SOLAPUR UNIVERSITY, SOLAPUR

NAAC Accredited-2015
'B' Grade (CGPA 2.62)

Faculty of Science

Syllabus

B.Sc.-III Zoology

Choice Based Credit System (CBCS)

Semester-V & VI

With effect from June-2018

Solapur University, Solapur, Faculty of Science
Choice Based Credit System (CBCS): (w.e.f. 2018-19)
Structure for B. Sc-III

Subject/ Core Course	Name and Type of the Paper		No. of papers/ Practical	Hrs/week			Total Marks Per Paper	UA	CA	Credits
	Type	Name		L	T	P				
Class :	**B.Sc.- III Semester - V**									
	Ability Enhancement Course(AE CC)	English	Paper-III	4			100	70	30	4
	Core	Subject	Paper IX	3	--	--	100	70	30	3
	Core		Paper X	3	--	--	100	70	30	3
	Core		Paper XI	3	--	--	100	70	30	3
	DSE-1	Subject	Paper XII	3	--	--	100	70	30	3
	DSE-2		Paper XII	3	--	--	100	70	30	3
Grand Total				**16**	--	--	**500**	**350**	**150**	**12**
Class :			**B.Sc.- III**	**Semester -VI**						
	Ability Enhancement Course(AECC)	English	Paper-IV	4			100	70	30	4
	Core	Subject	Paper XIII	3	--	--	100	70	30	3
	Core		Paper XIV	3	--	--	100	70	30	3
	Core		Paper XV	3	--	--	100	70	30	3
	DSE-1	Subject	Paper XVI	3	--	--	100	70	30	3
	DSE-2		Paper XVI	3	--	--	100	70	30	3
Total (Theory)				**16**	--	--	**500**	**350**	**150**	**12**
	Core	Subject	Practical IV	--	--	5	100	70	30	5
	Core	Subject	Practical V	--	--	5	100	70	30	5
	Core	Subject	Practical VI	--	--	5	100	70	30	5
	DSE	Subject	Practical VII	--	--	5	100	70	30	5
Total (Practicals)						**20**	**400**	**280**	**120**	**20**
Grand Total				**16**		**20**	**900**	**630**	**270**	**44**

- Core Subjects- Chemistry/Physics/Electronics/Computer Science/Mathematics/Statistics/Botany/Zoology/ Microbiology/Geology

- Discipline Specific Elective (DSE) Paper-The Subject will be specific as per the chosen core subjects.

Summary of the Structure of B.Sc.Programme as per CBCS pattern

Class	Semester	Marks-Theory	Credits-Theory	Marks-Practical	Credits-Practicals	Total - credits
B.Sc.-I	I	900	20	-	-	20
	II	900	20	400	16	36
B.Sc.-II	III	600	18	-	-	18
	IV	700	18	600	24	42
B.Sc.-III	V	500	12	-	-	12
	VI	500	12	400	20	32
Total		**4100**	**100**	**1400**	**60**	**160**

B.Sc.Programme:

- Total Marks 4100 (Theory)+1400 (Practical) =5500
- Credits : Theory + Practicals = 100 + 60 = 160
- Numbers of Papers Theory: Ability Enhancement Course(AECC) : 05
  Theory: Discipline Specific Elective Paper (DSE) : 02
  Theory: Core Course (CC) : 34

Total : Theory Papers:41

Practical: Core Course (CC) : 14

Abbreviations:

- **L**: Lectures
- **T**: Tutorials
- **P**: Practicals
- **UA** : University Assessment
- **CA** : College Assessment
- **CC**: Core Course
- **AEC** : Ability Enhancement Course
- **DSE** : Discipline Specific Elective Paper

Important Note:

1. Board of Studies in the respective subject may design the curriculum/syllabus of one additional paper of the same Number (Paper –XII) as DSE Paper, so that students can choose any one of these two papers for semester –V. Similarly, the students can opt for one DSE paper (Paper-XVI) for Semester- VI.
2. The Credits for the practicals are changed as per the number of Hours per week.
3. For B.Sc.-I, Sem -I and II. Papers of each subject are divided as per previous pattern to give more weightage and to reduce the stress of the students.

4. Combined passing for B. Sc.-II Practicals (Practical – II & III)
5. Combined passing for B. Sc-III Pratcticals (Practical – IV-VIII)
6. The 30 marks of College level Assessment (CA) may be distributed as, 15 Marks for Internal Test and 15 Marks for Home Assignment/seminars/Viva/industrial visit/Group discussion etc.

SOLAPUR UNIVERSITY, SOLAPUR
Faculty of Science
Choice Based Credit System (CBCS)
(w.e.f. June 2018)

•**Title of the Course:** B.Sc. Part-III

•**Subject:** Zoology

- **Objectives of the course:** The objectives of B. Sc. Zoology course are:
  - To provide an intensive and in depth learning to the students in field of Zoology.
  - Beyond simulating, learning, understanding the techniques, the course also addresses the underlying recurring problems of disciplines in today scientific and changing world.
  - To develop awareness & knowledge of different organization requirement and subject knowledge through varied branches and research methodology in students.
  - To train the students to take up wide variety of roles like researchers, scientists, consultants, entrepreneurs, academicians, industry leaders and policy.

- **Advantages of the Course:** Zoology has tremendous job potential.

  - The successful students will be able to establish research orgnizations with the help of agriculture, environment protection and also their own industry for transgenic animals, clinical pathology, genetic counseling, human karyotyping etc.
  - Scientific Research Organizations.
  - Universities in India & aboard.

•Choice Based Credit System CBCS

With the view to ensure worldwide recognition, acceptability, horizontal as well as vertical mobility for students completing undergraduate degree, Solapur University has implemented Choice Based Credit System (CBCS **)** of Evaluation at Undergraduate level. Credit is a numerical value that indicates students work load (Lectures, Lab work, Seminar, Tutorials, Field work etc.) to complete a course unit. In most of the universities 15 contact hours constitute one credit. The contact hours are transformed into credits. As per present norms, there are 3 contact hours per paper (subject) per week which works out to be 45 contact hours per paper (subject) per semester.

In Solapur University, for B.Sc.-III Zoology, there are 5 papers in each semester out of which 4 papers choice will be given to student in **DSE** and Compulsory English. For B.Sc.-III Zoology, there are 3 contact hours per paper (subject) per week for each paper and Compulsory English carry 4 contact hours per week. Therefore, total contact hours per week are 16. Each paper has 45 contact hours, which are transformed into 3 credits. Moreover, the grading system of evaluation is introduced for B.Sc. course wherein process of Continuous Internal Evaluation is ensured. The candidate has to appear for Internal Evaluation of 30 marks and University Evaluation for 70 marks. It is 70+30pattern of evaluation. It is applicable for theory and practical as well. The details regarding this evaluation system are as under.

•**Conversion of marks into Grades:**

A table for the conversion of the marks obtained by a student in each paper (out of 100) to grade and grade point is as given below:

Sr. No.	Range of Marks	Grade	Grade Point
1	80-100	O	10
2	70-80	A+	9
3	60-69	A	8
4	55-59	B+	7
5	50-54	B	6
6	45-49	C+	5
7	40-44	C	4
8	<39	FC	0(Failed in Term Exam)
9	<39	FR	0(Failed in Internal Assessment)

1. **Grade Point Average at the end of the Semester (SGPA)**

$$SGPA = \frac{(G_1 \times C_1) + (G_2 \times C_2) + \ldots\ldots\ldots\ldots..}{\Sigma Ci}$$

(Σ Ci= The total number of credits offered by the student during a semester)

2. **Cumulative Grade Point Average (CGPA)**

$$CGPA = \frac{(G_1 \times C_1) + (G_2 \times C_2) + \ldots\ldots\ldots\ldots..}{\Sigma Ci}$$

(Σ Ci= The total number of credits offered by the student upto and including the semester for which CGPA is calculated.)

