

**B.SC. – VI SEMESTER  
ZOOLOGY OPTIONAL (PROJECT WORK)  
ZO 354 – BIODIVERSITY AND WILDLIFE BIOLOGY**

**SCHEME OF EVALUATION**

- I. Field work and preparation of dissertation - 20 marks  
( to be evaluated by Project Guide\* + Internal Examiner + External Examiner  
Each for 20 marks and average shall be taken.)  
Project guide shall assess the candidates based on their involvement in  
The field work and preparation of dissertation. Marks allotted for the same shall be  
handed over to Head of the dept. in a sealed cover which will be transmitted to  
examiners.
- II. Presentation by the candidate (PPT slides may be used if necessary ) -10 marks
- III. Viva-voce ( Based on the content of dissertation.) -10 marks
- Total 40**

TEACHING HOURS (PRACTICALS)	: 2 Hours/week.
TOTAL MARKS (PRACTICALS)	: 40 Marks
INTERNAL ASSESSMENT	: 10 Marks
TOTAL	: 50 Marks

**Note : 1. Internal assessment marks to be allotted based on the preparation and presentation of the dissertation topic**

**B.SC. - VI SEMESTER  
ZOOLOGY OPTIONAL (THEORY)**

**ZO 352 - ENVIRONMENTAL BIOLOGY AND WILDLIFE BIOLOGY**

**SCHEME OF EXAMINATION**

Question no.	PART - A	Marks
<b>I</b>	<b>Answer any 10 questions</b>	<b>10X2= 20</b>
	<b>PART - B</b>	
<b>II</b>	<b>UNIT -I</b>	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
<b>III</b>	<b>-do-</b>	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
<b>IV</b>	<b>UNIT -II</b>	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
<b>V</b>	<b>- do-</b>	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
<b>VI</b>	<b>UNIT -III</b>	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
<b>VII</b>	<b>- do-</b>	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
<b>VIII</b>	<b>UNIT -IV</b>	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
<b>IX</b>	<b>- do-</b>	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
		<b>TOTAL - 80</b>

**Note: Part - A - Question no. I Answer any 10 questions out of 12 questions (a to l) (Give 3 questions from each unit)  
Part - B - Answer one full question from each unit.**

TOTAL TEACHING HOURS (THEORY) : 40 Hrs.  
TOTAL MARKS (THEORY) : 80 Marks  
INTERNAL ASSESSMENT : 20 Marks  
**TOTAL : 100 Marks**

**Note : Internal assessment marks to be allotted after conducting one theory test at the end of the semester**

## REFERENCES

1. S. M. Nair - Endangered animals of India and their conservation, National Book Trust, 1992.
2. S. H. Prater - The book of Indian Animals, Bombay Natural History Society, Oxford University Press, 1971.
3. Dr. Peter D. Moore - The Encyclopedia of Animal Ecology, Facts On File, New York, 1989.
4. Tony Hare - Habitats, Duncan Baird Publishers, London, 1994.
5. Odum - Ecology
6. Darlington P. J. - Zoogeography
7. BNHS - Wild Animals of India
8. BNHS - Preservation of wildlife in India
9. V.B. Saharia - Wildlife in India
10. A.B. Chaudhuri - Plant wildlife and Man
11. Nair Principles of Environmental Biology
12. Arora - Ecology
13. Verma and Agarwal - Principles of Ecology
14. Agarwal - Environmental Biology
15. Robert Lea Smith - Ecology and Field Biology, Fourth Edition, Harper Collins's Publishers, 1990.
16. The Preservation of Wild Life in India - Daya Publishing House, Delhi, 1988.
17. Jonathan Griffin & David Clive Price - Wildlife of India, The Guide book company Limited, Hong Kong, 1992.
18. Biodiversity - Enviroscope - Centre for Environment Education, Oxford University Press, New York, 1996.
19. G. Tyler Miller - Living in the Environment, Eighth Edition, International Thomson Publishing, 1994.
20. K. Sinha (Ed) - Biodiversity- Global Concerns, Commonwealth publishers, New Delhi, 1996.
21. P.R. Ehrlich & S. Rough garden - The Science of Ecology, Macmillan Publishing Company, New York, 1987.
22. M. M. Saxena - Applied Environmental Biology, Agro Botanical Publishers (India), 1989.
23. Moriarty - Ecotoxicology 2<sup>nd</sup> Edition, Academic Press, New York
24. Patrick I. Osborne - Tropical Ecosystems & Ecological concepts, Cambridge University Press, 2000.
25. A.B. Saxena - Introduction to Butterflies, Anmol Publications Pvt. Ltd., New Delhi, 1996
26. K. Prabhakar Achar & K. Geetha Nayak - Birds of Dakshina Kannada, Bhuvanendra Nature Club - India, 2000.
27. K. Gunathilagaraj - Some South Indian Butterflies, Nilgiri Wildlife & environment Association, 1998.
28. Richard Grimmett, Carol Inskipp, Tim Inskipp - Birds of the Indian Subcontinent, Oxford University Press, New Delhi, 1999.
29. Salim Ali & S. Dillon Ripley - A Pictorial Guide to the Birds of the Indian Subcontinent, Bombay Natural History Society, Oxford University Press, 1995.
30. Salim Ali - The book of Indian Birds, Bombay Natural History Society, Oxford University Press, 1993.

**B.SC. – VI SEMESTER**

**ZOOLOGY OPTIONAL (PROJECT WORK/FIELD TRAINING)  
ZO 354 – BIODIVERSITY AND WILDLIFE BIOLOGY**

**2HRS/WEEK**

1. Study of animal diversity in various habitats - gardens/croplands/grasslands/forests/ponds/rivers/stream/sea shores /sanctuaries/national parks .
  2. Bird watching and preparation of checklist of birds from different habitats.
  3. Identification and study of local edible fishes.
  4. Listing and identifying local butterflies and preparation of checklist of butterflies.
  5. Listing and identifying common spiders and ants.
  6. Listing and identifying terrestrial and fresh water mollusks.
  7. Identification of molluscan shells from nearby coasts. ✓
  8. Diversity of ornamental fishes.
  9. Diversity of insects.
  10. Insect pests of ,  
Vegetables, fruit crops, horticultural plants, paddy etc. ✓
  11. Store pests.
  12. Study of biodiversity in sacred groves.
  13. Study of community: By quadrat method to determine frequency, density and abundance of different species present in the community.
  14. In addition to the above mentioned exercises any faunal diversity of local interest and their characteristic features may be chosen for project work.
- Note: During field studies care should be taken not to disturb/remove the specimens/nests etc.,

**Project report**

**Certified dissertation shall be submitted during practical examination which shall be evaluated by both internal and external examiners.**

## 2.5 Food chains and energy flow

Types of food chains with examples. Food webs with examples. Ecological pyramids with examples – energy flow and laws of thermodynamics. –2hrs.

## UNIT – 3 : ENVIRONMENTAL BIOLOGY (Cont...)

### 3.1 Biogeochemical Cycles

Nitrogen, Carbon, oxygen, Phosphorous and sulphur cycles –3hrs.

### 3.2 Environmental Pollution with reference to India

Air pollution- major air pollutants( Carbon dioxide, oxides of sulphur and nitrogen), acid rain, photochemical smog, chlorofluorocarbon, radioactive elements, flyash

Water pollution – industrial, thermal pollution, sewage and eutrophication with examples.

Biochemical oxygen demand (BOD), bioindicators and geoindicators

Soil pollution, noise pollution, – sources, effects and control. –4hrs

### 3.3 Global impacts

Climate change -Greenhouse effect, el nino, la nino, Tsunami –2hrs.

### 3.4 Landscape Ecology

Landscape concept – landscape elements – corridors – mosaic – landscape matrix. –1hr

## UNIT – 4 : WILDLIFE BIOLOGY

### 4.1 Zoogeography

Zoogeographical realms of world, with climatic conditions and examples of characteristic fauna – a brief account of Wallace's line. –2hrs.

### 4.2 Distribution of wildlife

Continuous and discontinuous distributions with examples – Barriers of dispersals – topographic and vegetation barriers – large bodies of water as barriers – climatic barriers.

Indian wildlife - The Himalayan ranges – The Peninsular Indian sub region – Deccan Plateau – the Western Ghats – Eastern hill chain – Aravali ranges – the Indian desert – tropical rain forests – wildlife in Andaman and Nicobar islands. –4hrs.

### 4.3 Threats to wildlife and Wildlife Conservation

Anthropogenic factors - Hunting, over harvesting, habitat destruction, Degradation, habitat shrinkage, climate change, human animal conflict –1hr.

Laws related to wildlife conservation, Agencies engaged in wildlife conservation, Government organisation and non-government organizations (NGOs).

Wildlife (Protection) Act 1972. CITES (Convention on International Trade in endangered species of wildlife flora and fauna) endangered species of India. IUCN category of endangered animals. Red data book. Ramsar convention. CBD. Biosphere reserves- Important National parks and Wildlife sanctuaries of India (with special emphasis on Karnataka)- projects for endangered species, project tiger- project elephant – project rhino, protection of traditional knowledge, Intellectual property rights and patenting.

**B.SC. - VI SEMESTER**  
**ZOOLOGY OPTIONAL (THEORY)**  
**ZO 352 - ENVIRONMENTAL BIOLOGY AND WILDLIFE BIOLOGY**  
40 hrs

**UNIT- 1: ENVIRONMENTAL BIOLOGY**

**1.1 Introduction**

Ecological spectrum - subdivisions of ecology - scope of ecology. -1 hr.

**1.2 Abiotic factors**

Light - effect of light on plants and animals. Temperature - thermal stratification - extreme temperature - cyclomorphosis. Adaptations to extreme temperature Soil - soil formation - types of soil based on texture, soil profile - soil organisms, Water, Oxygen and Carbon dioxide, Fire and Wind) . -4 hrs.

**1.3 Biotic factors**

Animal relationships - mutualism, commensalism, parasitism, ammensalism, predation and competition with relevant examples. -2 hrs.

**1.4 Habitats**

Marine habitat - zonation of the sea and ecological classification of marine biota, coastal ecology, estuarine ecology and mangroves. Fresh water habitat - lentic and lotic systems. Ecological classification of fresh water animals. Terrestrial habitats - A brief account of biomes. Ecological adaptations to marine, fresh water and terrestrial habitats. - 3hrs.

**UNIT -2 : ENVIRONMENTAL BIOLOGY (Cont..)**

**2.1 Population Ecology**

Population density - natality and mortality - age distribution - population growth rate - population growth curves. Biotic potential - Allee's principle and Gause's principle. -2hrs.

**2.2 Community Ecology**

Community structure - ecological determinants - ecological stratification - ecotone and edge effect. Ecological niches - ecological succession - climax community - alpha, beta, gamma diversity, Shanon index. -3hrs.

**2.3 Ecosystem**

The tropical pond as an ecosystem - abiotic components - producers and consumers - interaction between components. Types of ecosystems with examples - natural ecosystems - man engineered ecosystem and microecosystems. Biosphere and ecotone. -3hrs.

