

**CHRIST COLLEGE (AUTONOMOUS),  
IRINJALAKUDA**

**IRINJALAKUDA, THRISSUR - PIN 680 125**



**DEGREE OF  
BACHELOR OF SCIENCE  
(CHOICE BASED CREDIT AND SEMESTER SYSTEM)**

**UNDER THE**

**FACULTY OF SCIENCE**

**SYLLABUS**

**(FOR THE STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2014 – 15 ONWARDS)**

**BOARD OF STUDIES IN ZOOLOGY (UG)**

**IRINJALAKUDA, THRISSUR - PIN**

**680 125 KERALA, 673 635, INDIA**

**JULY, 2014**

### MAIN SYLLABUS 2014 ONWARDS

- Pattern of the model question paper, scheme of evaluation for internal examination and credit distribution have been included.
- The syllabus of Complementary course 2013 will continue without any change. The pattern of the model question paper, scheme of evaluation for internal examination and credit distribution for the complementary course have also been given. [APPENDIX I](#)

**List of the members of Board of Studies in Zoology (U. G.)  
NO.GA 1/F2/302/2012 dated 27.04.2014, Calicut University.P.O**

Sl. No.	Name	Designation	College
1	Sri. Majeed P.P	Associate Professor [Chairman], BOS	MES Mampad College
2	Sri. Mohammed Iqbal	Associate Professor	PSMO College, Tirurangadi
3	Dr. Britto Joseph	Associate Professor	St. Thomas College, Thrissur
4	Sri. M.P. Ishak	Principal	Govt. College, Perinthalmanna.
5	Dr. Sheeba	Associate Professor	Vimala College Thrissur
6	Dr. P.A Sajudeen	Associate Professor (JD, Directorate of Higher Secondary Education, TVM)	St. Stephan's College, Pathanapuram (On Deputation)
7	Sri. Koshy P.M	Associate Professor	St. Stephan's College, Pathanapuram
8	Dr. Anitha Latha Sadanandan	Associate Professor	Malabar Christian College, Kozhikode
9	Smt. Jayasree V	Associate Professor	Sree Krishna College, Guruvayoor.
10	Dr Shobha T.R	Assistant Professor	Farook College, Kozhikode
11	Dr. N. Ramani	Professor Chairperson Zoology Board of studies (PG), Christ	Dept. of Zoology, Calicut University

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***SYLLABUS CORE COURSES 1 TO 24***

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***OPEN COURSES 1, 2 & 3***

***ELECTIVE COURSES 1, 2 & 3***

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## 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. All other calculations, including grading, will be done by the university using the software. Indirect Grading System in 7 point scale is 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**

<i>Sl. No.</i>	<i>Course</i>	<i>Marks</i>
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>	<b>3600</b>

**Seven point Indirect Grading System**

<i>% of Marks</i>	<i>Grade</i>	<i>Interpretation</i>	<i>Grade Point Average</i>	<i>Range of Grade points</i>	<i>Class</i>
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	Failure	0	0 – 0.49	Fail

## CREDIT AND MARK DISTRIBUTION IN EACH SEMESTERS

Total Credits: 120; Total Marks: 3600

<i>Semester</i>	<i>Course</i>	<i>Credit</i>	<i>Marks</i>
<b>I</b>	Common course: English	4	100
	Common course: English	3	100
	Common course: Additional Language	4	100
	Core Course I: Animal Diversity-Nonchordata-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-Nonchordata-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 V: Practical-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 VI: Environmental Biology, Wild Life Conservation And Toxicology	3	100
	Core Course VII: Ethology, Evolution And Zoogeography	3	100
	Core Course VIII: Cell Biology And Genetics	3	100
	Core Course IX : 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 X: Bio chemistry	2	100
	Core Course XI: , Physiology And Endocrinology	3	100
	Core Course XII: Molecular biology And Bio informatics	3	100
	Core Course XIII: Reproductive Biology, Developmental biology And Teratology	3	100
	Core Course XIV: Bio technology, Micro biology And Immunology	3	100
	Core Course-XV: Elective Course : Human Genetics/ 02-Aquaculture, Animal Husbandry And Poultry/ 03-Applied Entomology(Any one)	3	100
	Core Course-XVI: Practical II- II*A, II*B & II*C	4	100
	Core Course-XVII: Practical III-III*A, III*B, III*C & III*D	4	100

	Core Course-XVIII: Project Work	2	50
	Field Study/Study tour	1	
	Viva-voce	2	
	<b>Total</b>	<b>30</b>	<b>850</b>

### CORE COURSE STRUCTURE

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

<i>Se mes ter</i>	<i>Code No</i>	<i>Course Title</i>	<i>Hrs/ Week</i>	<i>Total Hrs/ Sem</i>	<i>Credits</i>	<i>Marks</i>
<b>I</b>	ZO1B01T	Core Course I: Animal Diversity Nonchordata-I	2	36	2	100
	-	Core Course V : Practical related to ZO1B01T Practical-I*A	2	36	*	-
<b>II</b>	ZO2B02T	Core Course II: Animal Diversity Nonchordata-II	2	36	2	100
	-	Core Course V : Practical related to ZO2BOT-Practical-I*B	2	36	*	-
<b>III</b>	ZO3B03T	Core Course III –Animal diversity- Chordata -I	3	54	3	100
	-	Core Course V : Practical related to ZO3B03T-Practical-I*C	2	36	*	-

<b>IV</b>	ZO4B04T	Core Course IV: Animal diversity Chordata-II	3	54	3	100
	-	Core Course V: Practical related to ZO4B04T- Practical-I*D	2	36	*	-
	ZO4B05P	Practical-I*A, I*B, I*C & I*D	8	144	4	100
<b>V</b>	ZO5B06T	Core Course VI: Environmental Biology, Wild life Conservation & Toxicology	3	54	3	100
	ZO5B07T	Core Course VII: Ethology Evolution & Zoogeography	3	54	3	100
	-	Practical Theory Course related to ZO5B06T & ZO5B07T-Practical II*A	3	54	*	-
	ZO5B08T	Core Course VIII: Cell Biology & Genetics	3	54	3	100
	-	Practical related to Theory Core Course : ZO5B08T-Practical II*B	3	54	*	-
	ZO5B09T	Core Course IX: General Methodology in Science, Bio Statistics & Informatics	3	54	3	100
	-	Practical Related to Theory Core Course ZO5B09T-Practical II*C	2	36	*	-
	-	Project Work	2	36	**	-
	-	Field Study	1	18	***	-
<b>VI</b>	ZO6B10T	Core Course X: Bio Chemistry	2	36	2	100
	ZO6B11T	Core Course XI: Physiology & Endocrinology	3	54	3	100

-	Practical related to Core Course ZO6B10T & ZO6B11T-III*A	2	36	*	-
ZO0612T	Core Course XII: Molecular Biology & Bioinformatics	3	54	3	100
ZO0613T	Core Course XIII: Reproductive Biology, Developmental Biology & Teratology	3	54	3	100
-	Practical related to Theory Core Course ZO0613T-Practical-III*B	2	36	*	-
ZO0614T	Core Course XIV : Bio Technology, Micro biology & immunology	3	54	3	100
-	Practical Related to theory Core Course ZO0614T-Practical III*C	2	36	*	-
ZO0615T (E1) (E2) (E3)	Core Course XV: Elective	3	54	3	100
	1. Human Genetics				
	2. Aquaculture, Animal husbandry & Poultry				
	3. Applied Entomology(An y One)				
-	Practical Related to Theory Elective Course ZO0615T(E)-Practical III*D	2	36	*	-
ZO0616P	Practical II-II*A, II*B & II*C	8	144	4*	100
ZO0617P	Practical III-III*A, III*B, III*C & III*D	8	144	4*	100

	ZO06 18Pr	Project Work	-	-	2**	50
	ZO06 19F	Field Study	1	18	1***	-
	ZO06 20V	Viva voce	-	-	2****	-
<b>Total</b>					<b>56</b>	<b>1750</b>

\* Exam will be held at the end of 4<sup>th</sup> semester.

\*\* Exam will be held at the end of 6<sup>th</sup> semester.

- ZO 06 15T An institution can choose any one Elective course among the three courses.
- Includes Field Study also. Marks: 90 (ZO0616P) + 10 (Hand written Field Study Report).
- Includes Viva Voce also. Marks: 85(ZO0617P) + 15(General Viva Voce).
- Practical Examinations are of 4 hrs Duration.

### CORE COURSE THEORY: EVALUATION SCHEME

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

#### INTERNAL EVALUATION

20% of the total marks in each course are for internal evaluation. The colleges shall send only the marks obtained for internal examination to the university.

**Table 1: Components of Evaluation**

<i>Sl. No.</i>	<i>Components</i>	<i>Marks</i>
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**

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

**Table 3: Pattern of Test Papers**

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

\*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

## EXTERNAL EVALUATION

External evaluation carries 80% marks. University examinations will be conducted at the end of each semester.

**Table 1: Pattern of Question Paper**

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

## CORE COURSE PROJECT: EVALUATION SCHEME

Project evaluation will be conducted at the end of sixth semester.

**Table 1: Internal Evaluation**

<i>Sl. No</i>	<i>Criteria</i>	<i>Marks</i>
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**

<i>Sl. No</i>	<i>Criteria</i>	<i>Marks</i>
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>

## ZOOLOGY COMPLEMENTARY COURSE STRUCTURE

**Total Credits: 12 (Internal: 20%; External: 80%)**

<i>Semester</i>	<i>Code No</i>	<i>Course Title</i>	<i>Hrs/Week</i>	<i>Total Hrs</i>	<i>Credits</i>	<i>Marks</i>
<b>I</b>	ZO1CO1	Complementary Course I: Zoology-I	2	36	2	80
	-	Complementary Course V: Zoology Practical-I	2	36	*	-
<b>II</b>	ZO2CO2	Complementary Course II: Zoology-II	2	36	2	80
	-	Complementary Course V: Zoology Practical-II	2	36	*	-
<b>III</b>	ZO3CO3	Complementary Course III: Zoology-III	3	54	2	80
	-	Complementary Course V: Zoology Practical-III	2	36	*	-
<b>IV</b>	ZO4CO4	Complementary Course IV: Zoology-IV	3	54	2	80
	-	Complementary Course V: Zoology Practical-IV	2	36	*	-
	ZO4C05(P)	Complementary Course V: Zoology Practical-V	2	36	4*	80
<b>Total</b>					<b>12</b>	<b>400</b>

\* Examination will be held at the end of 4<sup>th</sup> semester.

## COMPLEMENTARY COURSE THEORY: EVALUATION SCHEME

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

### INTERNAL EVALUATION

20% of the total marks in each course are for internal evaluation. The colleges shall send only the marks obtained for internal examination to the university.

**Table 1: Components of Evaluation**

<i>Sl. No.</i>	<i>Components</i>	<i>Marks</i>
1	Attendance	4
2	Test papers: I & II	4 + 4
3	Assignment	2
4	Viva-Voce	2
<b>Total Marks</b>		<b>16</b>

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

<i>% of attendance</i>	<i>Marks</i>
Above 90%	4
85-89%	3.2
80-84%	2.4
76-79%	1.6
75%	0.8

**Table 3: Pattern of Test Papers**

<i>Duration</i>	<i>Pattern</i>	<i>Total number of questions</i>	<i>Number of questions to be answered</i>	<i>Marks for each question</i>	<i>Marks</i>
1.5 Hours	One word	4	4	1	4
	Short answer	4	4	2	8
	Paragraph	3	2	5	10
	Essay	2	1	10	10
<b>Total Marks*</b>					<b>32</b>

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

### EXTERNAL EVALUATION

External evaluation carries 80% marks. University examinations will be conducted at the end of each semester.

**Table 1: Pattern of Question Papers**

<i>Duration</i>	<i>Pattern</i>	<i>Total number of questions</i>	<i>Number of questions to be answered</i>	<i>Marks for each question</i>	<i>Marks</i>
3 Hours	One word	10	10	1	10
	Short answer	10	7	2	14
	Paragraph	6	4	5	20
	Essay	4	2	10	20
<b>Total Marks</b>					<b>64</b>

## OPEN COURSE STRUCTURE

(FOR STUDENTS OTHER THAN B.Sc. ZOOLOGY)

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

<i>Semester</i>	<i>Code No</i>	<i>Course Title</i>	<i>Hrs/Week</i>	<i>Total Hrs</i>	<i>Marks</i>
<b>V</b>	ZO5D01	Open Course 1: Reproductive Health & Sex Education	2	36	50
	ZO5D02	Open Course 2: Nutrition, Health & Hygiene			
	ZO5D03	Open Course 3: Applied Zoology( Any One)			

### OPEN COURSE: EVALUATION SCHEME

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

### INTERNAL EVALUATION

20% of the total marks are for internal evaluation. The colleges shall send only the marks obtained for internal examination to the university.

Table 1: Components of Evaluation

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

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

<i>% of attendance</i>	<i>Marks</i>
Above 90%	2.5
85-89%	2
80-84%	1.5
76-79%	1
75%	0.5

**Table 3: Pattern of Test Papers**

<i>Duration</i>	<i>Pattern</i>	<i>Total number of questions</i>	<i>Number of questions to be answered</i>	<i>Marks for each question</i>	<i>Marks</i>
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.