3. **Final Grade Point Average (FGPA)**

It will be calculated in the similar manner for the total number of credits offered for the completion of the said course.

Where: Ci= Credits allocated for the i^{th}course.

Gi= Grade point scored in the i^{th}paper (subject)

4. Conversion of average grade points into grades:

SGPA/CGPA/FGPA	Letter Grade
9.5 – 10	O
8.5 – 9.49	A+
7.5 – 8.49	A
6.5 – 7.49	B+
5.5 – 6.49	B
4.5 – 5.49	C+

4.0 – 4.49	C
<3.99	FC / F
	FR

Syllabus Structure:

1. The University follows semester system.
2. An academic year shall consist of two semesters.
3. Each B.Sc. course shall consist of three years i.e. six semesters.
4. B.Sc. Part-III Zoology shall consist of two semesters: Semester V and Semester VI.

In semester V and VI, there will be a total of five out of which four papers of 100 marks for each semester with compulsory English.

The scheme of evaluation of performance of candidates shall be based on University assessment as well as College internal assessment as given below. For B.Sc. Part-III Zoology semester V & VI the internal assessment will be based on Unit tests, tutorials, Home assignment, viva, group discussion, attitude, sincerity, student seminars etc. as given below. Practical course examination of 100 marks for each paper shall be conducted at the end of VIth semester. The practical examination of 100 marks shall also consist of 70 marks for University practical assessment and 30 marks for college internal assessment.

For University practical examination both the examiners will be External and will be appointed by the University. The internal practical assessment shall be done as per scheme given below.

6. Scheme of Evaluation:

As per the norms of the grading system of evaluation, out of 100 marks, the candidate hasto appear for college internal assessment (CA) of 30 marks and external evaluation, University Assessment (UA) of 70 marks. The respective B.O.S. may decide the nature of college internal assessment after referring to scheme given below or may be used as it is.

Semester – V:

Theory: (100 marks)
University Examination (70 marks): No. of theory papers: 5 (1English + 4 Subjects)
Internal Continuous Assessment: (30 marks)
The 30 marks of College level Assessment (CA) may be distributed as , 15 Marks for Internal Test and 15 Marks for Home Assignment/seminars/Viva/ Group discussion etc.
Semester –VI
Theory: (100 marks)
University Examination (70 marks): No. of theory papers: 5 (1English + 4 Subjects)
Internal Continuous Assessment: (30 marks)

The 30 marks of College level Assessment (CA) may be distributed as , 15 Marks for Internal Test and 15 Marks for Home Assignment/seminars/Viva/Group discussion etc.

Practical Examination: (100 marks)

University Examination (70 marks): No. of practical course 4

Internal Continuous Assessment: (30 marks)

Scheme of marking: 30 marks – Internal test on any four practicals

(Weightages for Lab. Journal /performance/attendance/sketching of diagrams related to syllabus (A4 Size) / original print of photography with details will be taken into consideration)

Thus the course shall be of total 1400 marks including English.

7. Passing Standard:

The student has to secure a minimum of 4.0 grade points (Grade C) in each paper. A student who secure less than 4.0 grade point (39% or less marks, Grade FC/FR) will be declared fail in that paper and shall be required to reappear for respective paper. A student who failed in University Examination (theory) and passed in internal assessment of a same paper shall be given FC Grade. Such student will have to reappear for University Examination only. A student who fails in internal assessment and passed in University examination (theory) shall be given FR Grade. Such student will have to reappear for both University examination as well as internal assessment. In case of Annual pattern/old semester pattern students/candidates from the mark scheme the candidates shall appear for the same 70 marks of external examination and his performance shall be scaled to 100 marks.

8. <u>ATKT Candidate</u> passed in all papers except 6 (six) papers combined together of semester III and IV of B.Sc. Part-II Zoology examination and clearly passed in B.Sc. Part-I-Zoology shall be permitted to enter upon the course of Semester V of B.Sc. III Zoology.

SOLAPUR UNIVERSITY, SOLAPUR Faculty of Science CBCS Structure for B.Sc – III Zoology Theory -								
Semester V								
Paper No.	**Title of Paper**	**Hrs/Week**			**Paper Marks**	**UA**	**CA**	**Credits**
		L	T	P				
Ability Enhancement Course(AECC)	Compulsory English (Paper III)	4	-	-	100	70	30	3
Core-IX	Non-chordates	3	-	-	100	70	30	3
Core-X	Developmental Biology	3	-	-	100	70	30	3
Core-XI	Comparative Anatomy of Chordates	3	-	-	100	70	30	3
DSE-XII-A	Biostatistics, Bioinformatics, Medical Zoology and Evolutionary Biology	3	-	-	100	70	30	3
DSE-XII-B	Biodiversity & Conservation Biology	3	-	-	100	70	30	3
Total		16	-	-	500	350	150	12

Semester –VI								
Paper No.	**Title of Paper**	**Hrs/Week**			**Paper Marks**	**UA**	**CA**	**Credits**
		L	T	P				
Ability Enhancement Course(AECC)	Compulsory English(Paper IV)	4	-	-	100	70	30	3
Core-XIII	Physiology	3	-	-	100	70	30	3
Core-XIV	Economic Zoology	3	-	-	100	70	30	3
Core-XV	Molecular Biology & Biotechnology	3	-	-	100	70	30	3
DSE-XVI –A	Endocrinology, Environmental Biology and Toxicology	3	-	-	100	70	30	3
DSE-XVI-B	Techniques in Biology	3	-	-	100	70	30	3
Total		16			500	350	150	12

Practicals- B .Sc III Zoology (CBCS)									
Practical No.	**Paper No. based on**	**Title of Paper**	**Hrs/Week**			**Paper Marks**	**UA**	**CA**	**Credits**
			L	T	P				
I	Core-IX Core-X	Non Chordates & Developmental Biology		-	5	100	70	30	3
II	Core XI **AND** DSE-XII-A **OR** DSE-XII-B	Comparative Anatomy of Chordates and Developmental Biology **AND** Biostatistics, Bioinformatics, Medical Zoology and Evolutionary Biology **OR** Biodiversity & Conservation Biology		-	5	100	70	30	3
III	Core-XIII **AND** Core-XVI	Physiology **AND** Economic Zoology		-	5	100	70	30	3
IV	Core-XV **AND** DSE-XVI-A **OR** DSE-XVI-B	Molecular Biology and Biotechnology **AND** Endocrinology, Environmental Biology and Toxicology **OR** Techniques in Biology		-	5	100	70	30	3
	Total				**20**	**400**	**280**	**120**	**12**

Abbreviations:

L: Lectures
T: Tutorials
P: Practicals
UA: University Assessment by End Semester Examination
CA: College Assessment by Internal Continuous Examination
UA: University Assessment: - University Theory paper shall be of 70 marks
CA: College Assessment: - The internal examination for theory and practical course

SOLAPUR UNIVERSITY, SOLAPUR (CBCS)
Theory Syllabus
B.Sc. III-Zoology (Semester-V)
w. e. f. June 2018

Paper- Core-IX- Non-chordates
[Credits -3, Total Lectures-45]

UNIT-I. Protozoa – (4)
1. Nutrition in Protozoa.
2. Reproduction in Protozoa.