**B.S.C. - VI SEMESTER  
ZOOLOGY OPTIONAL (PRACTICAL)  
ZO 353 - REPRODUCTIVE BIOLOGY AND DEVELOPMENTAL BIOLOGY**

**SCHEME OF EXAMINATION**

I a. Mounting of any one larval stage, identify and comment	6	rd
b. Submission of two permanent slides	4	
II. Identify and comment on any 2 permanent slides of developmental stages (1 from frog + 1 from chick)	10	
III. Placenta slide -)	5	
IV. Viva voce (Topics from Reproductive & Developmental Biology)	5	
V. Records	10	
<b>Total :</b>	<b>40</b>	

**Note :** Questions must be framed as per the scheme provided.

TEACHING HOURS (PRACTICAL)	: 2 Hours/week.
TOTAL MARKS (PRACTICALS)	: 40 Marks
INTERNAL ASSESSMENT	: 10 Marks
<b>TOTAL</b>	<b>: 50 Marks</b>

**Note :** Internal assessment marks to be allotted after conducting one practical test at the end of the semester

**B.SC. - VI SEMESTER  
ZOOLOGY OPTIONAL (THEORY)  
ZO 351 - REPRODUCTIVE BIOLOGY AND DEVELOPMENTAL BIOLOGY**

**SCHEME OF EXAMINATION**

Question no.	PART -A	Marks
<b>I</b>	<b>Answer any 10 questions</b>	<b>10X2= 20</b>
	<b>PART -B</b>	
<b>II</b>	<b>UNIT -I</b>	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
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		<b>TOTAL - 80</b>

**Note: Part - A - Question no. I Answer any 10 questions out of 12 questions (a to l) (Give 3 questions from each unit)  
Part - B - Answer one full question from each unit.**

**TOTAL TEACHING HOURS (THEORY) : 40 Hrs.  
TOTAL MARKS (THEORY) : 80 Marks  
INTERNAL ASSESSMENT : 20 Marks  
TOTAL : 100 Marks**

**Note : Internal assessment marks to be allotted after conducting one theory test at the end of the semester**



**B.SC. – VI SEMESTER  
ZOOLOGY OPTIONAL (PRACTICAL)  
ZO 353 – REPRODUCTIVE BIOLOGY AND DEVELOPMENTAL  
BIOLOGY**

2hrs/week

1. Stages of development of frog: The study of cleavage stages, blastula, gastrula and neurula (sections) and various stages of tadpole.
2. Study of permanent slides of chick embryo : 18 hrs, 24hrs, 36hrs and 48hrs (WM).
3. Study of permanent slides of chick embryos: T.S. of 18 hrs and 24 hrs.
4. Study of permanent slides/ preparations of any two types of placenta
5. Mounting (Permanent)
  - a. Different stages of *Drosophila* Larvae
  - b. Mosquito larvae
  - c. Zoea, Nauplius, Mysis

**REFERENCES :**

1. Adamstone – Introduction to Vertebrate Embryology
2. Huebner A. F. Fundamentals of comparative embryology of Vertebrates
3. McEwen R.S. – Vertebrate Embryology
4. Patten B.M. – Early embryology of Chick
5. Patten B.M. – Fundamentals of Embryology
6. Darlington P. J. – Zoogeography
7. Nair and Achar – A text book of Embryology
8. Nair & Achar – A Manual of Practical Zoology, Vol. III
9. Bruce M. Carlson – Patten's Foundations of Embryology, 4<sup>th</sup> Edition, TMH Edition, New Delhi, 1984.
10. M.N. Majumder – T. B. of Vertebrate Embryology, Tata McGraw-Hill Publishing Co. Ltd., New Delhi

996649929  
(Patterson Lab - Ground Floor)

### UNIT - 3 : DEVELOPMENTAL BIOLOGY( Cont....)

#### 3.1 Organizer phenomenon

Definition - The amphibian organiser, The organizers role in development. Potencia of the dorsal lip of the blastopore of amphibian gastrula Brachet's experiment - experiment of Spemann and Mangold, Induction of Organizer, Chemical nature of organizer, Parts of organizer, Theories of organizer phenomenon. -2 hrs

#### 3.2 Early Development of Frog

Cleavage - Blastula - Fate maps of Blastula - Gastrulation - Mesogenesis Notogenesis and Neurulation. -4hrs.

#### 3.3 Early development of chick

Structure of hen's egg - cleavage - blastula - gastrulation - origin and structure primitive streak - structure of 18, 24, 48 hour chick embryos. - 4hrs.

### UNIT - 4 : DEVELOPMENTAL BIOLOGY (Cont.)

#### 4.1 Extraembryonic membranes of chick

Development, Structure and functions of Yolk-sac, Amnion, Chorion and Allanto - 2hrs.

#### 4.2 Placenta

Yolk sac placenta - Allantoic placenta - structure and functions of placenta Morphological and histological, Classification of placenta with examples. -3hrs.

#### 4.3 Early development of human foetus

Structure of a mature sperm and Graafian follicle - ovulation - fertilization - morula Blastocyst - implantation - gastrulation - placenta - structure and function. Twins and multiple births. - 3hrs.

#### 4.4 Role of hormones in development

Gonadotropins - hormones secreted by testis and ovaries. Hormones of placenta and their function. -2hrs.

B.SC. – VI SEMESTER

ZOOLOGY OPTIONAL (THEORY)  
ZO 351 – REPRODUCTIVE BIOLOGY AND DEVELOPMENTAL  
BIOLOGY

40 hrs

UNIT- 1 : REPRODUCTIVE BIOLOGY

1.1 Reproductive system

Introduction to Male and female reproductive systems. Accessory sex organs -2hrs  
Secondary sexual characters in humans

1.2 Gametogenesis

Spermatogenesis- Formation of spermatids – Spermiogenesis – Structure of mature spermatozoan. Oogenesis – Previtellogenesis and Vitellogenesis- Estrous cycle in non-primate mammals and menstrual cycle in humans. Comparison between spermatogenesis and Oogenesis. -3 hrs.

1.3 Parthenogenesis

Parthenogenesis -Kinds of parthenogenesis (Natural – Arrhenotoky, Thelytoky and Cyclical) Artificial Parthenogenesis. Significance of Parthenogenesis. Hermaphroditism - 3hrs

1.4. Modern trends in reproduction

Manipulation of reproduction - gene bank, sperm bank, superovulation, artificial insemination, in-vitro fertilisation (IVF), embryo splitting, Animal Cloning, surrogate mother - 2hrs.

UNIT – 2 : DEVELOPMENTAL BIOLOGY

2.1 Introduction

Historical review – Basic concepts in developmental Biology. Overview of developmental process. Cell fate and commitment. Theories of development, development and differentiation – branches of embryology – scope of embryology. -3hrs.

2.2 Fertilization

Types of eggs, Structure of sperm and eggs of frog and chick. Kinds of fertilization – Approximation of gametes – fertilizin and antifertilizin – Acrosome reaction – Cortical reaction – Amphimixis. Monospermic and Polyspermic fertilization. Significance of Fertilization. -4hrs.

2.3 Cleavage

Laws of cleavage – types of cleavage – holoblastic, meroblastic, radial and spiral types with examples – effects of yolk on cleavage, types of blastula, gastrulation. -3hrs.

**B.Sc. – V SEMESTER  
ZOOLOGY OPTIONAL (PRACTICAL)  
PAPER ZO 304 : GENETICS, BIOSTATISTICS, EVOLUTION AND  
PALEONTOLOGY**

**SCHEME OF EXAMINATION**

I. Work out the Problems with reasons (Genetics-1; Biostatistics-1)	2x5=10	10
II. Drosophila sex comb mounting	5	5
III. Mutants of Drosophila – Identify and comment (2)	5	3
IV. Staining of Buccal mucosa and display of Barr bodies and comment on the Significance		4
OR		
Identify the blood group and comment on the Significance of blood grouping	5	
V. 1 specimen or 1 model from Evolution & paleontology	5	
VI. Records		10
<b>TOTAL</b>		<b>40</b>

**Note: Questions must be framed as per the scheme provided.**

TOTAL TEACHING HOURS (PRACTICAL)	: 2 Hrs/week.
TOTAL MARKS (PRACTICAL)	: 40 Marks
INTERNAL ASSESSMENT	: 10 Marks
TOTAL	: 50 Marks

**Note: Internal assessment marks shall be awarded based on one practical test conducted at the end of the semester**

**B.SC. - V SEMESTER  
ZOOLOGY OPTIONAL (THEORY)  
PAPER ZO 302 : GENETICS, BIOSTATISTICS, EVOLUTION AND  
PALEONTOLOGY**

**SCHEME OF EXAMINATION**

Question no.	PART -A	Marks
I	Answer any 10 questions	10X2= 20
<b>PART -B</b>		
II	UNIT -I	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
III	-do-	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
IV	UNIT -II	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
V	- do-	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
VI	UNIT -III	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
VII	- do-	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
VIII	UNIT -IV	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
IX	- do-	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
		<b>TOTAL - 80</b>

Note: Part - A - Question no. I Answer any 10 questions out of 12 questions (a to l) (Give 3 questions from each unit)

Part - B - Answer one full question from each unit.

TOTAL TEACHING HOURS (THEORY) : 40 Hrs.  
TOTAL MARKS (THEORY) : 80 Marks  
INTERNAL ASSESSMENT : 20 Marks  
**TOTAL : 100 Marks**

Note : Internal assessment marks to be allotted after conducting one theory test at the end of the semester

## REFERENCES :

1. I.P.K. Gupta – Cell Biology, Genetics and evolution
2. P.S. Verma and Agarwal – Cell Biology, Genetics, Molecular Biology and Evolution.
3. Powar C. B. – Cell Biology
4. Swanson, Merz and Young – Cytogenetics
5. Dobzhansky – Heredity and Nature of Man
6. Gardner – Principles of Genetics, Wiley & Sons Inc., New York, 1975
7. Strickberger – Genetics, III Edition, Prentice Hall of India Pvt. Ltd., 1995.
8. Winchester – Genetics
9. Sinnott, Dunn, Dobzhansky – Principles of Genetics
10. F. Clarks Fraser & James J. Nora – Genetics of Man, IInd Edn., Lea & febiger. Philadelphia, 1986.
11. John E. Pfeiffer – The emergence of Man, Harper & Row, New York, 1969
12. P. Joshi – Genetic Engineering & its Application, Agro Botanica, India, 1999
13. A.P. JHA – Genes and Evolution, Rajiv Beri for Mac Millan India Ltd., 1993
14. Robert H. Tamarin – Principles of Genetics, PWS Publishers, 1982
15. B. Lewin (Ed) – Genes, VII Edition, John Wiley and Sons, New York, 1996
16. Nair & Achar – A text book of genetics & Evolution (2<sup>nd</sup> Edn)
17. M. Sudhakar Rao, N.A. Madhyastha – Cytology, Genetics and Evolution
18. Norman T. J. Bailey (1994) Statistical methods in biology, 3<sup>rd</sup> edition, Cambridge University Press.
19. T.H. Hassard (1991) Understanding Biostatistics, Mosby year Book St. Louis.
20. N.Gurumani (2004) An introduction to Biostatistics, MJP publishers Chennai

21. S.A. Khan and A. Khanum (1994)  
Fundamentals of Biostatistics, Vikas  
Publication, Hyderabad.

#### 4.3 Palaeontology

Brief account of geological time scale, Fossils and fossilization, Dinosaurs and Archaeopteryx.  
Origin and evolution of horse and man. 2hrs.

