VIMALA COLLEGE (AUTONOMOUS)

(NAAC Re-accredited(3rd Cycle): A Grade, CGPA-3.50**)**

Affiliated to University of Calicut

B.Sc. DEGREE PROGRAMME

IN

ZOOLOGY

Choice Based Credit and Semester System
(CBCSS)

SYLLABUS AND SCHEME FOR CORE, ELECTIVE AND OPEN COURSES

(2017 ADMISSION ONWARDS)

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

Board of studies – Zoology

Vimala College, Thrissur

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SYLLABUS FOR B.Sc ZOOLOGY PROGRAMME (CORE COURSES)

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

B.Sc ZOOLOGY COURSE STRUCTURE

Credit Distribution

Semester	Common Course		Core Course	Complementary Course		Open Course	Total
	English	Additional language		Chemistry	Botany		
I	4+3	4	2	2	2	-	17
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
Total	**22**	**16**	**56**	**12**	**12**	**2**	**120**

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

Mark Distribution and Indirect Grading System

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

Mark Distribution

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

Seven point Indirect Grading System

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

CREDIT AND MARK DISTRIBUTION IN EACH SEMESTERS

Total credits: 120; Total Marks: 3600

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

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

B.Sc ZOOLOGY CORE COURSE STRUCTURE

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

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

	VZO5B08	Core Course VIII: General Methodology in Science, Bio Statistics & Informatics	3	54	3	100
	-	Core Course Practical II (related to core course V & VI-Practical-II*A)	3	54	*	-
	-	Core Course Practical II (related to core course VII-Practical-II*B)	3	54	*	-
	-	Core Course Practical II (related to core course VIII-Practical-II*C)	2	36	*	-
	-	Project Work	2	36	**	-
	-	Field Study	1	18	***	-
VI	**VZO6B09**	Core Course IX: Bio Chemistry	2	36	2	100
	VZO6B10	Core Course X: Physiology & Endocrinology	3	54	3	100
	VZO6B11	Core Course XI: Molecular Biology & Bioinformatics	3	54	3	100
	VZO6B12	Core Course XII: Reproductive Biology, Developmental Biology & Teratology	3	54	3	100
	VZO6B13	Core Course XIII : Biotechnology, Microbiology & Immunology	3	54	3	100
	VZO6E01 Elective	Core Course XIV: Aquaculture, Animal husbandry & Poultry	3	54	3	100
	-	Core Course Practical III (related to core course IX & X-Practical-III*A)	2	36	*	-
	-	Core Course Practical III (related to core course XII -Practical-III*B)	2	36	*	-
	-	Core Course Practical III (related to core course XIII -Practical-III*C)	2	36	*	-

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

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

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

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

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

CORE COURSE THEORY: EVALUATION SCHEME

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

1. INTERNAL EVALUATION

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

Table 1: Components of Evaluation

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

Table 2: Percentage of attendance and Eligible Marks

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

Table 3: Pattern of test papers

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

2. EXTERNAL EVALUATION

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

Table 1: Pattern of test papers

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

CORE COURSE PRACTICAL: EVALUATION SCHEME

The evaluation scheme includes internal evaluation (20% marks) and external evaluation (80%marks). Evaluation will be done by a team of two examiners; one external and one internal.

1. INTERNAL EVALUATION

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

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

Table 2:- Percentage of Attendance and Eligible Marks

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

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

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

Table 4:- Percentage of Eligible Marks for Test Papers

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

Table 5:- Percentage of Eligible Marks for Record

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

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

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

Table 7:- Percentage of Attendance and Eligible Marks

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

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

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

Table 9:- Percentage of Eligible Marks for Test Papers

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

35-54%	1

Table 10:- Percentage of Eligible Marks for Record

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

2. EXTERNAL EVALUATION

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

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

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

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

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

CORE COURSE PROJECT: EVALUATION SCHEME

Project evaluation will be conducted at the end of sixth semester

Table 1: Internal evaluation

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

Table 2: External Evaluation

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

OPEN COURSE STRUCTURE

(For students other than B.Sc Zoology)

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

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

OPEN COURSE: EVALUATION SCHEME

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

1. INTERNAL EVALUATION

20% of the total marks are for internal evaluation.

Table1: Components of Evaluation

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

Table 2: Percentage of Attendance and Eligible Marks`

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

Table 3: Pattern of Test Papers

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

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

2. EXTERNAL EVALUATION

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

Table 1: Pattern of Question Paper

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

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

Section A (11 hrs) – Max. Marks: 29

Principles of classification and nomenclature (5 hrs)
Systematics: Natural and classical. Nomenclature: Binomial and Trinomial nomenclature; International rules of Zoological nomenclature (brief account), Mention new trends in systematics like Chemotaxonomy, Serotaxonomy, Cytotaxonomy, Numerical taxonomy (Phenetics), Cladistics (Phylogenetic systematics), Molecular systematics.

Five kingdom classification of living organisms (1 hr)
Mention Cavaller-Smith's eight kingdom classification.

Concepts of classification of animals (brief account) (5 hrs)
Classification based on number of cells, tissue or organ system level of organization, development of germ layers, development of symmetry, development of coelom, segmentation in the somite, homology and analogy of organs and their origin, development of mouth and digestive tract.

Section B (5 hrs) – Max. Marks: 21

KINGDOM PROTISTA
Characteristic features and classification of Kingdom Protista down to phyla
(Salient features of the following phyla with note on the examples cited)
Phylum Rhizopoda. Example: *Amoeba*
Phylum. Dinoflagellata. Example: *Noctiluca*
Phylum. Parabasalia. Example: *Trichonympha*
Phylum Apicomplexa [=Sporozoa]. Example: *Plasmodium*
Phylum Ciliophora. Example: *Vorticella, Ephelota*
Parasitic Protozoans of man
Nutrition in Protozoans
Reproduction in Protozoans

Section C (12 hours) – Max. Marks: 41

KINGDOM ANIMALIA
Salient features of the major phyla of animals and their diversity
[Habits, habitat, morphology, functional anatomy and life history of representative types (wherever specified) and classification of each phylum down to classes, except otherwise mentioned, and examples thereof: Study of animal diversity with typical examples from each

class, with emphasis on ecological and adaptive features, economic importance and such other points of biological interest expected. Only very brief account of each example is to be studied.]

MESOZOA (1hr)
A brief account of dicyemid and orthonectid mesozoans Examples: *Dicyema, Rhopalura*

METAZOA
Phylum PORIFERA (**3 hrs**)
Classification down to classes; salient features of the classes
Class Calcispongiae. Example: *Leucosolenia*
Class Demospongiae. Example: *Spongilla*
Class Hyalospongiae. Example: *Euplectella*
Canal system in sponges
Larval forms and gemmule of sponges

Phylum CNIDARIA [COELENTERATA] (**7 hrs**)
Type: *Obelia* (Morphology and life cycle only)
Classification down to classes; salient features of the classes
Class Anthozoa. Example: *Adamsia, Madrepora*
Class Hydrozoa. Example: *Halistemma, Physalia*
Class Scyphozoa. Example: *Rhizostoma*
Polymorphism in Cnidarians
Corals and coral reefs

Phylum CTENOPHORA [ACNIDARIA] (1 hr)
Unique features as exemplified by *Pleurobrachia*
Mention cydippid larva

Section D (**8 hours**) **– Max. Marks: 31**

ACOELOMATA
Phylum PLATYHELMINTHES (3 hrs)
Classification down to classes, give salient features of the following classes
Mention the life cycle and host of examples
Class Turbellaria. Example: *Dugesia*
Class Cestoda. Example: *Taenia*
Class Trematoda. Example: *Schistosoma*

PSEUDOCOELOMATA
Super phylum ASCHELMINTHES (3 hrs)
Highlight the heterogeneous nature of animals of this group, classification down to phyla
Phylum NEMATODA
Characteristic features of *Ascaris*
Examples: *Ancylostoma, Enterobius, Wuchereria*
Mention the life cycle, host and pathogenicity of examples

MINOR PHYLA (2hrs)
Salient features of the following
Phylum **GASTROTRICHA** Example: *Chaetonotus*

Phylum **ROTIFERA** Example: *Brachionus*

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

Section A (**31 hours**) **– Max. Marks: 93**

COELOMATA
Phylum ANNELIDA (**7 hrs**)
Type: *Neanthes* or *Nereis*
Classification down to classes, salient features of the following classes
Class Polychaeta. Example: *Arenicola*
Class Oligochaeta. Example: *Megascolex*
Class Hirudinea. Example: *Hirudinaria*