## EXTERNAL EVALUATION

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

**Table 1: Pattern of Question Paper**

<i>Duration</i>	<i>Pattern</i>	<i>Total number of questions</i>	<i>Number of questions to be answered</i>	<i>Marks for each question</i>	<i>Marks</i>
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>

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## FIRST SEMESTER B. Sc. DEGREE PROGRAMME (Theory) ZOOLOGY CORE COURSE- I

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### ANIMAL DIVERSITY: NON-CHORDATA PART- I Code: ZO1B 01T

[DIVERSITY, ADAPTATIONS AND FUNCTIONAL ANATOMY  
OF PROTOZOANS AND NONCHORDATES]

[36 hours] [2 hours per week] [2 Credits]

#### Section-A (10 hrs)

##### I. 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 and Serotaxonomy, Cytotaxonomy, Numerical taxonomy (Phenetics), Cladistics (Phylogenetic systematics), Molecular systematics.

##### II. Five kingdom classification of living organisms. (1 hr)

Mention Cavaller-smith's eight kingdom classification also.

##### III. Concepts of classification of animals (brief account) (4 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

##### IV KINGDOM PROTISTA (6 hrs)

(Give a comparative account of various functional systems of the types specified to get an idea on the evolutionary trends of diversity.)

Type: *Paramecium*: morphology and structural organization [as revealed by compound microscopy]; locomotion, nutrition, excretion, osmoregulation and reproduction; conjugation in detail. Characteristic features and classification of Kingdom Protista down to phyla [Salient features of the following phyla with note on the examples cited]

Phylum Rhizopoda. Eg: *Amoeba*

Phylum. Dinoflagellata. *Noctiluca*

Phylum. Parabasalia.

*Trichonympha*

Phylum Apicomplexa [=Sporozoa] eg: *Plasmodium*

Phylum Ciliophora eg: *Vorticella*, *Ephelota*

#### Section- C

##### V. KINGDOM ANIMALIA (20 hours)

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.]

Compare the various systems based on a specific example from each phylum

## VI. MESOZOA

(1hr)

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

## VII. METAZOA

(3 hrs)

Phylum PORIFERA

Classification down to classes; salient features of the classes

Class Calcispongiae example: *Leucosolenia*

Class Demospongiae example: *Spongilla*

Class Hyalospongiae example: *Euplectella*

Give an account of canal system; mention amphiblastula, parenchymula and gemmule

## VIII. Phylum CNIDARIA [=COELENTERATA]

(7 hrs)

Type: *Obelia* morphology and life cycle

Classification down to classes; salient features of the classes

Class Anthozoa example: *Adamsia*, *Zoanthus*, and *Madrepora*

Class Hydrozoa example: *Halitemma*, *Physalia*

Class Scyphozoa example: *Rhizostoma*

## IX .Phylum CTENOPHORA [=ACNIDARIA]

(1 hr)

Unique features as exemplified by *Pleurobrachia*; mention cidippid larva

## X. ACOELOMATA

(3 hrs)

Phylum PLATYHELMINTHES

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

Class Turbellaria Type: *Dugesia*

Class Cestoda example: *Echinococcus*, *Fasciola*

Class Trematoda example: *Schistosoma*

## XI. PSEUDOCOELOMATA

(3 hrs)

Super phylum ASCHELMINTHES

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

### Phylum Nematoda

Characteristic features of *Ascaris*

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

Minor Phyla (Salient features of the following)

(2hrs)

Phylum **Gastrotricha** mention example: *Chaetonotus*

Phylum **Rotifera** example: *Brachionus*

## XII. Topics for Assignment / Seminar

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1] Nutrition in protozoans;

2] Reproduction in

protozoans; 3] Parasitic

protozoans of man

4] Polymorphism in cnidarians with special reference to

siphonophores 5] Reef building corals and coral reefs

**CORE COURSE I: PRACTICAL- I\* A**  
**ANIMAL DIVERSITY NON-CHORDATA Part-**  
**I**

**(36 hours) (2 hrs per week)**

*[Students are expected to make sketches with notes, while they study the specimens in the laboratory / field itself. The record must carry sketches with notes of all specimens, mountings and dissections. Emphasis must be on scientific accuracy and not on beauty of sketches.]*

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

*Choose useful and harmful forms from different habitats. All animals intended for type study are to be included. 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)*

1. Protists: *Amoeba, Noctiluca, Ceratium, Entamoeba, Trichonympha, Paramecium,*

*Ephelota*

[any 4)

2. Poriferans: *Leucosolenia, Scypha, Spongilla,* sponge gemmule, spicules [any 2)

3. Cnidarians: Sedentary hydrozoans: *Hydra, Obelia*

[any 1)

*Obelia medusa*

Pelagic hydrozoans: *Physalia, Velella*

[any 1)

Pelagic scyphozoan: *Aurelia / Rhizostoma*

Common anthozoans: *Adamsia, Edwardsia, Madrepora,*

*Fungia, Tubipora, Gorgonia*

[any 2)

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

Parasitic flat worms: *Fasciola, Taenia solium*

[any 1)

5. Aschelminths: Parasitic round worms: *Ascaris, Ancylostoma, Wuchereria*

[any 1)

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

**Section B: Histology**

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

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## SECOND SEMESTER B. Sc. DEGREE PROGRAMME (Theory) ZOOLOGY CORE COURSE- II

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### ANIMAL DIVERSITY: NON-CHORDATA– PART- II

Code: ZO2B 02T

[DIVERSITY, ADAPTATIONS AND FUNCTIONAL ANATOMY OF  
NON-CHORDATE COELOMATES)

[36 hours] [2 hours per week] [2 Credits]

#### COELOMATA

Phylum **ANNELIDA** (7hrs)

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* [details of larval stages not expected]

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*, and *Tabanus* Southern bird  
wing butterfly

Phylum **MOLLUSCA** (8 hrs)

Type: *Pila*

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: *Turbinella*

Class Cephalopoda example: *Sepia*

Phylum **ECHINODERMATA** (4 hrs)

Structural peculiarities of star fish; water vascular system in detail

Classification down to classes [of extant forms only]; salient features of the following  
Classes and very brief account of examples

Class Crinoidea example: *Antedon* Class

Asteroidea example: *Astropecten* Class

Ophiuroidea example: *Ophiothrix*

Class Holothuroidea example: *Holothuria*

Phylum **HEMICHORDATA** (1 hr)

Salient features and example: *Balanoglossus*

**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*

## Phylum **Onychophora**

[2 hrs]

*Peripatus*: [distribution, peculiarities and affinities)

### **Topics for Assignment / Seminar**

**(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)**

- 1] Ecological importance of earthworm and vermiculture
- 2] Larval forms in Crustacea and their significance
- 3] Metamorphosis in insects; Social organization in insects
- 4] Economic importance of mollusks
5. Useful and harmful insects.
6. Economic importance of crustaceans.

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- Ruppert, E. E. *et al.*: *Invertebrate Zoology*. 7 e, 2004, Thomson Brooks Cole
- <http://www.ucmp.berkeley.edu>
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- <http://phylogeny.corne>

### **CORE COURSE II: PRACTICAL- I\* B ANIMAL DIVERSITY NONCHORDATA Part- II (36 hours) (2 hrs per week)**

1. **Annelids** : *Polychaetes Aphrodite, Chaetopterus, Arenicola, Tomopteris*

**Common earthworm: *Megascolex / Pheretima***

[any 2]

- : Leech: *Hirudinaria*, *Haemadipsa*, *Branchellion* [any 2]
2. Arthropods: Items of evolutionary / taxonomic importance - [Any 2]
- : *Limulus*, *Streptocephalus*
  - : 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]
9. Mollusks : Inter tidal 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]
10. Echinoderms: *sea lily*, *star fish*, *brittle star*, *sea cucumber*, *sea urchin*, *cake urchin*, *heart urchin* [any 3]
11. Hemichordata: *Balanoglossus*
12. Onychophora: *Peripatus* (Evolutionary significance)

**Section B: Histology:** Compare TS of an annelid [*Neanthes* / Earth worm//leech]

**Section C: Mountings**

1. Earthworm : Setae [a few loose setae] (minor)
2. *Neanthes* or any other polychaete: Parapodium [minor]
3. *Panaeus* : Appendages [minor]
4. Cockroach : Salivary apparatus [Major]
5. Honeybee/ plant bug: Mouth parts [minor]

**Section D: Dissections**

1. *Panaeus* : Nervous system [Major]
2. Cockroach : Nervous system [Major]

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**THIRD SEMESTER B. Sc. DEGREE PROGRAMME(Theory) ZOOLOGY  
CORE COURSE-III**

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**ANIMAL DIVERSITY – CHORDATA- PART-  
I CODE: ZO3B 03T**

[TAXONOMY, DIVERSITY, STRUCTURAL ANATOMY AND  
ADAPTATIONS OF CHORDATES]  
[54 hours] [3 hours per week] [3 credits]

**Introduction**

[3 hrs]

Chordate characters [fundamental, general and advanced]; chordates versus nonchordates; diversity of chordates; classification down to subphyla; salient features of each subphylum. Type study with special emphasis to comparing various functional systems (Comparative Anatomy) such as Morphology, Integumentary, digestive, respiratory, circulatory, excretory, nervous and reproductive systems. Also mention the evolutionary significance.

Subphylum 1. **UROCHORDATA** [Tunicata]

[5 hrs]

Affinities; add a note on neoteny [paedogenesis]

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]

Subphylum 3. **VERTEBRATA**

[3 hrs]

Division 1. **AGNATHA**

Characters and examples: *Myxine*; *Petromyzon* [mention Ammocoetous larva]

Division 2. **GNATHOSTOMATA**

Super class **PISCES**

[12 hrs]

Type: **Mullet**

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

Class **Chondrichthyes** [cartilaginous 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] examples: *Mugil*, *Rastrelliger*

Super class **TETRAPODA**

Class **AMPHIBIA**

[14 hrs]

Type: **Frog**

Classification of Amphibia down to orders with examples [of extant forms only]

Order **Apoda** examples: *Ichthyophis*, *Uraeotyphlus*

Order **Caudata** examples: *Necturus*, *Ambystoma*, mention Axolotl

Order **Anura** examples: *Bufo*, *Rhacophorus*

Mention discovery of *Nasikabatrachus sahyadrensis*

Class **REPTILIA**

[16 hrs]

## Type: Calotes

Classification of Reptilia down to subclasses; 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 Lepidosauria [= Super order 1. Lepidosauria under Subclass Diapsida]

Order Rhynchocephalia example: *Sphenodon*

Order Squamata examples: *Chamaeleon*, *Ophidia*: Common poisonous and non-poisonous snakes of Kerala. *Ptyas*, *Typhlops*, *Naja*, *Daboia*, *Bungarus*; identification key for poisonous snakes

Subclass Archosauria [= Super order 2. Archosauria under Subclass Diapsida]

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

Subclass Euryapsida and Subclass Synapsida

## Topics for Assignments / Seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Migration of fishes
2. Parental care in fishes
3. Parental care in amphibians
4. Snake venom: nature; composition; antivenin; polyantivenins; prophylaxis
5. Accessory respiratory organs in fishes.
6. Economic importance of fishes.



**CORE COURSE III: PRACTICAL- I\* C**  
**ANIMAL DIVERSITY –CHORDATA-PART**  
**I**

**(36 hours) (2 hours per week)**

[Students are expected to make sketches with notes, while they study the specimens in the laboratory and field. The Record must carry notes of all specimens, mountings and dissections. Emphasis must be on scientific aspects. The record sheets related to part I and part II must be bound together to get a single Record.]

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

(Students are expected to identify the specimens by their generic names and assign them to the respective phyla /classes/ orders)

1. Urochordates : *Ascidia*, ascidian tadpole, *Salpa*, *Doliolum* [any 2]
2. Cephalochordate : *Branchiostoma*
3. Agnathans : *Myxine*, *Petromyzon*, Ammocoetes larva [any 1]

Fishes : Common elasmobranchs - *Chiloscyllium*, *Stegostoma*, *Sphyrna*, *Pristis*, *Trygon*, *Narcine*, *Astrapes* [any 2]

: Common food fishes - *Sardinella*, *Rastrelliger*, *Cynoglossus*, *Parastromateus*, *Trichiurus*, *Cybium*, *Thunnus*, *Etroplus*, *Mugil*, *Wallagonia*, *Tilapia*, *Catla*, *Cirrhina*, *Labeo*, *Cyprinus* [any 3]

: Fishes with special adaptive features - *Hippocampus*, *Belone*, *Hemirhamphus*, *Exocoetus*, *Tetradon*, *Pterois*, *Ostracion*, *Heteropneustes*, *Clarias*, *Arius*, *Anabas*, *Channa* [=Ophiocephalus], *Echeneis*, *Antennarius*, *Amphisila*, eel [*Anguilla* / *Muraena*] [any 5]

4. Amphibians : Common amphibians- *Bufo*, *Hyla*, *Rana*, *Rhacophorus* *Ambystoma*/ Axolotl larva, an apodan [any 3]

5. 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 2]

: Poisonous snakes - *Naja*, *Daboia* [*Vipera*], *Bungarus*, *Echis* [any 2]

: Water snake – *Hydrophis* / *Enhydrina*

: Arboreal snake – *Dryphis* / *Python*

**Section B: Histology**

1. *Branchiostoma* - T. S. through pharyngeal region

**Section C: Mountings**

1. *Sardinella* : Cycloid scale [minor]
2. Shark/*Calotes* : Brain (minor)-Demonstration only.