### B.SC. - V SEMESTER ZOOLOGY OPTIONAL (PRACTICAL) PAPER ZO 304 : GENETICS, BIOSTATISTICS, EVOLUTION AND PALEONTOLOGY

2 hrs/week

1. Experiments with *Drosophila*.
  - a. Preparation of *Drosophila* culture media
  - b. Phenotypic characters of *Drosophila*
  - c. Life cycle of *Drosophila*
  - d. Mutants of *Drosophila* (minimum 4 mutants)
  - e. Mounting of sex comb
2. Display of Barr body in buccal smear.
3. Blood typing for the detection of blood group and Rh factor

#### 4. Genetics problems

- a. Genetic problems: Monohybrid inheritance (2)
- b. Genetic problems: Dihybrid inheritance (2)
- c. Genetic problems: Multiple alleles - ABO blood group in humans (2).
- d. Sex-linked inheritance in *Drosophila* (1)
- e. Sex linked inheritance in humans (2)
- f. Calculation of allele frequency - ABO blood group in humans.

#### 5. Biostatistics problems

- a. Graphical representation (2)
- b. Mean, median, mode (2)
- c. Chi-square test (1)
- d. Student t- test (1)
- e. ANOVA (1)

#### 6. Evolution

- a. Study of homologous organs - forelimbs of frog and bird; mouth parts of cockroach and mosquito, butterfly.
- b. Study of analogous organs - vertebrate and cephalopod eye, wing of bird and insect.
- c. Study of vestigial organs - appendix, coccyx and molar teeth in man.

#### 7. Palaeontology

- a. Study of models of Dinosaurs. (Ichthyosaurus, Tyrannosaurus, Brontosaurus, Stegosaurus and Triceratops).
- b. Study of extinct Archaeopteryx.
- c. Study of models of fossil man. (Any four available models).

*Australopithecus*  
*Neanderthal* (fossil man)  
*Eo man*  
38

### 2.3 Sex-determination and Sex linked inheritance:

Types of Sex chromosomes, Chromosomal mechanism of sex determination (XX-XY, XX-XO, ZZ-ZW with specific examples)

Sex linked inheritance in Drosophila (Cite examples). Haemophilia and colour blindness in man. Sex linkage in birds (poultry), Y-linked genes in humans.

Sex limited and sex influenced traits

4hrs.

### 2.4 Gene, Gene Mutation and DNA repair

Concept of gene, definition. Fine structure of gene - cistron, muton, recon, introns, regulation of gene expression. Operon concept - Lac Operon.  
Mutation - Types, point mutation, frame shift mutation, inversion, insertions. Molecular basis of mutations. DNA repair - excision repair, photoreactivation, recombinational and SOS repairs.

3hrs.

## UNIT - 3 : HUMAN GENETICS AND BIOSTATISTICS

### 3.1 Human Genetics

Human karyotype, ideogram, pedigree analysis - common human chromosomal syndromes - Klinefelter's and Turner's Syndromes, Down's syndrome. Inborn errors of metabolism - Albinism - Phenylketonuria, Alkaptonuria, Sickle cell anemia, Thalassemia, Huntington's chorea - Prenatal diagnosis - Amniocentesis, chorionic villus sampling, Genetic counseling.

4hrs

Human genome project.

### 3.2 Biostatistics

Introduction to biostatistics, basic concepts, presentation of data, Tabular and graphical representation.

Analysis of data - mean, median and mode.

Standard deviation, standard error of mean (SEM)

Tests of significance, Student t-test, chi-square test, Analysis of variance (ANOVA)

Statistical packages.

6 Hrs.

(Wherever necessary appropriate problems should be worked out.)

## UNIT - 4: EVOLUTION AND PALAEOLOGY

**4.1 Speciation and theories of Organic Evolution:** Concept of species - speciation - sympatric and allopatric speciation, Lamarckism, Darwin-Wallace theory of Natural selection, Synthetic theory of evolution - Neo-Darwinism, Hardy-Weinberg law of Equilibrium. Factors influencing change in gene frequencies in a population - Gene mutation, gene flow, genetic drift, natural selection and isolation, Microevolution and macroevolution, Molecular phylogeny

5hrs.

### 4.2 Evidences of Organic Evolution

Evidences from comparative morphology, anatomy, physiology, biochemistry, embryology and palaeontology.

3hrs.



**B.SC. - V SEMESTER  
ZOOLOGY OPTIONAL (PRACTICAL)  
PAPER ZO 303 : CELL BIOLOGY AND BIOTECHNOLOGY**

**SCHEME OF EXAMINATION**

I.	Squash preparation of onion root tip or grass hopper testis.	8
II.	Squash preparation of salivary gland chromosomes	8
III.	Extraction of DNA from coconut endosperm/ chicken liver ( any one)	8
IV.	Identify and comment with labeled diagram : 2 slides ( 1 mitosis & 1 meiosis)	2X3 = 6
V.	Class records.	10
	<b>TOTAL :</b>	<b>40</b>

**Note: Questions must be framed as per the scheme provided.**

TEACHING HOURS (PRACTICAL)	: 2 Hrs/week.
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INTERNAL ASSESSMENT	:10 Marks
<b>TOTAL</b>	<b>: 50 Marks</b>

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At the end of the semester**

**B.SC. - V SEMESTER  
ZOOLOGY OPTIONAL (THEORY)  
PAPER ZO 301 : CELL BIOLOGY AND BIOTECHNOLOGY**

**SCHEME OF EXAMINATION**

Question no.	PART -A	Marks
I	Answer any 10 questions	10X2= 20
<b>PART -B</b>		
II	UNIT -I	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
III	-do-	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
IV	UNIT -II	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
V	- do-	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
VI	UNIT -III	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
VII	- do-	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
VIII	UNIT -IV	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
IX	- do-	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
		<b>TOTAL - 80</b>

**Note: Part - A - Question no. I Answer any 10 questions out of 12 questions (a to l) (Give 3 questions from each unit)  
Part - B - Answer one full question from each unit.**

TOTAL TEACHING HOURS (THEORY) : 40 Hrs.  
TOTAL MARKS (THEORY) : 80 Marks  
INTERNAL ASSESSMENT : 20 Marks  
**TOTAL : 100 Marks**

**Note : Internal assessment marks to be allotted after conducting one theory test at the end of the semester**

19. Nair & Achar – A textbook of Cell Biology (2<sup>nd</sup> Edn)
20. Dalela and Verma – A textbook of Cytology
21. M. Sharmarajan – Genetic Engineering
22. M. Sudhakar Rao, N.A. Madhyastha – Cytology, Genetics and Evolution
23. H. D. Kumar – Molecular Biology & Biotechnology, Second Revised Edition, Vikas Publishing House Pvt. Ltd., 1993.
24. R. M. Twyman – Advanced Molecular Biology, A Concise Reference, Viva Books Private Limited, New Delhi, Mumbai, Chennai, 1999.
25. Keshav Trehan – Biotechnology, Wiley Eastern Limited, New Delhi, 1990

**B.Sc. - V SEMESTER**  
**ZOOLOGY OPTIONAL (PRACTICAL)**  
**PAPER ZO 303 : CELL BIOLOGY AND BIOTECHNOLOGY**  
**2 hrs/week**

1. Study of fixatives and stains:  
Formaldehyde (4 to 10%), Alcohol (70% to 100%), Carnoy's solution, Borax carmine (alcoholic), Eosin (alcoholic), Iron Haematoxylin, Acetocarmine, Aceto orcein, Schiff's reagent (Feulgen method), Mordant (4% Iron alum), Giemsa's stain  
**Note: Preparation procedure is to be included in the practical records**
2. Observation and study of permanent slides of onion root tip to study all stages of mitosis.
3. Observation and study of permanent slides of grasshopper testis to study various stages of meiosis.
4. Study of permanent slide of salivary gland chromosomes of *Drosophila*/Chironomous larva.
5. Squash preparation of onion root tip to study stages of mitosis.
6. Squash preparation of grasshopper testis to study stages of meiosis.
7. Squash preparation of salivary gland chromosomes of *Drosophila*.
8. Extraction of DNA from coconut endosperm/ chicken liver

**REFERENCES :**

1. J. H. Darnell, Lodish and D. Baltimore - Molecular Cell Biology, Scientific American Books, New York, 1995
2. Cohn N.S. - Elements of Cytology
3. M.J.D. White - Animal Cytology and Evolution
4. Watson, J. D. - The Double Helix
5. Bourns, G.H. - Cytology and Cell Physiology
6. P.K. Gupta - Cell Biology, Genetics and evolution
7. P.S. Verma and Agarwal - Cell Biology, Genetics, Molecular Biology and Evolution.
8. Powar C. B. - Cell Biology
9. Swanson, Merz and Young - Cytogenetics
10. Geoffrey Cooper - Cell
11. David E. Sadava - Cell Biology, Jones and Bartlett Publication Inc., Boston
12. Lewis L. Kleinsmith & Valerie M. Kish - Principles of Cell and Molecular Biology, Harper Collins College Publishers, 11nd Edn., 1995
13. E.D.P. De Robertis & E.M.F. Robertis - Cell & Molecular Biology, VIII Edn., B.I. Waverly Pvt. Ltd., New Delhi, Indian Edition Bombay, 1995
14. John E. Pfeiffer - The emergence of Man, Harper & Row, New York, 1969
15. P. Joshi - Genetic Engineering & its Application, Agro Botanica, India, 1999
16. A. P. JHA - Genes and Evolution, Rajiv Beri for Mac Millan India Ltd., 1993
17. Julio E. Celis- Cell Biology (A laboratory Handbook) Volumes I, II , Academic Press, New York, 1994
18. B. Lewin (Ed) - Genes, VII Edition, John Wiley and Sons, New York, 1996

## UNIT - 3 : CELL BIOLOGY (Cont...)

### 3.1 Genetic Code and Protein Biosynthesis

Genetic code - properties of genetic code - Wobble hypothesis.  
Components of protein biosynthesis. Mechanism of protein biosynthesis. -3 hrs.

### 3.2 Mitosis

Mitotic cycle - interphase - prophase - centriole cycle - mitotic apparatus - chemical events during Prophase, Metaphase, Anaphase, role of mitotic apparatus in chromosome movements - Telophase- Cytokinesis - Differences between mitosis in plant and animal cells - significance of Mitosis - Mitotic inhibitors. -3hrs

### 3.3 Meiosis

Phases of meiotic cycle - Stages of I and II meiotic divisions ; Synaptonemal complex and recombination , Mechanism of crossing over, cytological basis of crossing over. Significance of crossing over, Interkinesis, Second meiotic division, Significance of meiosis. - 4hrs.

## UNIT -4 : BIOTECHNOLOGY

### 4.1 Genetic Engineering

Introduction - Transduction, C - DNA. Recombinant DNA technique - Principles and methods of Gene cloning - Requirements ( Isolation of target DNA, cloning vectors, plasmids and episomes, restriction enzymes), method of cloning, gene libraries, Applications of recombinant DNA technique.

PCR technique, Southern and Western blot technique, DNA finger printing, applications. -5 hrs.

### 4.2 Biotechnology - Applications

Introduction, Biotechnology in industries and environment - microbes and biotechnology- Fermentation technology, Microbes in pollution control, Biotechnology in bioremediation. Biotechnology in disease prevention and diagnosis, Pharmaceuticals, Vaccines. Transgenic animals. Stem cells in transgenesis, gene therapy. - 5hrs.

**B.SC. - V SEMESTER**  
**ZOOLOGY OPTIONAL (THEORY)**  
**PAPER ZO 301 : CELL BIOLOGY AND BIOTECHNOLOGY**  
**40 hrs.**

**UNIT - 1 : CELL BIOLOGY**

**1.1 Introduction**

History of cell biology - subdivisions of cell biology. Tools and techniques of cell biology - different types of microscopy (Bright field, dark field, phase contrast and electron microscopy), Ultracentrifugation. - 2hrs.

