[54 hours] [3 hours per week] [3 credits]**

**Section A: GENERAL METHODOLOGY IN SCIENCE (20 hrs)**

**1. Science and Scientific Studies (1 hr)**

Science as a human activity, scientific attitude, Empiricism, Science disciplines, Interdisciplinary approach

**2. Scientific Methods (7 hrs)**

Major steps: Observation, defining the problem, collection of information, formulation of a hypothesis, experimentation, analysis of the results and conclusion based on interpretation of the results

Methods in scientific enquiry: Inductive and deductive reasoning

Hypothesis: Formulation of a hypothesis, different thought processes in developing hypothesis (analogy, induction, deduction and intuition)

Hypothetico-deductive model, testing hypothesis, auxiliary hypothesis, *Adhoc* hypothesis.

Theories and laws in Science, scientific evidences and proofs, peer reviews

Importance of models, simulations and virtual testing

**3. Experimentation (6 hrs)**

Types of experiments, design of an experiment: principles and procedures, necessity of units and dimensions, repeatability and replications, documentation of experiments

Planning of experiments: design, selection of controls, observational and instrumental requirements

Test animals used in experiments

**4. Ethics in Science and Animal Ethics (6 hrs)**

Scientific information: depositories of scientific information – primary, secondary and digital sources, sharing of knowledge, transparency and honesty

Reporting of observational and experimental data, influence of observer on observations publications, patents, plagiarism

Section 51A(G), Section 17.1(d) of the prevention of cruelty to animals (Act of 1960)

**Section-B: BIOSTATISTICS (15 Hrs)**

**1. Biostatistics (2 hrs)**

Definition, scope, role of statistics in life sciences, terminology and variables

**2. Collection of data (2 hrs)**

Sample and sampling: sample size, sampling errors, methods of sampling, specific aspects of statistical data

**3. Classification of data and frequency distribution (2 hrs)**

Classification and tabulation of data

#### **4.Presentation of data (3 hrs)**

Diagrammatic presentation of data: Line diagram, Bar diagram and Pie diagram  
Graphic representation: Histogram, Frequency Polygon and Frequency Curve

#### **5.Analysis of data (6 hrs)**

Measures of central tendency: Mean, Median and Mode

Measures of dispersion: Standard deviation, standard error

Interpretation: Significance of statistical tools in data interpretation  
(mention t test, f test and chi square)

### **SECTION C: INFORAMTICS (19 hours)**

#### **1. Knowledge skills for higher education (8 hrs)**

Data, information and knowledge, knowledge management

Internet access methods - Dial-up, DSL, Cable, ISDN, Wi-Fi - Internet as a knowledge repository, academic search techniques, creating cyber presence

Case study of academic websites, open access initiatives, open access publishing models

Basic concepts of IPR, copyrights and patents, plagiarism, introduction to use of IT in teaching and learning, case study of educational software, academic services - INFLIBNET, NICNET, BRNET

#### **2. Social informatics (6 hrs)**

IT & society - issues and concerns - digital divide, IT & development, the free software movement

IT industry: new opportunities and new threats, software piracy, cyber ethics, cyber crime, cyber threats, cyber security, privacy issues, cyber laws, cyber addictions, information overload, health issues, guide lines for proper usage of computers, internet and mobile phones

E-wastes and green computing

Impact of IT on language and culture, localization issues, Unicode, IT and regional languages

#### **3. It applications (very brief account of the following) (5 hrs)**

e-Governance applications at national and state level, IT for national integration, overview of IT application in medicine, healthcare, law, crime detection, publishing, communication, resources disabled management, weather forecasting, education.

IT in service of futuristic IT - Artificial Intelligence, Virtual Reality, Bio-Computing.

### **REFERENCES**

#### **General methodology & biostatistics**

Bailey, N. T. J. (1994/'95). Statistical Methods in Biology, 3e, CUP/ LPE.

Collins, H. and Pinch, T. (1993). The Golem: What Every one Should Know About Science, Cambridge University Press.

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Prasad, S. (2004 / '05). Elements of Biostatistics, Rastogi Publs., Meerut.  
Ruxton, G. D. and Colegrave, N. (2006). Experimental Design for Life Sciences, 2e, Oxford University Press.  
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Sokal, R. R. and Rohlf, F. I. Introduction to Biostatistics, W.H. Freeman.  
Steel, R.G.D. and Torrie, J.H. Principles and Practice of Statistics with special reference to Biological Science.  
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Victoria, E. McMillan. (1997). Writing Papers in the Biological Sciences, Bedford Books, Boston.  
Yadav, K. (1993). Teaching of Life Sciences, Anmol Pubns., New Delhi.

### **Useful webs**

Biological methods: [www.cfkeep.org/html/stitch.php?s=98965698293378 & id = 44650773279975](http://www.cfkeep.org/html/stitch.php?s=98965698293378&id=44650773279975).

Writing Papers : [www.ruf.rice.edu/~bioslabs/tools/report/reportform.html](http://www.ruf.rice.edu/~bioslabs/tools/report/reportform.html)

### **Informatics**

V. Rajaraman, Introduction to Information Technology, Prentice Hall.  
Alexis Leon & Mathews Leon, Computers Today, Leon Vikas, Rs. 180.  
Peter Norton, Introduction to Computers, 6e, (Indian Adapted Edition)  
Greg Perry, SAMS Teach Yourself Open Office.org, SAMS.  
Alexis & Mathews Leon, Fundamentals of Information Technology, Leon Vikas  
George Beekman, Eugene Rathswohl, Computer Confluence, Pearson Education.  
Barbara Wilson, Information Technology: The Basics, Thomson Learning  
Ramesh Bangia, Learning Computer Fundamentals, Khanna Book Publisher

### **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.Igta.org](http://www.Igta.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).  
<http://computer.howstuffworks.com>.  
[www.keralaitmission.org](http://www.keralaitmission.org).  
[http://ezinearticles.com/?Understanding-The-Operation-Of-Mobile-Phone networks & id = 68259](http://ezinearticles.com/?Understanding-The-Operation-Of-Mobile-Phone-networks&id=68259).  
<http://www.scribd.com/doc/259538/All-about-mobile-phones>.  
<http://www.studentworkzone.com/question.php?ID=96>.  
<http://www.oftc.usyd.edu.au/edweb/revolution/history/mobile2.html>

**SIXTH SEMESTER B.Sc DEGREE PROGRAMME (Theory)**

**ZOOLOGY CORE COURSE- IX**

**BIOCHEMISTRY**

**Code: VZO6B09**

**[36 hours] [2 hours per week] [2 credits]**

**Section A (18 hrs)**

**1. Introduction (2 hrs)**

History and scope, stabilising forces in biomolecules (micro and macro molecules) and elements of biological importance, electrostatic bonds, hydrogen bonds, hydrophobic interactions.

**2. Carbohydrates (6 hrs)**

Structure and classification

Monosaccharides - Glucose, Fructose, Mannose, Galactose

Disaccharides-Sucrose, Maltose

Polysaccharides - Starch, Glycogen and Mucopolysaccharides

Mention biological functions

Principles of analytical techniques (qualitative and quantitative) and clinical significance of Benedict's, Fehling's, Barford's, Selivanof's tests

Mention Colorimeter, Ultraviolet - visible spectrophotometer

**3. Amino acids and Proteins (6hrs)**

Structure and classification of aminoacids, Properties of aminoacids, Isoelectric point, Zwitterion, Peptide linkages, primary, secondary and tertiary structure of proteins, physical and chemical properties, denaturation of proteins

Mention the biological functions of proteins

Principles of analytical techniques such as Biuret reaction, Xanthoprotein test, Ninhydrin reaction

Separation techniques- Chromatography, Paper chromatography, Column chromatography

Electrophoresis- Mention Polyacrylamide Gel Electrophoresis (PAGE), Agarose Gel Electrophoresis

**4. Lipids (4 hr)**

Classification and functions (simple and compound lipids), Polyunsaturated fatty acids, Triglycerides, mention phospholipids, lecithins, cephalins, prostaglandins and cholesterol

**Section B (8 hrs)**

**5. Enzymes and co-enzymes (4 hrs)**

Classification, nomenclature and properties of enzymes, specificity of enzymes, active centre, mechanism and theories of enzyme action, enzyme inhibition, co-enzymes (NAD, FAD) and cofactors, mention isozyme and ribozymes

**6. Nucleic acids (4 hrs)**

Chemistry and structure of purines and pyrimidines, chemistry and structure of nucleotides (ATP, cAMP, NAD<sup>+</sup>, FAD), molecular structure of B DNA, A & Z DNA, Importance of Nucleic acids, molecular structure of tRNA

## Section C (10 hrs)

### 7. Metabolism of carbohydrates, proteins and lipids

Glycogenesis, glycogenolysis, gluconeogenesis, glycolysis, mention Kreb's cycle and its significance, Oxidation and reduction reactions, redox potentials, electrochemical gradients, electron transport chain, oxidative phosphorylation, role of cytochromes, release and storage of energy, high energy compounds, proton gradient, principles and chemiosmotic synthesis of ATP, deamination, transamination and decarboxylation of amino acids,  $\beta$ -oxidation of fatty acids

### REFERENCES

- Nelson, D.L. & Cox, M.M., Lehninger Principles of Biochemistry, 4e, Palgrave MC, WHF.  
Oser, B., Hawk's Physiological Chemistry, 14e, 1971, TMH  
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Mathews, C.K. *et al.*, Biochemistry, 3e, 2003, Pearson Edn. (Indian Edn.)  
Voet, D. & Voet, J.G., Biochemistry, JW & S.  
David P. Plummer - Introduction to Practical Biochemistry, 3<sup>rd</sup> edn., Tata McGraw Hill Pub. Comp., New Delhi.  
Wilson and Walker – Principles and Techniques of Biochemistry and Molecular Biology, 6<sup>th</sup> edition – Cambridge Low Price edition.