**Section D: Dissections(Digital versions to be downloaded or procured as per UGC guidelines)**

1. Shark/*Calotes*/Frog : IX and X cranial nerves on one side (Major)
2. Shark/*Calotes* /Frog: Heart and ventral aorta with branches on both sides (Major)
3. Mullet : [or any other bony fish]: Alimentary canal [Major]

**Section E: Osteology**

1. Frog : Vertebrae-Typical, 8th, 9th, 10th, Pectoral & pelvic girdle

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**FOURTH SEMESTER B. Sc. DEGREE PROGRAMME (Theory) ZOOLOGY  
CORE COURSE-IV**

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**ANIMAL DIVERSITY – CHORDATA PART-  
II Code: ZO4B 04T**

[TAXONOMY, DIVERSITY, STRUCTURAL ANATOMY AND  
ADAPTATIONS OF CHORDATES – AVES AND MAMMALS]  
[54 hours] [3 hours per week] [3 credits]

(Give a comparative account of various functional systems of the types specified)

Class **AVES**

[27

hrs]

**Type: Columba**

Classification of Aves down to the orders specified; mention one example each

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 Struthioniformes 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 & allies] example: *Alcedo*

Order Apodiformes [swifts, humming birds] example: *Micropodus*

Order Strigiformes [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*

Add a note on extinct birds: passenger pigeon [*Ectopistes migratorius*], dodo

[*Raphus cucullatus*], pink-headed duck [*Rhodonessa caryophyllacea*], elephant bird

[*Aepyornis*] rediscovery of Jerdon's courser [*Cursorius bitorquatus*]

Class **MAMMALIA**

[27 hrs]

Type: *Oryctolagus*

Classification of Mammalia down to the orders cited with examples specified

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: *Bradypus* (sloth), *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*, *Homo*  
 Order Carnivora examples: *Phoca* (seal), *Odobenus* (walrus), *Panthera* sps, *Viverricula indica* [civet]  
 Order Cetacea examples: *Physeter* (sperm whale) *Delphinus* (dolphins), *Phocaena* (porpoise) *Balaenoptera* (baleen whale)  
 Order Artiodactyla examples: *Sus scrofa cristatus*, *Gaur*, *Giraffa*, *Hemitragus* [tahr], *Cervus*, *Axis axis* (spotted deer), *Antelope cervicapra* [antelope, black buck]  
 Order Perissodactyla examples: *Equus caballus* (horse), *Rhinoceros*  
 Order Sirenia examples: *Trichechus* (manatee), *Dugong*  
 Order Proboscidea examples: *Elephas maximus indicus* [Indian elephant] and *Loxodonta africana* [African savanna elephant] *Loxodonta cyclotis* [African forest elephant]

### Topics for seminar:

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Aquatic mammals and their adaptations
2. Dentition in mammals [adaptations related to food]
3. Endangered mammals of Kerala
4. Flying mammals
5. Migration in birds
6. Flight adaptations in birds
7. Flightless birds

### REFERENCES:

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 Colbert's *Evolution of the Vertebrates*  
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 Ekambaranatha Ayyar, M. & Ananthakrishnan, T. N.: *A Manual of Zoology*. Vol. II Part I & II  
*Encarta*: (CDs), 2004 Edn or new versions, Microsoft  
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Romer, A. S: *The Vertebrate Body*; 1992 reprint, Vakils, Feffer & Simons, Bombay  
Salim Ali: *Birds of Kerala*. 2 e, 1969, O U P  
Salim Ali: *The Book of Indian Birds*. BNHS, Oxford  
Young, J. Z.: *Life of Vertebrates*. OUP  
<http://www.oit.itd.umich.edu>

**CORE COURSE IV: PRACTICAL- I\* D**  
**ANIMAL DIVERSITY –CHORDATA-PART II**  
**(36 ours) (2 hours per week)**

**1.Birds-**

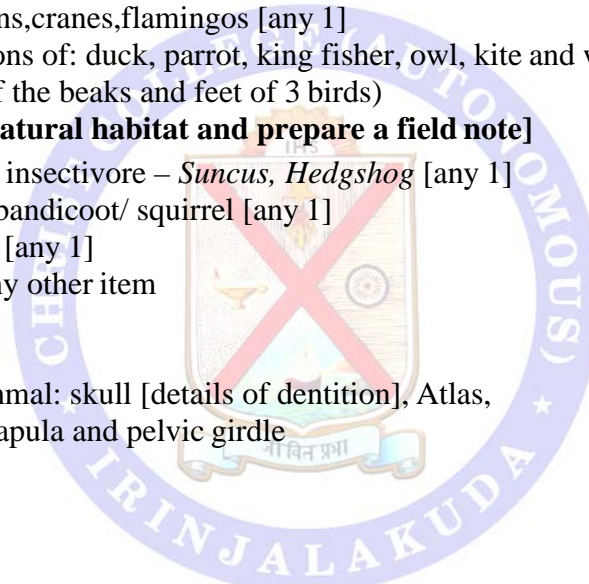
- 1.Fossil . Archaeopteryx
- 2.Flightless bird.Rhea,Struthio [any 1]
- 3.Aquatic birds.Jacana,duck,teal [any 1]
- 4.Wet land birds.heron,ibis,stroks,pelicans [any 2]
- 5.Migratory birds.pelicans,cranes,flamingos [any 1]
- 6: Features and adaptations of: duck, parrot, king fisher, owl, kite and wood pecker [draw sketches of the beaks and feet of 3 birds)

**[Watch birds in their natural habitat and prepare a field note]**

- 2. Mammals :** Common insectivore – *Suncus, Hedgshog* [any 1]  
: Common rodent – rat/ bandicoot/ squirrel [any 1]  
: Common bat of Kerala [any 1]  
: A primate – *Loris* or any other item

**3.Osteology:**

Rabbit or any other mammal: skull [details of dentition], Atlas, axis, typical vertebra, scapula and pelvic girdle



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**FIFTH SEMESTER B. Sc. DEGREE PROGRAMME (Theory) ZOOLOGY  
CORE COURSE –VI**

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**Code: ZO5B 06T**  
**ENVIRONMENTAL BIOLOGY, WILDLIFE CONSERVATION AND  
TOXICOLOGY,**  
**[54 hours] [3 hours per week] [3 credits]**

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

- |  |                |
|--|----------------|
| <b>1. Ecological tools and Techniques</b>  | <b>(4 hrs)</b> |
| 1. Sampling of animal populations  |                |
| (i) Trapping and collecting various groups of flying insects (aquatic organisms, soil organisms, birds and mammals).   |                |
| (ii) Marking of animals  |                |
| (iv) Determination of home range and territory   |                |
| (v) Estimation of number of animals in population  |                |
| (vii) Indirect method of estimating wild animals by their signs and symptoms.  |                |
| 2. Remote sensing.   |                |
| <b>2. Ecosystem and Energetics</b>   | <b>(6hrs)</b>  |
| (a) Definition, scope and branches of ecology, Habitat, Niche, Community, Autecology and Synecology.   |                |
| (b) Energy flow and energetics of ecosystem  |                |
| (c) Solar energy and photosynthetic and chemosynthetic production  |                |
| (d) Energy transformations and energy transfer   |                |
| (e) Laws of thermodynamics   |                |
| <b>3. Biogeochemical cycles</b>  | <b>(3 hrs)</b> |
| Basic types of biogeochemical cycles - Gaseous cycle - carbon and nitrogen cycles; sedimentary cycle   |                |
| <b>4. Limiting factors</b>   | <b>(2 hrs)</b> |
| Basic concepts - Leibig's law of minimum - Shelford's law of tolerance, combined concept of limiting factors   |                |
| <b>5. Population Ecology</b>   | <b>(5 hrs)</b> |
| 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 |                |
| <b>6. Community Ecology</b>  | <b>(5 hrs)</b> |
| Biotic community - definition, characteristics and classification, species diversity, fluctuations, stratification, succession, ecotone and edge effect  |                |
| <b>7. Population interactions</b>  | <b>(3 hrs)</b> |
| Intraspecific and interspecific associations - Positive and negative interactions: Mutualism, Commensalism, Parasitism, Predation, Competition   |                |
| <b>8. Man and Environment</b>  | <b>(4 hrs)</b> |
| (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   |                |

## 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 hotspots in Indian region (Western ghats and Sreelanka, 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-Strategeies of conservation, Natural Reserves, Classification of natural resourses.
- (f) ) Wild life conservation, Wild life (protection Act)1972,Conservation projects. Project Tiger,Elephant,Lion,Crocodile,Dolphins, Swamp deer,Blackbuck and Turtle.
- (g) Endangered fauna and flora.
- (h) Sanctuaries-Thattekkad bird sanctuary&Parambikulam wild life sanctuary, National parks – Eravikulam NP &Silent valley NP and 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) Protection of plant varieties and farmer's right Act (2001)
- (k) Biodiversity Act 2002
- (l) Seed Bill 2005
- (m) Wildlife Act 1972 and its Amendments

## 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 50, LC 50
- (d) Common bacterial poisoning (botulism)
- (e) Behavioural Toxicology

### Topics for Assignment/Seminar

**(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)**

1. Environmental ethics and legislation
2. Individual responsibilities – Role of Governmental and Non Governmental Organisations in biodiversity conservation

3. Survey of animal poisons
4. Environmental pollution-land, water, sound and radiation

### References:

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- Begon: *Ecology – From individuals to ecosystems*, 4th edition, John Wiley.
- Ramakrishnan, P.S- *Ecology and Sustainable Development 2nd edition – National Book Trust India*
- India 2009- Publication division Govt.of*

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**FIFTH SEMESTER B. Sc. DEGREE PROGRAMME(Theory) ZOOLOGY  
CORE COURSE –VII**

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**Code: ZO 5B 07T**  
**ETHOLOGY, EVOLUTION AND ZOOGEOGRAPHY**  
**[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 behaviour** (5 hrs)
- (a) Innate behaviour (orientation taxes/ kinesis), simple reflexes and instincts, motivation and categories of behavior.
- (b) 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 termites and elephants, pheromones and social behavior. (mention human pheromones also)

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

- 1. Introduction:** (2 hrs)
- 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:** i) Theory of abiogenesis ii) Theory of biogenesis iii) Theory of special creation iv) Theory of Panspermia and v) 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. Other experiments , 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)
- i) Morphological and anatomical evidences: Homologous, analogous and vestigial structures and their evolution. ii) Physiological and biochemical evidences: examples. iii) Embryological evidences: examples, Biogenetic Law. iv) Palaeontological evidences: Kinds of fossilization, formation of sedimentary rocks, determination age of rocks and fossils, conclusion drawn from fossil records (brief account). v) Taxonomical evidences: evolution based principles of classification, mention phylogenetic tree.

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

**Lamarckism:** Explanation of the major postulates of the Lamark's theory with examples, Criticism against Lamarckism, Neo-Lamarckism, Present status of Lamarckism. **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: i) Mutations (gene and chromosomal mutations brief account), ii) Variations: somatic or environmental variations and genetic or hereditary variations, iii) Hardy-Weinberg Principle: Hardy-Weinberg Equilibrium, Factors that upset Hardy-Weinberg Equilibrium, iv) Genetic drift: effects on population, Bottleneck effect and Founder effect, genetic drift and natural selection, importance of genetic drift in 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 (sub species, semispecies, sibling species, cline and deme) of species; Speciation: Types of speciation-i) Phyletic speciation (autogenous and alloigenous transformations) ii) True speciation (Instantaneous and gradual speciation [allopatric and sympatric speciation]).

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

Types of isolating mechanisms i) Geographic isolation: mention examples, ii) Reproductive isolation (a) Prezygotic isolation (habitat, seasonal, ethological, morphological, physiological and cytological isolation with examples.), (b) Postzygotic isolation (hybrid inviability, hybrid sterility and F2 breakdown isolation with examples.).

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

**Convergent Evolution:** mention examples.

**Pre-adaptation:** mention examples.

**9. Evolution of Vertebrate Groups:** (2 hrs)

Evolution of agnathans, fishes, amphibians, reptiles, birds and mammals (brief account).

**10. 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** (4 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**

(2 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.

### **Topics for Assignments / Seminars**

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Historical aspects of evolution - Inorganic and Organic
2. Fossils and fossilisation
3. Evolution of horse
4. Polyplidy and Evolution

### **REFERENCES**

#### ***For Ethology & Evolution***

- Susantha Goonathilake: Merged Evolution – Gordon and Breach Publishers.  
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Darwin, C.: *The Origin of Species*, 6e. OUP.  
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## **CORE COURSE XVI: PRACTICAL II\*-A ENVIRONMENTAL BIOLOGY, WILDLIFE CONSERVATION, TOXICOLOGY, ETHOLOGY, EVOLUTION & ZOOGEOGRAPHY**

[54 hours] [3 hours per week]

### **I. Ethology (Any 1)**

1. Demonstration of the effect of alarm pheromones in ants
2. Demonstration of phototaxis using earth worm

## II. Evolution

Study of models, charts and specimens related to comparative study of:

1. Study of homologous organs (limbs of 5 different groups of vertebrates)
2. Study of analogous organs (wings of bird, insect and bat)
3. Study of evolution of man based on three hominid fossils
4. Study of connecting links (*Archeopteryx* and *Peripatus*)
5. Study of any four vestigial organs in humans
6. Study of adaptive radiation in feet of birds / mouth parts of insects

## III. Zoogeography

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

## IV. Environmental Biology, Conservation Biology & Toxicology

1. Estimation of dissolved O<sub>2</sub> using Winkler method (in pond and tap water)
2. Estimation of dissolved CO<sub>2</sub> in pond and tap water
3. Determination of pH using pH paper / digital pH meter
4. Extraction of soil organism by hand picking, floatation and Berlese funnel method
5. Study of marine planktons (any five items up to genus level)
6. Study of food chain and food web.