**1.2 Chromosomes**

Morphology of chromosomes - Structure - centromere, telomere, Heterochromatin and Euchromatin. Types of chromosomes, chromosome number, genome. Ultra structure of chromosomes - Folded fiber model, Nucleosome model, Giant chromosome - Polytene and Lampbrush chromosomes, Supernumerary chromosomes. - 4hrs.

**1.3 Nucleic Acids**

Introduction - Identification of genetic material - Griffith's experiment, Chemistry of nucleic acids - structure of DNA - Watson and Crick DNA model - Replication of DNA - Enzymes of DNA replication. Forms of DNA., Types of RNA. Transcription and RNA processing (Intron splicing and post transcriptional modifications). - 4hrs.

**UNIT - 2 : CELL BIOLOGY (Cont...)**

**2.1 Plasma membrane and cell junctions**

Fluid mosaic model of plasma membrane, cell receptors, functions. Types of cell junctions, cell adhesion, extracellular matrix - 2hrs

**2.2 Cytoskeleton and cell motility**

Microtubules, microfilaments, intermediate filaments - Organisation and functions - 2hrs

**2.3. Cell differentiation**

General characteristics, Nucleocytoplasmic interactions -2hrs

**2.4 Cancer and Carcinogenic Agents**

Concept of cancer, Types of cancer. Characteristics of cancer cell. Oncogenes - immune system and cancer - Carcinogenic agents (physical, chemical and biological) - causes of human cancer. Strategies of cancer therapy - Immunotherapy, Radiotherapy, Chemotherapy. Role of telomere in cell ageing and cancer. -4hrs.

**B.SC. IV SEMESTER  
ZOOLOGY OPTIONAL (PRACTICAL)  
ZO 252 : HISTOLOGY, ANIMAL BEHAVIOUR  
APPLIED ZOOLOGY AND TOXICOLOGY**

**SCHEME OF EXAMINATION**

I. Histology – Stain, identify and comment on paraffin section provided	- 6
II. Histology – Identify and comment on permanent slides. (2 slides)	2x3 = 6
III. a) Identify and report on food adulterants (any two items)	2x2=4
b) Estimate CO <sub>2</sub> /O <sub>2</sub> /Hardness of water sample provided and comment (Any one)	6
IV. Field Report	8
V. Record & slides (submission of 3 slides)	7+3 = 10
<b>TOTAL</b>	<b>= 40</b>

**Note : Questions must be framed as per the scheme provided.**

TEACHING HOURS (PRACTICALS)	: 3 Hours/week.
TOTAL MARKS (PRACTICALS)	: 40 Marks
INTERNAL ASSESSMENT	: 10 Marks
<b>TOTAL</b>	<b>: 50 Marks</b>

**Note : Internal assessment marks to be allotted after conducting one practical test at the end of the semester**

**B.SC. IV SEMESTER  
ZOOLOGY OPTIONAL (THEORY)  
ZO 251 : HISTOLOGY, ANIMAL BEHAVIOUR  
APPLIED ZOOLOGY AND TOXICOLOGY**

**SCHEME OF EXAMINATION**

Question no.	PART -A	Marks
I	Answer any 10 questions	10X2= 20
	<b>PART -B</b>	
II	UNIT -I	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
III	-do-	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
IV	UNIT -II	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
V	- do-	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
VI	UNIT -III	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
VII	- do-	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
VIII	UNIT -IV	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
IX	- do-	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
		<b>TOTAL - 80</b>

Note:Part - A - Question no. I Answer any 10 questions out of 12 questions (a to l) (Give 3 questions from each unit)  
Part - B - Answer one full question from each unit .

**TOTAL TEACHING HOURS (THEORY) : 48 Hrs.**  
**TOTAL MARKS (THEORY) : 80 Marks**  
**INTERNAL ASSESSMENT : 20 Marks**  
**TOTAL : 100 Marks**

**Note : Internal assessment marks to be allotted after conducting one theory test at the end of the semester**



18. Loomis T. A. and A. Wallace Hayes (1996) Loomis's Essentials of Toxicology IV edition, Academic Press Ltd., London.
19. Sharma P. D, (1999) Toxicology, Rastogi Publishers Meerut.
20. Fan A. M and Chang L. W (Ed) (1996) Toxicology and Risk assessment : principles and methods and applications, Marcell Dekker publishers, New York
21. Hayes W. J Jr, Laws E.R Jr (Eds) (1991) Vol. 1, 2, and 3, Hand book of pesticide Toxicology, Academic press Inc, California.
22. Habermehl G.G (1981) Venomous animals and their toxins, Springer - Verlag, Berlin.
23. Kanth S (1989) Trends in environmental pollution and pesticide toxicology Jagmandar Book Agency, New Delhi
24. Duffus J. H. (1980) Environmental Toxicology, Edward Arnold Publishers, London.

Identification of casts/ Study of bee colonies, bee hives/ant colonies, ant nests/ termites and their mounds/ nesting behavior in solitary and social wasps/monkey troops etc.

- iii) Preparation of vermicompost using different raw materials ( such as weeds, paper waste, domestic waste, sugar cane etc.,)
- iv)
  - a) Visit to honey bee rearing centers
  - b) Visit to fish breeding centers
  - c) Visit to dairy
  - d) Visit to poultry farm

**Note :** The field studies should be based on the above mentioned topics which shall be allotted at the beginning of semester. Each student shall prepare separate field report which is to be certified by staff -in -charge and HOD. It should be submitted during practical examination which shall be evaluated by both internal and external examiners.

Field work must be supported by proper documents of the field visit by individual students.

#### REFERENCES :

1. Alan Stevens & James Lowe – Histology, Mosby Publishers, London, 1993, Edn.
2. W.H. Freeman & Brain Bracegirdle – An Atlas of Histology 2<sup>nd</sup> Edition, Heinemann Edwal Books Ltd., London
3. Kejoshi Aoki, Susuma et al., - Animal Behaviour, Springer Verlag, Newyork, 1984
4. Ron Freethy – Secrets of Bird Life ( A guide to Bird Biology), Blandford, London, 1982, 1990.
5. T. M. Caro – Behavioural Ecology & Conservation Biology, Oxford University Press, 1998.
6. Colin Hinrichsen – Organ Histology – A Student guide, World Scientific, London, 1997.
7. Eckert – Animal Physiology (Mechanisms & Adaptations), W.H. Freeman & Co., New York, 1997
8. Drickamer et al – Animal Behaviour, W.C. Brown Publisher, London, 1996.
9. G.S. Shukla & V. B. Upadhyya – Economic Zoology
10. F.V. Theobald – Economic Zoology
11. C.A. Edwards and P. J. Bohlen – Biology and Ecology of Earthworms, Third Edition, Chapman & Hall, London, 1977
12. B. S. Jangi – Economic Zoology, Oxford & IBH Publishing Co., New Delhi, 1991
13. J. M. Julka – Fauna Of India and the adjacent Countries, Megadrile Oligochaeta Zoological Survey of India, 1988.
14. K.E. Lee – Earthworms : their Ecology & Relationships with Soils & Land use, Academic press, Sydney, 1985.
15. Uday S. Bhawalkar – Vermiculture Ecotechnology, Bhawalkar earthworm Research Institute, Pune, 1995.
16. W. M. Wheeler – The Social Insects, Their Origin and Evaluation, Discovery Publishing House, New Delhi, 1994.
17. A.G. E. Pearse – Histochemistry (Theoretical & Applied) Vol. I, 4<sup>th</sup> Edn., Churchill Livingstone, London.

Extraction of honey, Nutritive value of honey.  
Uses of honey and bee wax  
Predators of honey bees  
Diseases of honey bees and control.

- 3 hrs

#### 4.3. Toxicology

Introduction, definition, major subdivisions of toxicology.  
Factors influencing toxicity – Route of administration, host factors- species, age, sex  
Bioactivation and detoxification of xenobiotics.  
Toxicological parameters – Acute and chronic toxicity, LD50, LC 50  
Pesticide toxicity, Toxicity of Organophosphates, organochlorine, carbamate  
and pyrethroid pesticides citing 2 examples for each, drug toxicity  
Biomagnification, Antidotal therapy  
Impact of pesticide pollution on wild animals  
Animal toxins  
Tissue toxicity, genotoxicity, reproductive toxicity

- 6 hrs

**B.SC. IV SEMESTER  
ZOOLOGY OPTIONAL (PRACTICAL)  
ZO 252 : HISTOLOGY, ANIMAL BEHAVIOUR,  
APPLIED ZOOLOGY AND TOXICOLOGY**

3hrs/week

1. Observation of mammalian histology slides of the following organs: Stomach, Small intestine, Liver, Pancreas, Kidney, Ovary, testis, Thyroid and Adrenal.

2. Demonstration of microtomy- tissue processing, block making  
Preparation of permanent slides of mammalian Stomach, Liver, Pancreas, Small intestine, Kidney, Testis, Ovary, Thyroid and Adrenal of rat. (Any three slides prepared by the students have to be submitted at the time of examination).

3. a. Milk products  
b. Fish products

4. Detection of food adulterants- Milk, ghee, turmeric, chillipowder, Edible oil, honey

1. Estimation of dissolved oxygen, carbon dioxide and hardness of water (normal and polluted water)

#### 2. Field oriented practicals

i) Study of nesting and roosting places in birds, study of various types of bird nests (as per the availability.)

ii) Field visit to study animal behavior in natural habitat -

## UNIT- 3 : APPLIED ZOOLOGY

### 3.1 Dairy

Introduction, breeds of dairy animals (cattle, buffaloes and goats).  
Feeding and raising of dairy animals.  
Milk and its uses.  
Utility of cattle in agriculture, transport.  
Importance of cattle in biogas, fertilizer and gelatin production.

4hrs

### 3.2 Poultry

Introduction, poultry breeds  
Housing and management of poultry .  
Management of chicks and growers.  
Poultry for egg production and poultry for meat production.  
Viral, bacterial and helminthic diseases of poultry ,  
Prevention and control of poultry diseases.

4hrs.

### 3.3 Vermitechnology

Life history of earth worms (different stages of development).  
Ecological classification of earth worms (Epigeic, anisic, endogeic)  
Identification of local species of earthworms.  
Introduction to vermiculture, culture of earthworms  
Methods of vermiculture.  
Preparation of vermicompost from any organic waste material (weeds, waste, domestic wastes, paper wastes etc.), vermiwash  
Uses of vermicompost and wormiwash in agriculture

4hrs.

## UNIT-4 : APPLIED ZOOLOGY ( Cont....)

### 4.1 Aquaculture

Definition, importance of aquaculture.  
Techniques of culturing fishes (fresh water, brackish water and marine).  
Techniques of culturing shrimps and pearls.  
Culture of ornamental fishes.  
Induced breeding and seed fish production.  
Transport of seed fish and brooding fish.  
Fish diseases and their control.

3 hrs.

### 4.2. Apiculture

Introduction : Bee species, species used for Apiculture, Flora for Apiculture.  
Methods of bee keeping.

**B.SC.- IV SEMESTER  
ZOOLOGY OPTIONAL (THEORY)  
ZO 251 : HISTOLOGY, ANIMAL BEHAVIOUR  
APPLIED ZOOLOGY AND TOXICOLOGY**

**UNIT -1 : HISTOLOGY**

48 hrs.

Importance of the study, Study of histological structure of following mammalian organs.