**SIXTH SEMESTER B.Sc DEGREE PROGRAMME (Theory)**  
**ZOOLOGY CORE COURSE- X**  
**PHYSIOLOGY AND ENDOCRINOLOGY**  
**Code: VZO6B10**  
**[54 hours] [3 hours per week] [3 credits]**

**Section- A: PHYSIOLOGY (36 hours)**

**1. Nutrition (6hrs)**

Balanced diet, importance of dietary fibres, role of enzymes in digestion of carbohydrates, proteins and lipids, absorption of carbohydrates, proteins, and lipids, nervous and hormonal control of digestion

Nutritional disorders–anorexia, ulcer, flatulence, starvation. Obesity causes and consequences, role of vitamins and minerals

**2. Respiration (7 hrs)**

Brief account of gaseous exchange and transport of respiratory gases, respiratory pigments, structure and properties of Hb, Oxygen dissociation curve, Neurophysiological control of respiration, physiological problems in diving mammals, newborn and aged individuals

Medical aids for respiration – aspirators, heart lung machine

Artificial respiration and ventilation

**3. Circulation (6 hrs)**

Blood- functions and composition, Composition and functions of lymph

Agglutination and coagulation of blood (enzyme cascade theory), clinical analysis of blood, haemostasis, haemolysis, jaundice, haemoglobinopathies, ESR, blood transfusion, aphaeresis, types of heart, haemodynamics

Common cardio-vascular problems: abnormal variations in BP, tachycardia, bradycardia, myocardial infarction, heart failure, cerebral haemorrhage and stroke, ECG

**4. Osmoregulation and Excretion (7 hrs)**

Osmotic and ionic regulation in terrestrial, fresh water and marine animals, osmoconformers, osmoregulators, water retention and conservation in desert forms, types of excretion, urea cycle Human kidney- urine formation with countercurrent mechanism and hormonal regulation, abnormal constituents of urine

Common renal problems - Renal hypertension, nephritis, renal failure, oedema, acidosis, uraemia, haematuria and calculi

**5. Muscle Physiology (5 hrs)**

Structure of vertebrate skeletal muscle, EM structure of Myofibrils and Myofilaments, contractile proteins, ultra structural changes, physiology and chemistry of muscle contraction, energy sources, role of creatine phosphate, coricycle, muscle twitch, fatigue, rigor mortis

**6. Nerve Physiology (5 hrs)**

Different types of nerve cells, glial cells, giant nerve fibre of crustaceans and cephalopods, regeneration of medullary fibres, neurotrophins, nerve impulse transmission, synapses and

neuromuscular junctions, synaptic transmission (electrical & chemical), neurotransmitters  
Brief notes on: Intelligence, memory, sleep, EEG, hunger, thirst and emotion

## **Section- B: ENDOCRINOLOGY (18 hrs)**

### **1. Invertebrate endocrinology (1 hrs)**

Neuro endocrine organs and hormones in insects and crustaceans

### **2. Vertebrate endocrinology (5 hrs)**

Classification of hormones, steroid and peptide hormones, Endocrine glands in man (Pituitary, adrenal, pineal, thyroid, parathyroid, gastro- intestinal, pancreas) and their hormones (brief account)

Hormonal disorders

### **3. Concepts of neurosecretion (4 hrs)**

Hypothalamus, Hypophysial interactions, Hypothalamus releasing and inhibiting hormones. roles of hypothalamic and pituitary hormones, Antidiuretic hormone, Oxytocin, growth hormone, Adrenocorticotrophic hormone, TSH, Gonadotrophins

### **4. Reproduction (4 hrs)**

Hormonal control of testes, functions of Testosterone, role of hormones in female sexual cycle, placental Hormones , female and male sexual dysfunctions (hormone related only)

### **5. Hormonal action (4 hrs)**

Mechanism of hormone action at the level of cell membrane (insulin), at the level of enzyme located in cell membrane (adrenaline and peptide hormones), at the level of organelles (thyroxine), at the level of genes (steroids), positive and negative feedback regulation, hormone receptors

## **REFERENCES**

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Vander, A.J. *et al.* Human Physiology, 1998, MGH.  
Bentley, P. J. Comparative vertebrate endocrinology, CUP.  
Berry, A.K., A Text book of Animal Physiology, 6e, Emkay Publications, Delhi-51.  
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Nair and Paul, Animal physiology and Biochemistry, Academia.  
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**SIXTH SEMESTER B.Sc DEGREE PROGRAMME (Theory)**  
**ZOOLOGY Core Course-XI**  
**MOLECULAR BIOLOGY & BIOINFORMATICS**  
**Code: VZO6B11**  
**[54 hours] [3 hours per week] [3credits]**

**Section- A: MOLECULAR BIOLOGY (27 hours)**

**1. Introduction (5 hrs)**

Milestones of molecular biology, DNA as the genetic material, Griffith's experiments-bacterial transformations, experiments by Hershey and Chase, concept of gene, gene action/ gene expression, one gene – one enzyme hypothesis, one gene – one polypeptide hypothesis, central dogma of molecular biology and central dogma reverse, retroviruses

**2. Repetitive and unique DNA sequences (2 hrs)**

Chromosome content, C-value and C-value paradox, unique, moderately repetitive and highly repetitive DNA sequences, satellite DNA, selfish DNA

**3. Genetic code (3 hrs)**

Gene and genetic code, deciphering / cracking of genetic code, contributions of Nirenberg and associates, Khorana, properties of genetic codes, codon assignments, Wobble hypothesis

**4. Mitochondrial genome (2 hrs)**

Special features of mitochondrial genome

**5. Protein synthesis (5 hrs)**

Regulation of Protein synthesis, Types and role of RNAs (mRNA, tRNA, rRNA), synthesis of mRNA, promoter, enhancer and silencer sites, post transcriptional modifications, cis-trans splicing, spliceosomes, hn RNAs, activation of Amino acids, Polypeptide chain initiation, elongation and termination, release, Ribozymes, post translational modifications, coupled transcription and translation, poly cistronic mRNA, role of molecular chaperons, cell targeting proteins (brief account only)

**6. Regulation of gene action (3 hrs)**

In prokaryotes (Operon concept, Lac Operon in detail), lytic cycle and lysogeny of phages (brief account) siRNA and RNAi, House keeping genes, gene modulation

**7. Organization of genome (5 hrs)**

Classical concepts of genes, modern concept of genes, cistron, muton, recon, compicon, transcripton, split genes, overlapping genes, pseudo genes, jumping genes, cryptic genes (brief accounts only)

**8. Human genome project (2 hrs)**

Significance, ethical social and legal aspects

## Section- B: BIOINFORMATICS (27 hours)

### I. Overview of bioinformatics (2 hrs)

Definition, history, development and scope, tasks

### 2. Major databases in bioinformatics (5 hrs)

a) Primary databases:

Nucleotide sequence databases – Mention EMBL, DDBJ, Genbank

Protein sequence databases – Mention Swiss Prot, PIR, MIPS

Metabolite databases – Mention KEGG, EcoCyc

b) Secondary databases: Mention PROSITE, PRINTS, Blocks

### 3. Database search engines (4 hrs)

Mention Entrez at NCBI of USA, SRS at EBI of England, STAG at DDBJ of Japan

### 4. Sequence similarity search (3 hrs)

Pairwise sequence alignment: Mention BLAST, FASTA, Multiple sequence alignment: Mention CLUSTAL W, CLUSTAL X

### 5. Micro arrays (2 hrs)

Data analysis tools and methods

### 6. Genomics (3 hrs)

DNA sequencing, applications (Brief account)

### 7. Proteomics (2 hrs)

Tools and applications (Brief account)

### 8. Metabolomics (2 hrs)

Tools and applications (Brief account)

### 9. Applications of bioinformatics (2 hrs)

### 10. Ethical issues in bioinformatics (2 hrs)

Accuracy and error

Appropriate uses and users

Privacy and confidentiality

## REFERENCES

### Molecular biology:

Alberts, B. *et al.* *Molecular Biology of the Cell*. Garland Pub. Inc., New York.