UNIT -II. Porifera –
1. Types of Canal Systems. (2)

UNIT -III A) Coelenterata – (4)
1.Polymorphism.
2.Corals and Coral reefs

UNIT -IV. Annelida –Type study - Leech : - (12)
1. Systematic position, Habits and Habitat.
2. Morphology, body wall, & Locomotion.
3. Food, feeding and digestive system.
4. Excretory system.
5. Nervous system and Sense organs.
6. Reproductive system, copulation and cocoon formation.
7. Parasitic adaptations and economic importance (medicinal use of Leech)

UNIT –V. Arthropoda – (8)
1.Evolutionary Significance of *Peripatus* and *Limulus*
2. Study of Crustacean larvae.
3. Types of Insect larvae.

UNIT –VI. Mollusca –
1. Phylogenetic significance of Trochophore larva.
2. Torsion and de-torsion (2)

UNIT-VII. Echinodermata –
A)Type study –Sea star (9)
a) Systematic position, Habits and Habitat.
b) Morphology and body wall.
c) Food, feeding and digestive system.
d) Water vascular system and locomotion.
e) Reproductive system.

B). **Echinoderm larvae -** (2)

C) Minor phyla - Salient features and affinities of- Lingula (2)

References for Paper- Core-IX- Non-chordates

- There are few websites providing free downloadable books. Website of NCBI provides more than thirty books on microbiology, molecular biology, genetics and Biotechnology
- Website named Books for Doctor gives books on histology, physiology, molecular biology and Human genetics.

1. Invertebrate Zoology- (W.B. Saunders Co.) – Barnes R.D.
2. Treatise in Zoology Sedgwick Vol III
3. Modern Text Book of Zoology, Invertebrates – R.L.Kotpal.
4. Life of Invertebrates – S.N. Prasad, Vikas publishing House, New Delhi.
5. A Life of Invertebrates- Russell & Hunter.
6. Practical Zoology, Invertebrates- S.S. Lal.

Paper-Core-X
Developmental Biology
[Credits -3, Total Lectures-45]

UNIT - I Gametogenesis- Spermatogenesis and Oogenesis (3)

UNIT - II General mechanism of fertilization (3)

UNIT - III Types of eggs and cleavages (5)

UNIT - IV Development of *Amphioxus*- (9)

a. Structure of egg and sperm
b. Fertilization and cleavage
c. Blastula and its fate map
d. Gastrulation

UNIT- V Development of Chick- (12)

a. Structure of Egg and Sperm
b. Fertilization, cleavage, blastulation and Gastrulation
c. Fate map of blastula
d. Structure of 24 hrs. Chick embryo.
e. Structure of 33 hrs. Chick embryo.
f. Structure of 48 hrs. Chick embryo.
g. Structure of 72 hrs. Chick embryo.

UNIT – VI Chick Foetal membranes or extra embryonic membranes (Amnion, Chorion, Allontois and Yolk sac) & their significance. (4)

UNIT – VII Types and significance of placenta in mammals. (4)

UNIT – VIII Human embryology- (5)

a) Principle and applications of ultra sound for foetus study
b) Causes of miscarriage(s)

Reference Books for Paper-Core-X

1. An Introduction to Embryology 2003, Balinsky B.L., Saunders College, Philadelphia.
2. Developmental Biology; Patterns/Principles/Problems, 1982, Saunders J. W. Collier MacMillan, Publishers, London.
3. Developmental Biology, 2004, 3rd Edition, Gilbert S.F. Saunder Associates Inc. U.S.A.
4. Developmental Biology, 1992 3rd edition, Browder L.W. Erickson C.A. & Williams, R.J. Saunders College, Publications, London.
5. A Text Book of Embryology, Dr. Puranik P. G. , S. Chand & Co.
6. Developmental Biology, 1984, Browder L.W. , Saunders College Publications, U.S.A.
7. Development of Chick embryo, 1972, Lillie.
8. Developmental Biology –P S Salunkhe
9. Human Embryology : Inderbir singh & G.P.Pal
10. Medical Physiology: A.C. Guyton

Paper- Core-XI
Comparative Anatomy of Chordates
[Credits -3, Total Lectures-45]

UNIT-I: a) Integument and its derivatives- (7)
b) Endoskeleton - Appendicular skeleton. (5)

UNIT-II:
Digestive system – Alimentary canal and associated glands. - (6)

UNIT-III:
Respiratory system – Cutaneous respiration, Gills and Lungs, Air sacs in birds. - (5)

UNIT-IV:
Circulatory system – Evolution of heart and Aortic arches, Portal systems. - (7)

UNIT –V: Excretory system **–** Evolution of Kidney and its ducts - (4)

UNIT-VI: Nervous system – Comparative anatomy of Vertebrate Brain - (6)

UNIT-VII: Sense organs – Comparative anatomy of vertebrate Ear and Eye. - (5)

Reference Books for Paper- Core-XI

1. Outlines of comparative Anatomy,Romer& Parsons, Central Book Depot, The Vertebrate Body (Saunders).
2. Biology of Vertebrates Walter & Sayles; (McMillan).
3. Modern Textbook of Zoology, R. L. Kotpal, Rastogi Publications, Meerut.
4. The Life of Vertebrates, 3rd Edition, 1993, J. Z. Young E. L. B.S. Oxford.
5. Chordate Zoology – E.L. Jordan, S. Chand & Co., New Delhi.
6. The Phylum Chordata – 1987, H.H. Newman, Distributor Satish Book Enterprise, Agra.
7. Comparative Anatomy of the Vertebrates G. C. Kent.

Paper-DSE- XII-A
Biostatistics, Bioinformatics, Medical Zoology and Evolutionary Biology
[Credits -3, Total Lectures-45]

A. Biostatistics:

UNIT -I. A) Classification and Tabulation. - (3)
B) Frequency distribution & Graphical representation. (2)

UNIT -II A) Measures of Central Tendency - Mean, Median and Mode. (4)
B) Dispersion –Standard Deviation & Standard Error, Student-T-test. (4)

UNIT -III Correlation –
a) Scatter diagram (3)
b) Types of correlation & Correlation coefficient.
i) Spearman's Rank Correlation Coefficient.
ii) Karl Pearson's Correlation Coefficient.

B. Bioinformatics :

UNIT – IV (7)
i) Introduction and applications of Bioinformatics
ii) Introduction to proteomics and genomics
iii) Applications of search Engine: Entrez, BLAST.