- a) Tongue (b) Salivary glands (c) Stomach (d) Intestine (f) Ovary (g) Testis  
(h) Liver (i) Pancreas (j) Thyroid (k) Kidney (l) Adrenal (m) Pituitary

Techniques of microtomy – Fixation of tissues, processing, block making, cutting sections, slide preparation, Haematoxylin-Eosin technique. 12hrs.

**UNIT- 2 : ANIMAL BEHAVIOUR**

**2.1 Introduction, types of animal behaviour**

Innate behaviour – taxes, reflexes, instincts and motivation;

Learnt behaviour - habituation, imprinting, conditioned reflexes and insight learning. 2hrs.

Biological clock – circadian rhythm

**2.2 Social organisation in animals**

Social behaviour, advantages of grouping, types of social groups, society/colony – Honey bees, termites, monkey troops, methods of their communication.

2hrs.

**2.3 Animal migration.**

Introduction, advantages of migration

Migration in fishes - anadromous, catadromous

Migration in birds – types of migration, patterns of migration, orientation and navigation, preparation for migration, mechanics of migration.

Methods of studying bird migration (suitable examples are to be cited)

3hrs.

**2.4 Courtship and nesting behaviour**

Introduction, courtship behaviour in birds.

Type of nests and nesting behaviour in birds (suitable examples are to be cited from common local birds)

Nesting behaviour in wasps.

3hrs

**2.5 Parental care**

Parental care in fishes (Hippocampus, Ophiocephalus, Tilapia species, Arius species) and amphibians (Racchophorus, salamander, Hyla, Pipa and Ichthyophis)

2hrs.

**B.SC. III SEMESTER  
ZOOLOGY OPTIONAL (PRACTICAL)  
PAPER 202 : PHYSIOLOGY, BIOCHEMISTRY AND IMMUNOLOGY**

**SCHEME OF EXAMINATION**

I. Major – two experiments in the same lot. Write the principle and procedure.	12x2 = 24	60
II. Minor – one - Common for all.	6x1 = 06	20
III. Class record		10
<b>TOTAL</b>	<b>= 40</b>	

**Note : Questions must be framed as per the scheme provided.**

TEACHING HOURS (PRACTICALS) : 3 Hours/week.

TOTAL MARKS (PRACTICALS) : 40 Marks

INTERNAL ASSESSMENT : 10 Marks

**TOTAL : 50 Marks**

**Note : Internal assessment marks to be allotted after conducting one practical test at the end of the semester**

**B .SC. III SEMESTER  
ZOOLOGY OPTIONAL (THEORY)  
PAPER 201 : PHYSIOLOGY, BIOCHEMISTRY  
AND IMMUNOLOGY**

**SCHEME OF EXAMINATION**

Question no.	PART -A	Marks
<b>I</b>	<b>Answer any 10 questions</b>	<b>10X2= 20</b>
<b>PART -B</b>		
<b>II</b>	<b>UNIT -I</b>	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
<b>III</b>	<b>-do-</b>	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
<b>IV</b>	<b>UNIT -II</b>	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
<b>V</b>	<b>- do-</b>	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
<b>VI</b>	<b>UNIT -III</b>	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
<b>VII</b>	<b>- do-</b>	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
<b>VIII</b>	<b>UNIT -IV</b>	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
<b>IX</b>	<b>- do-</b>	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
		<b>TOTAL - 80</b>

**Note:Part - A - Question no. I Answer any 10 questions out of 12 questions (a to l) (Give 3 questions from each unit)  
Part - B - Answer one full question from each unit.**

TOTAL TEACHING HOURS (THEORY): 48 Hrs.  
TOTAL MARKS (THEORY) : 80 Marks  
INTERNAL ASSESSMENT : 20 Marks  
TOTAL : 100 Marks

**Note : Internal assessment marks to be allotted after conducting one theory test at the end of the semester**

## REFERENCES :

1. Prosser and Brown - Comparative animal Physiology, 3<sup>rd</sup> Edition, Satish Book Enterprises, Booksellers & Publishers Agra.
2. C. Ladd Turner - Endocrinology
3. C. C. Chatterjee - Human Physiology, Vol. I
4. C. C. Chatterjee - Human Physiology, Vol. II
5. Parameshwaran et al - Animal Physiology
6. Ganong - Medical Physiology
7. Guyton - Medical Physiology
8. Giese A. C. - Cell Physiology, Saunders Co. Ltd.,
9. Nair, Achar and Bhat - Principles of Animal Physiology
10. Nandini Shetty - Immunology - Introductory T.B. - Wiley Estern Ltd., New Delhi, 1993
11. K.R. Joshi, N.O. Osama - immunology, 4<sup>th</sup> Edition, Agro Botanica IV E 176, J.N.Vyas Nagar, Bikaner, 1998.
12. Ivan M. Roitt - Essential Immunology, Low Price Edn. VI, ELBS Publisher, 1988
13. Eckert - Animal Physiology (Mechanisms & Adaptations), W.H. Freeman & Co., New York, 1997
14. Conn. E.E. Stumpf P.F. Bruening G. and Dool R. H (1995) Outlines of Biochemistry, John Wiley and Sons, Singapore.
15. Garrett R.H. and Grisham C.M. (1995) Biochemistry, Saunders College Publishing, Florida.
16. Murray R.K., Granner D.K., Mayes P.A. and Rodwell (1988) Harper's Biochemistry XXI edn. Prentice Hall International Inc. Connecticut.
17. Nelson D.L & Cox M.M (2005) Lehninger's Principle of Biochemistry, W.H. Freeman & Company, New York
18. West E.S , Todd W.R , Mason H.S. and Van Bruggen J.T. (1974) Text Book of Biochemistry, 4<sup>th</sup> Edition, Oxford and IBH Publishing Co, Pvt. Ltd.



**B.SC. – III SEMESTER  
ZOOLOGY OPTIONAL (PRACTICAL)  
PAPER 202 : PHYSIOLOGY, BIOCHEMISTRY AND  
IMMUNOLOGY**

**3 hrs/week**

**MAJOR EXPERIMENTS:**

1. Qualitative tests:
  - x ✓ a. Carbohydrates:\*  
Molisch's test, Benedict's test, Iodine test.
  - b. Proteins \*  
Biuret test, Xanthophoretic test, Ninhydrin test.
  - c. Qualitative tests for the detection of nitrogenous excretory wastes in the given samples.\*  
For Ammonia – Nessler's reagent, For Urea – Urease test (+ Phenol red)  
For Uric acid – Folin's reagent (+ saturated sodium carbonate/Folin's uric acid reagent).
2. Detection of abnormal excretion of sugar (glucose), albumen and ketone in human urine.
3. Differential count (DC) of white blood corpuscles (WBCs) of human blood using the human blood smear slides.
4. Total count (TC) of white blood corpuscles (WBCs) of human blood.
5. Total count (TC) of red blood corpuscles (RBCs) of human blood.
6. Salivary amylase activity test of human saliva.
7. Osmotic haemolysis in animal cells.

\*Note: (Students have to identify the presence of the organic compound in the sample provided, giving the principle of reaction).

**MINOR EXPERIMENTS:**

1. Preparation of stained human blood smear
2. Preparation of haematin crystal from human blood.
3. Determination of bleeding and clotting time of human blood.
4. Detection of lipids in a given sample

## UNIT - 3 : PHYSIOLOGY (Cont....)

### 3.1 Nerve coordination

Types of nervous system, structure and functions of human brain. Structure and types of neurons. Nature and conduction of nerve impulses, types of synapses and synaptic transmission, chemical transmitters in vertebrates.

- 3hrs.

### 3.2 Sense organs

Classification of sense organs, Photo, chemo and thermoreceptors, Statoacoustic organs (ear).

Structure of ear of mammals and mechanism of hearing.  
Structure of eye of mammals and mechanism of image formation.  
Organs of Jacobson, Echolocation.

- 3hrs.

### 3.3 Endocrine system

Human endocrine glands - Pituitary, thyroid, parathyroid, pancreas, adrenals, pineal glands and their hormones, hormonal disorders in humans. Neurosecretory releasing factors. Hypothalamus and its stimulating and inhibitory effects.

- 4hrs.

### 3.4 Thermoregulation

Ectotherms, Endotherms, Heterotherms. Temperature regulations in Poikilotherms and Homeotherms. Acclimation and hibernation.

- 2hrs.

## UNIT - 4: BIOCHEMISTRY AND IMMUNOLOGY

### 4.1 Biochemistry

General properties of proteins, aminoacids and their classification with examples.

General properties of carbohydrates, their classification with examples.

General properties of lipids, their classification with examples.

Classification of enzymes (IUB system), mechanism of enzyme catalysed reaction. Factors affecting enzyme action, mechanism of enzyme inhibition. Clinical importance of enzymes.

Vitamins - Fat soluble vitamins (A,D,K, and E), water soluble vitamins (B complex and vitamin C). Functions and deficiency symptoms.

- 6 hrs

### 4.2 Immunology:

Immune System - innate and acquired.

Cells of immune system, organs of immune system - Primary lymphoid organs (bone marrow, bursa of fabricius, thymus)

Secondary lymphoid organs (Lymphoid follicles, lymph nodes, peyers patches)

Antigens and Antigenicity.

Immunoglobulins - structure and functions of IgG.

Primary and secondary immune responses.

Immunization

AIDS - Causative factors, mode of transmission, effects and preventive measures.

-6hrs.

**B.SC. – III SEMESTER**  
**ZOOLOGY OPTIONAL (THEORY)**  
**PAPER 201 : PHYSIOLOGY, BIOCHEMISTRY AND**  
**IMMUNOLOGY**

48 hrs.

**UNIT – 1 : PHYSIOLOGY**

**1.1 Introduction**

General physiology, cellular physiology – Neurophysiology – Intestinal physiology, Endocrinology -2hrs.

**1.2 Osmoregulation**

Osmoconformers , Osmoregulators, Osmoregulation in shark, marine and fresh water teleosts, terrestrial mammals (Kangaroo rats and camel) -3hrs.

**1.3 Digestion**

Parts of human digestive system, mechanical and enzymatic digestion, digestion and absorption of proteins, carbohydrates and lipids. Hormonal control of digestion and absorption. Ruminant digestion. -3hrs

**1.4 Respiration**

External and internal respiration. Respiratory pigments – Haemoglobin, haemocyanin and haemoerythrin. Physiology of respiration – exchange of gases – transport of oxygen – oxygen dissociation curves – Bohr effect – transport of carbon dioxide – chloride shift – respiratory quotient. -4hrs

**UNIT – 2 : PHYSIOLOGY (Cont...)**

**2.1. Circulation**

Types of circulation – structure, functions and regulation of human heart. Origin and conduction of heart beat. Blood pressure. Composition of human blood- erythrocytes , leucocytes and blood platelets. Neurogenic and Myogenic hearts. -4hrs

**2.2 Nitrogen Excretion**

Nitrogen excretion in aquatic and terrestrial animals – Ammonotelism with examples – Ureotelism with examples –Uricotelism with examples, Ornithine cycle in humans. Physiology of urine formation in humans. Counter – current multiplier system. -4 hrs.

**2.3 Muscle Contraction**

Principal types of muscles – ultrastructure of striated muscles – contractile proteins – myosin, actin, tropomyosin, troponin and actinin. Mechanism of muscle contraction and relaxation – the sliding filament theory. Chemical changes during muscle contraction. Structure of neuromuscular junction. Properties of Muscle - Muscle fatigue, muscle twitch, muscle tetanus, rigor mortis -4 hrs.