Brooks, R. J.: *Genetics: Analysis and Principles*. 1999, Addison Wesley

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### **Bioinformatics**

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 Baxevanis & Ouellette. 2001. Bioinformatics - A practical guide to the Analysis of Genes and  
 Proteins, Wiley, New York.  
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 laboratory Press, New York.  
 S.C. Rastogi, Mendiratta, P. Rastogi. 2005. Bioinformatics: Method & Applications.  
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 Mani & Vijayaraj. 2004. Bioinformatics: A Practical Approach. Aparna Publications, India.  
 Higgins and Taylor. 2000. Bioinformatics: Sequence, Structure and Databanks. Oxford  
 University Press, Oxford.  
 Jin Xiong. 2006. Essential Bioinformatics. Cambridge University Press, India Pvt. Ltd.

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[www.fgcuedu/supp](http://www.fgcuedu/supp)

**SIXTH SEMESTER B.Sc DEGREE PROGRAMME (Theory)**  
**ZOOLOGY CORE COURSE- XII**  
**REPRODUCTIVE BIOLOGY, DEVELOPMENTAL BIOLOGY AND**  
**TERATOLOGY**  
**Code: VZO6B12**  
**[54 hours] [3 hours per week] [3 credits]**

**Section A: REPRODUCTIVE BIOLOGY (13 hrs)**

**1. Reproductive system in human beings (3 hrs)**

Male reproductive system: structure of testis, semen production and composition, ejaculation, female reproductive system: structure ovary and graafian follicle, ovulation, mention corpus haemorrhagicum, corpus luteum and corpus albicans, accessory reproductive organs, secondary sexual characteristics, gametogenesis male and female

**2. Pregnancy, gestation, placentation, parturition and lactation (2 hrs)**

**3. Reproductive cycles in mammals (2 hrs)**

Oestrous and menstrual cycles and their hormonal control

**4. Reproductive technologies (1 hr)**

Infertility and its management: Brief account of semen collection, preservation, storage, artificial insemination, surrogacy

**5. Cryopreservation and embryo transfer (1 hr)**

Collection, care and preservation of embryos, *In vitro* fertilization and embryo transfer - major steps, Test tube babies

**6. Assisted reproductive techniques (ART) (1 hr)**

GIFT, ZIFT, ICSI, oocyte donation and embryo donation

**7. Prenatal diagnosis (1 hr)**

Different methods (invasive and non invasive), Female foeticide, ethical issues and law, (Mention Prenatal diagnostic techniques – Prevention of misuse act – PNDT Act

**8. Fertility control (2 hr)**

Natural methods, artificial methods, chemical methods, hormonal methods, surgical contraception, removal of gonads and uterus, abortion

**Section B: DEVELOPMENTAL BIOLOGY (38 hrs)**

**1. Introduction (1 hr)**

Historical Perspective, Theories of Preformation, Epigenesis, Recapitulation and Germplasm, Determinate and Indeterminate types of development, Germ layers and derivatives

**2. Types of eggs (2 hrs)**

Classification of eggs based on the amount of yolk (micro, meso & macrolecithal), distribution of yolk (iso, centro & telolecithal), presence or absence of shell (cleidoic & non cleidoic), development (determinate & indeterminate) with examples, egg membranes (primary, secondary and tertiary)

### **3. Cleavage and cell lineage (3 hrs)**

Types of cleavage with examples based on planes (Meridional, Vertical, Equatorial and Latitudinal), based on amount of yolk (Holoblastic & Meroblastic), based on development (Determinate & Indeterminate), based on Pattern (Radial & Spiral), Cell lineage studies in *Planocera*, Different types of blastulae

### **4. Early development of Amphioxus (3 hrs)**

Cleavage, Blastulation, Gastrulation & Neurulation

### **5. Development of Frog (7 hrs)**

Fertilization, Cleavage, Blastulation & fate map, Gastrulation (Morphogenetic movements) and formation of germ layers, neurulation & notochord formation, mesoderm and coelom formation, organogeny of brain and eye, hormonal control of amphibian metamorphosis

### **6. Development of Chick (7 hrs)**

Fertilization, Structure of egg, cleavage, blastulation, gastrulation and formation of germ layers, salient features of chick embryo at primitive streak stage, 24, 33 and 48 hours stage. Development and functions of extra embryonic membranes

### **7. Development of Man (3 hrs)**

Cleavage and formation of morula, development of blastocyst, implantation, gastrulation up to the formation of germ layers  
Development of foetal membranes

### **8. Cell differentiation and gene action during development (3 hrs)**

Cell differentiation, totipotency, pluripotency, de-differentiation and re-differentiation, controlled gene expression during development, Homeotic genes, Mention Hoxgenes, Stem cells, their significance and applications

### **9. Parthenogenesis (2 hrs)**

Definition, Types- Natural parthenogenesis Arrhenotoky, Thelytoky, Obligatory and Facultative, Artificial parthenogenesis and significance

### **10. Regeneration (1 hr)**

Definition, Types (epimorphosis, morphallaxis) Heteromorphosis, super regeneration  
Histological and cytological events in regeneration

### **11. Experimental Embryology (4 hrs)**

Construction of fate map, Vital staining, Marking with carbon particles & radio active tracing, Spemann's constriction experiments on amphibian embryos (Potency of nuclei and grey

crescent), Importance of Grey crescent, Organizers in amphibian development (primary, secondary & tertiary organizers), Gradient experiments in sea urchin eggs

## **12. Placenta (2 hrs)**

Different types and functions

### **Section C: TERATOLOGY (3 hrs)**

Environmental disruption of animal development

Action of alcohol, drugs, nicotine and chemicals- brief account

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**SIXTH SEMESTER B.Sc DEGREE PROGRAMME (Theory)**  
**ZOOLOGY CORE COURSE- XIII**  
**BIOTECHNOLOGY, MICROBIOLOGY AND IMMUNOLOGY**  
**Code: VZO6B13**  
**[54 hours] [3 hours per week] [3 credits]**

**Section- A: BIOTECHNOLOGY (18 hrs)**

**1. Introduction to Biotechnology (1 hr)**

Definition, history

Mention branches of Biotechnology (brief)

**2. Animal cell culture and hybridoma technology (3 hrs)**

Primary cell culture, secondary culture, types of cell lines, valuable products from cell culture, Culture media, hybridoma technology, monoclonal antibodies and their uses

**3. Gene cloning and DNA sequencing (5 hrs)**

Introduction, cloning vectors (plasmid, pBR322, phages, cosmids, virus, YAC), enzymes of rDNA technology exonuclease, endonuclease, Restriction enzyme, DNA ligase, DNA polymerase, Reverse transcriptase), Use of Linkers, Construction of Recombinant DNA, amplification in host cell, selection of clones, DNA sequencing (brief)

**4. Transgenic organisms (3 hrs)**

Transfection methods- Calcium phosphate precipitation, Dextran mediated, Lipofection, Electroporation, Retroviral infection, Micro injection, Shotgun method (brief)

Transgenic animals- fish, sheep, rabbit, mice, and goat. One example from each

Molecular pharming and bioreactors

Mention knock out mice, Bt cotton

**5. Molecular markers (3 hrs)**

RFLP, RAPD, VNTR, Micro satellites or STR, and their uses.

Chromosome walking, Fluorescence *in situ* hybridization (FISH)

DNA Finger printing (Profiling) techniques

**6. Biotechnology and Environment (2hrs)**

Biosensors, Bioremediation – *Ex situ* and *in situ*, Biofiltration, Bioleaching (microbial mining)

**7. The ethical and social implications of genetic engineering (1 hr)**

**Section-B: MICROBIOLOGY (18 hrs)**

**1. Introduction (1 hr)**

History and Scope

**2. Survey of Microorganisms (outline only) (3 hrs)**

Prions, Viroids, Viruses, Rickettsias, Mycoplasmas, Bacteria, Cyanobacteria, Prochlorophyta, Protozoa, Algae, Fungi, Slime moulds

**3. Bacteria (2 hrs)**

Structure, characteristics and major groups of bacteria, growth phases, measurement of growth

**4. Viruses (2 hrs)**

Structure, shape, replication

**5. Basic methods in Microbiology (4 hrs)**

Microscopic methods, Techniques of sterilization, Media preparation, isolation and inoculation, Direct observation and Staining techniques, Maintenance and preservation of cultures

**6. Microorganisms in Industry (2 hrs)**

Products of industrial fermentations, Citric acid, Lactic acid, Amino acids, Enzymes, Vitamins, antibiotics, single cell protein, Steroids.