C) Medical Zoology

UNIT-V

Study of following diseases with respect to structure of pathogen, mode of infection, symptoms and treatment of- (7)
a) Rabies
b) HIV
c) Swine-flu
d) Tuberculosis

UNIT –VI Study of following diseases with respect to their mode of infection , symptoms and treatment (7)

a) Malaria
b) Fasciolasis
c) Elephantiasis
d) Dengue

D) Evolutionary Biology

UNIT –VII

1. Hardy-Weinberg Law of genetic equilibrium. (08)
2. Destabilizing forces of Natural selection with reference to:
a) Genetic drift
b) Migration

Reference Books for Paper-DSE- XII-A

1. Info technology- S. Chand and Co.
2. Bioinformatics- Murti, Himalaya Publications.
3. Introduction to Bioinformatics Attwood Pearson Education Delhi
4. Introduction to Biostatistics Pranab Kumar Banerjee S. Chand and Company. New Delhi
5. General Parasitology- Cheng, T.C. Academic Press.
6. Parasitology-Chandler, Allied Agency, Kolkata.
7. Essentials of Parasitology – Gerald D. Smidth.
8. Wikipedia: Free encyclopedia Major topics in Population genetics and related examples can be searched.
9. Evolution: Mark Ridley Blackwell Publishing In India marketed by John Wiley and Sons.
10. Textbook of medical Parasitology: K.D.Chatterjee

Paper-DSE- XII-B
Biodiversity and Conservation Biology
[Credits -3, Total Lectures-45]

Unit-I: Concept of Biodiversity: 08

(1) Scope and constraints of Biodiversity science
(2) Definition and Introduction to scales of biodiversity- genetic, species, ecosystem, landscape, and Agro-biodiversity; Brief idea of diversity indices (Shannon & Simpson)
(3) Values of biodiversity: Definition and Introduction of Utilitarian value, direct use value, non-consumptive value (indirect value), ethical and aesthetic value

Unit-II: Threats to Biodiversity: 08

(1) Habitat destruction and fragmentation- Causes and consequences
(2) Invasive Species: Introduction, biological impact of invasive species on terrestrial and aquatic ecosystem
(3) Extinction: Types of extinction, process of extinction, sixth extinction or biological crisis, IUCN threatened categories

Unit-III: Protected Areas and Human intervention 06

(1) Protected areas: Major National Parks and Sanctuaries in Maharashtra.
(2) Role of NGOs & GOs in conservation
(3) Wildlife Protection Act- 1972, Forest Conservation Act-1980.
(4) Child Labour Act-1986.

Unit-IV: Conservation Biology: 05

(1) Introduction to conservation biology: history and emergence of conservation biology in India.
(2) Human and wildlife conflict with reference to bustard and tiger in Maharashtra.
(3) Introduction to
i) Red Data Book - Indian fauna,
ii) Biodiversity Hot-spots
iii) Sacred groves in India.

Unit-V: Recent Advances in Conservation Biology: 08

(1) Role of biotechnology and molecular approaches in biodiversity conservation- Use of captive breeding, cloning and cryopreservation for conservation of rare species
(2) Application of GIS & remote sensing in conservation: Use of remote sensing, GIS, GPS & radio collar in conservation and biodiversity mapping
(3) Use of molecular markers in biodiversity conservation, biodiversity informatics.
i) Scope and importance of Wildlife Institutes in India : WII, Dehradun; CDFD, Hydrabad, NCBS, Banglore; BNHS, Mumbai and their efforts in conservation of rare species in India

Unit: VI: Climate Change and Biodiversity Conservation: 08

(1) Introduction to climate change: Definition, causes and impacts on environment.
(2) Climate change policy in India; Ministry of environment, forest & climate change (MoEFCC) and mitigation of climate change impacts.

Reference Books for Paper-DSE- XII-B

(1) Ecological diversity and its measurement: Magguran A.E. (1996)-Princeton University
(2) Essentials of conservation biology: Primack R.B. (2002): Sinaur Publisher
(3) Conservation & Biodiversity: Dobson A.P. (1996): Scientific American Library, NewYork
(4) Fundamentals of conservation Biology: Hunter, Malcolm & Gibbs, P. (2006): Wiley Blackwall Publication
(5) Environmental Biology: E. Bharucha (2006): University Publication
(6) Conservation Biology for all (2009) - Sodhi & Ehrlich- Oxford University Press

Semester-VI

Paper-Core-XIII

Physiology

[Credits -3, Total Lectures-45]

UNIT-I. Nutrition and Metabolism – (14)

a) Balanced diet, Physiology of digestion and absorption.

b) Vitamins- (with reference to source, Physiological role and deficiency) Water soluble –B complex and C; Fat soluble – A, D, E and K.

c) Carbohydrate metabolism -

Glycogenesis, Glycogenolysis, Glycolysis, Krebs cycle, and Gluconeogenesis.

d) Protein metabolism:

Transamination, Deamination and Ornithine cycle

e**) Lipid metabolism:** β- Oxidation

UNIT II Physiology of Respiration –

1. Transport of respiratory gases (4)
2. Chemical and nervous regulation of Respiration

UNIT III. Physiology of Circulation

1. Origin and conduction of heart beat, Cardiac cycle (7)
2. ECG, Blood pressure

UNIT IV. Physiology of Excretion

1. Structure of nephron (4)
2. Physiology of urine formation.
3. Dialysis.

UNIT V Physiology of Muscle

1. Ultra structure of striated muscle fiber (6)
2. Molecular mechanism of muscle contraction.

UNIT - VI Physiology of Nerve

1. Ultra structure of neuron (7)
2. Origin and conduction of nerve impulse
3. Synapse and synaptic transmission

UNIT - VII Physiology of Stress

1. Introduction to stress physiology
2. Managing stress by exercise, yoga and meditation (3)

Reference Books for Paper-Core-XIII

1. General and Comparative Physiology – Hoar (Prentice Hall).
2. Animal Physiology – Nelson (Cambridge).
3. Comparative Animal Physiology – Prosser (Satish Book Enterprise).
4. Animal physiology: Usha Gavhane and Mohan Babare , Wizcraft publication and distribution Pvt. Ltd ,Solapur , (2014).
5. Animal Physiology – Adaptation and Environmental – Schiemdt Nielson (Cambridge)
6. Physiology: A regulatory systems approach – Strand F.L. (McMillon Publications Co.).
7. Environmental and Metabolic Animal Physiology – Prosser C.L. (Wiley –Liss Inc.)
8. Environment Physiology- Willmet P.G., Stone &Johnsion (Blackwell Science, Oxford).
9. Physiological Animal Ecology – Loan G.N. (Longman Harlog, UK)
10. Principles and methods of Toxicology – Hayes (Edited A. Wallace, Hayes Publications, Raven Press, N.Y.)

Paper- Core-XIV
Economic Zoology
[Credits -3, Total Lectures-45]

UNIT-I-Fisheries (9)

1. Introduction to marine & freshwater fisheries with reference to -
   a) Coastal fishery- Sardine, Mackerel, Bombay duck
   b) Off-shore fishery- Sole, Tuna, Pomphret
   c) Crustacean fishery- Lobsters, Crabs, Shrimps
   d) Inland Fishery- Indian Major Carps
2. Economic importance of Fish Products and byproducts
3. Fish migration- types & its importance in fishery
4. Parental care in Fishes

UNIT-II-Fishing Crafts and Gears- (8)

a) Crafts-

i) Rafts; ii) Trawler; iii) Rampan; iv) Canoe v) Catamaran

b) Gears-

i) Hooks and lines; ii) Cast net; iii) Gill net; iv) Trap net; v) Rampani net; vi)Trawl net

UNIT-III- Agricultural Pest Management- (7)

(a) Agricultural pests – *Pyrilla*, *Tribolium* (Jowar grain borer), Cotton Boll worm, Grass hopper and Rat.
(b) Biological control of crop pests.
(c) Integrated Pest Management (IPM)