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# FIFTH SEMESTER B. Sc. DEGREE PROGRAMME (Theory) ZOOLOGY CORE COURSE- VIII

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Code: ZO 5B 08T  
CELL BIOLOGY AND GENETICS  
(54 hours) (3 hours per week) (3

credits) Section A: CELL BIOLOGY

(27 hours)

## I. Scientific instruments and techniques in Cell Biology

### 1. Microscopy:

(5 hrs)

(i) Light microscopy: (a) Simple microscope (b) Compound microscope: Principles and uses; Use of oil immersion objectives; Use of ocular

micrometer and stage micrometer for microscopic calibration (Micrometry); Use of cameralucida, principle and uses. Mention phase contrast microscope, Fluorescence microscope

(ii) Electron microscopy: Principle, applications, advantages and disadvantages. Mention (a) Transmission Electron Microscope (TEM), (b) Scanning Electron Microscope (SEM). (c) Scanning-tunnelling microscope (d) Atomic force microscope.

### 2. Histological Techniques:

(3 hrs)

(i) Microtomy: Rotatory microtome (brief description), uses  
(ii) 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 Balsam

### 3. Histochemicals

Mention the techniques for the demonstration of proteins (mercuric  
bromophenol blue), carbohydrates (PAS) and lipids (Sudan)

(1hr)

## II. Structure of eukaryotic cell (2 hrs)

1. **Plasma membrane** –Unit membrane concept. Structure (fluid-mosaic  
model) and Chemical organization; Functions – Transmembrane  
transportation –diffusion, osmosis, active transport, pinocytosis, phagocytosis.  
Glycocalyx – Modifications of plasma membrane

### 2. Ribosomes:

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.

(2hrs)

### 3. Mitochondria:

Structure and Functions of mitochondria, mitochondriogenesis

(2 hr)

### 4. Lysosomes:

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

(1 hr)

### 5. Centrioles and basal bodies:

Structure, chemical composition and functions.

(1hr)

### 6. Golgi complex:

Morphology, chemical components, secretory and endocytic path  
ways, functions, golgiogenesis.

### 7. Interphase nucleus:

General structure and functions, and 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.

(3hrs)

### 8. Giant chromosomes:

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

(1hr)

Lamp brush chromosomes: occurrence, structure, loops, significance.

## Cell Divisions

**1. Cell division** – Cell cycle; G1, S, G2 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 G0 as an elevated part of cell cycle.

**2. Cytogenetics of cancer**

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

**3. Cell aging:**

Apoptosis – Cell death

(3hrs)

(2 hrs)

(1 hr)

## Section-B: GENETICS (27 hrs)

**1. Variations from Mendelian ratios:**

Incomplete dominance and co-dominance, lethal genes, Pleiotropism

**2. Interaction of genes:**

Allelic and non allelic interactions, factor hypothesis, inheritance of comb pattern in Poultry, supplementary genes, complementary genes, epistasis, duplicate genes, polymeric genes, modifying genes, atavism, penetrance, expressivity, polygenic (quantitative) inheritance, skin colour in man

**3. Multiple alleles:**

Definition, characteristics and examples: coat colour in rabbits, mention isoalleles, blood group alleles, genetics of ABO bloodgroup system, mention other systems of blood grouping; MN blood group, Levin, and Bombay phenotype; Rh factor and erythroblastosis foetalis; (problems related to blood group inheritance are to be worked out)

**4. Linkage, crossing over and recombination:**

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:**

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 in honey-bees and *Bonellia*; short notes on intersexes; gynadromorphism

**6. Sex-linked, sex-influenced and sex-limited characters:**

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] – Pedigree analysis – importance of Y; dosage compensation – Barr body – Lyon hypothesis

(2 hrs)

(3 hrs)

(3 hrs)

(4 hrs)

(3 hrs)

(4 hrs)

## 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 and structural changes

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:

(4 hrs)

Normal chromosome complement in human beings, classification and grouping of human chromosomes (Patau's scheme), Gene therapy.

Chromosomal anomalies and disorders: Down's, Patau's, Edward's and Cri-du-chat syndromes, sex chromosomal anomalies like Turner's and

Klinefelter's syndromes), Gene mutations: autosomal mutations like

albinism, PKU, alkaptonuria, galactosemia, Tay-Sach's syndrome, Gaucher's disease, sickle cell anaemia, thalassemia, brachydactyly, sex chromosomal

mutations: haemophilia, Lesch-Nyhan syndrome, dermal hypoplasia

Polygenic traits: cleft palate / lip, club foot, hydrocephaly

## 9. Genetic counselling:

(1 hr)

Eugenics, Euthenics and euphenics.

### Topics for assignments/seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. History of genetics
2. Human cloning – pros and cons.
3. Cytoplasmic or extra nuclear inheritance: Shell coiling in *Limnaea*, cytoplasmic organelles, DNA in chloroplast and mitochondria and endo-symbionts like kappa particles and sigma.
4. Microbodies : Peroxisomes and glyoxysomes, Structure, functions and origin of microbodies.
5. Human genome project
6. Cytogenetics of cancer

### REFERENCE

Bhaskaran, K.K. & Biju Kumar, A.: *Cell Biology, Genetics & Molecular Biology*. Manjusha.

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Burns, G. W. & Bottino, P. J.: *The Science of Genetics*. 6/7e, Maxwell McMillan

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De Robertis, E. D. P. *et al.*: *Cell and Molecular Biology* TMH

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 Mange, E. J. & Mange, A. P.: *Basic Human Geneics*. 1999. Indian edn. Rastogi  
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 Philip Sheeler and Donald E. Bianchi: *Cell Biology – Structure, Biochemistry and Functions*.  
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 Red: *New Clinical Genetics*.  
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 Sharma, A., *Chromosomes*. 1992, Oxford & IBH  
 Sharma, B. K.: *Instrumental Methods of Chemical Anlasis*. Goel Pub House  
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 Verma, P.S. & Agarwal, V.K.: *Cytology*. S. Chand & Co.  
 Vijayakumaran Nair, K. & Jayaprakash, M.: *Cell Biology, Genetics, Molecular Biology*.  
 Academica, TVM.  
 Weaver, H.: *Genetics*. 1997, W.C. Brow

**CORE COURSE XVI: PRACTICAL- II\*B**  
**CELLBIOLOGY AND GENETICS**  
**(54hours) (3 hours per week)**

**Section A: Cell Biology**

1. Staining of eukaryotic cells: Temporary mount of buccal epithelial cells to study their structure and observe Barr body.(Major)
2. Mitosis: stages in onion (*Allium cepa*) root meristem (squash preparation)
3. Calculation of mitotic index and metapase index in root meristem of *Allium cepa*
4. Meiosis: stages in testis of grass hopper (demonstration only)
5. Giant chromosomes in Diptera: (*Drosophila / Chironomus* larvae) salivary gland cells (demonstration only).

6. Study of the parts of a compound microscope, its proper use and maintenance (Minor)
7. Measurement of size of microscopic objects using ocular and stage micrometers (Major)
8. Study of the applications of centrifuge. Demonstration of cell fractionation and centrifugation using fish liver (or any other specimen)

### Section B: Genetics

1. Scheme of Pedigree chart
2. Study of sex-linked inheritance (haemophilia and colour blindness)
3. Study of inheritance of human traits: (use Pedigree charts). Blood groups, widow's peak, eye colour
4. Genetic problems on Monohybrid, dihybrid crosses, blood groups, incomplete dominance and sex-linked inheritance (minimum ten problems to be worked out)
5. Study of normal male and female human karyotype (use photographs or xerox copies) and abnormal human karyotypes (any two)
6. Study of genetic syndromes: Down's, Klinefelter's and Turner's, Edward's 7  
Study of phenotypic characters in male and female *Drosophila*



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**FIFTH SEMESTER B. Sc. DEGREE PROGRAMME(Theory) ZOOLOGY  
CORE COURSE- IX**

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**Code: ZO5B 09 T**  
**GENERAL METHODOLOGY IN SCIENCE, BIOSTATISTICS  
AND INFORMATICS**  
**(54 hours) (3 hrs per week) (3 credits)**

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

- I. Science and Scientific Studies** (1hrs)  
Science as a human activity; scientific attitude; Empiricism; Science disciplines; Interdisciplinary approach.
- II. 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.
- III. Experimentation** (6hrs)  
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.
- IV. Ethics in Science and Animal Ethics** (6hrs)  
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)**

- I- Biostatistics: Definition, Scope, Role of statistics in Life Sciences,  
Terminology and variables .  
Sample and Sampling: Sample size, Sampling errors, Methods of sampling  
Specific aspects of statistical data  
i) Collection / documentation of data of the experiments:  
Classification and tabulation of data  
ii) Presentation of data: a) Graphic representation: Histogram, Frequency Polygon and Frequency Curve  
b) Diagrammatic representation: Line diagram, Bar diagram and Pie diagram  
iii) Analysis of data:  
(a) Measures of central tendency: Mean, Median and Mode Standard error  
iv) Interpretation:  
Significance of statistical tools in data interpretation(mention t test, f test and chisquare)  
Statistics-based acceptance or rejection of hypothesis

## SECTION-C: INFORAMTICS (19 hours)

### I. 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

### II. 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.

### III. 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.

#### Topics for Assignments / Seminars.

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Findings that changed the course of science.
2. Prepare a table showing the height of 20 students in a class. Calculate the mean height.
3. What are the mathematical properties of SD? How is it a better measure of Dispersion than range? Calculate the arithmetic mean and the SD of the frequency distribution obtained from a sample of data.
4. Report an experimental data in tabular / graphical form.

#### References – GENERAL METHODOLOGY & BIostatISTICS

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

#### **References on INFORMATICS**

Technology in Action, Pearson.

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), Additional References.

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

John Ray, 10 Minute Guide to Linux, PHI, ISBN 81-203-1549-9.

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://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>

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

#### **Any 4 items of the following (1-7)**

1. Design an experiment to prove a hypothesis by testing the specificity of the

enzyme salivary amylase on starch.

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

3. Measure the size of given shells / any sample of data and represent it in a graphical form and interpret it.
4. Calculate the standard deviation of the given set of data.
5. Censusing of the avian fauna / any fauna of an area and present the data in a suitable graphical form.
6. Construct frequency curve, frequency polygon, bar diagram, histogram and pie diagram using suitable data.
7. Formulate a hypothesis of any scientific observation made by you.
  - Feeding rate and BMI in an insect larva.
  - Phototaxis in Earth worms.
  - Mortality of mosquito larvae on application of oil / kerosene.



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**SIXTH SEMESTER B.Sc .DEGREE PROGRAMME(Theory) ZOOLOGY  
CORE COURSE- X**

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**Code: ZO6B 10T  
(36) (2hours/ week) (2 credits)**

**BIOCHEMISTRY (36 hrs)**

**1. Introduction (2hrs)**

History and scope, Stabilising forces in biomolecules (micro and macro molecules) and elements of biological importance; Electrostatic bonds, Hydrogen bonds, hydrophobic interactions,

**2. Carbohydrates (6hrs)**

Structure and classification. Monosaccharides, Glucose, Fructose, Mannose, Galactose, Disaccharides, Sucrose, Maltose, Polysaccharides, Starch and Glycogen. Mention the biological functions.

Principles of analytical techniques (qualitative and quantitative) and clinical significance of these tests; (Benedict's, Fehling's, Barford's, Selivanof's etc.) Mention (i) Colorimeter (ii) Ultraviolet - visible spectrophotometer,

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

Structure and classification of amino acids. Properties of amino acids. Isoelectric point, Zwitterion. Peptide linkages.

Primary, Secondary and Tertiary structure of proteins, physical and chemical properties. Denaturation of proteins.

Principles of analytical techniques such as Biuret reaction, Xanthoprotein test, Ninhydrin reaction. Separation techniques. Brief introduction to (1)Chromatography:(a) Paper chromatography (b) Column chromatography, 2.Electrophoresis: Mention (a) Polyacrylamide Gel Electrophoresis (PAGE) b) Agarose Gel Electrophoresis

**4. Lipids (4 hr)**

Classification and functions (simple and compound lipids), Triglycerides Mention phospholipids, lecithins, cephalins, prostaglandins and cholesterol.

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

Classification, nomenclature and properties 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, molecular structure of tRNA.

**7. Metabolism of carbohydrates, proteins and lipids (10 hrs)**

Glycogenesis, glycogenolysis, gluconeogenesis, glycolysis, mention Kreb's cycle, 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 and principles and chemiosmotic

synthesis of ATP. Deamination, transamination and decarboxylation of amino acids. □-oxidation of fatty acids.

**Topics for assignments/seminars**

**(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)**

1. Biological roles of water
2. Mucopolysaccharides
3. Polyunsaturated fatty acids.
4. Importance of Nucleic acids
5. Structure of DNA
6. Specificity of Enzymes
7. Significance of TCA cycle.

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2. Oser, B., Hawk's Physiological Chemistry, 14e, 1971, TMH
3. D.M. Vasudevan and Sreekumari Text book of Biochemistry, Jaypee.
4. .Arora, M. P. (2004). Biophysics, 1e, Himalaya Publications

5. Asha Bhate (2005). Modern Tools and Techniques. Sarup & Sons.
6. Bajpai, P. K. (2006). Biological Instrumentation and Methodology, 1e, S. Chand & Company Ltd.
7. Boyer, R. (2004). Modern Experimental Biochemistry, 3e, Pearson Edn.
8. Conn, E.E. *et al.* Outlines of Biochemistry, 5e, 2001, John Wiley & Sons.
9. Mathews, C.K. *et al.*, Biochemistry, 3e, 2003, Pearson Edn. (Indian Edn.).
10. Voet, D. & Voet, J.G., Biochemistry, JW & S.
11. David P. Plummer - Introduction to Practical Biochemistry, 3<sup>rd</sup> edn., Tata McGraw Hill Pub. Comp., New Delhi.
12. Wilson and Walker – Principles and Techniques of Biochemistry and Molecular Biology, 6<sup>th</sup> edition – Cambridge Low Price edition.