Effects of environment on microbial growth (Temperature, Atmosphere, pH, Osmotic factors)

**7. Genetically modified microorganisms (1 hr)**

**8. Microorganisms in Human Diseases (3 hrs)**

Normal micro flora of the human body

Diseases caused by Bacteria, Protozoa, Viruses (brief)

Epidemiology and control of diseases, Chemotherapy

**Section-C: IMMUNOLOGY (18 hrs )**

**1. Introduction and History (2 hrs)**

Immunity – Natural and Acquired, Active and Passive, Immunisation, Vaccines, Principles of vaccination, Attenuated bacterial or viral vaccines, inactivated viral or bacterial vaccines, Toxoid vaccines (brief)

**2. Immune System (3 hrs)**

Cells of the immune system- B lymphocytes, T lymphocytes, NK cells, monocytes, macrophages, Neutrophils, Basophils, Eosinophils, Mastcell and Dendritic cells.

Organs of immune system - Spleen, Thymus, Bone marrow and Lymph nodes

**3. Immunoglobins (2 hrs)**

Structure, classes, biological functions

**4. Antigens (3 hrs)**

Exogenous antigens, Endogenous antigens, adjuvants, haptens, epitopes,

Antigen-antibody reaction - Precipitation reaction, Agglutination reaction, Agglutination inhibition reaction

### **5. Auto immune diseases (2 hrs)**

Systemic- SLE, Multiple sclerosis, Rheumatoid arthritis

Organ specific- Hashimoto's thyroiditis, Grave's disease, Myasthenia gravis

### **6. Techniques in Immunology (2 hrs)**

Principles and Applications of Immuno assays: RIA, ELISA, Flow cytometry

Blotting techniques:- Western blotting, mention dot blot, slot blot

### **7. Tumour immunology (2hrs)**

Malignant transformation of cells, tumour antigens, immune response to Tumour effector mechanisms in antitumor immunity, Antibodies, T-lymphocytes, NK cells, Macrophages, Immuno therapy

### **8. Cellular and Humoral Immunity (2 hrs)**

## **REFERENCES**

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Mansi – Fermentation, Microbiology and Biotechnology, Second Edition.- Taylor and Francis

Wise- Bioinstrumentation and Biosensors - Taylor and Francis.

**SIXTH SEMESTER B.Sc DEGREE PROGRAMME (Theory)**  
**ZOOLOGY ELECTIVE COURSE**  
**AQUACULTURE, ANIMAL HUSBANDRY & POULTRY SCIENCE**  
**Code: VZO6E01**  
**[54 hours] [3 hours per week] [3 credits]**

**Section A : AQUACULTURE (36 hrs)**

**1. Introduction (2 hrs)**

Scope in India and Kerala, Export potential, Different types of cultures

**2. Mariculture (10 hrs)**

Prawn culture: Important culture varieties, Pokkali culture, breeding spawning, control breeding, induced maturation, eye stalk ablation, culture methods, freezing, curing and canning

Mussel culture: *Perna indica*, *Perna viridis*

Seed collection, artificial seed production, induced spawning, rearing, raft culture, harvesting

Pearl culture- *Pinctada fucata*, *Pinctada margaritifera*

Sea weed culture - *Grassilaria*, *Sargassum*

**3. Pisci culture (4 hrs)**

Egg collection, induced spawning, construction, preparation and maintenance of ponds, manuring, feeding and harvesting, cryo preservation of fish germplasm, semen bank and preservation media

**4. Biology and culture of Indian major carps (2 hrs)**

*Catla catla*, *Labeo rohita*

Biology and culture of exotic carps. *Hypophthalmichthys molitrix* (silver carp)

**5. Inland Fish and Fisheries (1 hr)**

*Channa*, *Clarius*

Rivers, paddy fields

**6. General account and fishery aspect of Sardine and Tuna (1 hr)**

**7. Ornamental fisheries (2 hr)**

Common aquarium fishes, aquarium management and identification of sex

*Carassius auratus* (gold fish), *Poecilia reticulatus* (guppy)

**8. Plankton and Fishery production (2 hrs)**

Zoo and Phytoplankton – vertical migration – plankton and productivity

**9. Fishing Gears (2 hrs)**

Gill net, drift gill net, purse-seines, harpoon, Chinese dip nets, echo sounders, sonar, remote sensing

**10. Fish Spoilage and Preservation (3 hrs)**

Biochemical changes, spoilage, use of ice, freezing, canning, dehydration, salting, smoking

**11. Fish utilization (4 hrs)**

Nutritive value, by products, liver oil, body oil, fish meal, fish flour, isinglass, glue, skin, fin soup, lime, chitin, chitosan

**12. Diseases and parasites of Fish (2 hrs)**

Fungal infection – *Saprolegnia*

Bacterial – Fin & tail rot disease, Dropsy

**13. Mud banks of Kerala coast (1 hr)**

**Section B: POULTRY SCIENCE (7 hrs)**

Introduction and Scope

Egg production, cable bird production, nutritive value, bye products

Different breeds: Exotic – 3 examples

Indigenous – 2 examples

Poultry rearing - Selection of eggs, hatching, incubation, brooding, sexing, vaccination

Poultry housing- Free range system, Semi-intensive system (deep litter system and individual cage system)

Equipments for feeding- Nutrients for starting, growing, laying hen

Common poultry feeds, food rations, feed formulation

Common diseases of poultry- Ranikket, Pullorum, Fowl pox

**Section C: ANIMAL HUSBANDRY (7 hrs)**

Introduction- history, origin, domestication

Breeds of cattle:

Milk type - Sindhi, Gir

Draft breed- Nagori, Kangayam

Dual purpose- Ongole, Hariana

Exotic breed - Jersey, Holstein – Friesian

Native breeds- Conservation programmes, Vechur cattle.

Feeding- Common cattle feeds, fodder

Common diseases - Anthrax, foot & mouth disease, parasites

Meat hygiene- Slaughter and clean meat production

Zoonotic diseases

**Section D: DAIRY SCIENCE (4 hrs)**

Role of dairy development in rural economy employment opportunities, white revolution.

Dairy processes- Staining, Filtration, Cooling, Chilling, Clarification, Pasteurisation, Freezing

Recombined milk, Soft curd milk, Skimmed and toned milk

Artificial milk

Milk – adulteration

Dairy products and nutritive value

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**SIXTH SEMESTER B.Sc. DEGREE PROGRAMME-(Theory)**  
**ZOOLOGY ELECTIVE COURSE**  
**HUMAN GENETICS**  
**Code: VZO6E02**  
**[54 hours] [3 hours per week] [3 credits]**

**1. Introduction (1 hr)**

Scope and significance

**2. History and nomenclature of human chromosomes (3 hrs)**

Various conferences and their contributions: Denver, Chicago, Paris and Stockholm conferences

**3. Characteristics of human chromosomes (4 hrs)**

Non-banding techniques, A to G groups

Various banding techniques, G-banding, Q-banding, R-banding, C-banding, Y-banding, NOR banding and fluorescent in-situ hybridization (FISH)

**4. Non -disjunction of chromosomes (3 hrs)**

Meiotic non-disjunction, mitotic non-disjunction, non disjunction of autosomes, non- disjunction of sex chromosomes and mosaicism

**5. Human Pedigree (4 hrs)**

Pedigree construction, data collection, analysis and pedigree charts of autosomal dominant, autosomal recessive, X-linked dominant and recessive gene mutation disorders

**6. Autosomal dominant inheritance (4 hrs)**

Familial hyper cholesterolemia, metabolic and genetic control of cholesterol, Huntington's disease, Marfan's syndrome (Arachnodactyly), Osteogenesis- imperfecta (brittle bone disease), Ehlers- Danlos Syndrome (Rubber man or the Elastic Woman)

**7. Autosomal recessive inheritance (4 hrs)**

Cystic fibrosis, CF gene and protein, Detection of CF homozygotes and carriers, hereditary microphaly, retinoblastoma, craniodiaphyseal dysplasia, Hutchinson-Gilford syndrome (progeria), Thalasemia and Hereditary hemolytic anemia.

**8. X-linked dominant and recessive inheritance (4 hrs)**

Duchene's muscular dystrophy, identification of the DMD gene, carriers and hemizygotes, Hypophosphatemia, Von willebrand's disease, SCID & Albright's hereditary osteodystrophy

**9. Multifactorial inheritance (4 hrs)**

Congenital heart diseases (ASD & VSD), Alzheimer's disease, Schizophrenia, intelligence, stature, blood pressure, refractive index of the eye & dermatoglyphic ridge count

**10. Chromosome structural modification and the human phenotype (3 hrs)**

Ring chromosome, iso chromosomes, Philadelphia chromosome, Cri-du-chat syndrome (5p-

syndrome) Prader willi syndrome, Fragile X- Syndrome (Martin Bell syndrome), Burkitt's lymphoma (14q+ syndrome)

### **11. Reproduction and Development (5 hrs)**

Prenatal development- genes and hormones

Errors in sexual development - Defects of androgen target cells, deficiency of 5 alpha reductase, congenital adrenal hyperplasia, and sex reversal

Genetics of embryonic development

Maternal effect genes, segmentation and pattern formation genes, adhesion molecules and genes  
Programmed cell death (apoptosis)

### **12. Genomic imprinting (3 hrs)**

Inbreeding in isolates, consanguineous marriages, twin studies, biology of twinning, analysis of twin data

### **13. Prenatal diagnosis and genetic services (4 hrs)**

Amniocentesis, chorionic villi biopsy, foetoscopy, ultrasound sonography, alpha foeto protein screening, prenatal sexing, test tube babies, karyotyping.