UNIT-IV-Rearing Technology of Silk worm (7)

(a) Silkworm species
(b) Silkworm rearing appliances and maintenance
(c) Silkworm rearing methods and rearing houses
(d) Government schemes for propagation of sericulture

UNIT-V-Silkworm diseases:- (6)

(a) Protozoon diseases (Pebrime)
(b) Bacterial diseases (Flacherie)
(c) Viral diseases (Polyhedrosis)
(d) Fungal diseases (Green Muscardine)

UNIT-VI-General Topics

(a) Pearl Culture & its economic importance
(b) Forest Insect Pests- Wood borers & defoliators

Reference Books for Core XIV-

1. Prawn and Prawn Fishery of India – Kurian.
2. Fish Culture – K. H. Alikuhni.
3. Fish Culture – Lagler.
4. Fishes of India. – Zingran
5. Manual of sericulture – Krishnaswami *et al.*
6. Introduction to sericulture – Ganga and Shetty.
7. Economic Zoology –Upadya and Shukla
8. Modern Entomology: D.B.tembhare (2017)- Himalaya Publication
9. Economic Zoology: Manju Yadav and Upadhya

Paper-Core-XV
Molecular Biology and Biotechnology
[Credits -3, Total Lectures-45]

A. Molecular Biology:

UNIT-I Organization of DNA (8)

a) Nucleosome concept and Solenoid model
b) Evidences for DNA as genetic material-
(i) Griffith's Transformation Experiment
(ii) Avery, McLeod & McCarty Experiment &
c) Mechanism of DNA replication in prokaryotes & eukaryotes
d) DNA damage & repair mechanism- Photoreactivation, Excision-repair and SOS method

UNIT-II -Transcription - (8)

(a) Mechanism of transcription in prokaryotes and eukaryotes
(i) RNA polymerases in Prokaryotes.
(ii) RNA polymerases in eukaryotes.
(b) Process of transcription in prokaryotes & eukaryotes
(c) Post-transcriptional modifications in eukaryotic hn-RNA:- Capping, Polyadenylation & Splicing

UNIT-III- Translation – (7)

(a) Activation and binding of amino acid to t-RNA.
(b) Initiation, Elongation, Termination.

UNIT-IV-Genetic Code- (7)
(a) Properties of Genetic Code: Nature of code- triplet nature, Commaless, non-overlapping, non-ambiguous
(b) Initiation and termination codons
(c) Degeneracy of codon
(d) Wobble hypothesis

B. Biotechnology:

(8)

UNIT-V-1. Recombinant DNA technology

(a) Restriction enzymes- Exo and endonuclease, types of restriction enzymes & mechanism of action with examples
(b) Enzymes in recombinant DNA technology: DNA-ligase, DNA polymerase, reverse transcriptase
(c) Cloning vectors- Plasmids, Cosmids, Bacterial Artificial Chromosome (BAC) & Yeast Artificial Chromosome (YAC)

Unit-VI: Applications of Biotechnology: (7)

(a) Biotechnological products : Insulin, Factor-VIII and IX , Interferon , Human growth hormone , Erythropoietin, Golden rice --Brief idea & their applications .
(b) Cloning technique & its applications
(c) Applications of biotechnology in agriculture

Reference Books for Paper-Core-XV

1. Cell and Molecular Biology, 8th Edition, De. Robertis EDP and De Robertis Jr. EMF, Lippincott Williams and Wilkins, Philadelphia,'
2. Cell Biology, C.B. Powar, Himalaya Publication House.
3. Cell and Molecular Biology, E.J. Dupraw, Academic Press, NewYork.
4. Cell Structure and Function – A. G. Loewy, P. Siekevitz, J. R. Meninger& J. A. N. Gallant, Saunder College, Philadelphia.
5. Molecular Biology of the Cell – 3rd Edition, Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts & James D. Watson, Garlan Publishing, New York.
6. Elements of Biotechnology – P. K. Gupta, Rastogi Publications.
7. Gene V & VI, 1994, Lewin B., Oxford University Press, Oxford.

Paper-DSE-XVI
Endocrinology, Environmental Biology and Toxicology
[Credits -3, Total Lectures-45]

A. Endocrinology:

UNIT-I-Study of endocrine glands- **(**12)

Anatomy, histology and hormones – Nature, functions, regulation and disorders with reference to the following glands :

a. Thyroid gland
b. Parathyroid gland
c. Adrenal gland
d. Pancreas (islet of Langerhans).

UNIT-II-

(a) Hormones: Definition, Mechanism of action of protein and steroid hormones with example
(b) Neurosecretory Hormones: Excitatory & Inhibitory, Action of acetylcholine
(c) Neurohormones – Origin, structure & function of - GnRH, CRH and TRH (8)
(d) Hormones of pineal gland & its functions- Role of melatonin in Biological(Circadian) rhythms.

B. Environmental Biology:

UNIT-III-

(7)

1. General characteristics and faunal adaptations of following habitats:
(a) Fresh water: Lentic & lotic ecosystem
(b) Marine Water: Rocky & Sandy sea shore
(c) Terrestrial Ecosystem: Grassland & Desert ecosystem

2. Biological indicators of pollution. (2)

UNIT-IV-

1. Solid waste management (2)
2. Rain water harvesting (2)
3. Animal Ethics- Introduction, prevention of cruelty to animals, need of virtual dissection (2)

C. Toxicology-

UNIT-V- (4)

1. Classification of toxicants.
2. Toxic agents and their action – Pesticides
3. Determination of LC_{50} Values

UNIT-VI-

1 Bioaccumulation and biomagnifications
2. Applications of Toxicology (4)

Reference Books for Paper-DSE-XVI

1. Books4Doctors Website Downloadable book of Endocrinology Nussey
2. Endocrinology – Hadley Pearson Education Delhi
3. General Endocrinology – Bagnara& Turner (W.B. Saunders)
4. Ecology – Odum (Amerind)
5. Limnology – Welch (McGraw Hill)
6. Introduction to Environmental Science – Y Anjaneyulu (B.S. Publications)
7. Physiology & Endocrinology by R.V. Shastri
8. Basic Human Physiology: Dr.H.D.Singh (S. Chand Publication)
9. Medical Physiology by A.C. Guyton
10. Endocrinology by P.R.Yadav (Discovery Publications)
11. Biology by Raven and Johnson (Times Mirror / Mosby College Publisher)

Paper-DSE-XVI-B
Techniques in Biology
[Credits -3, Total Lectures-45]

UNIT-I- Basic Techniques in Biology

a) **Tools and Techniques (Basic principles and applications)** (8)

P^H meter, colorimeter, spectrophotometer

b) Separation techniques
i. Chromatography- Thin Layer Chromatography (TLC) and Column chromatography.
ii. Gel Electrophoresis- Polyacrylamide Gel Electrophoresis and Agarose Gel Electrophoresis

Unit-II-Techniques in Genetic Engineering (8)

Introduction, mechanism and applications of following techniques-

i) Polymerase chain reaction (PCR)
ii) DNA probes
iii) Blotting (Southern, Northern, Western blotting)
iv) DNA fingerprinting

UNIT-III- Cell & Tissue Culture (7)

a) Animal Cell Culture
i) Introduction and principle, Requirements and applications
ii) Stem cells and their culture
b) Cryopreservation of gametes and its application