**B.SC. II SEMESTER  
ZOOLOGY OPTIONAL (PRACTICAL)  
PAPER ZO 152 : ANIMAL DIVERSITY-II**

**SCHEME OF EXAMINATION**

I. Dissection with display - Identify, draw labeled diagram and comment on any two flagged system/items.	5	09	0
II. One temporary mounting of fish scale	3	03	5
III. Identification with reasons, classification and labeled figures (2 items)	a & b 3	6	2x 4 = 08
IV. Identify, comment with labeled diagram on given items (1 skull + 2 vertebrae)		10	
V. Class records.	15/20 - 10	6	10
	<b>TOTAL</b>	<b>=</b>	<b>40</b>

**Note :** Questions must be framed as per the scheme provided.  
Question no. 1 Dissection shall be done by concerned staff beforehand.

TEACHING HOURS (PRACTICALS)	: 3 Hours/week.
TOTAL MARKS (PRACTICALS)	: 40 Marks
INTERNAL ASSESSMENT	: 10 Marks
<b>TOTAL</b>	<b>: 50 Marks</b>

**Note :** Internal assessment marks to be allotted after conducting one practical test at the end of the semester

**B.SC.II SEMESTER  
ZOOLOGY OPTIONAL (THEORY)  
PAPER ZO 151 : ANIMAL DIVERSITY - II  
( Chordata )**

**SCHEME OF EXAMINATION**

Question no.	PART -A	Marks
<b>I</b>	<b>Answer any 10 questions</b>	<b>10X2= 20</b>
	<b>PART -B</b>	
<b>II</b>	<b>UNIT -I</b>	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
<b>III</b>	<b>-do-</b>	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
<b>IV</b>	<b>UNIT -II</b>	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
<b>V</b>	<b>- do-</b>	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
<b>VI</b>	<b>UNIT -III</b>	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
<b>VII</b>	<b>- do-</b>	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
<b>VIII</b>	<b>UNIT -IV</b>	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
<b>IX</b>	<b>- do-</b>	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
		<b>TOTAL - 80</b>

**Note:Part - A - Question no. I Answer any 10 questions out of 12 questions (a to l) (Give 3 questions from each unit)  
Part - B - Answer one full question from each unit .**

**TOTAL TEACHING HOURS (THEORY): 48 Hrs.  
TOTAL MARKS (THEORY) : 80 Marks  
INTERNAL ASSESSMENT : 20 Marks  
TOTAL : 100 Marks**

**Note : Internal assessment marks to be allotted after conducting one theory test at the end of the semester**

## REFERENCES :

1. Ekambaranatha Ayyar – A manual of Zoology Vol.I, Part I & II & Vol. II
2. Vishwanath – A Text book of Zoology
3. Vidhyarthi – A Text book of Zoology
4. Jordan & Verma – Chordate Zoology and Animal Physiology
5. Agarwal & Dalela – A Text book of Vertebrate Zoology
6. Dhami & Dhami – Chordate Zoology
7. Srivastava – Vertebrate types
8. Nair & Achar – A manual of practical Zoology Vol.II (Chordata)
9. Verma – A Manual of practical Zoology (Vertebrates)
10. S. A. Hussain & K.P. Achar – Biodiversity of the Western Ghats. Complex of Karnataka, Biodiversity Initiative Trust, Mangalore, 1999.
11. M. Prakash & C. K. Arora – Laboratory Animals, Anmol Publishing, Ansari Road, New Delhi, 1998.
12. Newman – Chordate Zoology
13. Goodrich – Studies on the structure and Development of Vertebrate Vols. I & II
14. Colbert – Evolution of Vertebrates
15. K. Prabhakar Achar & K. Geetha Nayak – Birds of Dakshina Kannada, Bhuvanendra Nature Club – India, 2000.
16. Adam Sedgwick - A Students Text book of Zoology, Low Price Publications, Delhi, Vol. I, II & Vol.III, 1990.
17. T. Jeffery Parker, William A. Haswell – A text book of Zoology, Low Price Publications, Delhi, Vol. I & II, 1990.

Python), *Trimeresurus malabaricus* (Pit Viper), *Eryx conicus* (Russell's Earth Boa), *Vipera russelli* (Russell's Viper), ( any two)

Chelone ✓

*Geochelone elegans* (Starred Tortoise), *Geochelone travancorica* (Travancore Tortoise), *Chelone mydas* ( any one)

Crow  
house sparrow  
wood pecker

8. *Hypsipetes madagascariensis* (Black Bulbul), *Dicrurus adstmilis* (Black Drongo or King crow), *Ictinaetus malayensis* (Black Eagle), *Oriolus xanthornus* (Blackheaded Oriole), *Sturnus pagodarum* (Blackheaded or Brahminy Myna), *Psittacula cyanocephala* (Blossomheaded Parakeet), *Haliastur Indus* (Brahminy Kite), *Centropus sinensis* ( Crow-Pheasant), *Ardea cinerea* (Grey Heron), *Hemicircus canente* ( Heartspotted Woodpecker), *Corvus splendens* (House Crow), *Passer domesticus* (House Sparrow), *Tyto alba* (Indian Barn Owl), *Ploceus philippinus* (Indian Baya), *Oriolus oriolus* (Indian Golden Oriole), *Pavo Cristatus* (Indian Peafowl), *Sturnus contra* ( Indian Pied Myna), *Ardeola grayii* (Indian Pond Heron or Paddybird), *Nectarinia asiatica* ( Indian Purple Sunbird), *Saxicoloides fulicata* (Indian Robin), *Neophron percnopterus* (Indian Scavenger Vulture), *Amaurionis phoenicurus* (Indian Whitebreasted Waterhen), *Dinopium benghalense* (Lesser Goldenbacked Woodpecker), *Egretta garzetta* (Little Egret), *Strix ocellata* (Mottled Wood Owl), ( any three)

squirrel  
Bat  
rat

9. *Echidna*, *Bandicota indica* (Bandicoot Rat), *Lepus nigricollis* (Blacknaped hare), *Macaca radiata* (Bonnet Macaque), *Presbytis entellus* (Common Langur), *Herpestus edwardsi* ( Common Mongoose), *Paradoxurus hermaphroditus* (Common Palm Civet), *Petaurista philippensis* (Common giant flying squirrel), *Funambulus pennantii* (Five striped palm squirrel), *Rousettus leschenulti* (Fulvous fruit bat), *Mus musculus* (House Mouse), *Rattus rattus* (House Rat), *Suncus murinus* (House Shrew) ( any three)

Note : 1. Local examples with common and scientific names are to be given more emphasis for all the groups.

2. Only such of the salient features of the examples have to be mentioned which are necessary to explain the general characters of the phylum/class.

3. In the event of non availability of specimens, related internet downloaded photos/movies can be shown.

**B.SC. II SEMESTER  
ZOOLOGY OPTIONAL ( PRACTICAL)  
ZO 152 : ANIMAL DIVERSITY - II  
(Chordata)**

3hrs/week

**A. Museum specimens and slides.**

Commonly available specimens cited in the list of examples are to be selected for practicals.

**B. Dissections**

**1. Mouse**

- a) Digestive system - **Demonstrations**
- b) Male and Female Urinogenital systems - **Demonstrations**

**OR**

- 2. Fish** - Afferent branchial system, Cranial nerves V, VII, X - **Demonstrations**

**C. Mounting**

Fish scales

**D. Study of skull and vertebrae of amphibians and mammals**

**LIST OF MUSEUM SPECIMENS AND SLIDES**

1. *Balanoglossus*, *Herdmania*, *Amphioxus*, *Tornaria* larva. (all)
  2. *Petromyzon*, *Myxine*, *Ammocoetes* larva (all)
  3. *Narcine* (Electric ray), *Pristis* (Saw fish), *Trygon* (Sting ray), *Scoliodon* (Shark) (Any two)
  4. *Anguilla*, *Hippocampus*, *Anabas testudineus*, *Catla catla*, *Clarius batrachus*, *Gambusia affinis* (Any two)
  5. *Ichthyophis* (Caecilians), *Bufo melanostictus* (Common Toad), *Rana hexadactyla* (Indian Pond Frog), *Rana cyanophlyctis* (Skipper Frog), *Rana tigrina* (Indian Bull Frog), *Rhacophorus malabaricus* (Malabar Gliding Frog), *Ambystoma*, *Salamander*, Axolotl larva (1 limbless; 1 tailed; others -2)
  7. *Hemidactylus frenatus* (Southern House Gecko), *Calotes versicolor* (common garden Lizard), *Varanus bengalensis* (Common Indian Monitor), *Draco dussumieri* (Draco), *Calotes rouxi* (Forest Calotes), *Chameleon zeylanicus* (Indian Chameleon), *Crocodylus molurus* (Mugger). (any two)
- Ptyas mucosus* (Common rat snake), *Bungarus fasciatus* (Banded Krait), *Bungarus caeruleus* (Common Indian Krait), *Naja naja* (Indian Cobra), *Python molurus* (Indian



## **UNIT – 3 : REPTILIA AND AVES**

### **3.1 Reptilia**

General characters and classification upto orders (living orders only) with suitable examples. Temporal fossae and arcades in reptiles.

Distribution of common chelonians, crocodiles and lizards. Indian snakes - poisonous and nonpoisonous, poison apparatus and its working mechanisms. - 6hrs

### **3.2 Aves**

General characters and classification. Distinctive features of Archaeornithes and Neornithes with reference to Palaeognathae, Impennae and Neognathae, giving suitable examples. Flight Adaptation in birds.

-6 hrs.

## **UNIT – 4: MAMMALIA**

### **4.1 Classification and distinctive features**

General characters and classification upto subclasses. Distinctive features of prototheria and metatheria with important examples. Affinities of prototheria

### **4.2. Important characters and distribution with examples**

Primates, Chiroptera, Cetacea, Perissodactyla, Artiodactyla, Carnivora and Rodentia.

### **4.3. Organ systems**

Detailed study of digestive system and reproductive system of rat.

- 12 hrs

- Note:**
1. Local examples with common and scientific names are to be given more emphasis for all the groups.
  2. While selecting the examples, only such of the salient features of the examples have to be mentioned which are necessary to explain the general characters of the phylum/class.

**B.SC. II SEMESTER  
ZOOLOGY OPTIONAL (THEORY)  
PAPER ZO 151 : ANIMAL DIVERSITY - II  
(Chordata)**

48 hrs.

**UNIT - 1: HEMICHORDATA, CHORDATA, AND CYCLOSTOMATA**

**1.1 Hemichordata -**

General characters of the phylum and external features of *Balanoglossus* and *Tornaria* larva, systematic position of hemichordata. -2hrs

**1.2 Chordata and protochordata**

General characters and outline classification upto subphylum. - 4hrs.  
External features of *Herdmania*, *Branchiostoma*.

**1.3. Vertebrata**

General characters of vertebrates, outline classification upto classes. -2hrs.

**1.4 Cyclostomata**

General characters, external features and differences between lampreys (*petromyzon*) and hag fishes (*myxins*), structure of ammocoetes larva and its metamorphosis. - 4 hrs.

**UNIT - 2: PISCES AND AMPHIBIA**

**2.1. Pisces** - General characteristics of fishes and aquatic adaptations.

**2.2 Chondrichthyes and osteichthyes**

General characters and distribution of chondrichthyes with examples.

General characters and distribution of osteichthyes with examples. - 4hrs

**2.3 Amphibians**

General characters and classification upto orders, distinguishing features of anurans, apoda and urodela with suitable examples. - 3hrs.