### **14. Genetic counseling (5 hrs)**

Procedures and ethical concern, history of counselling, methods of genetic counselling, marriage counselling, directive and non directive reason for seeking counselling, psychodynamics of genetic counselling

### **15. Pharmacogenetics (3 hrs)**

Ecogenetics and the Phenocopy

## **REFERENCE**

Basic Human Genetics: Elaine Johansen Mange & Arthur P. Mange, Rastogi Publications, Shivaji Road, Meerut.

Fundamentals of Genetics, John Ringo; - Cambridge University press

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**SIXTH SEMESTER B.Sc DEGREE PROGRAMME (Theory)**  
**ZOOLOGY ELECTIVE COURSE**  
**APPLIED ENTOMOLOGY**  
**Code: VZO6E03**  
**[54 hours] [3 hours per week] [3 credits]**

**Section A: AGRICULTURAL ENTOMOLOGY (42 hrs)**

**1. Introduction to Entomology (5 hrs)**

Mention Agricultural entomology, forest entomology, veterinary entomology, medical entomology, forensic entomology, industrial entomology, nutritional entomology, cultural entomology

Classification of Class Insecta down to orders, general organization of an insect

**2. Insects in service of man (2 hrs)**

Useful products, useful body, galls, pollinators, destroyers of insect pests, as food for animals and even man, destroyers of weeds, improve soil fertility, as scavengers, in scientific research, aesthetic and entertainment value, in medicine, pollution indicators, arrow poisons, cold light, in forensic science, insect pheromones and hormones (very brief account)

**3. Insects as enemies of man (23 hrs)**

Definition of pests, kinds of insect pests, causes of pest outbreak, pests injurious to plants and animals, pests as vectors of diseases

Life history, damage and control measures of

**a) Pests of Paddy** - *Spodoptera mauritia*, *Leptocorisa acuta*, *Dicladispa armigera*

**b) Pests of coconut** - *Oryctes rhinoceros*, *Opisina arenosella*, *Aceria guerreronis*

Damage and control measures of

**c) Pests of sugar cane** - *Chilo infuscatellus*, *Scirpophaga novella*, *Sacchariococcus sacchari*

**d) Pests of plantation crops**

Pests of Coffee - *Xylotrechus quadripes*, *Coccus viridis*

Pests of Tea - *Helopeltis antonii*, *Toxoptera aurantii*

Pests of Rubber - *Aspidiotus destructor*, *Comocrits pieria*

Pests of Pepper - *Longitarsus nigripennis*, *Laspeyresia hemidoxa*

Pests of Cardamom - *Sciothrips cardamom*, *Eupterote canarica*

**e) Pests of fruit plants**

Pests of Banana - *Cosmopolites sordidus*, *Pentalonia nigronervosa*

Pests of Mango - *Batocera rufomaculata*, *Dacus dorsalis*

Pests of Cashew - *Plocoederus ferrugineus*, *Helopeltis antonii*

**f) Pests of vegetables**

Pests of Lady's finger - *Platyedra gossypiella*, *Earias vitella*

Pests of Brinjal - *Leucinodes orbonalis*, *Epilachna vigintioctopunctata*

Pests of Cucurbits - *Dacus cucurbitae*, *Raphidopalpa foveicollis*

**g) Pests of stored products** - *Tribolium castaneum*, *Callasobruchus chinensis*

**h) Pests of domestic animals**

Pests of Domestic fowl - *Menopon gallinae*

Pests of Goat - *Oestrus ovis*

Pests of Cattle - *Tabanus striatus*

#### **4. Insect Pest Control (12 hrs)**

(a) Natural control

(b) Applied control or Artificial control

Prophylactic and curative methods - cultural, mechanical, legal methods (brief account),  
Biological control – history, ecological, biological and economic dimensions of biological pest control methods

Mention any 3 important biological control project undertaken in India, merits and demerits

Chemical control - classification, insecticides of plant origin; insecticides, mention insecticide residue, resistance and resurgence of insect pests

Pesticide appliances - hand compression sprayer, knapsack sprayer and rocker sprayer ;

Precautions in handling insecticides (brief account)

Modern methods of Pest control - Autocidal and Pheromonal control (brief account)

Integrated Pest Management (IPM) - features, advantages (brief account)

#### **Section B: INDUSTRIAL ENTOMOLOGY (12 hrs)**

##### **Productive Insects (12 hrs)**

(a) **Honey bee** - Apiculture and its scope, different species, social organization, structure of worker bee, life history (brief account) and communication

Bee products: honey and bee wax, composition and uses, bee diseases

(b) **Silk moth** - Different types of silkworms, life cycle (brief account), sericulture (brief account), moriculture, processing and extraction of silk (brief account)

Diseases of silk worms, composition and uses of silk

(c) **Lac insect** -Different strains of Lac insects, cultivation, inoculation and harvesting, propagation of lac, composition and uses of lac, enemies of lac insects

##### **REFERENCES**

Atwal, A.S and Dhaliwa, G.S.(2008) Agricultural Pests of south Asia and their Management,6 e, Kalyani Publishers

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Ramakrishna Ayyar, T.V. Maras, 1963.Handbook of Economic Entomology for South India, Srivastava,K. P. A Text book of Applied Entomology , Vol. I & Vol. II, Kalyani Publishers, Ludhiana, New Delhi, Noida (U.P.)

**FIFTH SEMESTER B.Sc DEGREE PROGRAMME (Theory)**  
**ZOOLOGY OPEN COURSE**  
**REPRODUCTIVE HEALTH AND SEX EDUCATION**  
**Code: VZO5D01**  
**[36 hours] [2 hours per week] [2 credits]**  
**Section A (9 hrs)**

**1. Reproductive Biology and sex education (3 hrs)**

Introduction, phases of body growth, stages of sexual growth, sexual hygiene, need for sex education

Problems of adolescence, reproductive rights

**2. Reproductive system (4 hrs)**

Male genitalia- testis, accessory glands, penis

Female genitalia- ovaries, uterus, vulva

Sexual cycle- ovarian cycle, uterine cycle

Menarche, menopause, adropause

**3. Hormones and human reproduction (2 hrs)**

Functions of male and female hormones, Hormones in pregnancy

**Section B (14 hrs)**

**4. Sex determination and Chromosomal anomalies (4 hrs)**

Chromosomal mechanism of sex determination in human, Normal Human Karyotype, Barr body, Twin studies

Autosomal anomalies- Down's syndrome, Edward's syndrome

Sex chromosomal anomalies- Turner's syndrome, Klinefelter's syndrome

Sex linked inheritance- Haemophilia, Colourblindness

**5. Prenatal Diagnosis (3 hrs)**

Prenatal diagnostic techniques (invasive and non invasive), Female foeticide- Ethical issues and laws (Prenatal Diagnostic techniques – Prevention of misuse act – PNDT Act)

**6. Fertility Control (3 hrs)**

Population explosion, birth control, Natural methods, Artificial methods, Contraceptive devices and medications, Abortion, Legal termination of pregnancy, Vasectomy, Tubectomy, Vaccines and hormones in fertility control

**7. Infertility and assisted reproductive techniques (4 hrs)**

Physiological infertility, pathological infertility, causes and problems in male and female infertility

Assisted Reproductive Techniques (ART) – IVF, ET, AI, GIFT, ZIFT, ICSI, Embryo or oocyte donation, health hazards in ART

Cryopreservation of blastocysts and ethics, designer baby and ethics

## Section C (13 hrs)

### 8. Sexual abuses and myths (4 hrs)

Premarital and extramarital sex, Sexual abuse and rape, Sexual perversions, Alternate orientations (Homosexuality, Lesbianism, Bisexuality, Paraphilias), Oral sex, Animal sex, Cyber sex, Child abuse, Prostitution, Sexual myths, Sexual hygiene

### 9. Sexually transmitted infectious diseases (6 hrs)

Symptoms, mode of transmission, diagnosis, treatment and prophylaxis of AIDS, Syphilis, Gonorrhoea, Herpes (genital), Human papilloma virus and genital warts, hepatitis, gonococcal vulvo vaginitis, Trichomonal vaginitis, Mention the term venereal disease  
Socio economic dimensions of STD

### 10. Ethical aspects of sex (3 hrs)

Introduction, Healthy relationship with opposite sex, Role of counseling, Sexual counseling, Marriage counseling, Gender discrimination in family and society, sperm bank, ovum bank.