**ZOOLOGY CORE COURSE- XI**

**Code: ZO6B 11T**

**(54) (3hours/ week) (3 credits)**

**PHYSIOLOGY AND ENDOCRINOLOGY- (54 hours)**

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

**1. Nutrition (5hrs)**

Balanced diet, nutrition in pregnancy, infant nutrition, breast feeding. Importance of dietary fibres, nervous and hormonal control of digestion, ruminant digestion. Nutritional disorders

–anorexia, acidity, ulcer, flatulence, starvation, fasting and its significance. Obesity causes and consequences, Role of vitamins and minerals.

**2. Respiration (6 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.

**3. Circulation (6 hrs)**

Blood functions and composition, agglutination and coagulation of blood (enzyme cascade theory), clinical analysis of blood, haemostasis, haemolysis and 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 (6 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.

**5. Muscle Physiology (6 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

**7. Bioluminescence and Bioelectricity (2 hr)**

Classification -symbiotic, extra cellular and intracellular. Physiology and significance of light production. Structure and functions of electric organs.

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

**1. Invertebrate endocrinology**

Neuro endocrine organs and hormones in insects and crustaceans. (1hrs)

**2. Vertebrate endocrinology**

Classification of hormones, steroid and peptide hormones, Endocrine glands in man (Pituitary, Adrenal, Pineal, Thyroid, Parathyroid, Gastro- intestinal, and Pancreas) and their hormones (brief account). Hormonal disorders. (5hrs)

**3. Concepts of neurosecretion**

Hypothalamus Hypophysial interactions, Hypothalamus releasing and inhibiting hormones. Roles of hypothalamic and pituitary hormones: Antidiuretic hormone, Oxytocin, growth hormone, Adrenocorticotrophic hormone, TSH, Gonadotrophins. (4hrs)

**3. Reproduction**

Hormonal control of Testes, Functions of Testosterone. Role of Hormones in Female Sexual cycle, Placental Hormones , Female & Male sexual dysfunctions-Hormone related only.

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

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 (4hrs)

**Topics for assignments/seminars**

**(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)**

1. Role of enzymes in digestion of Carbohydrates, proteins and lipids.
2. Absorption of carbohydrates, proteins, and lipids.
3. Respiratory problems and health hazards caused by smoking.
4. Medical aids for respiration - aspirators, artificial respiration and ventilation, heart lung machine
5. Composition and functions of lymph.
6. Common renal problems - Renal hypertension, nephritis, renal failure, oedema, acidosis, uraemia, haematuria and calculi.
7. Brief notes on: Intelligence, memory, sleep, EEG, hunger, thirst and emotion
8. Emergency hormones, Epinephrine and norepinephrine.

**REFERENCES**

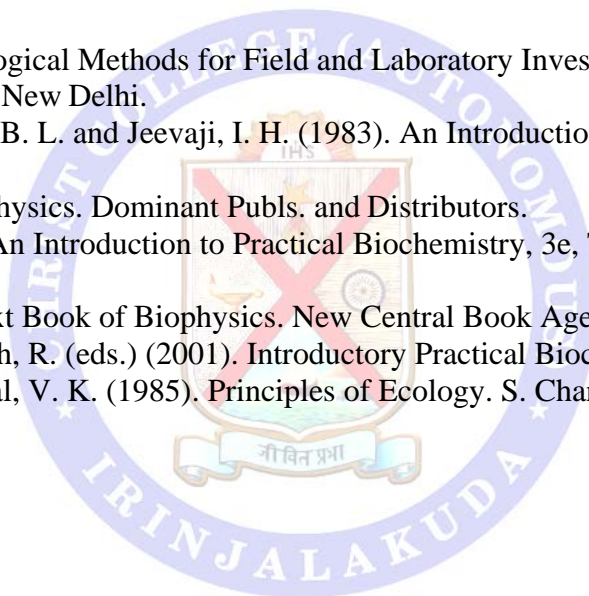
1. Chatterjee, C.C., Human Physiology, Medical Allied Agency.
2. Ganong, W.F., Lange Review of Medical Physiology, 20, Indian Edn., 2002, MGH. .
3. Guyton, A.C., Hall, J.E.: Text book of Medical Physiology, IOC, Harcourt.
4. Vander, A.J. *et al.* Human Physiology, 1998, MGH.
5. Bentley, P. J. Comparative vertebrate endocrinology, CUP.
6. Berry, A.K., A Text book of Animal Physiology, 6e, Emkay Publications, Delhi-51.
7. Gorbman, A. *et al.* Comparative Endocrinology, JW & S.
8. Hoar, W.S.: General and Comparative Animal Physiology. 1975, PHI.
9. Vijayakumaran Nair and Paul, Animal physiology and Biochemistry, Academia.
10. Hadley, M.E., Endocrinology, 5e, 200, Pearson Edn. (Singapore), ND
11. Highnam & Hill: Invertebrate Endocrinology.
12. Turner, C.D. General and Comparative Endocrinology.
13. Williams, R.H., Text book of Endocrinology, W.B. Saunders.
14. Nielsen – Animal Physiology – Cambridge University Press.

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

1. Qualitative Tests for mono, di and polysaccharides (reducing and nonreducing) (major)
2. Qualitative Tests for protein
3. Qualitative Tests for lipids
4. Abnormal constituents of urine (glucose and albumin ) (major)
5. Determination blood clotting time (Demo)
6. Determination of blood pressure (Demo)
7. Determination of Hb content in man using Haemoglobinometer (Demo)
8. Determination of body mass index (individuals)
9. Separation of amino acids (or any other compounds) from a mixture by using paper chromatography (demonstration)
10. Determination of concentration of unknown solutions using Photo colorimeter (demonstration)

**References:**

- 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.



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**SIXTH SEMESTER B. SC. DEGREE PROGRAMME(THEORY)**

**ZOOLOGY CORE COURSE-XII CODE: ZO6B 12T**

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**MOLECULAR BIOLOGY & BIO INFORMATICS**  
**[54 hours] [3 hours per week] [3credits]**

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

**1. Introduction**

**(5 hrs)**

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**

**(3 hrs)**

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

**3. Genetic code**

**(4hrs)**

Gene and genetic code, deciphering / cracking of genetic code; contributions of 1) Nirenberg and associates, 2) Khorana; properties of genetic codes, codon assignments, wobble hypothesis

**4. Protein synthesis:**

**(5 hrs)**

Regulation of Protein synthesis – Role of RNAs  
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 cystronic mRNA – role of molecular chaperons – cell targeting proteins (brief account only).

**5. Regulation of gene action:**

**(4hrs)**

In prokaryotes [operon concept, Lac operon in detail], lytic cycle and lysogeny of phages [brief account] siRNA and RNAi, House keeping genes, gene modulation.

**6. Organization of genome**

**(5 hrs)**

Classical concepts of genes. Modern concept of genes – cistron, muton, recon, complicon, transcripton; split genes, overlapping genes, pseudo genes, jumping genes, cryptic genes [brief accounts only]

## Topics for assignments / seminar

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Human genome project
2. Structure of DNA
3. Types of DNA
4. Milestone of molecular biology
5. Mitochondrial genome
6. Types of RNA

## Section- B: BIO INFORMATICS (27 hours)

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

Introduction: Definition, history, development and scope, tasks

### II. 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

### III. Database Search Engines (4hrs)

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

### IV. Sequence Similarity Search (3hrs)

Pairwise sequence alignment: Mention BLAST, FASTA, Multiple

sequence alignment: Mention CLUSTAL W, CLUSTAL X

### V. Micro arrays (2hrs)

Data analysis tools and methods

### VI. Genomics (3 hrs)

DNA sequencing, applications (Brief account)

### VII. Proteomics (2 hrs)

Tools and applications (Brief account)

### VIII. Metabolomics (2hrs)

Tools and applications (Brief account)

### IX. Applications of Bioinformatics (2hrs)

### X. Ethical issues in Bioinformatics (2hrs)

Accuracy and error

a. Appropriate uses and users

b. Privacy and confidentiality

References:-Molecular biology:

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

Bhaskaran, K.K. & Biju Kumar, A.: *Cell Biology, Genetics & Molecular Biology*. Manjusha.

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

Burns, G. W. & Bottino, P. J.: *The Science of Genetics*. 6/7e, Maxwell McMillan

Darnell, J. *et al.*: *Molecular Cell Biology*. Scientific American Book

De Roberties, E. D. P. *et al.*: *Cell and Molecular Biology* TMH

Dobzhansky, Th.: *The Genetics and Origin of Species*. Columbia Uty. Press

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Gangane, S. D.: *Human Genetics*. 2e, 2000, B. I. Churchill Livingstone, N D.

Gerlad Karp: *Cell and Molecular Biology*.

Good Enough, U.: *Genetics*. Halt, Reinharts & Winston

Gupta, P. K.: *Cell and Molecular Biology*, 2e, 2002, Rastogi Pubs., Meerut.

John Ringo: *Fundamental Genetics*- Cambridge University Press.

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

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Robert H. Tamarin, *Principles of Genetics*.

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

A., *Chromosomes*. 1992, Oxford & IBH

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Stine, C. J.: *The New Human Genetics*, W.C. Brown

Strachan, I. & Read, A.P.: *Human Molecular Genetics*. 1999, JW & S

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Watson, Baker, Bell, Gann and Levin, *Molecular Biology of Genes*.

Watson, J.D. *et al.*, *Molecular Biology of the Gene*, 4e, Benjamin Cummings

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Vides, *Integrative Approach to Molecular Biology*, MIT Press

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*Medical Genetics at a Glance*, Blackwell

Jan Vijg, *Aging of the Genome*, Oxford University Press

Frank H. Stephenson, *Calculations for Molecular Biology and Biotechnology: A guide to Mathematics in the Laboratory*, Academic Press, Elsevier

### References:Bioinformatics

Atwood and Parry-Smith. 2001. Introduction to Bioinformatics. Pearson Education Asia, New Delhi.

Baxevanis & Ouellette. 2001. Bioinformatics - A practical guide to the Analysis of Gdnes and Proteins, Wiley, New York.

Mount, 2001. Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbour laboratory Press, New York.

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A. Dwyer - Genomic Peril - From Bioinformatics Basics to Working Code (with CD) -

Cambridge University Press. Atwood and Parry-Smith. 2001. Introduction to Bioinformatics.

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



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

**ZOOLOGY Core Course XIII Code: ZO6B 13 T**

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**REPRODUCTIVE BIOLOGY, DEVELOPMENTAL BIOLOGY AND TERATOLOGY**

**(54 Hours) (3 hours per week, 3 credits)**

**Section A: REPRODUCTIVE BIOLOGY (14 hrs)**

- 1. Introduction** (1 hr)  
Scope, reproductive strategies in invertebrates and vertebrates: semiparity and iteroparity, sex patterns: unisexual, reversal of sex, examples.
- 2. 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
- 3. Pregnancy, Gestation, Placentation, parturition and lactation** (2 hrs)
- 4. Reproductive cycles in Mammals** (2 hrs)  
Oestrous and menstrual cycles and their hormonal control
- 5. Reproductive technologies** (1 hr)  
Infertility and its management: Brief account of semen collection, preservation, storage, artificial insemination, surrogacy.
- 6. Cryopreservation and embryo transfer** (1 hr)  
Collection, care and preservation of embryos; *In vitro* fertilization and embryo transfer : major steps; Test tube babies
- 7. Assisted Reproductive Techniques (ART)** (1hr)  
GIFT, ZIFT, ICSI, oocyte donation and embryo donation
- 8. 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
- 9. Fertility Control** (2 hr)  
Natural methods, Artificial methods, chemical methods, hormonal methods, surgical contraception, removal of gonads and uterus , abortion.

**Section B: DEVELOPMENTAL BIOLOGY (37hrs)**

- 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), the distribution (iso, centro & telo lecithal), presence or absence of shell (cleidoic & non cleidoic), the 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** (8 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, 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.

**8. Cell Differentiation and Gene action during development** (4 hrs)

Cell differentiation, totipotency, pluripotency, Dedifferentiation and Redifferentiation; controlled gene expression during development, Homeotic genes, Mention Hoxgenes; Stem cells, their significance and applications .

**9. Parthenogenesis** (2 hrs)

Definition, Types: i). Natural parthenogenesis: Arrhenotoky, Thelytoky, Obligatory and Facultative, ii). Artificial parthenogenesis, and significance

**10. 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).

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

Environmental disruption of animal development (alcohol, drugs, Nicotine and chemicals- brief account) [Refer Developmental Biology, Scott F.Gilbert].

### Topics for Seminar / Assignment/Discussion

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Placenta: different types and functions
2. Development of foetal membranes in man.
3. Regeneration in animals.
4. Factors affecting regeneration
5. Factors inducing parthenogenesis.
6. Structure of different types of eggs (amphioxus, frog, insect)
7. Corpus luteum, corpus albicans and corpus haemorrhagicum

### References

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- Gilbert, S.C., *Developmental Biology*, 5e, Sinauer Associates.
- Jayaprakash, M. *A Manual of Developmental Biology*, 2e, Academia, Trivandrum.
- Patten, B.M.: *Early Embryology of the Chick*, 1973, TMH.
- Patten, B.M.: *Foundations of Embryology*, 1958, McGraw Hill.
- Rugh, R.: *Frog Reproduction and Development*.
- Sastry & Shukul: *Developmental Biology*, 2003, 1e, Rastogi Pub.
- Scott, F., Gilbert: *Developmental Biology – Sinaur Associates*.
- Verma, P.S. & Agarwal V.K.: *Chordate Embryology*.
- Vijayakumaran Nair, K. & George P.V. *A Manual of Developmental Biology*, 3e, 2002.
- Wolpert, L.: *Principles of Development*, 1994, OUP.
- Muller, *Developmental Biology*, Springer Publishers.