**2.3.1 Skeletal systems** - Endo skeleton of frogs - skull, vertebral column, limb girdles, limb skeleton. -5hrs.

**B.S.C. I SEMESTER  
ZOOLOGY OPTIONAL (PRACTICAL)  
PAPER ZO 102 : ANIMAL DIVERSITY- I  
(Non-Chordata)  
SCHEME OF EXAMINATION**

I. Dissection with display - Identify, draw labeled diagram and comment on any two flagged system /items.	09.
II. One temporary mounting	05
III. Identification with reasons, classification and labeled figures ( 2 slides, 2 specimens).	4 x 4 = 16
IV. Class records	10
<b>TOTAL</b>	<b>= 40</b>

**Note: Questions must be framed as per the scheme provided.  
For question no. 1 dissection shall be done by concerned staff beforehand.**

TEACHING HOURS (PRACTICALS)	: 3 Hours/week.
TOTAL MARKS (PRACTICALS)	: 40 Marks
INTERNAL ASSESSMENT	: 10 Marks
<b>TOTAL</b>	<b>: 50 Marks</b>

**Note : Internal assessment marks to be allotted after conducting one practical test at the end of the semester**

5

3

**B.SC. I SEMESTER  
ZOOLOGY OPTIONAL (THEORY)  
PAPER ZO 101 : ANIMAL DIVERSITY - I  
( Non chordata )**

**SCHEME OF EXAMINATION**

Question no.	PART -A	Marks
I	Answer any 10 questions	10X2= 20
	<b>PART -B</b>	
II	UNIT -I	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
III	-do-	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
IV	UNIT -II	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
V	- do -	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
VI	UNIT -III	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
VII	- do -	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
VIII	UNIT -IV	a) 1X4 = 04 b) 1X4 = 04 c) 1X7 = 07
IX	- do -	a) 1X3 = 03 b) 1X5 = 05 c) 1X7 = 07
		<b>TOTAL - 80</b>

**Note: Part - A - Question no. I Answer any 10 questions out of 12 questions (a to l) (Give 3 questions from each unit)  
Part - B - Answer one full question from each unit.**

TOTAL TEACHING HOURS (THEORY): 48 Hrs.  
TOTAL MARKS (THEORY) : 80 Marks  
INTERNAL ASSESSMENT : 20 Marks  
TOTAL : 100 Marks

**Note : Internal assessment marks to be allotted after conducting one theory test at the end of the semester**

7. Carcinus (male and female crab), Peripatus, Lepas, Scolopendra, Limulus and Palamnaeus (scorpion)
8. Chiton, Dentalium, Xaricus, Aplysia, Pila, Unio, Nautilus, Octopus.
9. Asterias (Star-fish), Ophiothrix, (Brittle Star), Echinus (Sea-urchin), Cucumaria (Sea-Cucumber), Antedon (Sea-lily), Bipinnaria, Pluteus larva.

**REFERENCES :**

1. Ekambaranatha Ayyar - A manual of Zoology Vol.I, Part I & II & Vol. II
2. Jordan & Verma - Invertebrate Zoology
3. Dhama & Dhama - Invertebrate Zoology
4. S.N. Prasad - A text book of Invertebrate Zoology
5. Srivastava - Invertebrate Zoology
6. Kotpal - Modern Text book of Invertebrates
7. Kotpal - Protozoa to Echinodermata (Phylum Series)
8. S.S. Lal - A Text book of Practical Zoology - Invertebrate
9. Dalca - Practical Invertebrate Zoology
10. Gupta and Malik - Practical Invertebrate Zoology
11. Nair and Achar - A manual of practical Zoology - Vol.I (Non-Chordata)
12. P.S. Verma - A Manual of Practical Zoology Invertebrates
13. M. Prakash & C. K. Arora - Laboratory Animals, Anmol Publishing, Ansari Road, New Delhi, 1998.
14. Barnes R. D. Invertebrate zoology
15. Hyman, L. H. - The Invertebrates - Vols.I to IV
16. Adam Sedgwick - A Students Text book of Zoology, Low Price Publications, Delhi, Vol. I, II & Vol.III, 1990.
17. T. Jeffery Parker, William A. Haswell - A text book of Zoology, Low Price Publications, Delhi, Vol. I & II, 1990.

**B.SC. I SEMESTER  
ZOOLOGY OPTIONAL (PRACTICAL)  
PAPER ZO 102 : ANIMAL DIVERSITY- I  
( Non chordata)**

3hrs/week

**A. Museum specimens and slides.**

Commonly available specimens cited in the list of examples are to be selected for practicals.

**B. Dissections**

1. Prawn: Nervous system - demonstrations
2. Leech:
  - a) Digestive system - demonstrations
  - b) Reproductive system - demonstrations
3. Cockroach:
  - a) Digestive system - demonstrations
  - b) Nervous system - demonstrations

4. Observations of hay infusion culture to study living protozoans like Euglena, Paramecium, Vorticella, Amoeba etc., ( Demonstration only).

**C. Mounting and Whole mount preparations**

i) Demonstration of mounting of the following:

- a. Prawn : Appendages
- b. Leech :
  - i) Salivary gland cells
  - ii) Jaw
- c. Cockroach : Mouth parts
- d. Earthworm : Body setae

ii) Whole mount preparation: Obelia, sertularia, pennaria, tubularia, mosquitos ( Processing and mounting)

**LIST OF MUSEUM SPECIMENS AND SLIDES**

1. Slides of Elphidium, Euglena, Plasmodium, Paramecium, and Vorticella
3. Specimens of Euplectella, Sycon, slides of spicules of sponges.
4. Obelia, Physalia, Aurelia, Sea anemone, Fungia
5. Planaria, Liverfluke, Tapeworm, Ascaris (Male and Female). Wuchereria bancrofti.
6. Nereis, Arenicola, Chaetopterus, Pheretima

## UNIT - 3: PLATYHELMINTHES, NEMATHELMINTHES AND

### ANNELIDA

#### 3.1 Phylum: Platyhelminthes

General characters of the phylum and classification upto classes with distinctive characters and suitable examples, Host - parasitic interaction, Parasitic adaptations with reference to liver flukes and tapeworms. 4hrs

#### 3.2 Phylum: Nematelminthes

General characters of the phylum with suitable examples, external characters, life cycle and pathogenicity of *Ascaris* and *Wuchereria* (Filarial worm), preventive measures. 3hrs

#### 3.3 Phylum: Annelida

General characters of the phylum and classification upto classes, distinctive characters giving suitable examples. Tubicolous polychaetes - *Sabella*, *Terebella*, *Chaetopterus*, External features of leech, earthworm and neries. 5hrs

## UNIT- 4 : ARTHROPODA, ONYCHOPHORA, MOLLUSCA AND ECHINODERMATA

#### 4.1 Phylum: Arthropoda and Onychophora

General characters of the phylum and classification upto classes with distinctive characters and suitable examples.  
Externals of marine prawn (*Penaeus*) with detailed account of appendages.  
External characters and affinities of onychophora. 5hrs

#### 4.2 Phylum: Mollusca

General characters of the phylum and classification upto classes, with distinctive characters and suitable examples.  
External features of *Unio* and *Pila*. 3hrs.

#### 4.3 Phylum : Echinodermata

General characters of the phylum and classification upto classes with distinctive characters and suitable examples. External features and water-vascular system of *Asterias*. Larval forms and their phylogeny. 4hrs.

- Note: 1. Local examples with common and scientific names are to be given more emphasis for all the groups.  
2. While selecting the examples, Only such of the salient features of the examples have to be mentioned which are necessary to explain the general characters of the phylum/class.

**SEMESTER  
ZOOLOGY OPTIONAL (THEORY)  
PAPER ZO 101 : ANIMAL DIVERSITY - I**

48 hrs.

(Non-chordata)

**UNIT 1 : INTRODUCTION, BIODIVERSITY, PROTOZOA**

**1.1 Introduction :**

Principles of animal classification – Binomial nomenclature, hierarchy, salient features of non chordates, body layers, coelom, body symmetry, metamerism, cephalisation  
Definition of species, Phylogeny, classification up to phylum.

3 hrs

**1.2 Biodiversity**

Levels of biodiversity – species, genetic and ecosystem level diversity, Biodiversity hotspots of India with examples, Biodiversity hotspots of the world.

3hrs.

**1.3 Phylum: Protozoa**

General characters of the phylum and classification upto classes, with distinctive characters and suitable examples. Structure and life history of malarial parasite (*Plasmodium vivax*) and human parasitic protozoan (*Entamoeba histolytica*).

6hrs.

**UNIT – 2 : PORIFERA, COELENTERATA, CTENOPHORA,**

**2.1 Phylum: Porifera**

General characters of the phylum and classification upto classes with distinctive characters and suitable examples. Histology, spicules and canal system in sponges. Systematic position of Porifera.

6hrs.

**2.2 Phylum: Coelenterata and Ctenophora**

General characters of the phylum and classification upto classes with distinctive characters and suitable examples, Polymorphism in hydrozoa with reference to *Physalia*, *Halimeda* ; Coral reefs and Coral formation with examples, metagenesis in *Obelia*.

2.2.1 Distinctive characters of Ctenophora, External of *Pleurobrachia*

6hrs.



**V SEMESTER**

Subject & Semester	Paper	Instruction hours	Duration of Exam (hrs)	Max. marks for exam	Int.assessment (Max. marks)	Total Marks	CREDITS
V Sem. Zoology	Theory ZO- 301	3	3	80	20	100	2
	Theory ZO -302	3	3	80	20	100	2
	Practical ZO- 303	2	3	40	10	50	1
	Practical ZO -304	2	3	40	10	50	1

ZO - 301: Theory - Cell Biology and Biotechnology

ZO - 302 : Theory - Genetics , Biostatistics, Evolution and Palcontology

ZO - 303 : Practical - Cell Biology and Biotechnology

ZO - 304: Practical - Genetics , Biostatistics, Evolution and Paleontology

**VI SEMESTER**

Subject & Semester	Paper	Instruction hours	Duration of Exam (hrs)	Max. marks for exam	Int.assessment (Max. marks)	Total Marks	CREDITS
VI Sem. Zoology	Theory ZO- 351	3	3	80	20	100	2
	Theory ZO -352	3	3	80	20	100	2
	Practical ZO- 353	2	3	40	10	50	1
	Project work ZO -354	2	3	40	10	50	1

ZO - 351: Theory - Reproductive Biology and Developmental Biology

ZO - 352: Theory - Environmental Biology and Wildlife Biology

ZO - 353: Practical - Reproductive Biology and Developmental Biology

ZO - 354: Project work - Biodiversity and Wildlife Biology

**MANGALORE UNIVERSITY**  
**B.S.C. DEGREE COURSE**  
 (Three optionals of equal importance)  
**OPTIONAL SUBJECT : ZOOLOGY**  
 Three year ( Six semester ) course

**SCHEME FOR CREDIT BASED SEMESTER**

**I AND II SEMESTER**

Subject & Semester	Paper	Instruction hours	Duration of Exam (hrs)	Max. marks for exam	Int.assessment (Max. marks)	Total Marks	CREDITS
I Sem. Zoology	Theory ZO- 101	4	3	80	20	100	2
	Practical ZO -102	3	3	40	10	50	1
II Sem. Zoology	Theory ZO- 151	4	3	80	20	100	2
	Practical ZO -152	3	3	40	10	50	1

ZO- 101 : Theory - Animal Diversity -I (Non chordata)

ZO- 102 : Practical - Animal Diversity -I (Non chordata)

ZO -151 : Theory - Animal Diversity -II (Chordata)

ZO -152 : Practical - Animal Diversity -II (Chordata)

**III AND IV SEMESTER**

Subject & Semester	Paper	Instruction hours	Duration of Exam (hrs)	Max. marks for exam	Int.assessment (Max. marks)	Total Marks	CREDITS
III Sem. Zoology	Theory ZO- 201	4	3	80	20	100	2
	Practical ZO -202	3	3	40	10	50	1
IV Sem. Zoology	Theory ZO- 251	4	3	80	20	100	2
	Practical ZO -252	3	3	40	10	50	1

ZO- 201: Theory - Physiology, Biochemistry and Immunology

ZO- 202: Practical- Physiology, Biochemistry and Immunology

ZO -251: Theory - Histology, Animal behavior, Applied Zoology and Toxicology

ZO -252: Practical- Histology, Animal behavior, Applied Zoology and Toxicology

**MANGALORE UNIVERSITY**  
**SYLLABUS OF OPTIONAL ZOOLOGY**  
**( Revised )**  
**Three year (6 Semester) B.Sc. Degree Course**

**PREAMBLE**


The syllabus of Optional Zoology (credit based) in B.Sc. degree course of Mangalore University was introduced in 2006-07 academic year. Since this syllabus is 6 years old now, it was felt that the content of syllabus has to be revised to incorporate some newer aspects of Animal Sciences. In addition, as per the recent UGC guidelines for discontinuation of dissection in Zoology/Life sciences in phased manner by the students of B.Sc. Zoology, certain changes have been made in the practical syllabus also.