Phylum ARTHROPODA (**11 hrs**)
Type: *Penaeus* (larval stages included)
Classification down to classes, salient features of the following classes
Class Trilobita (brief account only)
Class Merostomata. Example: *Limulus*
Class Arachnida. Example: *Palamnaeus,* spider, mention ticks and mites
Class Myriapoda. Examples: *Scolopendra, Spirostreptus*
Class Crustacea. Example: *Sacculina, Eupagurus*
Class Insecta. Examples: *Lepisma, Mantis, Tabanus, Troides minos*
Useful and harmful insects
Economic importance of crustaceans
Social organisation and caste system in honey bee

Phylum MOLLUSCA (**7 hrs**)
Classification down to classes; salient features of the following classes
Class Aplacophora. Example: *Neomenia*
Class Monoplacophora. Example: *Neioplina*
Class Polyplacophora. Example: *Chiton*
Class Bivalvia. Example: *Perna*
Class Scaphopoda. Example: *Dentalium*
Class Gastropoda. Example: *Pila*
Class Cephalopoda . Example: *Sepia*
Economic importance of Molluscs

Phylum ECHINODERMATA (4 hrs)
Classification down to classes (extant forms only)
Salient features of the following classes
Class Crinoidea. Example: *Antedon*

Class Asteroidea. Example: *Asterias*
Class Ophiuroidea. Example: *Ophiothrix*
Class Holothuroidea. Example: *Holothuria*
Class Echinoidea. Example: *Echinus*

Phylum HEMICHORDATA (2 hr)
Salient features.
Example: *Balanoglossus* (Habit, habitat, morphology and affinities)

Section B (**3 hours**) **– Max. Marks: 17**

COELOMATE MINOR PHYLA (**3 hrs**)
Salient features of the following minor phyla, mention examples specified
(Structure and life history not required)
Phylum PHORONIDA Example: *Phoronis*
Phylum ECTOPROCTA [=**Bryozoa]** Example: *Bugula*
Phylum ECHIURA Example: *Bonellia*

Section C (**2 hours**) **– Max. Marks: 12**

Phylum ONYCHOPHORA (2 hrs)
Peripatus (Distribution, peculiarities and affinities)

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

Section A (13 hours) – Max. Marks: 27

Introduction (6 hrs)
Chordate characters (fundamental, general and advanced)
Diversity of chordates, classification down to subphyla, salient features of each subphylum

Subphylum 1. UROCHORDATA (Tunicata) (**3 hrs**)
Affinities, add a note on neoteny
Classification down to classes.
Class: Ascidiacea Type: *Ascidia* (morphology and retrogressive metamorphosis)
Class Larvacea. Example: *Oikopleura*
Class Thaliacea. Example: *Doliolum*

Subphylum 2. CEPHALOCHORDATA (4 hrs)
Example**:** *Branchiostoma* (*Amphioxus*) morphology, primitive, degenerate and specialized features (affinities and systematic position to be emphasized)

Section B (19 hours) – Max. Marks: 39

Subphylum 3. VERTEBRATA (3 hrs)
Division 1. AGNATHA
Characters. Examples: *Myxine, Petromyzon* (mention Ammocoete larva)

Division 2. GNATHOSTOMATA (16 hrs)
Super class PISCES
Type: Mullet
Classification of Pisces down to orders; salient features of the following groups
Class Chondrichthyes (cartilagenous fishes)
Order Selachii. Examples: *Scoliodon, Trygon*
Order Holocephali. Example: *Chimaera*
Class Osteichthyes (bony fishes)
Order Crossopterygii (coelacanths). Example: *Latimeria*
Order Dipnoi (lung fishes). Examples: *Neoceratodus, Protopterus, Lepidosiren*
(Add a note on distribution of lung fishes)
Order Acanthopterygii (spiny-rayed fishes). Example: *Rastrelliger*
Parental care in fishes
Migration in fishes
Accessory respiratory organs in fishes

Section C (15 hours) – Max. Marks: 37

Super class TETRAPODA
Class Amphibia (15 hrs)
Type: Frog
Classification of Amphibia down to orders with examples (extant forms only)
Order Apoda. Example: *Ichthyophis*
Order Caudata. Examples: *Necturus, Ambystoma,* mention Axolotl larva
Order Anura. Examples: *Bufo, Rhacophorus*
Mention discovery of *Nasikabatrachus sahyadrensis*
Parental care in Amphibians

Section D (7 hours) – Max. Marks: 19

Class Reptilia (7 hrs)
Classification of Reptilia down to subclasses and salient features of the following subclasses. Mention the given orders with examples
Subclass Anapsida
Order Cotylosauria (stem reptiles) example: *Hylonomus*
Order Chelonia (common turtles, tortoises etc.) example: *Chelone*
Subclass Diapsida
Super order Lepidosauria
Order Rhynchocephalia example: *Sphenodon*
Order Squamata example: *Chamaeleon,*
Common poisonous and non-poisonous snakes of Kerala - *Ptyas, Typhlops, Naja, Daboia, Bungarus*
Super order Archosauria
Order Crocodilia examples: *Crocodylus, Gavialis, Alligator*
Subclass Euryapsida (Parapsida)
Subclass Synapsida
Identification key for snakes
Poison apparatus and snake venom
Mesozoic reptiles

FOURTH SEMESTER B.Sc DEGREE PROGRAMME (Theory)
ZOOLOGY CORE COURSE-IV
ANIMAL DIVERSITY CHORDATA PART-II
Code: VZO4B04
(TAXONOMY, DIVERSITY, STRUCTURAL ANATOMY AND ADAPTATIONS OF CHORDATES – AVES AND MAMMALS)
[54 hours] [3 hours per week] [3 credits]

Section A (16 hours) – Max. Marks: 37

Class AVES (16 hrs)
Classification of Aves down to the orders specified with examples
Subclass Archaeornithes
Order Archaeopterygiformes. Example: *Archaeopteryx* – brief account
Subclass Neornithes
Super order Palaeognathae (Ratitae)
Order Casuariiformes. Example: *Casuarius* (cassowary)
Order Dinornithiformes (Apterygiformes). Example: *Apteryx* (kiwi)
Order Rheiformes. Example: *Rhea*
Order Struthiorniformes. Example: *Struthio* (ostrich)
Super order Neognathae (Carinatae)
Order Galliformes (pheasants, quail, turkeys, grouse). Example: *Pavo cristatus*
Order Anseriformes (screamers, water fowls). Example: *Anas*
Order Passeriformes (perching birds). Example: *Passer domesticus*
Order Piciformes (wood peckers, barbets, honey guides). Example: *Dinopium*
Order Coraciiformes (kingfishers). Example: *Alcedo*
Order Apodiformes (swifts, humming birds). Example: *Micropodus*
Order Strugiformes (owls). Example: *Bubo*
Order Cuculiformes (cuckoos, roadrunners, turacos). Example: *Eudynamys*
Order Psittaciformes (parrots, lories, cockatoos). Example: *Psittacula krameri*
Order Gruiformes (cranes, rails, coots, bustards). Example: *Choriotis*
Order Charadriiformes (plovers, gulls, terns, auks, sand pipers). Example: *Tringa*
Order Columbiformes (pigeons, doves, dodos, sand grouse). Example: *Columba*
Order Falconiformes (diurnal birds of prey- falcons, hawks). Example: *Mylvus*
Order Ciconiiformes (herons, storks, ibis, spoon bills). Example: *Ardea*
Order Pelecaniformes (pelicans, cormorants). Example: *Pelecanus*
Order Sphenisciformes (Impennae). Example: *Aptenodytes* (penguin)
Order Phoenicopteriformes (flamingos). Example: *Phoenicopterus*

Extinct birds
Passenger pigeon (*Ectopistes migratorius*), Dodo (*Raphus cucullatus*), Pink-headed duck (*Rhodonessa caryophyllacea*), Elephant bird (*Aepyornis*)
Rediscovery of Jerdon's courser (*Cursorius bitorquatus*)
Migration in birds (mention local movements of birds, trans himalayan, trans continental migrations)

Flight adaptations in birds
Flightless birds
Nesting behaviour and parental care in birds