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

1. Demonstration of chick blastoderm
2. Induced ovulation in fish
3. Study of life cycle in *Drosophila*

### Spotters

- 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 – 18, 24, 32, 48 hours of incubation
- Mammal - Any two mammalian embryos
- Larval forms of invertebrates (any five) and vertebrates (any two)

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

**ZOOLOGY Core Course XIV Code: ZO6B 14T**

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**BIOTECHNOLOGY, MICROBIOLOGY AND IMMUNOLOGY**

**(54 hours) (3 hours per week) (3 credits)**

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

1. **Definition and brief introduction of Biotechnology** – Mention branches of Biotechnology (brief). **(2 hrs)**
2. **Fundamentals of animal cell culture and hybridoma technology:** Primary cell culture, secondary culture, types of cell lines, valuable products from cell culture, hybridoma technology, monoclonal antibodies and their uses . **(3 hrs)**
3. **Gene cloning and DNA sequencing:** 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, DNA sequencing (brief) **(4 hrs)**
4. **Transgenic organisms:**
  - (a) Transfection methods: Calcium phosphate precipitation, Dextran mediated, Lepofection, Electroporation, Retroviral infection, micro injection, Shotgun method (brief)
  - (b) Transgenic animals: Fish, sheep, rabbit, mice, and goat. 1 example from each
  - (c) ) Molecular pharming and bioreactors
  - (d) Mention knock out mice, Bt cotton **(3 hrs)**
5. **Molecular markers** – RFLP, RAPD, VNTR Micro satellites or STR, and their uses. Chromosome walking, Fluorescence in situ hybridization (FISH) and DNA Finger printing (Profiling) techniques. **(3 hrs)**
6. **Biotechnology and Environment:**  
Biosensors, Bioremediation – Ex situ and in situ  
Biofiltration , Bioleaching (microbial mining) **(2hrs)**
7. **The ethical and social implications of genetic engineering.** **(1 hr)**

**Section-B: MICROBIOLOG Y (18 hrs)**

1. **Introduction and scope of microbiology.** **(1 hr)**
2. **Survey of Microorganisms** (outline only) **(3 hrs)**  
Prions, Viroids, Viruses, Rickettsias, Mycoplasmas, Bacteria, Cyanobacteria, Prochlorophyta, Protozoa, Algae, Fungi and Slime moulds
3. **Structure of a typical bacterium:** **(3 hrs)**  
Characteristics and major groups of bacteria, growth phases, measurement of growth

4. **Viruses:** Structure and shape (2 hrs)

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

7. **Microorganisms in Human Diseases:** (3 hrs)

Normal micro flora of the human body, Diseases caused by Bacteria, Protozoa, Virus (brief). Epidemiology and control of diseases, chemotherapy

### Section-C IMMUNOLOGY(18 hrs)

#### 1. Introduction and History

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). (2hrs)

#### 2. Immune System

Cells and organs of the immune system.(B- lymphocytes, T-lymphocytes, NK cells, monocytes, macrophages, Neutrophils, Basophils, Eosinophils, Mastcell & Dendritic cells. Organs-Spleen, Thymus .Bonemarrow and Lymphnodes (3hrs)

3. **Structure and classes of immunoglobins**, their biological functions. (2 hrs)

#### 4. Antigens:

Exogenous antigens, Endogenous antigens, adjuvants, haptens, Epitopes, Antigen-antibody reaction - Precipitation reaction, Agglutination reaction, Agglutination inhibition reaction. (3hrs)

#### 5. Autoimmune diseases:

Systemic-Examples (a).SLE,(b) Multiple sclerosis and(c) Rheumatoid arthritis - Organ specific-Examples (a) Hashimoto's thyroiditis (b) Grave's disease and (c) Myasthenia gravis.

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

(Principles and Applications of)

(i) Immuno assays: RIA, ELISA and Flow cytometry

(ii) PCR

(iii) Blotting techniques: (a) Southern blotting (b) Northern blotting

(c) Western blotting; Mention dot blots and slot blots. (3hrs)

### **7. Tumour immunology:**

Malignant transformation of cells, tumour antigens, immune response to Tumour effector mechanisms in antitumor immunity-a) Antibodies b) T-lymphocytes c) NK cells d) Macrophages (e) Immunotherapy.

(3hrs)

### **Topics for Assignment / Seminar**

**(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)**

1. Gene therapy.
2. Biofertilizers and Biopesticides.
3. Organ transplantation.
4. Genetically engineered microorganisms and their applications.
5. Hyper sensitivity reactions.
6. Genetically engineered food crops and concerns.

### **7. Cellular immunity.**

### **8. Humoral immunity.**

### **References**

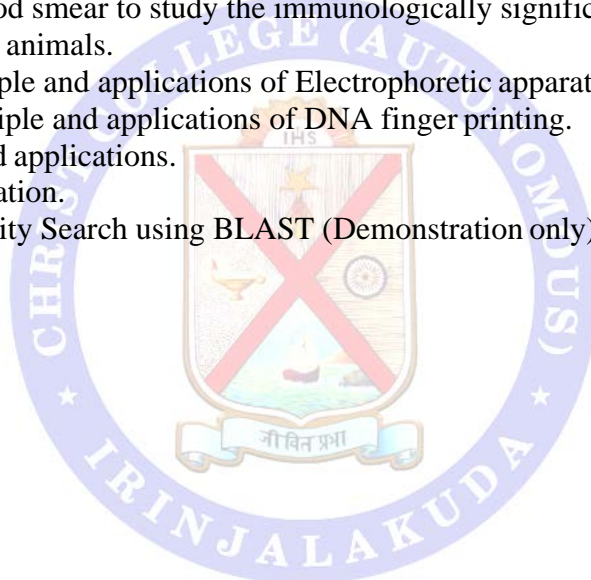
- R. C. Dubey, A text book of Biotechnology, S. Chand & Co.  
Benjamin Lewin – Genes, Vol. IX.  
Old and Primrose – Molecular Cloning.  
L.P. Rema – Applied Biotechnology – MJP Publishes.  
R.C. Sobti and S. Pachauri – Essentials of Biotechnology – Ane books Pvt. Ltd.  
B.D. Singh – A text book of Biotechnology, Kalyani Publishers.  
Pelezar, M.J., Reid, R.D. and Chan, E.C.S., Microbiology, TMH.  
Kuby, J., Immunology, W.H. Freeman.  
Joshy K.R. Immunology – Agro Bios.  
Ananthanarayan & Paniker, J. Microbiology Orient Longman.  
A.S. Rao, Introduction to Microbiology, Prentice Hall of India.  
Hans G. Schiegl – General Microbiology, Cambridge University Press.  
Heritage, Evans and Killington – Introductory Microbiology – Cambridge University Press.  
Kanika Sharma – Manual of Microbiology tools and techniques – Ane Books Pvt. Ltd.  
Dominic W.C. Wong – The ABCS of gene cloning – Springer International Edn.

Veebala Rastogi – Fundamentals of Molecular Biology, Ane Books Pvt. Ltd.  
Colin Ratledge and Bjorn Kristiansen – Basic Biotechnology, Cambridge University Press. John Smith – Biotechnology, Cambridge University Press.  
Wise – Immunology – Blackwell Publishers.  
Todd – Lecture notes on Immunology – Blackwell Publishing.  
Monica Cheesbrough, District Laboratory Practice in Tropical Countries, Part I and II, Cambridge Low Price Editions.  
Nicholl – An Introduction to Genetic Engineering – Cambridge University Press. Wise – Immunology a Comprehensive Review – Ane Books.  
Alphey – DNA Sequencing – Bios Scientific Publishers.  
Hardin – Cloning, gene expression, and protein purification – Oxford University Press. Gandhi – Microbiology and Immunology notes and cases – Blackwell Publishing.  
N. Ahmed, Qureshi and Khan – Industrial and Environmental Biotechnology, Horizon Press.  
Mansi – Fermentation, Microbiology and Biotechnology, Second Edition.- Taylor and Francis Wise,- Bioinstrumentation and Biosensors - Taylor and Francis.



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

1. Staining of bacterial cell using appropriate bacterial stain. *Lacto bacilli*
2. Staining of root nodule Nitrogen fixing bacteria. *Rhizobium*.
3. Identification of motile bacteria by hanging-drop method. (Demonstration only).
4. Preparation of culture media for bacteria. (Synthetic Media, Natural Media, Simple Media, Differential Media, Selective Media,
5. Study of microbial byproducts. (Antibiotics, Milk products)
6. Identification of human blood group (A B O and Rh )
7. Prepare human blood smear to study the immunologically significant cells.
8. Study of transgenic animals.
9. Study of the principle and applications of Electrophoretic apparatus.
10. Study of the principle and applications of DNA finger printing.
11. PCR-Principle and applications.
12. ELISA-Demonstration.
13. Sequence Similarity Search using BLAST (Demonstration only)



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## *PROJECT WORK Code No: [ZO06 18(Pr)] – Vth SEMESTER*

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(36 hrs 2 hrs/week, 2-credits)

Internal Mark-10

External Mark-40

Students are required to undertake project work on problems pertaining to biological science of 36hrs duration in Vth 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 9 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 candidate* for evaluation separately on the day of practical examination during VIth semester. The project must contain the following sections.

1. Introduction and objectives of study. (This part may contain citations of relevant literature in the field, if available)
2. Methodology
3. Interpretation of results
4. Reference

### **Field Study / Study Tour (One credit, 10 Marks)**

A field study/study tour of 5 days is compulsory during the tenure of the programme. A total of atleast 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 VIth semester. The study tour report is compulsory for each student appearing for practical examination.

### **Viva-Voce (Two credit, 15 Marks)**

At the end of VIth semester each student shall appear for a viva-voce before a team of two external examiners. It will be conducted on a separate day for all candidates of the centre concerned. 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. There shall be an internal viva-voce for 3 Marks.

**SYLLABUS**  
**OPEN COURSES**  
**ZO5 D 01 , 02 & 03**  
**FIFTH SEMESTER B. Sc. DEGREE PROGRAMME(Theory)**  
**ZOOLOGY OPEN COURSE- I**

**Code: ZO5-D 01**  
**REPRODUCTIVE HEALTH AND SEX EDUCATION**  
**(36 hours) (2 hours per week) (2 credits)**

- 1.Introduction** (1 hrs)  
Reproductive rights, Need for sex education
- 2.Sex determination and Chromosomal anomalies** (5hrs)  
Chromosomal mechanism of sex determination, Environmental control of sex determination, Hormonal control of sex determination, Barr body, Twin studies, Sex reversal, Sex chromosomal anomalies:Turner's syndrome and Klinefilter's syndrome.
- 3.Sexualabuses and myths** (4hrs)  
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.
- 4.Prenatal Diagnosis** (3hrs)  
Different methods (invasive and non invasive). Female foeticide: Ethical issues and laws. (Mention Prenatal Diagnostic techniques – Prevention of misuse act – PNDT Act)
- 5.FertilityControl** (4 hrs)  
Natural methods, Artificial methods, Contraceptive devices and medications, Abortion, Legal termination of pregnancy, Vasectomy, Tubectomy, Vaccines and hormones in fertility control.
- 6.Infertility and assisted reproductive technologic** (5hrs)  
Physiological infertility, pathological infertility, causes and problems in male and female infertility. Assisted Reproductive Technologies (ART) – IVF, ET, AI, GIFT, ZIFT, ICSI, Embryo or oocyte donation, health hazards in ART, cryopreservation of blastocysts and ethics, designer baby and ethics.
- 7.Sexually transmitted infectious diseases** (6hrs)  
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.
- 8. Ethical aspects of sex** (2 hrs)  
Introduction, Healthy relationship with opposite sex, Role of counseling, Gender discrimination in family and society, Sperm bank, Ovum bank,

## 9.Common diagnostic techniques

(6 hrs)

Imaging techniques and purpose of imaging – Angiography, CT scanning, MRI, PET, and Ultra sound scanning.

Techniques to monitor body vital functions – EEG, ECG, LFT.

Laboratory diagnostic methods – ELISA, WESTERN BLOT.

Therapeutic methods – Endoscopies, Laser microscopy, haemodialysis, bypass surgery, angioplasty.