## REFERENCES

- Prakash Kothari : *Common sexual problems and solutions*, UBS Publishers and Distributors Ltd.  
Lynn L. Long, Judith A. Burnett, R. Valorie Thomas: *Sexuality counseling, An integrated approach* , Pearson, Merrill Prentice Hall.  
Robert T. Francoeur: *Becoming a sexual person*, John Wiley and Sons.  
Guyton & Hall: *Textbook of Medical Physiology*  
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Vijayakumaran Nair, K.and Paul, P.I: *Animal Physiology and Biochem*

**FIFTH SEMESTER B.Sc DEGREE PROGRAMME (Theory)**  
**ZOOLOGY OPEN COURSE**  
**NUTRITION, HEALTH AND HYGIENE**  
**Code: VZO5D02**  
**[36 hours] [2 hours per week] [2 credits]**

**Section A: NUTRITION (18 hrs)**

1. Introduction
2. Components of food, classification of foodstuffs, balanced diet
3. Dietary recommendations to a normal adult, infant, pregnant woman and aged
4. Malnutrition disorders
5. Significance of breast feeding
6. Importance of fibers in food
7. Food toxins, food adulteration, food processing and preservation
8. Defects of modern food habits, mention food additives
9. Nausea, vomiting, diarrhea, constipation, piles, anorexia, starvation, acidity, ulcer and flatulence
10. Fasting and its significance
11. BMI and its significance
12. Different feeding habits: vegetarians, non-vegetarians and vegans
13. Human digestive system

**Section B: HEALTH & HYGIENE (18 hrs)**

**1. Health and Fitness (2 hrs)**

Physical health, psychological health, sociological health, genetic influence on health  
Three elements of health programmes: environment- education- surveillance  
Fitness- body conditioning, principles of exercise programmes, sports, use of leisure time

**2. Alcoholism (1 hr)**

Alcoholic beverages, physiological effects of alcohol, abuse of alcohol, treatment of chronic abuse of alcohol

**3. Smoking (1 hrs)**

Rights of non smokers, composition and effects of tobacco smoke, the smoking habits (active and passive smoking)

**4. Communicable and non-communicable diseases (brief account) (2 hrs)**

Bacterial, viral, fungal, protozoan, helminth

**5. Parasites and their diseases (2 hrs)**

Mode of infection, pathogenecity, diagnosis, treatment and prophylaxis (life cycle not expected) of *Entamoeba histolytica* & *Taenia solium*

**6. Vector borne diseases and their control (1 hrs)**

*Anopheles, Culex & Aedes*

**7. Disorders of blood vascular system (2 hrs)**

Hypotension and hypertension, coronary thrombosis, stroke

**8. Other diseases (brief account) (2 hrs)**

Cancer, hepatitis, jaundice, diabetes type I and II, insulinoma, Hyperinsulinism, AIDS

**9. Early intervention (1 hr)**

Autism, dyslexia and mental retardation

**10. First aid (2 hrs)**

Snake bite (add a note on identification of poisonous and non poisonous snakes from the bite mark and observing the snake, mention haemotoxic and neurotoxic venom, anti venom, poly venom (preparation)

Dog bite; scorpion/ bee/ wasp sting; burns, road accidents, drowning

**11. Proper use of drugs-ill-effects of self medication (1 hr)**

**12. Hygiene (1 hr)**

Hygiene and health factors at home, personal hygiene, oral hygiene and sex hygiene

**REFERENCES**

Gibney, Public Health Nutrition, Blackwell.

Gibney, Clinical Nutrition, Blackwell. 99

Sarada Subramanyam and K. Madhavankutty, Textbook of Human Physiology.

Churchill Livingstone, Davidson's Principles of Practice of Medicine.

Guyton & Hall, Textbook of Medical Physiology.

**FIFTH SEMESTER B.Sc DEGREE PROGRAMME (Theory)**  
**ZOOLOGY OPEN COURSE**  
**APPLIED ZOOLOGY**

**Code: VZO5D03**

**[36 hours] [2 hours per week] [2 credits]**

**Section A: ENTOMOLOGY (18 hrs)**

**1. Introduction (1 hr)**

Mention agricultural entomology, forest entomology, veterinary entomology, medical entomology, forensic entomology, industrial entomology, nutritional entomology, cultural Entomology

**2. Agricultural pests (6 hrs)**

Definition of pest, kinds of insect pests, nature of damage caused and control measures of the following pests:

- a) Pests of paddy - *Spodoptera mauritia*, *Leptocorisa acuta*
- b) Pests of coconut - *Oryctes rhinoceros*, *Rhynchophorus ferrugineus*
- c) Pests of stored products - *Sitophilus oryzae*, *Callasobruchus chinensis*

**3. Productive Insects (6 hrs)**

**a) Apiculture**

Brief description of common species of *Apis*

Honey bee products - bee wax and its uses, chemical composition of honey and uses

**b) Sericulture**

Brief description of *Bombyx mori* (Mulberry silk moth), *Antheraea paphia* (tussar silkworm)

Sericulture and extraction of silk

Types of silk - Tussar, Muga and Eri Silk

**4. Insect Pest Management (5 hrs)**

Cultural control, mechanical controls, biological control, chemical control

Integrated pest management (IPM)

**Section B: AQUACULTURE (4 hrs)**

Brief account with examples on

Pisciculture

Prawn culture

Mussel culture

Pearl Culture

**Section C: POULTRY SCIENCE (4 hrs)**

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

2. Breeds of fowl

a) Exotic breeds: Rhode Island Red, Plymouth Rock, New Hampshire

b) Indigenous breeds: Chittagong, Gangus

#### **Section D: ANIMAL HUSBANDRY (6 hrs)**

1. Introduction.
2. Breeds of cattle
3. Artificial insemination
4. Storage of semen
5. Embryo transfer technology
6. Common diseases  
(a) Anthrax (b) Foot and mouth diseases (c) Rinderpest

#### **Section E: PARASITOLOGY (4 hrs)**

1. Introduction
2. Human Parasites:  
Mention the habits, habitat, life cycle, mode of infection, control measures of the following Parasites - *Entamoeba histolytica*, *Plasmodium vivax* & *Taenia solium*
3. Insect Vectors of human diseases:  
*Anopheles*, *Culex* & *Aedes* (Mention habits, structure, disease caused and control)

#### **REFERENCES**

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- Sobti Medical Zoology Shoban Lal & Co.
- Boraiah, G. Lecturers on Sericulture 2e. 1994, SBS Pub. Bangalore.
- Cherian & Ramachandran Bee keeping in South Indian Govt. Press, Madras.
- Dileep de Sarkar: The Silkworm Biology Genetics and breeding.
- FAO. manual of silkworm rearing. A manual of mulberry cultivation. A manual of silk Reeling.
- Gupta, K.C. Romance of Scientific Bee keeping - Khadi Pratisthan. Calicut.
- Mahadevappa, D. *et al.* Mulberry Silk reeling Technology.
- Mishra, R.C. Perspectives in Indian. Apiculture 2002. Agro Bios
- Phillips, E.F., Bee Keeping 2003. Agro Bios.
- Sarda Singh: Bee Keeping in India, ICAR.
- Sreerama Reddy G. Silkworm Breeding
- Sulochana Chetty & Ganga: Sericulture.
- Tamaki. Y. Sericology: Central Silk Board, 95-B, Marine Drive, Bombay-2.
- Ullal, S.R. & Narasimhanna. M.N.: *HB* of Practical Sericulture, Central Silk Board, Bombay.
- Alikunhi, K.M. Fish Culture in India, Cutting, C.L. Fish Processing and preservation. 2002, Agro.
- Day, F. The Fishes of India. Vols. 1 & 11, 1971. Today and Tomorrow Book Agency

**CORE COURSE PRACTICAL - I (Practical - I\* A)**  
**ANIMAL DIVERSITY NON-CHORDATA Part-I**  
**[36 hours] [2 hrs per week]**

[Students are expected to make notes, while they study the specimens in the laboratory / field itself. The record must carry notes of all specimens and sketches of mountings and dissections. Emphasis must be on scientific accuracy.]