Section B (38 hours) – Max. Marks: 85

Class MAMMALIA
Type*: Oryctolagus* **(16 hrs)**

Classification of Mammalia down to the orders cited with examples **(22 hrs)**
Subclass Prototheria
Infraclass Ornithodelphia (egg-laying mammals)
Order Monotremata. Examples: *Ornithorhynchus* (platypus*), Tachyglossus (Echidna*)
Subclass Theria
Infraclass Metatheria (marsupials)
Order Marsupialia. Examples: *Didelphis* (opossum), *Macropus* (kangaroo)
Infraclass Eutheria (true placental mammals)
Order Edentata. Examples: *Dasypus* (armadillo) *Myrmecophaga* (spiny ant eater)
Order Pholidota. Example: *Manis* (pangolin / scaly ant eater)
Order Lagomorpha (rabbits and hares)
Order Rodentia. Examples: *Funambulus, Ratufa*
Order Insectivora. Examples: *Paraechinus* (hedgehog), *Suncus* (*Crocidura*)
Order Dermoptera. Examples: *Cynocephalus* (*Galeopterus* - flying lemur)
Order Chiroptera. Examples: *Pteropus, Pipistrellus*
Order Primates. Examples: *Loris, Macaca, Gorilla, Pongo, Hylobates*
Order Carnivora. Examples: *Phoca* (seal), *Odobenus* (walrus), *Panthera* sps
Order Cetacea. Examples: *Physeter* (sperm whale), *Delphinus*, *Balaenoptera* (baleen whale)
Order Artiodactyla. Examples: *Sus scrofa cristatus*, *Hemitragus* (tahr), *Axis axis* (spotted deer), *Antelope cervicapra* (black buck)
Order Perissodactyla. Examples: *Equus caballus* (horse), *Rhinoceros*
Order Sirenia. Examples: *Trichechus* (manatee), *Dugong*
Order Proboscidea. Examples: *Elephas maximus indicus*(Indian elephant), *Loxodont africana* (African savanna elephant), *Loxodonta cyclotis* (African forest elephant)
Aquatic mammals and their adaptations
Dentition in mammals (adaptations related to food)
Social groups in mammals

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

Section A: ENVIRONMENTAL BIOLOGY (32 hrs) Max. Marks: 72

1. Ecological tools and Techniques (4 hrs)

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

2. Ecosystem and Energetics (5 hrs)

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

3. Biogeochemical cycles (3 hrs)

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

4. Limiting factors (2 hrs)

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

5. Population Ecology (4 hrs)

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

6. Community Ecology (5 hrs)

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

7. Population interactions (2 hrs)

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

8. Aquatic Ecology (3 hrs)

(a) Marine ecology- major divisions of marine habitat, pelagic realm, benthic realm

(b) Freshwater ecology- lentic and lotic environments

9. Man and Environment (4 hrs)

(a) Sustainable development (in brief)

(b) Destruction of habitat and its consequences - wetland, paddy fields, mangrove, river encroachment, sand and clay mining, ecological impacts of tourism

(c) Individual responsibilities – Role of Governmental and Non Governmental Organizations in biodiversity conservation

Section B: WILDLIFE CONSERVATION (18 hrs) Max. Marks: 41

1. Biodiversity (12 hrs)

(a) Introduction, alpha, beta and gamma diversities, mention Shannon diversity index and Simpson's dominance index

(b) Hot spots of biodiversity, mention hot spots in Indian region (Western Ghats and Sri Lanka, Eastern Himalayas and Indo Burma)

(c) Threats to biodiversity (Habitat modification, pollution, poaching, etc.)

(d) Role of systematics in biodiversity, extinction of species

(e) Natural resources and conservation-strategies, Natural Reserves, classification of natural resources

(f) Wildlife conservation, Wildlife protection Act 1972, Conservation projects-
Project Tiger, Elephant, Lion, Crocodile, Dolphins, Swamp deer, Black buck and Turtle

(g) Endangered fauna and flora.

(h) Sanctuaries-Thattekkad bird sanctuary & Parambikulam wildlife sanctuary
National parks – Eravikulam NP & Silent Valley NP
Biosphere Reserves-Nilgiri BR & Agasthyamalai BR

(i) Mention IUCN categories and Red data book

(j) Conservation of biodiversity - *in situ* and *ex situ* conservations
Mention conservation of germplasm

2. Global Strategy for Conservation (6 hrs)

(a) Stockholm Conference / Declaration (1972)

(b) Nairobi Conference / Declaration

(c) Rio Declaration (Earth Summit (1992)

(d) CITES

(e) Biodiversity Convention of UNCED

(f) Kyoto Agreement (1997)

(g) Johannesburg Conference (2002)

(h) World Summit on Sustainable Development

(i) UNEP and its major strategies

(j) Biodiversity Act (2002)

(k)Wildlife Act (1972) and its Amendments

(l) Ramsar Conventions

(m)Paris Conference (2015)

Section C: TOXICOLOGY (4 hrs) Max. Marks: 9

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

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

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

Section A: ETHOLOGY (14 hrs) Max. Marks: 32

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

2. Patterns of behavior (5 hrs)

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

3. Biological clocks / rhythms (4 hrs)

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

4. Sociobiology (3 hrs)

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

Section B: EVOLUTION (32 hrs) Max. Marks: 72

1. Introduction (2 hrs)

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

2. Course of Evolution (6 hrs)

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

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

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

(d) Living fossils**:** mention common features and examples

3. Evidences of Organic Evolution (5 hrs)

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

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

Convergent Evolution: mention examples

Pre-adaptation: mention examples

b) Physiological and biochemical evidences: examples

c) Embryological evidences: examples, Biogenetic Law

d) Palaeontological evidences: Kinds of fossilization, formation of sedimentary rocks, determination of age of rocks and fossils, conclusion drawn from fossil records (brief account)
e) Taxonomical evidences: evolution based principles of classification, mention phylogenetic tree

4. Theories of Evolution (5 hrs)
a) Lamarckism: Explanation of the major postulates of the Lamark's theory with examples, Criticism against Lamarckism, Neo-Lamarckism, Present status of Lamarckism
b) Darwinism: Explanation of important postulates of Darwin's theory, Examples for natural selection, Criticism against Darwinism, Neo-Darwinism (Synthetic theory of evolution)

5. Modern Concepts of Evolutionary Process (3 hrs)
Genetic basis of evolution: Mutations (gene and chromosomal mutations brief account), Variations: somatic or environmental variations and genetic or hereditary variations, Hardy-Weinberg Principle: Hardy-Weinberg Equilibrium, Factors that upset Hardy-Weinberg Equilibrium, Genetic drift: effects on population, Bottleneck effect and Founder effect, genetic drift and natural selection, importance of genetic drift in evolution**,** Micro and Macro evolution, Theory of Punctuated equilibrium and its relevance

6. Nature of Evolution (3 hrs)
Species and Speciation: Species concept, morphological and biological species concepts, General characteristics and subdivisions of species (sub species, semispecies, sibling species, cline and deme), Speciation: Types of speciation, Phyletic speciation (autogenous and allogenous transformations), True speciation, Instantaneous and gradual speciation, allopatric and sympatric speciation

7. Isolation and Isolating Mechanisms: **(3hrs)**
Types of isolating mechanisms - Geographic isolation (mention examples), Reproductive isolation - Prezygotic isolation (habitat, seasonal, ethological, morphological, physiological and cytological isolation with examples, Postzygotic isolation - hybrid inviability, hybrid sterility and F2 breakdown isolation with examples

8. Evolution of horse (2 hrs)
Time and place of origin, major evolutionary trends, phylogeny of probable sequence species of horse of Eocene, Oligocene, Miocene, Pliocene, and Pleistocene forms, Orthogenesis

9. Evolution of Modern Man (3 hrs)
Evolutionary trends in humans, Ancestors of Primates, Apes-the closest relatives of man, Fossil ancestors of man: *Dryopithecus, Australopithecus* (The Man-Ape of Africa), *Homo habilis* (The Handy Man), *H. erectus*, *H. neanderthalensis* (Neanderthal man), The Cro-magnon, *Homo sapiens* (Modern man); Socio-cultural evolution (brief account).

Section C: ZOOGEOGRAPHY (8 hrs) Max. Marks: 18

1. Animal Distribution (3 hrs)
(a) Geographic distribution of animals - cosmopolitan distribution, discontinuous distribution, bipolar distribution and isolated distribution
(b) Factors affecting animal distribution, Barriers to animal distribution – Physical barriers (topographical and climatic); biological barriers

2. Zoogeographical realms (3 hrs)

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

3. Biogeography of India (2 hrs)

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

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FIFTH SEMESTER B.Sc DEGREE PROGRAMME (Theory)
ZOOLOGY CORE COURSE- VII
CELL BIOLOGY AND GENETICS
Code:VZO5B07
[54 hours] [3 hours per week] [3 credits)]

Section A: CELL BIOLOGY (27 hours) Max. Marks: 61

Scientific instruments and techniques in Cell Biology

1. Microscopy (5 hrs)
Light microscopy: Simple microscope, Compound microscope, Principles and uses, Use of oil immersion objectives, Use of ocular micrometer and stage micrometer for microscopic calibration (Micrometry)
Use of camera lucida, principle and uses. Mention Phase contrast microscope, Fluorescence microscope
Electron microscopy: Principle, applications, advantages and disadvantages
Mention Transmission Electron Microscope (TEM), Scanning Electron Microscope (SEM), Scanning-tunnelling microscope, Atomic force microscope