Unit-IV- Biophysical Techniques (6)

i) Radioactive labeling & counting
ii) Autoradiography
iii) Ultracentrifugation

Unit-V-Microtomy (8)

i) Basic Principle, Applications & Methodology up to sectioning
ii) Stains and staining procedures- Double staining (H-E), Feulgen technique & PAS method
iii) Histochemical methods- Acid and alkaline phosphatase

Unit-VI- Advanced Techniques in Biology (8)

i) DNA sequencing techniques- Sanger & Maxam Gilbert method, Automated DNA sequencing
ii) DNA Chip: - Microarray technique & its applications
iii) DNA Barcoding & its applications

Reference Books for Paper-DSE-XVI-B

1. Techniques & Methods in Biology by K.L.Ghatak (Phi publisher)
2. Techniques in molecular biology by J.M.Walker (Springer Publisher)
3. Basic Techniques in Molecular Biology by Stefan Surzycki (Springer Publisher)
4. Molecular Biology Techniques by Heather Miller & D. Scott ()
5. Principles & Techniques of Biochemistry and Molecular Biology by Wilson & Walker
6. Cell & Molecular Biology Techniques-I by R.V.Lloyd
7. Fundamentals of Laboratory Approaches by Ninfa A.J.
8. Molecular cell biology by Lodish & Baltimore

Practical Syllabus
B.Sc. Zoology-Part – III
Practical-I
Paper-Core-IX & X
(Non Chordates & Developmental Biology)

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1) Leech: Anatomical observations and detailed explanation of Leech with the help of CD (virtual mode)/ Model / Chart of systems- Digestive system, Nervous system and Reproductive system.

2) Leech: Study of mounting material from leech: Nephridium, Salivary glands and jaw with the help of CD / Model / Chart /Slides.

3) Sea Star: Anatomical Observations and detailed explanation of Sea star with the help of CD/Model/Chart of systems- Digestive system, Water vascular System.

4) Sea Star: Study of mounting material: Tube foot, pedicellarae with the help of CD/Model/Chart /Slides.

Of Note for practicals 1-4:- During regular practical and at the time annual examination students should be provided with an outline of the animal body and they have to draw, label & discuss the given system and face viva-voce on the same.

5) Study of locomotion in Protozoa– *Amoeba*, *Paramoecium* and *Euglena* using pond samples/Permanent slides/photographs

6) Study of Zooplanktons- Procedure for collection, identification and counting of any 10 zooplanktons from local water bodies

7) Study life cycle of *Drosophila*: Culturing of *Drosophila* for study of life cycle and identification of male & female

8) Study of Zooids: *Porpita* and *Obelia* colony with the help of CD/Model/Chart/Permanent Slides and Museum Specimens

9) Study of Canal systems- T.S. and L.S of Sycon using Permanent slides/photographs / Permanent Slides and Museum Specimens (flow chart of water current is expected)

10) Study of Coelenterata: Physalia and any four Corals using models / photographs / Museum specimens / Permanent Slides and Museum Specimens

11) Study of following using photographs / Permanent Slides or Museum Specimens

1. Crustacean larvae.
2. Insect larvae.
3. Peripatus and Limulus.
4. Echinoderm larvae

12) Study of types of eggs: Eggs of Insects, Amphioxus, Frog and Chick with the help of Permanent slides/ Model/museum specimens/CD/Chart/

13) Study of Cleavage, Blastula and Gastrula: Amphioxus with the help of CD/Chart/Model/Permanent slides

14) Study of T.S. & Whole Mounts: T.S. of 18, 24, 33, 48, and 72 hrs Chick embryos

with the help of CD/Chart/Model/Permanent slides

15) Study of Embryology: **'procedure to understand embryological stages of chick**: Demonstration of **structure of egg** of chick (shell, shell membrane, air space, albumen, yolk and position of blastodisc) / or by non invasive method' and procedure for chick embryo mounting using CD/Model/Chart (During regular practical students are expected to learn demonstration along with flow chart for the whole mount of chick embryo starting from incubation of egg - location of embryo -transferring of embryo on glass slide-fixation-dehydration-staining-identification-drawing-labeling and submission. **At the time examination** students will be provided a permanent slide of any one developmental stage (hrs' 18/24/33/48/72) of chick embryo to identify, draw, label and write the procedure for making a whole mount and defend viva-voce).

16) Study of placenta: Rat/ Human using museum specimen/CD/Chart/Model (spotters)

17) Study of human embryology: Principle and mechanism of ultra sound or ultra-sonography with the help of photograph/flow-chart/Chart

18) Field Visits: Local water bodies for collection of planktons / Visit to medical college/ blood bank / IVF center, for study and submission of report.

Practical-II

Paper-Core-XI & DSE-XII-A or DSE-XII-B

Core-XI- Comparative Anatomy of Chordates and
DSE-XII-A- Biostatistics, Bioinformatics, Medical Zoology & Evolutionary Biology OR
DSE-XII-B- Biodiversity & Conservation Biology

Core-XI- Comparative Anatomy of Chordate

1) Scoliodon: Anatomical observations and detailed explanation of-Cranial Nerves of Scoliodon with the help of CD/Model/Chart

2) Scoliodon: Anatomical Observations and detailed explanation of -Membranous labyrinth of Scoliodon with the help of CD/Model/Chart

3) Scoliodon: Anatomical Observations and detailed explanation of-Eye muscles with innervations with the help of CD/Model/Chart

4) Rat: Anatomical Observations and detailed explanation of Neck Nerves of Rat with the help of CD/Model/Chart

5) Study of Scales– Placoid, Cycloid and Ctenoid/Ampulla of Lorenzini ,Webberian ossicle of Labeo with the help of CD/Model/Chart/ permanent slides

Note for practicals 1-5:- During regular practical and while annual examination students should be provided with unlabelled figures/Models and are expected to **label and write** a brief account on location, structure and function of various parts and submit the labeled figure and a **viva-voce** on the same is expected for the thorough understanding of his/her knowledge).

6) Study of comparative anatomy of following organs/ structures museum specimens/slides/ CD/Chart

1. T.S. / V.S. of skin of vertebrates
2. Scales- Fishes and Reptiles.
3. Feathers
4. Gills of Fishes and Lungs of Amphibian, Reptiles, Birds and Mammals
5. Hearts of Vertebrates
6. Brains of Vertebrates.

6) Project work- Research project should be prepared in consultation with faculty either individually or in group as required. The research guide will support students in selecting and executing the entire topic and preparing the report for final submission during examination after approval of the guide in the following format

(a) Format of Report: Title, Introduction, Review of literature, Objectives, Material and Methodology, Result and discussion, Conclusion & References

(b) Submission & presentation of research work: At the time of practical examination submit the final project report (hard copy) and present your research findings using 'PowerPoint'.