**Section A: Study of the following specimens**

Choose useful and harmful forms from different habitats. Slides / museum preparations are to be used; charts / models may be used in exceptional cases. Students are expected to identify the specimens by their generic names and assign them to the respective phyla and classes

**Protists:** *Amoeba*, *Noctiluca*, *Ceratium*, *Entamoeba*, *Trichonympha*, *Paramecium*, *Ephelota* (any 3)

**Poriferans:** *Leucosolenia*, *Scypha*, *Spongilla*, sponge gemmule (any 2)

**Cnidarians:** Sedentary hydrozoans: *Hydra*, *Obelia* (any 1)

Pelagic Hydrozoans: *Physalia*, *Velella* (any 1)

Pelagic Scyphozoan: *Aurelia* / *Rhizostoma*

Common Anthozoans: *Adamsia*, *Madrepora*, *Fungia*, *Tubipora*, *Gorgonia* (any 2)

**Platyhelminths:** Free living flat worm: *Bipalium* / *Dugesia*

Parasitic flat worms: *Fasciola*, *Taenia solium* (any 1)

**Aschelminths:** Parasitic round worms: *Ascaris*, *Ancylostoma*, *Wuchereria* (any 1)

**Minor Phyla :** *Sipunculus* / *Bonellia* or any other specimen

**Section B: Histology**

Transverse sections of a coelenterate, a platyhelminth, a nematode (*Ascaris* male/female)

**CORE COURSE PRACTICAL- I (Practical - I\* B)**  
**ANIMAL DIVERSITY NON-CHORDATA Part- II**  
**[36 hours] [2 hrs per week]**

**Section A: Study of following specimens.**

**Annelids**

Polychaetes: *Aphrodite*, *Chaetopterus*, *Arenicola*, *Tomopteris* (any 2)

Common earthworm: *Megascolex* / *Pheretima*

Leech: *Hirudinaria*, *Haemadipsa*, *Branchellion* (any 2)

**Arthropods**

Items of evolutionary / taxonomic importance - *Limulus*, *Streptocephalus* (any 1)

Common fouling barnacle – *Lepas* / *Balanus*

Parasitic crustaceans– *Sacculina*, *Cymathoa*, *Argulus* (any 2)  
 Crustacean of the sandy shore– *Emerita* / *Albunea*  
 Symbiotic crustacean - *Eupagurus*  
 Economically important crustacean– prawn, crab (any 1)  
 Vectors – *Cyclops*, mosquito, housefly, rat flea (any 2)  
 Insect pests –*Lepisma*, termite queen, pest of paddy, pest of coconut, pest of stored grains (any 5)  
 Aquatic insects – *Belostoma*, *Nepa*, *Ranatra* (any 1)  
 Predatory insect - dragonfly, ant lion, *Mantis* (any 1)  
 Insect which camouflages - stick insect / *Phyllium*  
 Common myriapods – *Scolopendra*/ *Scutigera*, *Julus*/ *Spirostreptus* / *Jonespeltis* (any 2)  
 Common arachnids – *Palamnaeus* / *Buthus*, spider/ tick /mite (any 2)  
**Molluscs**  
 Intertidal mollusks – *Chiton*, *Patella*, *Haliotis*, *Onchidium*, *Aplysia* (any 2)  
 Ornamental gastropods –*Cypraea*, *Murex*, *Turbinella* (any 2)  
 Poisonous gastropod – *Conus*  
 Pelecypods of economic importance – *Perna*, *Pinctada*, *Teredo*, *Ostrea* (any 2)  
 Scaphopod - *Dentalium*  
 Cephalopods of economic or evolutionary importance- *Sepia*, *Loligo*, *Octopus*, *Nautilus* (any 2)  
**Echinoderms**  
 Sea lily, star fish, brittle star, sea cucumber, sea urchin, cake urchin, heart urchin (any 3)  
**Hemichordata**  
*Balanoglossus*  
**Onychophora**  
*Peripatus* (Evolutionary significance)

### Section B: Histology

TS of an annelid (*Neanthes* / Earth worm/leech)

### Section C: Mountings

Earthworm : Setae (a few loose setae) (minor)  
*Penaeus* : Appendages (minor)  
 Cockroach : Salivary apparatus (major)  
 Honeybee/ plant bug: Mouth parts (minor)

### Section D: Dissections

*Penaeus* : Nervous system (Major)  
 Cockroach : Nervous system (Major)

**CORE COURSE PRACTICAL- I (Practical - I\* C)**  
**ANIMAL DIVERSITY - CHORDATA Part- I**  
**[36 hours] [2 hours per week]**

Students are expected to make notes, while they study the specimens in the laboratory and field. The Record must carry notes of all specimens and sketches of mountings and dissections. Emphasis must be on scientific aspects. Students are expected to identify the specimens by their generic names and assign them to the respective phyla /classes/ orders

**Section A: Study of the following specimens**

**Urochordates** : *Ascidia*, ascidian tadpole, *Salpa*, *Doliolum* (any 2)

**Cephalochordate** : *Branchiostoma*

**Agnathans** : *Myxine*, *Petromyzon*, Ammocoete larva (any 1)

**Pisces**

Common elasmobranchs - *Chiloscyllium*, *Stegostoma*, *Sphyrna*, *Pristis*, *Trygon*, *Narcine* (any 2)

Common food fishes - *Sardinella*, *Rastrelliger*, *Cynoglossus*, *Parastromateus*, *Trichiurus*, *Cybius*, *Etroplus*, *Mugil*, *Wallagonia*, *Tilapia*, *Catla*, *Cirrhinus*, *Labeo*, *Cyprinus* (any 2)

Fishes with special adaptive features - *Hippocampus*, *Belone*, *Hemirhamphus*, *Exocoetus*, *Tetradon*, *Pterois*, *Ostracion*, *Heteropneustes*, *Clarias*, *Arius*, *Anabas*, *Channa*, *Echeneis*, *Antennarius*, *Amphisila*, eel (*Anguilla* / *Muraena*) (any 2)

**Amphibians**

Common amphibians- *Bufo*, *Rhacophorus*, *Ambystoma*/ Axolotl larva, an apodan (any 2)

**Reptiles**

Common lizard- *Hemidactylus*, *Calotes*, *Mabuya* (any 1)

Lizards with special adaptations - *Draco*, *Chamaeleon*, *Phrynosoma*, *Uromastix* (any 2)

Non poisonous snakes- *Ptyas*, *Natrix*, *Eryx*, *Lycodon*, *Typhlops* (any 1)

Poisonous snakes - *Naja*, *Daboia* (*Vipera*), *Bungarus*, *Echis* (any 2)

Water snake – *Hydrophis* / *Enhydrina*

Arboreal snake – *Dryophis* / *Python*

**Section B: Histology**

*Branchiostoma* - T. S. through pharyngeal region

**Section C: Mountings**

*Sardinella* : Cycloid scale (minor)

Shark/*Calotes* : Brain (minor)-Demonstration only

**Section D: Dissections**

(Digital versions to be downloaded or procured as per UGC guidelines)

Shark/*Calotes*/Frog: IX and X cranial nerves on one side (major)

Shark/*Calotes* /Frog: Heart and ventral aorta with branches on both sides (major)

Mullet : [or any other bony fish]: Alimentary canal (major)

**Section E: Osteology**

Frog : Vertebrae-Typical, 8<sup>th</sup>, 9<sup>th</sup>, 10<sup>th</sup>, pectoral & pelvic girdles

**CORE COURSE PRACTICAL- I (Practical - I\* D)**  
**ANIMAL DIVERSITY - CHORDATA Part- II**  
**[36 hours] [2 hours per week]**

**Section A: Study of the following specimens**

**Birds**

Fossil - Archaeopteryx

Flightless bird- *Rhea*, *Struthio* (any 1)

Aquatic birds- Jacana, duck, teal (any 1)

Wet land birds- Heron, Ibis, Storks, Pelicans (any 1)

Migratory birds- Pelicans, Cranes, Flamingos (any 1)

Features and adaptations of duck, parrot, king fisher, owl, kite, wood pecker (draw sketches of the beaks and feet of 3 birds)

Observe birds in their natural habitat and prepare a field note

**Mammals**

Common insectivore – *Suncus*, *Hedgshog* (any 1)

Common rodent – rat/ bandicoot/ squirrel (any 1)

Common bat of Kerala (any 1)

Primate – *Loris* or any other item

**Section B: Osteology**

Rabbit - skull (details of dentition)

Atlas, axis, typical vertebra

Scapula, pelvic girdle

**CORE COURSE PRACTICAL II (PRACTICAL II \*-A)**  
**ENVIRONMENTAL BIOLOGY, WILDLIFE CONSERVATION,**  
**TOXICOLOGY, ETHOLOGY, EVOLUTION & ZOOGEOGRAPHY**  
**[54 hours] [3 hours per week]**

**Section A: Ethology**

Any one of the following  
Demonstration of the effect of alarm pheromones in ants  
Demonstration of phototaxis using earth worm

**Section B: Evolution**

Study of models, charts and specimens related to comparative study of-  
Homologous organs (limbs of 5 different groups of vertebrates)  
Analogous organs (wings of bird, insect and bat)  
Evolution of man based on three hominid fossils  
Connecting links (*Archeopteryx* and *Peripatus*)  
Vestigial organs in humans (any four)  
Adaptive radiation in Darwin's finches / mouth parts of insects (any 4 types)

**Section C: Zoogeography**

Preparation of world map to show six zoogeographical realms  
Preparation of world map to show islands of zoogeographical significance.  
Preparation of world map to show Wallace line, Weber line and Wallacea  
Locate the distribution of following animals in the world map:  
*Peripatus*, lung fishes, *Sphenodon*, monotremes (any two), marsupials (any two)

**Section D: Environmental Biology, Conservation Biology & Toxicology**

Estimation of dissolved O<sub>2</sub> using Winkler method (pond and tap water)  
Estimation of dissolved CO<sub>2</sub> in pond and tap water  
Determination of pH using pH paper / digital pH meter  
Study of butterflies in relation to its host plants  
Study of marine planktons (any five items up to genus level)  
Study of food chain and food web