2. Histological Techniques (2 hrs)
Microtomy: Rotatory microtome (brief description), uses, preparation of materials for light microscopy (for temporary and permanent)
Fixation: Common fixatives, such as buffered formalin, ethanol, Bouin's solution and Carnoy's fluid
Common histological stains: Haematoxylin, Eosin and Leishman's
Vital stains: Neutral red and Janus green
Mounting medium: DPX, Canada Balsum

Structure of eukaryotic cell
4. Plasma membrane (3 hrs)
Unit membrane concept. Structure (fluid-mosaic model) and chemical organization, Glycocalyx
Functions – Transmembrane transport – diffusion, osmosis, active transport, pinocytosis, phagocytosis.
Modifications of plasma membrane

5. Ribosomes (2 hrs)
Types of ribosomes in prokaryotes, eukaryotes and mitochondria; Structure and chemical composition of subunits; free and attached ribosomes, monosomes, polysomes; functions of ribosomes; biogenesis of ribosomes

6. Mitochondria (2 hrs)
Structure and Functions of mitochondria, mitochondriogenesis

7. Lysosomes (1 hr)
Structure and chemistry, kinds of lysosomes, polymorphisms, enzymes in Lysosomes, concept of GERL (Golgi body – Endoplasmic Reticulum – Lysosome complex), functions of lysosomes

8. Centrioles and basal bodies (1 hr)
Structure, chemical composition and functions

9. Golgi complex (1 hr)
Morphology, chemical components, secretory and endocytic pathways, functions, Golgiogenesis

10. Interphase nucleus (3 hrs)
General structure and functions, Nucleo-Cytoplasmic index, Nuclear envelope : Structure, nuclear pores and pore complex formation, Functions, Nucleoplasm
Nucleolus: Structure, composition, nuclear cycle, nucleolar organizer, functions
Chromosomes: Chromatin, euchromatin, heterochromatin
Nucleosomes : chemical composition, nucleosome packing, organization of chromatin

11. Giant chromosomes (1 hr)
Polytene chromosomes: occurrence, structure, puffs and bands, endomitosis, significance in cytological studies
Lamp brush chromosomes: occurrence, structure, loops, significance

12. Cell Divisions (3hrs)
Cell cycle: 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 G_0 as an elevated part of cell cycle

13. Cytogenetics of cancer (2 hrs)
Types of cancer, characteristics of cancer cells, Carcinogenesis (theories- brief account)

14. Cell ageing (1 hr)
Apoptosis – Cell death

Section-B: GENETICS (27 hrs) Max. Marks: 61

1. Variations from Mendelian ratios (2 hrs)
Incomplete dominance, Co-dominance, lethal genes, Pleiotropism

2. Interaction of genes (3 hrs)
Allelic and Non allelic interactions, factor hypothesis, inheritance of comb pattern in poultry, Supplementary genes, Complementary genes, Epistasis, Duplicate genes, Polymeric genes, Penetrance, Expressivity, Polygenic (quantitative) inheritance, Skin colour in man

3. Multiple alleles (3 hrs)
Definition, characteristics and examples: coat colour in rabbits, mention isoalleles, blood group alleles, genetics of ABO blood group system, mention other systems of blood grouping; MN blood group, Levin and Bombay phenotype; Rh factor and erythroblastosis foetalis

4. Linkage, crossing over and recombination (3 hrs)
Morgan's work on *Drosophila*, define chromosome theory of linkage, linkage types with examples- complete and incomplete linkage, linkage groups, crossing over, factors influencing linkage and crossing over, recombination, linkage map (definition and principle)

5. Sex determination (3 hrs)
Sex determination and sex differentiation, sex chromosomes(X and Y) male heterogametic and female heterogametic chromosome mechanism of sex determinations (XX-XO, XX-XY, ZZ-ZW types) Genic balance (ratio) theory of Bridges, environmental and hormonal influence of sex determination, sex determination in honey-bees and *Bonellia*
Short notes on intersexes and gynadromorphism

6. Sex-linked, sex-influenced and sex-limited characters (4 hrs)
Types of sex-linkage – sex linkage in man (colour blindness as an example) holandric genes (hypertrichosis as an example) sex-influenced traits and sex-limited traits (definition and examples), importance of Y, dosage compensation, Barr body, Lyon hypothesis

7. Mutation (3 hrs)
Definition, kinds of mutations, gene mutations, molecular basis of gene mutations, substitution mutations and frame shift mutations, mechanisms, factors influencing mutations, induced mutations, mutagens, detection of mutations (ClB Method)
Chromosome mutations: Numerical changes: euploidy and aneupoloidy with subdivisions
Structural changes: deletion, duplication, insertion, inversion, translocation. Mention significance of mutations in speciation and breeding

8. Human Genetics (3 hrs)
Normal chromosome component in human beings, classification and grouping of human chromosomes (Patau's scheme)
Chromosomal anomalies and disorders: Down's, Patau's, Edward's Syndrome
Sex chromosomal anomalies : Turner's and Klinefelter's syndrome
Gene mutations: autosomal mutations: albinism, PKU, alkaptonuria, thalassemia, brachydactyli
Sex chromosomal mutations: haemophilia, dermal hypoplasia, polygenic traits: cleft palate, club foot
Gene Therapy

9. Genetic counseling (1 hr)
Eugenics, Euthenics and Euphenics

10. Cytoplasmic inheritance(2 hrs)
Shell coiling in *Limnaea*, Cytoplasmic organells- DNA in chloroplast and mitochondria

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Micklos, D. A. & Freyer, G. A.: *DNA Science*. 1990, Cold-Spring Harbour Lab Press.
Niel O. Thorpe: *Cell Biology*.
Philip Sheeler and Donald E. Bianchi: *Cell Biology – Structure, Biochemistry and Functions*.
Primrose, S. B. *et al*.: *Principles of Gene Manipulation*, 6e, 2000, Blackwell Science.
Ricki, L.: *Human Genetics: Concepts and Applications*. WCB MGH
Robert H. Tamarin, *Principles of Genetics*.
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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.

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

Section A: GENERAL METHODOLOGY IN SCIENCE (20 hrs) Max. Marks: 45

1. Science and Scientific Studies (1 hr)

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

2. Scientific Methods (7 hrs)

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

Methods in scientific enquiry: Inductive and deductive reasoning

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

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

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

Importance of models, simulations and virtual testing

3. Experimentation (6 hrs)

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

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

Test animals used in experiments

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

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

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

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

Section-B: BIOSTATISTICS (15 Hrs) Max. Marks: 34

1.Biostatistics (2 hrs)

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

2.Collection of data (2 hrs)

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

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

Classification and tabulation of data

4.Presentation of data (3 hrs)
Diagrammatic presentation of data: Line diagram, Bar diagram and Pie diagram
Graphic representation: Histogram, Frequency Polygon and Frequency Curve

5.Analysis of data (6 hrs)
Measures of central tendency: Mean, Median and Mode
Measures of dispersion: Standard deviation, standard error
Interpretation: Significance of statistical tools in data interpretation
(mention t test, f test and chi square)

SECTION C: INFORAMTICS (19 hours) Max. Marks: 43

1. Knowledge skills for higher education (**8 hrs**)
Data, information and knowledge, knowledge management
Internet access methods - Dial-up, DSL, Cable, ISDN, Wi-Fi - Internet as a knowledge repository, academic search techniques, creating cyber presence
Case study of academic websites, open access initiatives, open access publishing models Basic concepts of IPR, copyrights and patents, plagiarism, introduction to use of IT in teaching and learning, case study of educational software, academic services - INFLIBNET, NICNET, BRNET

2. Social informatics (6 hrs)
IT & society - issues and concerns - digital divide, IT & development, the free software movement
IT industry: new opportunities and new threats, software piracy, cyber ethics, cyber crime, cyber threats, cyber security, privacy issues, cyber laws, cyber addictions, information overload, health issues, guide lines for proper usage of computers, internet and mobile phones
E-wastes and green computing
Impact of IT on language and culture, localization issues, Unicode, IT and regional languages

3. It applications (very brief account of the following) (5 hrs)
e-Governance applications at national and state level, IT for national integration, overview of IT application in medicine, healthcare, law, crime detection, publishing, communication, resources disabled management, weather forecasting, education.
IT in service of futuristic IT - Artificial Intelligence, Virtual Reality, Bio-Computing.

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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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Useful webs

Biological methods: www.cfkeep.org/html/stitch.php?s=98965698293378 & id = 44650773279975.
Writing Papers : www.ruf.rice.edu/~bioslabs/tools/report/reportform.html

Informatics

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

Web Resources

www.fgcuedu/support/office2000.
www.openoffice.org Open Office Official web site.
www.microsoft.com/office MS Office web site.
www.Igta.org Office on-line lessons.
www.learnthenet.com Web Primer.
www.computer.org/history/timeline.
www.computerhistory.org.
http://computer.howstuffworks.com.
wwwkeralaitmission.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

SIXTH SEMESTER B.Sc DEGREE PROGRAMME (Theory)
ZOOLOGY CORE COURSE- IX
BIOCHEMISTRY
Code: VZO6B09
[36 hours] [2 hours per week] [2 credits]

Section A (23 hours) Max. Marks: 78

1. Introduction (2 hrs)
History and scope, stabilising forces in biomolecules (micro and macro molecules) and elements of biological importance, electrostatic bonds, hydrogen bonds, hydrophobic interactions.