### . Topics for Assignments and Seminars

**(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)**

1. Sexual counseling
2. Marriage counseling
3. Population explosion and birth control
4. Functions of male and female hormones
5. Hormones of pregnancy

### References

1. Prakash Kothari : *Common sexual problems and solutions*, UBS Publishers and Distributors Ltd.
2. Kinsey, sex and fraud, Judith, Edward W. Eichel, John H. Court and J. Gordon, Editors Lochinvar : Huntington House Publications.
3. Lynn L. Long, Judith A. Burnett, R. Valorie Thomas: *Sexuality counseling An integrated approach* , Pearson, Merrill Prentice Hall.
4. Robert T. Francoeur: *Becoming a sexual person*, John Wiley and Sons.
5. Guyton & Hall: *Textbook of Medical Physiology*
6. Churchill Livingstone : *Davidson's Principles and Practice of Medicine*.
7. Vander, Sherman and Luciano : *Human Physiology*, McGraw Hill.
8. Vijayakumaran Nair, K.and Paul, P.I: *Animal Physiology and Biochemistry*,

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

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**Code: ZO5D 02**  
**NUTRITION, HEALTH AND HYGIENE**  
**(36 hours) (2 hours per week) (2 credits)**

**Section-A: NUTRITION (18 Hours)**

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, flatulence, ulcer
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 and HYGIENE (18 Hours)**

1. Physical health, psychological health, sociological health, Genetic influence on health. Three elements of health programmes: environment-education-surveillance. (1 hrs)
2. Fitness-body conditioning, principles of exercise programmes, sports, use of leisure time. (1 hr)
3. Alcoholism: Alcoholic beverages, physiological effects of alcohol, abuse of alcohol, treatment of chronic abuse of alcohol; Smoking: rights of non smokers, composition and effects of tobacco smoke, the smoking habits (active and passive smoking). (2 hrs)
4. Familiarization of various diseases and disorders of human body.
  - a. Communicable and non-communicable diseases (brief account): Bacterial, viral, fungal and protozoan, helminth. (2 hrs)
  - b. Parasites and their diseases (life cycle not expected): Mode of infection, pathogenicity, diagnosis, treatment and prophylaxis of *Entamoeba histolytica* & *Taenia solium* (2hrs)
  - c. Vector borne diseases and their control: *Anopheles*, *Culex* & *Aedes*. (1 hrs)
  - d. Disorders of blood vascular system: Hypotension and hypertension, coronary thrombosis, stroke. (2 hrs)
  - e. Cancer, hepatitis, jaundice, diabetes type I and II, insulinoma, Hyperinsulinism, Aids (brief account) (2 hrs)

- f. Early intervention in autism, dyslexia and mental retardation. (1 hr)
- 5 .First aid-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. (2 hrs)
- 6 .Proper use of drugs-ill-effects of self medication. (1 hr)
7. Hygiene: Hygiene and health factors at home, personal hygiene, Oral hygiene and sexhygiene. (1 hr)

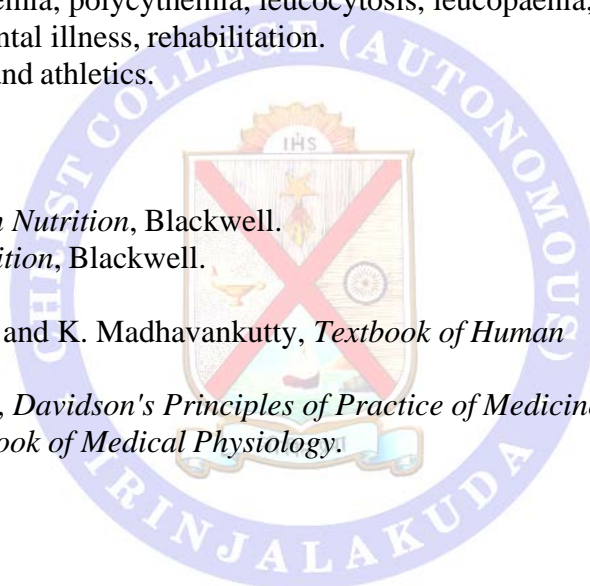
### **Topics for Assignments and Seminars;**

**(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)**

1. Vitamins, hypovitaminosis, hypervitaminosis
2. Substance abuse (alcohol, tobacco, resins, solvents, narcotics)
3. Blood pathology: anaemia, polycythemia, leucocytosis, leucopaenia, leukemia.
4. Genetic disorders, mental illness, rehabilitation.
5. Drug abuse in sports and athletics.

### **References**

1. Gibney, *Public Health Nutrition*, Blackwell.
2. Gibney, *Clinical Nutrition*, Blackwell.  
99
3. Sarada Subramanyam and K. Madhavankutty, *Textbook of Human Physiology*.
4. Churchill Livingstone, *Davidson's Principles of Practice of Medicine*.
5. Guyton & Hall, *Textbook of Medical Physiology*.



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

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**Code: ZO5D 03**  
**APPLIED ZOOLOGY**  
**(36 ours) (2 hours per week) (2 credits)**

**Section- A: ENTOMOLOGY**

**1. Introduction: ( 1hr)**

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

1. *Spodoptera mauritia* (Rice swarming caterpillar)

2. *Leptocorisa acuta* (Rice bug)

(b). Pests of coconut

1. *Oryctes rhinoceros* (Rhinoceros beetle)

2. *Rhynchophorus ferrugineus* (Red palm weevil)

(c). Pests of stored products

1. *Sitophilus oryzae* (Rice weevil)

2. *Callasobruchus chinensis* (Pulse beetle)

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

**(a). Apiculture**

1. Brief description of common species of *Apis*

2. Honey bee products : bee wax and its uses, chemical composition of honey and uses

**(b). Sericulture**

1. Brief description of *Bombyx mori* (Mulberry silk moth), *Antheraea paphia* (tassar silkworm)

2. Sericulture and extraction of silk

3. Types of silk: Tasar, Muga and Eri Silk

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

1. Cultural control

2 Mechanical controls

3. Biological control

4. Chemical control

5. Integrated pest management (IPM)

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

1. Brief account on Pisciculture, Prawn culture, Mussel culture and Pearl Culture (with examples).

### Section- C: POULTRY SCIENCE (4hrs)

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 (4hrs)

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

- Nayar, M.R.G.K. *A Monograph on Crop pests of Kerala and their control*. 1989, Published KAU, Vellanikkara.
- 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*.

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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.

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Pillai, T.P.: *Aquaculture Principles and Practices of Fishing*, New Books.

Rajendra Kumar Nath, R.: *Freshwater Aquaculture*, Scientific Pubs., Jodhpur.

Samuel, C.T.: *Marine Fisheries in India*, Cochin University.

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Sinu, V.R.P. & Ramachandran, V. *Reshwater Fish Culture*. ICAR.

Srivastava, C.B.L. *Fishery Science and Indian Fisheries*, 2e. 2002, Kitab Mahal.

Allahabad Winton. A. L.: *Fish and Fish Products*, 2000. Agro.

Banerjee, G.C.: *ATB of Animal Husbandry*. 8e. 1998. Oxford & IBH.

Banerjee, G.C.: *Poultry*, Oxford & IBH.

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

Eckles, C.R. Combs, W.B. & Macy, H.: *Milk & Milk Products*. Tata MGH.

ICARD: *Handbook of Animal Husbandry*, 1990/97, ICAR, Pusa, N.d.

Jull, M.A.: *Poultry Husbandry*, 3e, TMH.

Lasley, J.F.: *Genetics of Livestock Improvement*. 1987, Prentice Hall Eaglewood.

Linter & Sunk: *Poultry Science*, Lippincot & Co. N.Y.

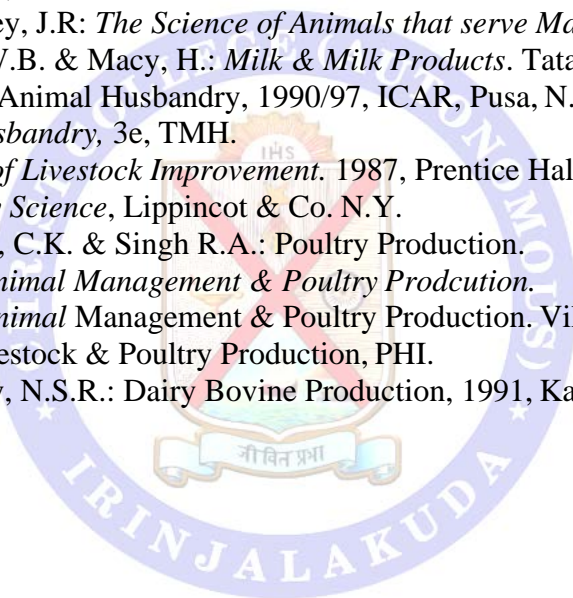
Sastry, N.S.R. Thomas, C.K. & Singh R.A.: *Poultry Production*.

Sastry, N.S.R. *Farm Animal Management & Poultry Prodcution*.

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

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

Thomas, C.K. & Sastry, N.S.R.: *Dairy Bovine Production*, 1991, Kalyani.



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## SYLLABUS

### ELECTIVE COURSES

#### ZO6B 15(E) 01,02&03

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#### SIXTH SEMESTER B.Sc. DEGREE PROGRAMME-(Theory)

#### ZOOLOGY ELECTIVE COURSE- III

Code: ZO6B 15(E) 01T

#### HUMAN GENETICS

(54 hours) (3 hours per week) (3 Credits)

- 1. Introduction: Scope and Significance** (1 hr)
- 2. Identification of human chromosomes**
- (a) History and nomenclature of human chromosomes – various conferences and their contributions: Denver, Chicago, Paris and Stockholm Conferences.
- (b) Characteristics of human chromosomes by 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). (3 hr)
- (c) Non-disjunction of chromosomes- Meiotic non-disjunction, mitotic non-disjunction, non-disjunction of autosomes, non-disjunction of sex chromosomes and mosaicism (4hr)
- 3. Human Pedigrees**
- Pedigree construction, data collection, analysis and pedigree charts of autosomal dominant, autosomal recessive, X-linked dominant and recessive gene mutation disorders. (3 hr)
- 4. Autosomal dominant inheritance**
- Familial hypercholesterolemia, 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) (4hr)
- 5. Autosomal recessive inheritance**, cystic fibrosis, CF gene and protein, Detection of CF homozygotes and carriers, hereditary microphaly, retinoblastoma, craniodiaphyseal dysplasia, Hutchinson-Gilford syndrome (progeria), Thalassaemia and Hereditary hemolytic anemia. (4hr)
- 6. X-linked dominant and recessive inheritance:**
- Duchene's muscular dystrophy, identification of the DMD gene, carriers and hemizygotes, Hypophosphatemia, Von Willebrand's disease, SCID & Albright's hereditary osteodystrophy (4hr)
- 7. Multifactorial inheritance**
- Congenital heart diseases (ASD & VSD), Alzheimer's disease, Schizophrenia, intelligence, stature, blood pressure, refractive index of the Eye & dermatoglyphic ridge count. (4hr)

## 8. Chromosome structural modification and the human phenotype

Ring chromosome, Iso chromosomes, Philadelphia chromosome, cri-du-chat syndrome (5p<sup>-</sup> syndrome) Prader willi syndrome, Fragile X- Syndrome (Martin Bell syndrome), Burkitt's lymphoma (14q<sup>+</sup> syndrome)

(4hr)

## 9. Reproduction and Development

(a) 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.

(b) Genetics of embryonic development

Maternal effect genes, segmentation and pattern formation genes, adhesion molecules and genes: programmed cell death (apoptosis).

(5hr)

10. **Genomic imprinting**, inbreeding in isolates, consanguineous marriages, twin studies, biology of twinning, analysis of twin data.

(4hr)

## 11. Prenatal diagnosis and genetic services

Amniocentesis, chorionic villi biopsy, foetoscopy, ultrasound sonography, Alpha foeto protein screening, Prenatal sexing, test tube babies, Karyotyping.

(4hr)

## 12. Genetic counselling:

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.

(5 hrs)

13. **Pharmacogenetics**, Ecogenetics and the Phenocopy.

(3hr)

## Topics for Seminars / Assignment / Discussion

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Human genome project: Pros and cons in new era.
2. Role of genetics in modern reproductive techniques.
3. Gene therapy
4. Inborn errors of metabolism
5. Y-linked genes
6. XYY syndrome & XXX Females.
7. Triplet repeat disorders ( syndromes)
8. The effect of chromosome aneuploidy on the human phenotype

## Books for Reference

1. Basic Human Genetics: Elaine Johansen Mange & Arthur P. Mange, Rastogi Publications, Shivaji Road, Meerut.
2. Fundamentals of Genetics, John Ringo; - Cambridge University press
3. Genetics in Medicine: Thomson & Thomson, W.B. Saunders
4. Human Genetics: Gangane S.D., Bichurlev, New Delhi.
5. Human Genetics: Mc: Kursick, V.A.
6. Principles of Human Genetics: Curtstein Euresia Publishing House.
7. The New Human Genetics-Jerald.J. Stine (University North Florida) Wm. C. Brown Publishers, Dubuque. Iowa.

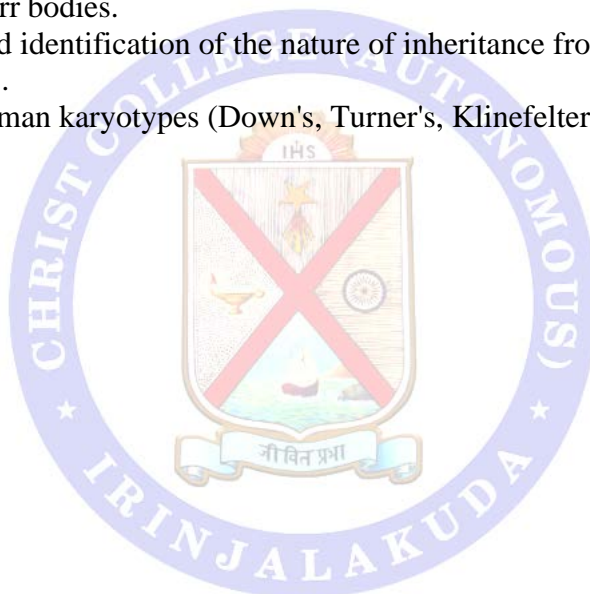
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**CORE COURSE XVII: ELECTIVE COURSE PRACTICALS**  
**III\*D**

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**Human Genetics**

1. Problems on (a) autosomal dominant and recessive (b) polygenic traits (skin colour), (c) Sex linkage (X-linked genes and Y-linked genes).
2. Study of identical and fraternal twins.
3. Dermatoglyphics: Identification of arch, loop and whorl patterns; total ridge count in male and female; Tri- radii, importance of  $\theta$  and angle, simian line.
4. Ishihara chart (to detect red-green colour blindness) .
5. Seminars on genetics in cardiology, oncology and genetic counselling, Pre-natal sexing, amniocentesis, importance of genetic screening.
6. Examination of Barr bodies.
7. Pedigree studies and identification of the nature of inheritance from pedigree chart (any one trait).
8. Identification of human karyotypes (Down's, Turner's, Klinefelter's) from idiogram.