DSE-XII-A: Biostatistics, Bioinformatics, Medical Zoology & Evolutionary Biology

1) Biostatistics: Calculation of mean & median using given data using MS-EXCEL
2) Biostatistics: Graphical representation & submission of given data using MS-EXCEL
3) Bioinformatics: Retrieval of DNA/Protein sequences from available databases/search engines- NCBI, Entrez, BLAST and submission of sequences in FASTA format
4) Bioinformatics: Construction & submission of Phylogenetic trees using software(s) from given sequences
5) Medical Zoology: study of pathogens- *Plasmodium, Fasciola hepatica, Wuchereria* using permanent slides/museum specimens/CD/Chart
6) Medical Zoology: Study of structure of viruses 'Rabies, HIV, Swine-flu & Tuberculosis' their symptoms & treatment
7) Evolutionary Biology: Examples based on Hardy-Weinberg Law (8 examples)
8) Evolutionary Biology: Study of homologous and analogous organs in museum specimens & its evolutionary significance

DSE-XII-B- Biodiversity & Conservation Biology

1) Concept of sampling: Determination of species area curve
2) Concept of sampling: To perform random sampling, quadrat, transect and point count survey
3) Concept of survey: Use of GPS or Google earth for geo-tagging and map making of study area
4) Concept of Diversity: Study of biodiversity indices of floral and faunal species recorded in and around campus (Species richness, Evenness, Shannon, Simpson diversity)
5) Concept of taxonomy: Classification with keys for identification of local fauna recorded during field survey (Planktons, insects, Pisces, Reptiles, birds and mammals)
6) Concept of Conservation:IUCN categorization of animals found in local area & in India (extinct, extinct in wild, critically endangered, endangered, vulnerable, lower risk, near threatened, least concern, data deficient, not evaluated etc.)
7) Concept of Biogeography: Biogeographic regions of world with indicator species (map based study of Neotropical, Nearctic, Palaerctic, Ethiopian, Oriental, Australian)
8) Study of Biogeographic zones in India with species: Trans-Himalayan, Himalayan, Indian desert, semi-arid zone, Western Ghats, Deccan Peninsula, Gangetic plains, coasts, North-east India, the islands
9) Analysis trophic structure in grassland ecosystem: Study of vertebrate & invertebrate prey & predator interactions in grassland ecosystem and locating their trophic level

Practical-III
Paper-Core-XIII & Core-XIV
(Physiology & Economic Zoology)

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1) Physiology of Muscle: Study of Simple Muscle Twitch
2) Physiology of Heart: Study of Normal Cardiogram

Note for Practical 1 & 2: Demonstration of physiological practical with the help of **CD/Virtual** Dissection

(At the time of examination students are supposed to 'Analyze the given graph and write details of principle, procedure, result, inference and viva-voce based on the given practical)

3) Physiology of Heart: Measurement of blood pressure and heart beat under normal and stress condition .

4) Haematology: Estimation of hemoglobin.
5) Haematology: Enumeration of total count of R.B.C and W.B.C
6) Haematology: Preparation of Haemin crystals
7) Metabolism: Determination of Body Mass Index (BMI)
8) Respiration: Estimation of normal oxygen ($O_{2)}$ consumption using any aquatic Animal.
9) Economic Zoology: Economic importance of Leech, Prawn, Lobster, Crab and Oyster **(spotters)**
10) Economic Zoology: Economic importance of Shark, Pomphret, Oil Sardine, Mackerel, Bombay duck, Eel, Ophiocephalus, Catala, Rohu, Mrugal and Cyprinus - **(spotters)**
11) Economic Zoology: Study of different Fishing Crafts and Gears using CD/Model/Chart-**(spotters)**
12) Study of Crop pests: Pyrilla, Jawar grain borer, Cotton ball worm, Grass hopper using lab specimens-**(spotters)**
13) Fish Products: Fish meal, fish glue, fish oil, fish manure, shagreen using chart/model/CD **(spotters)**
14) Study tour / Internship: **(a)** Sericulture, Agriculture research center, Yoga & Meditation center, Biotechnology lab, fisheries centre etc.
(b) Internship/summer or winter training programmes/workshops/field survey with NGOs & GOs: students can work in various institutes/laboratories/NGOs etc. for period up to 07 days and prepare a report for submission during exam

Practical-IV

Paper-Core-XV & DSE-XVI-A or DSE-XVI-B

Core-XV- Molecular Biology & Biotechnology and
DSC-XVI-A- Endocrinology, Environmental Biology & Toxicology OR
DSC-XVI-B- Techniques in Biology

Core-XV- Molecular Biology & Biotechnology & Toxicology

1) Cell Division:	Study of meiosis in onion bud
2) Chromosomal study:	Staining of chromatin using 'Feulgen Method' in onion root tip
3) Molecular Biology:	Isolation of DNA from suitable material
4) Chromatography:	Separation of amino acids using paper chromatography
5) Electrophoresis:	Demonstration of electrophoresis and photographic analysis of nucleotide / DNA sequence to learn principle of di-deoxy Sanger method
6) Karyotyping:	Study of human Karyotype(s): Normal male and female (Classification of chromosomes according to size and position of centromere); Down syndrome, Klinefelter's syndrome, Turners syndrome using pictures of karyotypes & Idiograms
7) Codon Analysis:	To find out codon sequences for known polypeptide chain of ten amino acids or to find out amino acid sequence from given codons (chart will be provided)

8) **Tour/Review of research:**

(a) Excursion/Study Tour:- Visit to any National Parks/ Zoo parks / marine water / freshwater habitat / Wildlife Sanctuaries / National or State Research Institutes / University departments / or other appropriate Institutes.

OR

(b) Review of research work / student research publication: Review of 10 research papers related to zoology or life science and to prepare a review articles of minimum 5-10 pages

Or

Publication of one research paper in a peer reviewed journal in collaboration with teacher (accepted/published or personated research paper in seminar/conferences/symposia and submission of copy of presented paper with certificate

DSC-XVI-A- Endocrinology, Environmental Biology & Toxicology

1) Histology of Endocrine Glands:	Thyroid, Adrenal, Parathyroid, Pancreas
2) Hydrobiology:	Estimation of dissolved O_2 and free CO_2 & hardness of water.
3) Ecological Adaptations:	Study of animals in relation to their habitats using Charts / videos **(spotters)**

1. Lotic – Guppies.
2. Lentic – Anabas/ Indian major Carp

3. Pelagic – Puffer fish/Mackerel, Sardine
4. Benthic – Lobster, Prawn
5. Grass land – Stick insect/Grasshopper
6. Desert – Phrynosoma, Uromastix.

4) Ecological Pyramid: Study of ecological pyramid using charts

Presentation of given data in the form of ecological pyramids. Data for the ecological pyramids.

a. Members of Grass land ecosystem –
Grasshopper, Rat Snake, Grass, Herbs, Shrubs, Weeds, Trees, Vulture, Squirrel, Earthworm, Centipede, Scorpion , Rabbit and Indian Bustard.

b. Members of Pond ecosystem –
Sponge, Nepa, Leech, Planaria, Hydra, Lymnea, Planorbis, Heron, Kingfisher, Cyclops, Daphnia, Tortoise , Diatoms Vallisneria, Hydrilla, Chara and Spirogyra.

c. Members of Forest ecosystem-
Monkey, Tree Snake, Hyla, Python, Vulture, Giant Squirrel, Gaur, Tiger,Leopard, Deer, Loris, Millipede, King Cobra, Shrub, Herb, Tree, Jungle Fowl, Moss and Fern.

d. Members of Desert ecosystem-
Opuntia, Aloe, Wild Ass, Camel, Ground Spider, Scorpion, Phrynosoma, Uromastix, vitis , Blackbuck, Pencil tree, Nerium.