2. Carbohydrates (5 hrs)
Structure and classification
Monosaccharides - Glucose, Fructose, Mannose, Galactose
Disaccharides-Sucrose, Maltose
Polysaccharides - Starch, Glycogen and Mucopolysaccharides
Mention biological functions
Principles of analytical techniques (qualitative and quantitave) and clinical significance of- Benedicts, Fehlings, Barfords, Selivanof's tests

3. Amino acids and Proteins (4 hrs)
Structure and classification of aminoacids, Properties of aminoacids, Isoelectric point, Zwitterion, Peptide linkages, primary, secondary and tertiary structure of proteins, physical and chemical properties, denaturation of proteins
Mention the biological functions of proteins
Principles of analytical techniques such as Biuret reaction, Xanthoprotein test, Ninhydrin reaction

4. Lipids (4 hr)
Classification and functions (simple and compound lipids), Polyunsaturated fatty acids, Triglycerides, mention phospholipids, lecithins, cephalins, prostaglandins and cholesterol

5. Enzymes and co-enzymes (4 hrs)
Classification, nomenclature and properties of enzymes, specificity of enzymes, active centre, mechanism and theories of enzyme action, enzyme inhibition, co-enzymes (NAD, FAD) and cofactors, mention isozyme and ribozymes

6. Nucleic acids (4 hrs)
Chemistry and structure of purines and pyrimidines, chemistry and structure of nucleotides (ATP, cAMP, NAD^+, FAD), molecular structure of B DNA, A & Z DNA, Importance of Nucleic acids, molecular structure of tRNA

Section B (10 hours) Max. Marks: 34

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

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

Section C (**3 hours**) **Max. Marks: 10**

8. Biotechniques – principle and applications

Colorimeter, Ultraviolet - visible spectrophotometer

Seperation techniques- Chromatography, Paper chromatography, Column chromatography

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

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Wilson and Walker – Principles and Techniques of Biochemistry and Molecular Biology, 6th edition – Cambridge Low Price edition.

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

Section- A: PHYSIOLOGY (36 hours) Max. Marks: 81

1. Nutrition (6hrs)
Balanced diet, importance of dietary fibres, role of enzymes in digestion of carbohydrates, proteins and lipids, absorption of carbohydrates, proteins, and lipids, nervous and hormonal control of digestion
Nutritional disorders–anorexia, ulcer, flatulence, starvation. Obesity causes and consequences, role of vitamins and minerals

2. Respiration (7 hrs)
Brief account of gaseous exchange and transport of respiratory gases, respiratory pigments, structure and properties of Hb, Oxygen dissociation curve, Neurophysiological control of respiration, physiological problems in diving mammals, newborn and aged individuals
Medical aids for respiration – aspirators, heart lung machine
Artificial respiration and ventilation

3. Circulation (6 hrs)
Blood- functions and composition, Composition and functions of lymph
Agglutination and coagulation of blood (enzyme cascade theory), clinical analysis of blood, haemostasis, haemolysis, jaundice, haemoglobinopathies, ESR, blood transfusion, aphaeresis, types of heart, haemodynamics
Common cardio-vascular problems: abnormal variations in BP, tachycardia, bradycardia, myocardial infarction, heart failure, cerebral haemorrage and stroke, ECG

4. Osmoregulation and Excretion (7 hrs)
Osmotic and ionic regulation in terrestrial, fresh water and marine animals, osmoconformers, osmoregulators, water retension and conservation in desert forms, types of excretion, urea cycle
Human kidney- urine formation with countercurrent mechanism and hormonal regulation, abnormal constituents of urine
Common renal problems - Renal hypertension, nephritis, renal failure, oedema, acidosis, uraemia, haematuria and calculi

5.Muscle Physiology (5 hrs)
Structure of vertebrate skeletal muscle, EM structure of Myofibrils and Myofilaments, contractile proteins, ultra structural changes, physiology and chemistry of muscle contraction, energy sources, role of creatine phosphate, coricycle, muscle twitch, fatigue, rigor mortis

6. Nerve Physiology (5 hrs)
Different types of nerve cells, glial cells, giant nerve fibre of crustaceans and cephalopods,

regeneration of medullary fibres, neurotrophins, nerve impulse transmission, synapses and neuromuscular junctions, synaptic transmission (electrical & chemical), neurotransmitters
Brief notes on: Intelligence, memory, sleep, EEG, hunger, thirst and emotion

Section- B: ENDOCRINOLOGY (18 hrs) Max. Marks: 41

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

2. Vertebrate endocrinology (5 hrs)
Classification of hormones, steroid and peptide hormones, Endocrine glands in man (Pituitary, adrenal, pineal, thyroid, parathyroid, gastro- intestinal, pancreas) and their hormones (brief account)
Hormonal disorders

3. Concepts of neurosecretion (4 hrs)
Hypothalamus, Hypophysial interactions, Hypothalamus releasing and inhibiting hormones. roles of hypothalamic and pituitary hormones, Antidiuretic hormone, Oxytocin, growth hormone, Adrenocorticotrophic hormone, TSH, Gonadotrophins

4. Hormonal action (5 hrs)
Mechanism of hormone action at the level of cell membrane (insulin), at the level of enzyme located in cell membrane (adrenaline and peptide hormones), at the level of organelles (thyroxine), at the level of genes (steroids), positive and negative feedback regulation, hormone receptors

5. Hormonal disorders (3 hrs)
Hypo and hyper secretion of of hormones.
Hypopituitarism
Addison's disease
Cushing's syndrome
Diabetes mellitus- Type I and Type II
Acromegaly

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Bentley, P. J. Comparative vertebrate endocrinology, CUP.
Berry, A.K., A Text book of Animal Physiology, 6e, Emkay Publications, Delhi-51.
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Hoar, W.S.: General and Comparative Animal Physiology. 1975, PHI.
Nair and Paul, Animal physiology and Biochemistry, Academia.
Hadley, M.E., Endocrinology, 5e, 200, Pearson Edn. (Singapore), ND
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SIXTH SEMESTER B.Sc DEGREE PROGRAMME (Theory)
ZOOLOGY Core Course-XI
MOLECULAR BIOLOGY & BIOINFORMATICS
Code: VZO6B11
[54 hours] [3 hours per week] [3credits]

Section- A: MOLECULAR BIOLOGY (27 hours) Max. Marks: 61

1. Introduction (5 hrs)
Milestones of molecular biology**,**DNA as the genetic material,Griffith's experiments-bacterial transformations, experiments by Hershey and Chase, concept of gene, gene action/ gene expression, one gene – one enzyme hypothesis, one gene – one polypeptide hypothesis, central dogma of molecular biology and central dogma reverse, retroviruses

2. Repetitive and unique DNA sequences (2 hrs)
Chromosome content, C-value and C-value paradox, unique, moderately repetitive and highly repetitive DNA sequences, satellite DNA , selfish DNA

3. Genetic code (3 hrs)
Gene and genetic code, deciphering / cracking of genetic code, contributions of Nirenberg and associates, Khorana, properties of genetic codes, codon assignments, Wobble hypothesis

4. Mitochondrial genome (2 hrs)
Special features of mitochondrial genome

5. Protein synthesis (5 hrs)
Regulation of Protein synthesis , Types and role of RNAs (mRNA, tRNA, rRNA), synthesis of mRNA, promoter, enhancer and silencer sites, post transcriptional modifications, cis-trans splicing, spliceosomes, hn RNAs, activation of Amino acids, Polypeptide chain initiation, elongation and termination, release, Ribozymes, post translational modifications, coupled transcription and translation, poly cistronic mRNA, role of molecular chaperons, cell targeting proteins (brief account only)

6. Regulation of gene action (3 hrs)
In prokaryotes (Operon concept, Lac Operon in detail), lytic cycle and lysogeny of phages (brief account) siRNA and RNAi, House keeping genes, gene modulation

7. Organization of genome (5 hrs)
Classical concepts of genes, modern concept of genes, cistron, muton, recon, complicon, transcripton, split genes, overlapping genes, pseudo genes, jumping genes, cryptic genes (brief accounts only)