**CORE COURSE PRACTICAL - II (PRACTICAL II \*-B)**  
**CELL BIOLOGY AND GENETICS**  
**[54 hours] [3 hours per week]**

**Section A: Cell Biology**

Staining of eukaryotic cells (major)

Temporary mount of buccal epithelial cells to study their structure and observe Barr body  
Mitosis: stages in onion (*Allium cepa*) root meristem (squash preparation)- Major Calculation of mitotic index and metaphase index in root meristem of *Allium cepa*- Major Meiosis: stages in testis of grass hopper (demonstration only)  
Giant chromosomes- (*Drosophila* /*Chironomus* larvae) salivary gland cells (demonstration)  
Study of the parts of a compound microscope, its proper use and maintenance (minor)  
Measurement of size of microscopic objects using ocular and stage micrometers (major)  
Study of the applications of centrifuge  
Demonstration of cell fractionation and centrifugation using fish liver/ any other specimen

### **Section B: Genetics**

Scheme of Pedigree chart  
Study of inheritance of human traits- Blood groups, widow's peak, eye colour (use Pedigree charts)  
Study of sex-linked inheritance (haemophilia and colour blindness)  
Genetic problems on Monohybrid, dihybrid crosses, blood groups, incomplete dominance and sex-linked inheritance (minimum ten problems to be worked out)  
Study of normal male and female human karyotype (use photographs or xerox copies)  
Study of abnormal human karyotypes (any two)  
Study of genetic syndromes- Down's, Klinefelter's, Turner's and Edward's  
Study of phenotypic characters in male and female *Drosophila*

## **CORE COURSE PRACTICAL - II (PRACTICAL II \*- C) GENERAL METHODOLOGY IN SCIENCE, BIostatISTICS AND GENERAL INFORMATICS [36 hours] [2 hours per week]**

(Any 4 items of the following)

Design an experiment to prove a hypothesis by testing the specificity of salivary amylase on starch

Measure size of given leaves/ any sample of data and calculate the mean, median & mode

Measure size of given shells/ any sample of data and represent it in a graphical form and interpret it

Calculate the standard deviation of the given set of data.

Estimation of the avian fauna / any fauna of an area and present the data in a suitable graphical form

Construct frequency curve, frequency polygon, bar diagram, histogram and pie diagram using suitable data

Formulate a hypothesis of any scientific observation made by you

a) Feeding rate and BMI in an insect larva

b) Phototaxis in earthworms

c) Mortality of mosquito larvae on application of oil /kerosene

**CORE COURSE PRACTICAL - III (PRACTICAL III \*- A)**  
**BIOCHEMISTRY, PHYSIOLOGY AND ENDOCRINOLOGY**  
**[36 hours] [2 hours per week]**

Qualitative tests for mono, di and polysaccharides (reducing and non reducing) (major)  
Qualitative tests for protein  
Qualitative tests for lipids  
Abnormal constituents of urine (glucose and albumin) (major)  
Determination blood clotting time  
Determination of blood pressure (demonstration)  
Determination of Hb content in man using Haemoglobinometer (demonstration)  
Determination of body mass index  
Separation of amino acids (or any other compounds) from a mixture by using paper chromatography (demonstration)  
Determination of concentration of unknown solutions using Photo colorimeter

**CORE COURSE PRACTICAL III (PRACTICAL III\*B)**  
**REPRODUCTIVE BIOLOGY AND DEVELOPMENTAL BIOLOGY**  
**[36 hours] [2 hours per week]**

Demonstration of chick blastoderm  
Induced ovulation in fish  
Study of life cycle in *Drosophila*  
Study of models, charts, specimen or slides related to:  
Types of eggs (Insect, amphioxus, frog, chick, and human)  
Cleavage in frog (use slides / diagrams/ models)  
Shark - Yolk sac placenta  
Frog- Blastula, gastrula, neurula  
Chick embryo– 18, 24, 33, 48 hours of incubation  
Mammal - Any two mammalian embryos  
Larval forms of invertebrates (any five) and vertebrates (any two)

**CORE COURSE PRACTICAL III (PRACTICAL III\*C)**  
**BIOTECHNOLOGY, MICROBIOLOGY, IMMUNOLOGY, MOLECULAR**  
**BIOLOGY & BIOINFORMATICS**  
**[36 hours] [2 hours per week]**

Staining of bacterial cell using appropriate bacterial stain (*Lacto bacilli*)  
Staining of root nodule Nitrogen fixing bacteria (*Rhizobium*)  
Identification of motile bacteria by hanging-drop method (demonstration only)  
Preparation of culture media for bacteria (Synthetic media, Natural media, Simple media,

Differential media, Selective media)  
Study of microbial by products (Antibiotics, Milk products)  
Identification of human blood group (ABO and Rh)  
Preparation of human blood smear to study the immunologically significant cells.  
Study of transgenic animals  
Study of the principle and applications of Electrophoretic apparatus  
Study of the principle and applications of DNA finger printing  
PCR- Principle and applications  
ELISA (demonstration only)  
Sequence similarity search using BLAST (demonstration only)

### **REFERENCES FOR PRACTICAL**

Michael, P. (1986). Ecological Methods for Field and Laboratory Investigations. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.  
Patki, L. R., Balchandra, B. L. and Jeevaji, I. H. (1983). An Introduction to Microtechnique, S.Chand & Co. Ltd.  
Piramal, V. (2005). Biophysics. Dominant Publs. and Distributors.  
Plummer, D. T. (1995). An Introduction to Practical Biochemistry, 3e, Tata Mc Graw-Hill Publ.Co. Ltd., New Delhi.  
Roy, R. N. (2005). A Text Book of Biophysics. New Central Book Agency, Pvt. Ltd. Sawbney, S. K. and Singh, R. (eds.) (2001). Introductory Practical Biochemistry.  
Narosa. Verma, P. S. and Agarwal, V. K. (1985). Principles of Ecology. S. Chand & Co. Ltd., New Delhi.

### **CORE COURSE PRACTICAL III ELECTIVE COURSE PRACTICAL- III\*D AQUACULTURE, ANIMAL HUSBANDARY AND POULTRY SCIENCE [36 hours] [2 hours per week]**

Culture of fish food organisms: Protozoans, Rotifers and Crustaceans  
Maintenance of spawn and its transportation to hatching or rearing tanks  
Identification of major food fishes (fresh water, estuarine and marine)  
Study of different crafts and gears  
Study of aquarium and aquarium fishes / ornamental fishes  
Breeding techniques: preparation of hormone extracts and injection of hormones to fishes  
Eyestalk ablation in prawns  
Study of fish products and by products.  
Identification of larval forms of prawn, pearl oyster, mussel, lobster and crab  
Identification of major edible Crustaceans and Molluscs  
Identification of edible sea weeds  
Age determination in fishes using  
    a) Scales  
    b) Otolith  
Morphometrics and meristic study of fishes (any 5)

**PROJECT WORK – V<sup>th</sup> SEMESTER**  
**Code No: VZO6PR**  
**[36 hours] [2 hrs per week] [2 credits]**

Internal Mark-10

External Mark-40

Students are required to undertake project work on problems pertaining to biological science of 36 hrs duration in V<sup>th</sup> Semester. Scientific study on the topic selected is required to be carried out under the supervision and guidance of faculty members. A group consisting of not more than 12 students can undertake a particular project. Each student has to actively participate in the project work.

The problem/ topic chosen by an earlier batch of students for their project work shall not be repeated by a latter batch. A certificate to this effect has to be attached by the Head of the department. A well documented project report duly attested by the supervising teacher and the Head of the Department must be submitted by each group for evaluation separately on the day of project assessment in the sixth semester. The project must contain the following sections.

Introduction and objectives of study

Review of literature (include citations of relevant literature in the field)

Methodology

Results

Interpretation of results

Reference

**FIELD STUDY / STUDY TOUR**  
**[1 credit]**

A field study/study tour of 5 days is compulsory during the tenure of the programme. A total of at least 3 days should be kept apart for visiting places of biological interest. One day trip should be associated with a site of ecological importance and one day trip should be associated with elective course chosen. A detailed tour report certified by the teacher in charge of study tour and also by the Head of the Department regarding the field study/ study tours specifying the places and institutions visited, date and time of visit, details of observations made etc. must be submitted by each student for evaluation during the day of practical examination of VI<sup>th</sup> semester. The study tour report is compulsory for each student appearing for practical examination. Out of 10 marks, 2 marks will be given under internal assessment.

**VIVA-VOCE**  
**[2 credits]**

At the end of VI<sup>th</sup> semester each student shall appear for a viva-voce before a team of two examiners. It will be conducted on a separate day. The questions will be based on basic biological concepts and field study. It shall not normally exceed 10 mts per candidate. Marks shall be given according to their performance.

Out of 10 marks, 2 marks will be allotted according to the internal assessment.