5) Toxicology: Commonly used household & agricultural toxicants and insecticides, their classification and impact (pyrethroids, mosquito repellants, DDT, sprays, endosulphan, malathion, endrin)

DSC-XVI-B- Techniques in Biology

1) Microtomy:	Principle, procedure & applications of microtomy; Principle & procedure of H-E staining / whole mount (study of protocol using flowchart)
2) Micrometry:	Use of stage & ocular micrometer for of cell(s)
3) Preparation of solutions:	Preparation of Molar, Normal & Percent solution
4) Determination of P^H:	Determination of P^H of any three samples
5) Centrifugation:	Homogenization & cell fractionation for isolation of nucleus and mitochondria (Demo/Protocol)
6) Colorimeter:	Estimation of DNA using DPA method
7) Colorimeter:	Estimation of glucose by Folin-Wu Method
8) Enzymology:	Estimation of Acid & Alkaline Phosphatase using Kit / standard methods

Note:

1. Kindly note that during field visits students shall observe only animals and make record of the observations without disturbing natural habitat not kill the animals. Students should be told about the importance of biodiversity and conservation;
2. Students are encouraged to prepare and submit a concise report of the excursion;
3. Report on multiple excursion tours may be clubbed for preparing and submitting report at the time of final examination will be allowed;
4. Reduce or avoid the use of plastic files during submission of reports / projects as an ecofriendly method.

Skeleton paper for practical examination
(University Examination for 70 Marks)

Practical – I- Core IX & X (Non-chordate & Developmental Biology)	
Questions	Marks
Q.1: Analysis and explanation of anatomical parts of given figure/CD/Chart/Model of Leech/Sea star (Digestive /nervous/reproductive system of Leech **&** Digestive & water vascular system of sea star- (Provide outline of animal and students should draw the given system)	10
Q.2: Analysis and explanation of anatomical parts of given figure/CD/Chart/Model of Leech/Sea star / *Drosophila* culture (Nephridia, salivary gland, Jaws of Leech & Tube foot & Pedicellariae of sea star)	10
Q.3: Protocol for chick embryo mounting (non-invasive method)	10
Q.4: Identification of Zooplanktons from given sample	10
Q-5: Spotting/Identification (only five spotters)	10
Q-6: Field visit report submission (Museum/Freshwater Lake)	10
Q-7: Journal & Viva	10
Total Marks	**70**

Practical-II- Core XI & DSE-XII-A OR XII-B **Core-XI: Comparative Anatomy of Chordates AND** **DSE-XII-A: Biostatistics, Bioinformatics, Medical Zoology & Evolutionary Biology OR** **DSE-XII-B: Biodiversity & Conservation Biology**	
Questions	Marks
Q.1: Analysis and explanation of anatomical parts of given figure/CD/Chart/Model of **Scoliodon/Rat** as per practical syllabus (Cranial nerves of scoliodon, Neck Nerves of rat)	10 10
Q.2: Analysis and explanation of anatomical parts of given figure/CD/Chart/Model of **Scoliodon** as per practical syllabus (membranous labyrinth, eye muscles with innervations of Scoliodon)	10
Q.3: DSE-XII-A: Example based on biostatistics using Hardy-Weinberg Law OR DSE-XII-B: Calculate Shannon-Simpson diversity indices from given data / To Perform line or quadrat sampling using chart	10
Q.4: DSE-XII-A: Example based on bioinformatics / MS-EXCEL OR DSE-XII-B: Identification of biogeographic zones in India using Map / Identification of Biogeographic regions of world using map	10
Q-5: Spotting/Identification (only five spotters)	10
Q-6: Project- Submission & PPT presentation	10
Q-7: Journal & Viva	10
Total Marks	**70**

Practical-III- Core-XIII & XIV Physiology & Economic Zoology	
Questions	Marks
Q.1: Analysis and explanation of given graph- Muscle Twitch / Cardiogram	10 10
Q.2: Estimation of Haemoglobin / Enumeration of RBC or WBC	10
Q.3: Determination of haemin crystals	10
Q.4: Determine Body Mass Index / Estimate oxygen consumption of aquatic animals	10
Q.5: Spotters / Identification	10
Q-6: Submission of study tour report / Internship report- Sericulture/Agriculture research centre/Yoga & meditation centre/fisheries/biotechnology lab/	10
Q-7: Journal & Viva	10
Total Marks	**70**

Practical-IV- Core-XV & DSE-XVI-A- OR DSE-XVI-B **Core-XI: Molecular Biology & Biotechnology AND** **DSE-XII-A: Endocrinology, Environmental Biology & Toxicology OR** **DSE-XII-B: Techniques in Biology**	
Questions	Marks
Q.1: Cytological preparation of meiosis / Feulgen	10 10
Q.2: Isolation of DNA / Karyotype analysis / Electrophoretic analysis	10
Q.3: Paper Chromatography / Codon Analysis	10
Q.4: DSE-XVI-A: Five Spotters (Ecological adaptations) DSE-XVI-B: Estimation of Glucose / DNA / **flow chart of-** microtomy / Principle & procedure H-E staining / Whole mount / spotters (instruments- P^H meter, colorimeter, microtome, centrifuge, H-E slide, whole mount slide)	10
Q.5: DSE-XII-A: Ecological Pyramid DSE-XII-B: Acid phosphatase / Alkaline phosphatase / Determination of P^H/Normal,molar,percent solution	10
Q-6: (a)Study tour- Submission of report (National parks/Marine or freshwater habitat/sanctuaries/national or state research lab./university departments) **OR** (b) Review of research work / student research publication(s) **OR** (c) Paper presentation – Certificate and copy of Presented paper.	10
Q-7: Journal & Viva	10
Total Marks	**70**

Important Instructions:

-All necessary precautions must be taken while organizing study tour with special reference to the safety of students as per Higher Education rules and regulations.

Note:

-As per the guidelines of **UGC notification number F.14-6/2014(CPP-II) dated 1st August, 2014** it is now essential to make necessary modifications to stop dissection and promote and orient students towards the knowledge component rather than skill development. However, ITC

based virtual dissections are promoted. Now, the responsibility to discontinue dissections and use of animals in experiments totally rests on concerned authorities of respective colleges/Institutes. As per the notification it is important to encourage the field trips and observations without disturbing the biodiversity. For laboratory observations existing permanent slides and specimens should be shown. As per the guidelines of UGC , all the Zoology departments should be empowered with infrastructure to adopt Information communication technology (ICT) required for the purpose of virtual dissections for which virtual class room / laboratory to be enriched with few computers (according to the strength of students),internet facility , printer etc.

Equivalence:

Sr.No.	Old CGPA	New CBCS
Semester-V		**Semester-V**
Paper-VII	Non-chordate	Core-IX- Non-chordate
Paper-VIII	Biostatistics, bioinformatics, medical zoology, evolutionary genetics	DSE-XII-A- Biostatistics, bioinformatics, medical zoology, evolutionary biology
Paper-IX	Comparative anatomy of chordates	Core-XI- Comparative anatomy of chordates
Semester-X	Developmental biology	Core-X- Developmental biology
Semester-VI		**Semester-VI**
Paper-XI	Physiology	Core-XIII- Physiology
Paper-XII	Endocrinology, environmental biology & toxicology	DSE-XVI-A- Endocrinology, environmental biology & toxicology
Paper-XIII	Molecular Biology & Biotechnology	Core-XV- Molecular Biology & Biotechnology
Paper-XIV	Biotechniques & Applied Zoology	DSE-XVI-B-Techniques in Biology & Core-XIV- Economic Zoology

Chairman
(Board of studies in Zoology)