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**SIXTH SEMESTER B.Sc. DEGREE PROGRAMME (Theory)**  
**ZOOLOGY ELECTIVE COURSE**

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**Code: ZO6B 15(E)02T**  
**AQUACULTURE, ANIMAL HUSBANDRY & POULTRY SCIENCE**  
**(54 hours) (2 hours per week) (3 credits)**

**A. AQUACULTURE**

1. Introduction, its scope in India and Kerala, Export potential, Different types of cultures. (2 hrs)
2. Mariculture (3 hrs)
  - (a) Prawn culture: Important culture varieties, Pokkali culture, breeding spawning, control breeding, induced maturation, eye stalk ablation, culture methods, freezing, curing and canning.
  - (b) Mussel culture: *Perna indica*, *Perna viridis*, Seed collection, artificial seed production, induced spawning, rearing, raft culture, harvesting.
3. Pisci culture
  - (a) 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 hrs)
  - (b) Biology and culture of Indian major carps – *Catla catla*, *Labeo rohita*, *Cirrhina mrigala*. (2 hrs)
  - (c) Biology and culture of Exotic carps. Eg: *Hypophthalmichthys molitris* – (Silver carp). (1 hr)
  - (d) Inland fishes and Fisheries – eg: *Channa*, *Clarius* - Rivers, Paddy fields, Utilisation of sewage in fish culture.
  - (e) Genral account and fishery aspect of sardine, shark, tuna. (3 hrs)
  - (f) Ornamental fisheries – common aquarium fishes, aquarium management and identification of sex. eg: *Carassius auratus* (Gold fish), *Peterophyllum* sps., *Astronotus ocellatus* (Guppy) – *Lebister reticulatus*. (2 hrs)
4. Plankton and Fishery production – Zoo and Phytoplankton – Vertical migration – Plankton and Productivity. (2 hrs)
5. Fishing Gears: Gill net / drift gill net, purse-seines, harpoon, Chinese dipnets, echo sounders, sonar, remote sensing. (3 hrs)
6. Fish Spoilage and Preservation – Biochemical changes, spoilage, use of ice, freezing, canning, dehydration, salting, smoking. (4 hrs)
7. Fish utilisation (4 hrs)

Nutritive value, bye products, liver oil, body oil, fish meal, fish flour, Isin glass, glue, skin, fin soup, lime, chitin, chitosan.
8. Disease and parasites of Fish – Fungal infection – by – Saproleginia – Bacterial – Fin & tail rot disease, Dropsy. (2 hrs)
9. Mud banks of Kerala coast (1 hr)

## B. POULTRY SCIENCE:

### Introduction and Scope

(a) Egg production, cable bird production, nutritive value, bye products. (6 hrs)

(b) Different breeds – Exotic – 3 examples.

Indigenes – 2 examples.

(c) 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, and feed formulation.

Common diseases of poultry (Ranikket, Pullorum, Fowl pox).

## C. ANIMAL HUSBANDARY

(6 hrs)

Introducin: history, origin, domestication.

Breeds of cattle:

Milk type : Sindhi, Gir

Draft breed: Nagori & Kangayam

Duel purpose: Ongole, Hariana

Exotic breed : Jersey, Holstein – Friesian

Native breeds: Conservation programmes, Vechur cow.

Feeding: Common cattle feeds, fodder

Common diseases : Anthrax, Foot & Mouth disease. Parasites.

Meat hygiene: Slaughter and clean meat production – Zoonotic diseases.

## 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.

### Topics for Seminar / Assignment / Discussion

1. Role of physical and chemical factors in aquaculture.
2. Fish weed organism: Sea weed culture. eg: Grassilaria, Sargassum.
3. Dairy products, manufacture and nutritive value.

### References:

1. Banerji, G.C. : A text book of Animal husbandry, 1998. Oxford & IBH.
2. Banerji, G.C. Poultry, Oxford & IBH.
3. P.R. Venkitaraman: Economic Zoology.
4. V. Sudheeran: Economic Zoology.
5. Kurian C.V., Sebastian C.V. : Prawn and Prawn fisheries in India, Hindustan Publication Corporation of India.
6. Alikunhi, K.R. : Fish culture in India, KAV, ICAR.

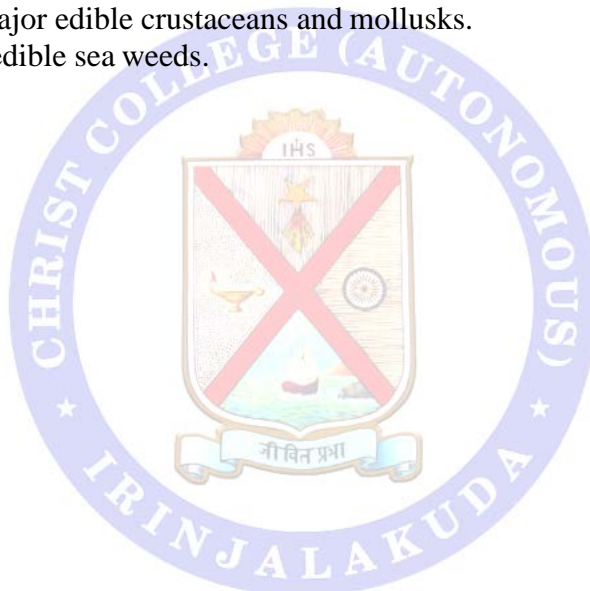
## ELECTIVE COURSE PRACTICALS- XVII

### ELECTIVE COURSE PRACTICAL- III\*D

**36 Hours 2 Hours per week**

#### **Aquaculture, Animal husbandary and Poultry Science**

1. Culture of fish food organisms: protozoans, rotifers and crustaceans.
2. Maintenance of spawn and its transportation to hatching or rearing tanks.
3. Identification of major food fishes (fresh water, estuarine and marine).
4. Study of different crafts and gears.
5. Study of aquarium and aquarium fishes / ornamental fishes.
6. Breeding techniques: preparation of hormone extracts and injection of hormones to fishes; eyestalk ablation in prawns.
7. Study of fish products and byproducts.
8. Identification of larval forms of prawn, pearl oyster, mussel, lobster and crab.
9. Identification of major edible crustaceans and mollusks.
10. Identification of edible sea weeds.



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**SIXTH SEMESTER B.Sc. DEGREE PROGRAMME(Theory)**  
**ZOOLOGY ELECTIVE COURSE- I**

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**Code: ZO6B 15(E) 03T**  
**APPLIED ENTOMOLOGY**  
**(54 hours) (3 hours per week) (3 credits)**

**A. Agricultural Entomology**

**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, Serve as food for animals and even man, Destroyers of weeds, Improve soil fertility, Act as scavengers, Aid in scientific research, Aesthetic and entertainment value, Use in medicine, Pollution indicators, Arrow poisons, Cold light, Insects in forensic science, Utility of 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,

**(a) Pests of Paddy:** (Life history, damage and control measures)

1. *Spodoptera mauritia* (Rice swarming caterpillar)
2. *Leptocorisa acuta* (Rice bug)
3. *Diadipsa armigera* (Rice hispa)

**(b) Pests of coconut:** (Life history, damage and control measures)

1. *Oryctes rhinoceros* (Rhinoceros beetle)
2. *Opisina arenosella* (Black headed caterpillar)
3. *Aceria guerreronis* (Coconut mite)

**(c) Pests of sugar cane** (damage and control measures)

1. *Chilo infuscatellus* (Sugarcane shoot borer)
2. *Scirpophaga nivella* (Sugarcane top shoot borer)
3. *Sacchariococcus sacchari* (Cane mealy bug)

**(d) Pests of plantation crops:** Coffee, rubber, tea, pepper and cardamom.  
(Two examples for each, Damage, control measures)

Coffee: 1. *Xylotrechus quadripes* (Coffee white stem borer)

2. *Coccus viridis* (Coffee green bug)

Tea : 1. *Helopeltis antonii* (Tea mosquito bug)

2. *Toxoptera aurantii* (Tea aphid)

Rubber: 1. *Aspidiotus destructor* (Scale insect)

2. *Comocrits pieria* (Bark caterpillar)

Pepper: 1. *Longitarsus nigripennis* (Pollu beetle)

2. *Laspeyresia hemidoxa* (Shoot borer) Cardamom: 1. *Sciothrips cardamomi* (Cardamom thrips)

2. *Eupterote canarica*(Cardamom hairy caterpillar)

(c) **Pests of fruits and vegetables** (Banana, mango, cashew, lady's finger, chilly, pulses, etc.) Two examples for each, Damage and control measures.

**Pests of fruit plants:**

- Banana : 1. *Cosmopolites sordidus* (Banana weevil)  
2. *Pentalonia nigronervosa* (Banana aphid)  
Mango : 1. *Batocera rufomaculata* (Mango stem borer)  
2. *Dacus dorsalis* (Fruit fly)  
Cashew : 1. *Placoederus ferrugineus* (Cashew stem borer).  
2. *Helopeltis antonii* (Cashew mirid).

**Pests of vegetables:**

- Lady's finger: 1. *Platyedra gossypiella* (Pink ball worm)  
2. *Earias vitella* (Spotted ball worm)  
Brinjal : 1. *Leucinodes orbonalis* (Shoot and fruit borer)  
2. *Epilachna vigintioctopunctata* (Epilachna beetle)  
Cucurbits : 1. *Dacus cucurbitae* (Melon fly)  
2 *Raphidopalpa foveicollis* (Pumpkin beetle)

(d) **Pests of stored products.** ( damage and control measures).

1. *Tribolium castaneum* (Rust red flour beetle)  
2. *Callasobruchus chinensis* (Pulse beetle)

(e) **Pests of domestic animals:** 3 examples.

1. Domestic fowl: *Menopon gallinae* (Shaft louse)  
2. Goat : *Oestrus ovis*  
3. Cattle : *Tabanus striatus* (Horse fly)

**4. Insect Pest Control:**

(a) **Natural control** (b) **Applied control** or **Artificial control:**

Prophylactic and Curative methods [cultural, mechanical, legal methods (brief account), biological and chemical methods].

**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).

(12 hrs)

## B. Industrial Entomology

(12 hrs)

### Productive Insects

(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.

### Seminars / Assignment / Discussion

1. Biology of major insect vectors of human diseases, *Anopheles*, *Culex*, *Aedes*, *Xenopsylla*, *Pediculus*, *Cimex*, *Phthirus*.
2. Diseases and its control measures of Filariasis, Yellow fever, Dengue, Typhus fever, Plague and Kala-azar.
3. Collection and Preservation of Insects.
4. Insects as human food for the future.
5. Causes of success of insects.

### References

1. Atwal, A.S and Dhaliwa, G.S.(2008) *Agricultural Pests of south Asia and their Management*, 6 e, Kalyani Publishers
2. Bhaskaran, K.K and Francy, C. F (2010) *Elements of Applied Entomology*, Manjusha Publications.
3. Dhaliwal, G.S. *et al* (2008) *Essentials of Agricultural Entomology*, Kalyani Publishers
4. Hill D.S. *Agricultural Entomology*
5. Metcalf, C.L. & Flint, W.P. (1973) *Destructive and Useful Insects*, USTMH,
- 6 Nalina Sundari, M.S and Santhi,R. *Entomology*, MJP Publishers
7. Nayar, K.K. *et al*. *General and Applied Entomology*, TMH
8. Nair, M.R.G.K. *A Monograph on Crop pests of Kerala and their control*. 3e. 1989 KAU Publ., Vellanikkara.
9. Nair. M.R.G.K. *Insect & Mite Crops in India*
10. Pedigo .*Entomology & Pest Management*
11. Ramakrishna Ayyar, T.V. Maras, 1963.*Handbook of Economic Entomology for South India*,
- 12 Srivastava,K. P. *A Text book of Applied Entomology* , Vol. I & Vol. II, Kalyani Publishers, Ludhiana, New Delhi, Noida (U.P.).

**ZOOLOGY ELECTIVE COURSE: XVII (PRACTICAL  
III\* – D) APPLIED ENTOMOLOGY  
(36 hours) (2hours per week)**

1. Identification and brief notes on the following pests:  
Any 2 pests each of paddy, coconut, banana, mango, cashew, coffee, tea, rubber, pepper, cardamom, and pests of vegetables.  
Pests of stored products (any 3)
2. Study of damage caused by pests: (damaged parts of plants, fruits and seeds, wood, pepper, etc. may be used).
3. Identification and study of insect pests / ectoparasites of man, domestic animals and wild animals: mosquitoes [different stages of life history], head louse, pubic louse, bird louse, rat flea, *Tabanus*, *Hippobosca*, a tick and a mite on dog / cat.
4. Identification and economic importance of the following:
  - (a) Honey bees and bee products
  - (b) Silkworm moth: life cycle stages, silk fibre
  - (c) Lac insect and stick lac or shellac.
5. Preparation of: a) tobacco decoction, b) kerosene soap emulsion, c) neem kernel suspension.
6. Pesticide appliances: Dusters or sprayers a) Hand compression sprayer, b) Rocker sprayer, c) Knapsack sprayer / duster (d) Hand automizer (any 3).