8. Human genome project (2 hrs)
Significance, ethical social and legal aspects

Section- B: BIOINFORMATICS (27 hours) Max. Marks: 61

I. Overview of bioinformatics (2 hrs)
Definition, history, development and scope, tasks

2. Major databases in bioinformatics (5 hrs)
a)Primary databases:
Nucleotide sequence databases – Mention EMBL, DDBJ, Genbank
Protein sequence databases – Mention Swiss Prot, PIR, MIPS
Metabolite databases – Mention KEGG, EcoCye
b)Secondary databases: Mention PROSITE, PRINTS, Blocks

3. Database search engines (4 hrs)
Mention Entrez at NCBI of USA, SRS at EBI of England, STAG at DDBJ of Japan

4. Sequence similarity search (3 hrs)
Pairwise sequence alignment: Mention BLAST, FASTA, Multiple sequence alignment: Mention CLUSTAL W, CLUSTAL X

5. Micro arrays (2 hrs)
Data analysis tools and methods

6. Genomics (3 hrs)
DNA sequencing, applications (Brief account)

7. Proteomics (2 hrs)
Tools and applications (Brief account)

8. Metabolomics (2 hrs)
Tools and applications (Brief account)

9. Applications of bioinformatics (2 hrs)

10. Ethical issues in bioinformatics (2 hrs)
Accuracy and error
Appropriate uses and users
Privacy and confidentiality

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Molecular biology:

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Brooks, R. J.: *Genetics: Analysis and Principles*. 1999, Addison Wesley
Darnell, J. *et al*.: *Molecular Cell Biology*. Scientific American Book
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Vides, *Gene Regulation and Metabolism*, MIT Press
Potchard, *Medical Genetics at a Glance*, Blackwell
Jan Vijg, *Aging of the Genome*, Oxford University Press

Bioinformatics

Atwood and Parry-Smith. 2001. Introduction to Bioinformatics. Pearson Education Asia, NewDelhi.
Baxevanis & Ouellette. 2001. Bioinformatics - A practical guide to the Analysis of Genes and Proteins, Wiley, New York.
Mount, 2001. Bioinformatics: Sequence and Genome Analysis. Cold Sprint Harbour laboratory Press, New York.
S.C. Rastogi, Mendiratta, P. Rastogi. 2005. Bioinformatics: Method & Applications. Genomics,Proteomiocs & Drug Discovery. Prentice Hall of India, New Delhi.
Mani & Vijayaraj. 2004. Bioinformatics: A Practical Approach. Aparna Publications, India.
Higgins and Taylor. 2000. Bioinformatics: Sequence, Structure and Databanks. Oxford University Press, Oxford.
Jin Xiong. 2006. Essential Bioinformatics. Cambridge University Press, India Pvt. Ltd.
Rex A. Dwyer - Genomic Peril - From Bioinformatics Basics to Working Code (with CD) - Cambridge University Press.
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www.fgcuedu/supp

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

Section A: REPRODUCTIVE BIOLOGY (13 hrs) Max. Marks: 29

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1. Reproductive system in human beings (3 hrs)

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

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

3. Reproductive cycles in mammals (2 hrs)

Oestrous and menstrual cycles and their hormonal control

4. Reproductive technologies (1 hr)

Infertility and its management: Brief account of semen collection, preservation, storage, artificial insemination, surrogacy regulation bill 2016

5. Cryopreservation and embryo transfer (1 hr)

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

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

GIFT, ZIFT, ICSI, oocyte donation and embryo donation

7. Prenatal diagnosis (1 hr)

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

8. Fertility control (2 hr)

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

Section B: DEVELOPMENTAL BIOLOGY (38 hrs) Max. Marks: 86

1. Introduction (1 hr)

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

2. Types of eggs (2 hrs)
Classification of eggs based on the amount of yolk (micro, meso & macrolecithal), distribution of yolk (iso, centro & telolecithal), presence or absence of shell (cleidoic & non cleidoic), development (determinate & indeterminate) with examples, egg membranes (primary, secondary and tertiary)

3. Cleavage and cell lineage (3 hrs)
Types of cleavage with examples based on planes (Meridional, Vertical, Equatorial and Latitudinal), based on amount of yolk (Holoblastic & Meroblastic), based on development (Determinate & Indeterminate), based on Pattern (Radial & Spiral), Cell lineage studies in *Planocera*, Different types of blastulae

4. Early development of Amphioxus (3 hrs)
Cleavage, Blastulation, Gastrulation & Neurulation

5. Development of Frog (7 hrs)
Fertilization, Cleavage, Blastulation & fate map, Gastrulation (Morphogenetic movements) and formation of germ layers, neurulation & notochord formation, mesoderm and coelom formation, organogeny of brain and eye, hormonal control of amphibian metamorphosis

6. Development of Chick (7 hrs)
Fertilization, Structure of egg, cleavage, blastulation, gastrulation and formation of germ layers, salient features of chick embryo at primitive streak stage, 24, 33 and 48 hours stage.
Development and functions of extra embryonic membranes

7. Development of Man (3 hrs)
Cleavage and formation of morula, development of blastocyst, implantation, gastrulation up to the formation of germ layers
Development of foetal membranes

8. Cell differentiation and gene action during development (3 hrs)
Cell differentiation, totipotency, pleuripotency, de-differentiaton and re-differentiation, controlled gene expression during development, Homeotic genes, Mention Hoxgenes, Stem cells, their significance and applications

9. Parthenogenesis (2 hrs)
Definition, Types- Natural parthenogenesis Arrhenotoky, Thelytoky, Obligatory and Facultative, Artificial parthenogenesis and significance

10. Regeneration (1 hr)
Definition, Types (epimorphosis, morphallaxis) Heteromorphosis, super regeneration Histological and cytological events in regeneration

11. Experimental Embryology (4 hrs)

Construction of fate map, Vital staining, Marking with carbon particles & radio active tracing, Spemann's constriction experiments on amphibian embryos (Potency of nuclei and grey crescent), Importance of Grey crescent, Organizers in amphibian development (primary, secondary & tertiary organizers), Gradient experiments in sea urchin eggs

12. Placenta (2 hrs)
Different types and functions

Section C: TERATOLOGY (3 hrs) Max. Marks: 7

Environmental disruption of animal development
Action of alcohol, thalidomide, heavy metals, bisphenol, nicotine - brief account

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Scott F.Gilbert, Developmental Biology

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

Section- A: BIOTECHNOLOGY (18 hrs) Max. Marks: 41

1. Introduction to Biotechnology (1 hr)
Definition, history
Mention branches of Biotechnology (brief)

2. Animal cell culture and hybridoma technology (3 hrs)
Primary cell culture, secondary culture, types of cell lines, valuable products from cell culture, Culture media, hybridoma technology, monoclonal antibodies and their uses

3. Gene cloning and DNA sequencing (5 hrs)
Introduction, cloning vectors (plasmid, pBR322, phages, cosmids, virus, YAC), enzymes of rDNA technology exonuclease, endonuclease, Restriction enzyme, DNA ligase, DNA polymerase, Reverse transcriptase), Use of Linkers, Construction of Recombinant DNA, amplification in host cell, selection of clones, DNA sequencing (brief)

4. Transgenic organisms (3 hrs)
Transfection methods- Calcium phosphate precipitation, Dextran mediated, Lipofection, Electroporation, Retroviral infection, Micro injection, Shotgun method (brief)
Transgenic animals- fish, sheep, rabbit, mice, and goat. One example from each
Molecular pharming and bioreactors
Mention knock out mice, Bt cotton

5. Molecular markers (3 hrs)
RFLP, RAPD, VNTR, Micro satellites or STR, and their uses.
Chromosome walking, Fluorescence *in situ* hybridization (FISH)
DNA Finger printing (Profiling) techniques

6. Biotechnology and Environment (2hrs)
Biosensors, Bioremediation – *Ex situ* and *in situ*, Biofiltration, Bioleaching (microbial mining)

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

Section-B: MICROBIOLOGY (18 hrs) Max. Marks: 40

1. Introduction (1 hr)
History and Scope

2. Survey of Microorganisms (outline only) **(3 hrs)**
Prions, Viroids, Viruses, Rickettsias, Mycoplasmas, Bacteria, Cyanobacteria, Prochlorophyta, Protozoa, Algae, Fungi, Slime moulds

3. Bacteria (2 hrs)
Structure, characteristics and major groups of bacteria, growth phases, measurement of growth

4. Viruses (2 hrs)
Structure, shape, replication

5. Basic methods in Microbiology (4 hrs)
Microscopic methods, Techniques of sterilization, Media preparation, isolation and inoculation, Direct observation and Staining techniques, Maintenance and preservation of cultures

6. Microorganisms in Industry (2 hrs)
Products of industrial fermentations, Citric acid, Lactic acid, Amino acids, Enzymes, Vitamins, antibiotics, single cell protein, Steroids.
Effects of environment on microbial growth (Temperature, Atmosphere, pH, Osmotic factors)