Present syllabus includes the topics of applied interest, <sup>and</sup> modern biotechnology, Animal behavior, Applied Zoology, Toxicology, Biostatistics, Environmental Biology, conservation, Wildlife biology etc., It was also decided to introduce a field visit oriented project work in the final semester, to make the students to have the experience of visiting different habitats of animals and documenting the available species, studying their behavior, habitat preference and other aspects. This will be recorded as written document in the form of a dissertation.

The regulation and scheme of examination remains the same which are in consensus with the guidelines issued by the University.

**U.G. BOS IN ZOOLOGY**

- |                              |               |
|------------------------------|---------------|
| 1. Dr. K.K. Vijayalaxmi      | - Chairperson |
| 2. Dr. Seetharama Mayya      | - Member      |
| 3. Dr. Seetharam Kadamannaya | - Member      |
| 4. Dr. Nagaratna             | - Member      |
| 6. Mrs. Meenakshi            | - Member      |

  
**DR. K. K. VIJAYALAXMI, Ph.D.**  
PROFESSOR & ~~chairperson~~ <sup>U.G. BOS</sup> Zoology  
DEPT. OF APPLIED ZOOLOGY  
MANGALORE UNIVERSITY  
MANGALA GANGOTRI - 574 199

**MANGALORE UNIVERSITY  
SYLLABUS OF OPTIONAL  
ZOOLOGY  
( Revised )**

**Three year  
(6 Semester)  
Credit based  
B.Sc. Degree Course**

**2012**

MANGALORE



UNIVERSITY

Office of the Registrar  
Mangalagangothri - 574 199

CR.18/SLB(ZO)/2012-13/A2

Date: 22.04.2013

**NOTIFICATION**

Sub: Revised Syllabus of Zoology, optional subject for B.Sc. degree programme.

Ref: Academic Council decision No.3:7 (2012) dated 22.12.2012.

The revised Syllabus of Zoology, optional subject for B.Sc. degree programme which was approved by the Academic Council at its meeting held on 22.12.2012, is hereby notified for implementation with effect from the academic year 2013-14..

  
REGISTRAR

To:

- 1) The Principals, of the Colleges concerned.
- 2) Registrar (Evaluation), Mangalore University.
- 3) The Chairperson, UG BOS in Zoology, Mangalore University.
- 4) The Superintendent (ACC), O/o the Registrar, Mangalore University.
- 5) Guard File.

V Semester B.Sc.:

As given in the Syllabus	As assigned by the University Examination Section	Proposed Changes
Theory - ZO - 301: Cell Biology and Biotechnology	Theory - ZO - 304: Cell Biology and Biotechnology	Theory - ZO - 304: Cell Biology and Biotechnology
Theory - ZO - 302: Genetics, Biostatistics, Evolution and Paleontology	Theory - ZO - 305: Genetics, Biostatistics, Evolution and Paleontology	Theory - ZO - 305: Genetics, Biostatistics, Evolution and Paleontology ✓
Practical - ZO - 303: Cell Biology and Biotechnology	- -	Practical - ZO - 306: Cell Biology and Biotechnology
Practical - ZO - 304: Genetics, Biostatistics, Evolution and Paleontology	- -	Practical - ZO - 307: Genetics, Biostatistics, Evolution and Paleontology ✓

VI Semester B.Sc.:

As given in the Syllabus	As assigned by the University Examination Section	Proposed Changes
Theory - ZO - 351: Reproductive biology and Developmental Biology	Theory - ZO - 354: Reproductive biology and Developmental Biology	Theory - ZO - 354: Reproductive biology and Developmental Biology
Theory - ZO - 352: Environmental biology and Wildlife Biology	Theory - ZO - 355: Environmental biology and Wildlife Biology	Theory - ZO - 355: Environmental biology and Wildlife Biology
Practical - ZO - 353: Reproductive Biology and Developmental Biology	- -	Practical - ZO - 356: Reproductive Biology and Developmental Biology ✓
Project work - ZO - 354: Biodiversity and Wildlife Biology	- -	Project work - ZO - 357: Biodiversity and Wildlife Biology ✓

  
 Chairman  
 U.G. Board of Studies in Zoology  
 Mangalore University  
 Mangalore

**Changes in the Paper Codes from I to VI Semester B.Sc.:**

**Subject: Zoology**

**I Semester B.Sc.:**

As given in the Syllabus	As assigned by the University Examination Section	Proposed Changes
Theory - ZO-101: Animal Diversity - I (Non chordata)	Theory - ZO-102: Animal Diversity - I (Non chordata)	Theory - ZO-102: Animal Diversity - I (Non chordata)
Practical - ZO-102: Animal Diversity - I (Non chordata)	--	Practical - ZO-103: Animal Diversity - I (Non chordata)

**II Semester B.Sc.:**

As given in the Syllabus	As assigned by the University Examination Section	Proposed Change:
Theory -- ZO-151: Animal Diversity -II (Chordata)	Theory -- ZO-152: Animal Diversity -II (Chordata)	Theory -- ZO-152: Animal Diversity -II (Chordata)
Practical - ZO-152: Animal Diversity -II (Chordata)	--	Practical - ZO-153: Animal Diversity -II (Chordata) ✓

**III Semester B.Sc.:**

As given in the Syllabus	As assigned by the University Examination Section	Proposed Changes
Theory -- ZO-201: Physiology, Biochemistry and Immunology	Theory -- ZO-202: Physiology, Biochemistry and Immunology	Theory -- ZO-202: Physiology, Biochemistry and Immunology
Practical -- ZO-202: Physiology, Biochemistry and Immunology	--	Practical -- ZO-203: Physiology, Biochemistry and Immunology

**IV Semester B.Sc.:**

As given in the Syllabus	As assigned by the University Examination Section	Proposed Changes
Theory -- ZO-251: Histology, Animal behavior, Applied Zoology	Theory -- ZO-252: Histology, Animal behavior, Applied Zoology	Theory -- ZO-252: Histology, Animal behavior, Applied Zoology
Practical -- ZO-252: Histology, Animal behavior, Applied Zoology	--	Practical -- ZO-253: Histology, Animal behavior, Applied Zoology ✓

ಮಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ  
MANGALORE UNIVERSITY  
(Accredited by NAAC with 'A' Grade)



Office/No. MU/ACC/CR48/Zo(UG)/2017-18/A2

ವಿಶ್ವವಿದ್ಯಾಲಯ ಕಾಲೇಜು, ಮಂಗಳೂರು  
UNIVERSITY COLLEGE, MANGALORE  
14 MAR 2018  
Office of the Registrar  
Mangalagangothri - 574 154  
Karnataka, India  
Digitized/Date: 8/3/2018

No. 2683

**CIRCULAR**

Sub: Correction in the Code number of Zoology an optional subject for B.Sc. degree.  
Ref: 1) This office Notification No: MU/ACC/CR18/SLB (Zo)/2012-13/A2 dated: 22-4-2013.  
2) Approval of the Academic Council meeting dated: 18-1-2018 for Agenda No. 3:7 (2017-18).  
\*\*\*\*\*

The Code numbers assigned to theory and practicals papers of Zoology syllabus notified vide notification referred to (1) above are corrected on par with Examination Code numbers and approved by the Academic Council at its meeting held on 18-1-2018.

2683  
53  
15/3

These Code numbers are hereby circulated for implementation with immediate effect.

REGISTRAR  
✓ K.P.

- To:
- 1) The Principals of the colleges concerned.
  - 2) The Registrar (Evaluation), Mangalore University.
  - 3) The Chairman, UG BOS in Zoology, Mangalore University.
  - 4) The Supt. (ACC), O/o. the Registrar, Mangalore University.
  - 5) Guard file.



UNIVERSITY COLLEGE MANGALORE

DEPARTMENT OF ZOOLOGY

RED CROSS & ECO CLUB

Workshop on - **CURRENT TRENDS IN BIODIVERSITY**

Venue. Shivarama Karanth Bhavana Date. 27.12.2018, Time. 9.30am to 3.45pm

Program List.

9.30am to 10.00 am . Inaugral Program

10.00am to 11.15 am . Talk on **Biodiversity Study\***

Speaker. Mrs.Karen., Dept .of Zoology, St.Aloysius College, Mangalore

11.15 am to 11.30. Tea Break

11.30am to 12.15pm . Talk on " **Mosquitoes of Dakshina Kannada**"

Speaker . Mr.Ishwara Prasad, Dept .of Zoology, Vivekananda College, Futtur

12.15pm to 1.15pm . Talk on "**Buttrflies of Western Ghats**"

Speaker.Mr.Deepak, Research Scholar, Dept .of Zoology, Mangalore University

1.15 pm to 1.45 pm . Lunch Break

1.45 pm to 2.30 pm . Talk on "**World of Wasp**"

Speaker..Mr.Kiran, , Dept .of Zoology., St.Aloysius College, Mangalore

2.30 pm to 3.30pm Talk on "**Birds and Frogs**"

Speaker.. Mr.Vineeth, . Dept .of Zoology., St.Aloysius College, Mangalore

3.30pm to 3.45pm ; **Student feed back**

Concluding;

**MANGALORE UNIVERSITY**

**UNIVERSITY COLLEGE MANGALORE**

(Re-accredited with 'A' grade by NAAC & College with Potential for Excellence by UGC)

**"From A Glorious Past to Promising Future"**

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**DEPARTMENT OF ZOOLOGY**

**RED CROSS & ECOCLUB**

Jointly

**Organises a Workshop on**

**CURRENT TRENDS IN BIODIVERSITY**

Venue, Shivarama Karanth Bhavana

Date, 27.12.2018,

Time, 9.30am to 3.45pm

**President.** Dr. Uday Kumar M A

Principal,

University College, Mangalore

**Chief Guest.** Prof. Mohammed Jaffar

Rtd. HOD, Dept. of Zoology

University College, Mangalore

**YOU ARE CORDIALLY INVITED**

Dr. Nagarathna KA

HOD, Dept of Zoology

Dr. Meenakshi

Vice President, Red Cross & Eco Club

Staff and Students