7. Genetically modified microorganisms (1 hr)

8. Microorganisms in Human Diseases (3 hrs)
Normal micro flora of the human body
Diseases caused by Bacteria, Protozoa, Viruses (brief)
Epidemiology and control of diseases, Chemotherapy

Section-C: IMMUNOLOGY (18 hrs) Max. Marks: 41

1. Introduction and History (2 hrs)
Immunity – Natural and Acquired, Active and Passive, Immunisation, Vaccines, Principles of vaccination, Attenuated bacterial or viral vaccines, inactivated viral or bacterial vaccines, Toxoid vaccines (brief)

2. Immune System (3 hrs)
Cells of the immune system- B lymphocytes, T lymphocytes, NK cells, monocytes, macrophages, Neutrophils, Basophils, Eosinophils, Mastcell and Dendritic cells.
Organs of immune system - Spleen, Thymus, Bone marrow and Lymph nodes
Role of primary and secondary lymphoid organs in the maturation of T and B lymphocytes

3. Immunoglobins (2 hrs)
Structure, classes, biological functions

4. Antigens (3 hrs)
Exogenous antigens, Endogenous antigens, adjuvants, haptens, epitopes,

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

5. Auto immune diseases (2 hrs)
Systemic- SLE, Multiple sclerosis, Rheumatoid arthritis
Organ specific- Hashimoto's thyroiditis, Grave's disease, Myasthenia gravis

6. Techniques in Immunology (2 hrs)
Principles and Applications of Immuno assays: RIA, ELISA, Flow cytometry
Blotting techniques:- Western blotting, mention dot blot, slot blot

7. Tumour immunology (2hrs)

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

8. Cellular and Humoral Immunity (2 hrs)

REFERENCES

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A.S. Rao, Introduction to Microbiology, Prentice Hall of India.
Hans G. Schiegel – General 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.
Veerbala 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.
Nicholl – An Introduction to Genetic Engineering – Cambridge University Press.
Wise – Immunology a Comprehenive Review – Ane Books.
Alphey – DNA Sequencing – Bios Scientific Publishers.
Hardin – Cloning, gene expression, and protein purificaiton – 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.

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

Section A : AQUACULTURE (36 hrs) Max. Marks: 81

1. Introduction (2 hrs)
Scope in India and Kerala, Export potential, Different types of cultures

2. Mariculture (10 hrs)
Prawn culture: Important culture varieties, Pokkali culture, breeding spawning, control breeding, induced maturation, eye stalk ablation, culture methods, freezing, curing and canning
Mussel culture: *Perna indica, Perna viridis*
Seed collection, artificial seed production, induced spawning, rearing, raft culture, harvesting
Pearl culture- *Pictada fucata, Pinctada margaritifera*
Sea weed culture - *Grassilaria, Sargassum*

3. Pisci culture (4 hrs)
Egg collection, induced spawning, construction, preparation and maintenance of ponds, manuring, feeding and harvesting, cryo preservation of fish germplasm, semen bank and preservation media

4. Biology and culture of Indian major carps (2 hrs)
Catla catla, Labeo rohita
Biology and culture of exotic carps. *Hypophthalmichthys molitrix* (silver carp)

5. Inland Fish and Fisheries (1 hr)
Channa, Clarius
Rivers, paddy fields

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

7. Ornamental fisheries (2 hr)
Common aquarium fishes, aquarium management and identification of sex
Carassius auratus (gold fish), *Poecilia reticulatus* (guppy)

8. Plankton and Fishery production (2 hrs)
Zoo and Phytoplankton – vertical migration – plankton and productivity

9. Fishing Gears (2 hrs)
Gill net, drift gill net, purse-seines, harpoon, Chinese dip nets, echo sounders, sonar, remote sensing

10. Fish Spoilage and Preservation (3 hrs)

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

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11. Fish utilization (4 hrs)

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

12. Diseases and parasites of Fish (2 hrs)

Fungal infection – *Saprolegnia*

Bacterial – Fin & tail rot disease, Dropsy

13. Mud banks of Kerala coast (1 hr)

Section B: POULTRY SCIENCE (7 hrs) Max. Marks: 16

Introduction and Scope

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

Different breeds: Exotic – 3 examples

Indigenous – 2 examples

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

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

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

Common poultry feeds, food rations, feed formulation

Common diseases of poultry- Ranikket, Pullorum, Fowl pox

Section C: ANIMAL HUSBANDRY (7 hrs) Max. Marks: 16

Introduction- history, origin, domestication

Breeds of cattle:

Milk type - Sindhi, Gir

Draft breed- Nagori, Kangayam

Dual purpose- Ongole, Hariana

Exotic breed - Jersey, Holstein – Friesian

Native breeds- Conservation programmes, Vechur cattle.

Feeding- Common cattle feeds, fodder

Common diseases - Anthrax, foot & mouth disease, parasites

Meat hygiene- Slaughter and clean meat production

Zoonotic diseases

Section D: DAIRY SCIENCE (4 hrs) Max. Marks: 9

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

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

Recombined milk, Soft curd milk, Skimmed and tonned milk

Artificial milk

Milk – adulteration
Dairy products and nutritive value

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P.R.Venkitaraman: Economic Zoology.
V. Sudheeran: Economic Zoology.
Kurian C.V., Sebastian C.V: Prawn and Prawn fisheries in India, Hindustan Publication Corporation of India.
Alikunhi, K.R. : Fish culture in India, KAV, ICAR.

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

Section A (9 hrs) Max. Marks: 15

1. Reproductive Biology and sex education (3 hrs)
Introduction, phases of body growth, stages of sexual growth, sexual hygiene, need for sex education
Problems of adolescence, reproductive rights

2. Reproductive system (4 hrs)
Male genitalia- testis, accessory glands, penis
Female genitalia- ovaries, uterus, vulva
Sexual cycle- ovarian cycle, uterine cycle
Menarche, menopause, adropause

3. Hormones and human reproduction (2 hrs)
Functions of male and female hormones, Hormones in pregnancy

Section B (14 hrs) Max. Marks: 23

4. Sex determination and Chromosomal anomalies (4 hrs)
Chromosomal mechanism of sex determination in human, Normal Human Karyotype, Barr body, Twin studies
Autosomal anomalies- Down's syndrome, Edward's syndrome
Sex chromosomal anomalies- Turner's syndrome, Klinefelter's syndrome
Sex linked inheritance- Haemophilia, Colourblindness

5. Prenatal Diagnosis (3 hrs)
Prenatal diagnostic techniques (invasive and non invasive), Female foeticide- Ethical issues and laws (Prenatal Diagnostic techniques – Prevention of misuse act – PNDT Act)

6. Fertility Control (3 hrs)
Population explosion, birth control, Natural methods, Artificial methods, Contraceptive devices and medications, Abortion, Legal termination of pregnancy, Vasectomy, Tubectomy, Vaccines and hormones in fertility control

7. Infertility and assisted reproductive techniques (4 hrs)
Physiological infertility, pathological infertility, causes and problems in male and female infertility
Assisted Reproductive Techniques (ART) – IVF, ET, AI, GIFT, ZIFT, ICSI, Embryo or oocyte donation, health hazards in ART

Cryopreservation of blastocysts and ethics, designer baby and ethics

Section C (13 hrs) Max. Marks: 21

8. Sexual abuses and myths (4 hrs)

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

9. Sexually transmitted infectious diseases (6 hrs)

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

10. Ethical aspects of sex (3 hrs)

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

REFERENCES

Prakash Kothari : *Common sexual problems and solutions*, UBS Publishers and Distributors Ltd.
Lynn L. Long, Judith A. Burnett, R. Valorie Thomas: *Sexuality counseling, An integrated approach* , Pearson, Merril Prentice Hall.
Robert T. Francoeur: *Becoming a sexual person*, John Wiley and Sons.
Guyton & Hall: *Textbook of Medical Physiology*
Churchill Livingstone : *Davidson's Principles and Practice of Medicine*.
Vander, Sherman and Luciano : *Human Physiology*, McGraw Hill.
Vijayakumaran Nair, K.and Paul, P.I: *Animal Physiology and Biochem*

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

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

Section A: Study of the following specimens

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

Protists: *Amoeba, Noctiluca, Ceratium, Entamoeba,Trichonympha, Paramecium, Ephelota* (any 3)
Poriferans: *Leucosolenia, Scypha, Spongilla,* sponge gemmule (any 2)
Cnidarians: Sedentary hydrozoans: *Hydra, Obelia* (any 1)
Pelagic Hydrozoans: *Physalia, Velella (*any 1)
Pelagic Scyphozoan: *Aurelia / Rhizostoma*
Common Anthozoans: *Adamsia, Madrepora, Fungia, Tubipora, Gorgonia* (any 3)
Platyhelminths: Free living flat worm: *Bipalium / Dugesia*
Parasitic flat worms: *Fasciola, Taenia solium* (any 1)
Aschelminths: Parasitic round worms: *Ascaris, Ancylostoma, Wuchereria* (any 1)

Section B: Histology

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

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

Section A: Study of following specimens.

Annelids
Polychaetes: *Aphrodite, Chaetopterus, Arenicola, Tomopteris* (any 2)
Common earthworm: *Megascolex / Pheretima*
Leech: *Hirudinaria, Heamadipsa, Branchellion* (any 2)
Arthropods
Items of evolutionary / taxonomic importance - *Limulus, Streptocephalus* (any 1)
Common fouling barnacle – *Lepas / Balanus*
Parasitic crustaceans– *Sacculina, Cymathoa, Argulus* (any 2)
Crustacean of the sandy shore– *Emerita* / *Albunea*
Symbiotic crustacean - *Eupagurus*
Economically important crustacean– prawn, crab (any 1)
Vectors – *Cyclops*, mosquito, housefly, rat flea (any 2)
Insect pests – *Lepisma*, termite queen, pest of paddy, pest of coconut, pest of stored grains(any 5)
Aquatic insects – *Belostoma, Nepa, Ranatra* (any 1)
Predatory insect - dragonfly, ant lion, *Mantis* (any 1)
Insect which camouflages - stick insect / *Phyllium*
Common myriapods – *Scolopendra/ Scutigera, Julus/ Spirostreptus / Jonespeltis (*any 2)
Common arachnids – *Palamnaeus / Buthus*, spider/ tick /mite (any 2)
Molluscs
Intertidal mollusks – *Chiton, Patella, Haliotis, Onchidium, Aplysia* (any 2)
Ornamental gastropods –*Cypraea, Murex, Turbinella* (any 2)
Poisonous gastropod – *Conus*
Pelecypods of economic importance – *Perna, Pinctada, Teredo, Ostrea* (any 2)
Scaphopod - *Dentalium*
Cephalopods of economic or evolutionary importance- *Sepia, Loligo, Octopus, Nautilus* (any 2)
Echinoderms
Sea lily, star fish, brittle star, sea cucumber, sea urchin, cake urchin, heart urchin (any 4)
Hemichordata
Balanoglossus
Minor Phyla : *Sipunculus / Bonellia* or any other specimen
Onychophora
Peripatus (Evolutionary significance)

Section B: Histology

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

Section C: Mountings

Earthworm : Setae (a few loose setae) (minor)
Neanthes or any other polychaete: Parapodium (minor)
Penaeus : Appendages (minor)
Cockroach : Salivary apparatus (major)
Honeybee/ plant bug: Mouth parts (minor)

Section D: Dissections

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

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

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

Section A: Study of the following specimens

Urochordates : *Ascidia*, ascidian tadpole, *Salpa, Doliolum* (any 2)
Cephalochordate : *Branchiostoma*
Agnathans : *Myxine, Petromyzon,* Ammocoete larva (any 1)
Pisces
Common elasmobranchs - *Chiloscyllium, Stegostoma, Sphyrna, Pristis, Trygon, Narcine* (any 2)
Common food fishes - *Sardinella, Rastrelliger, Cynoglossus, Parastromateus, Trichiurus, Cybium, Etroplus, Mugil, Wallagonia, Tilapia, Catla, Cirrhinus, Labeo, Cyprinus* (any 5)
Fishes with special adaptive features - *Hippocampus, Belone, Hemirhampus, Exocoetus, Tetradon, Pterois, Ostracion, Heteropneustes, Clarias, Arius, Anabas, Channa Echeneis, Antennarius, Amphisile,* eel (*Anguilla / Muraena*) (any 5)
Amphibians
Common amphibians- *Bufo, Rhacophorus, Ambystoma*/ Axolotl larva, an apodan (any 3)
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 – *Dryophis / Python*

Section B: Histology

Branchiostoma - T. S. through pharyngeal region

Section C: Mountings

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

Section D: Dissections

(Digital versions to be downloaded or procured as per UGC guidelines**)**
Shark/*Calotes*/Frog: IX and X cranial nerves on one side (major)
Shark/*Calotes* /Frog: Heart and ventral aorta with branches on both sides (major)
Mullet : [or any other bony fish]: Alimentary canal (major)

Section E: Osteology

Frog **:** Vertebrae-Typical, 8^{th} ,9^{th}, 10^{th}, pectoral & pelvic girdles

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

Section A: Study of the following specimens

Birds
Fossil - Archaeopteryx
Flightless bird- *Rhea*, *Struthio* (any 1)
Aquatic birds- Jacana, duck, teal (any 1)
Wet land birds- Heron, Ibis, Stroks, Pelicans (any 2)
Migratory birds- Pelicans, Cranes, Flamingos (any 1)
Features and adaptations of duck, parrot, king fisher, owl, kite, wood pecker (draw sketches of the beaks and feet of 3 birds)
Observe birds in their natural habitat and prepare a field note

Mammals
Common insectivore – *Suncus, Hedgshog* (any 1)
Common rodent – rat/ bandicoot/ squirrel (any 1)
Common bat of Kerala (any 1)
Primate – *Loris* or any other item

Section B: Osteology

Rabbit - skull (details of dentition)
Atlas, axis, typical vertebra
Scapula, pelvic girdle

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

Section A: Ethology

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

Section B: Evolution

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

Section C: Zoogeography

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

Section D: Evironmental Biology, Conservation Biology & Toxicology

Estimation of dissolved O_2 using Winkler method (pond and tap water)
Estimation of dissolved CO_2 in pond and tap water
Determination of pH using pH paper / digital pH meter
Study of butterflies in relation to its host plants
Study of marine planktons (any five items up to genus level)
Study of food chain and food web

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

Section A: Cell Biology

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

Section B: Genetics

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

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

(Any 4 items of the following)

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

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

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

Calculate the standard deviation of the given set of data.

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

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

Formulate a hypothesis of any scientific observation made by you

a) Feeding rate and BMI in an insect larva

b) Phototaxis in earthworms

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

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

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

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

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

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

Staining of bacterial cell using appropriate bacterial stain (*Lacto bacilli*)
Staining of root nodule Nitrogen fixing bacteria (*Rhizobium*)
Identifiation of motile bacteria by hanging-drop method (demonstration only)
Preparation of culture media for bacteria (Synthetic media, Natural media, Simple media, Differential media, Selective media)
Study of microbial by products (Antibiotics, Milk products)
Identification of human blood group (ABO and Rh)
Preparation of human blood smear to study the immunologically significant cells.
Study of transgenic animals
Study of the principle and applications of Electrophoretic apparatus
Study of the principle and applications of DNA finger printing
PCR- Principle and applications
ELISA (demonstration only)
Sequence similarity search using BLAST (demonstration only)

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Patki, L. R., Balchandra, B. L. and Jeevaji, I. H. (1983). An Introduction to Microtechnique, S.Chand & Co. Ltd.

Piramal, V. (2005). Biophysics. Dominant Publs. and Distributors.

Plummer, D. T. (1995). An Introduction to Practical Biochemistry, 3e, Tata Mc Graw-Hill Publ.Co. Ltd., New Delhi.

Roy, R. N. (2005). A Text Book of Biophysics. New Central Book Agency, Pvt. Ltd. Sawbney, S. K. and Singh, R. (eds.) (2001). Introductory Practical Biochemistry.

Narosa. Verma, P. S. and Agarwal, V. K. (1985). Principles of Ecology. S. Chand & Co. Ltd., New Delhi.

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

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

a) Scales
b) Otolith

Morphpmetrics and meristic study of fishes (any 5)

PROJECT WORK – Vth SEMESTER
Code No: VZO6PR
[36 hours] [2 hrs per week] [2 credits]

Internal Mark-10
External Mark-40
Students are required to undertake project work on problems pertaining to biological science of 36 hrs duration in 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 12 students can undertake a particular project. Each student has to actively participate in the project work.
The problem/ topic chosen by an earlier batch of students for their project work shall not be repeated by a latter batch. A certificate to this effect has to be attached by the Head of the department. A well documented project report duly attested by the supervising teacher and the Head of the Department must be submitted by each group for evaluation separately on the day of project assessment in the sixth semester. The project must contain the following sections.
Introduction and objectives of study
Review of literature (include citations of relevant literature in the field)
Methodology
Results
Interpretation of results
Reference
Project presentation and Viva-voce will be conducted on a separate day by two external examiners at the end of VIth semester.

FIELD STUDY / STUDY TOUR
[1 credit]

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

VIVA-VOCE
[2 credits]

At the end of 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. The questions will be based on basic biological concepts and field study. It shall not normally exceed 10 mts per candidate. Marks shall be given according to their performance.

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