

BA/BCOM/BSc/BVoc ZOOLOGYPROGRAM (4 years Honors) Syllabus  
2020-21 onwards

<b>SUBJECT</b>
<b>ZOOLOGY</b>

Members of BOS (Contact details)		
Dr. P. VIJAYA NIRMALA(Chairperson) Assistant Professor, Head of the Department of Life Sciences, Adikavi Nannaya University, Rajamahendravaram	9441140857	<a href="mailto:vijaya.nirmala3@gmail.com">vijaya.nirmala3@gmail.com</a>
Dr. N. Srinivas Head of the Department of Zoology, P.R Government College(A), Kakinada	9912760880	zoonsreenivas4@gmail.com
Dr. P. Anil Kumar PR College, Department of Zoology, KKD	9441257827	zoologistanil@gmail.com
Dr. M. Tejomurthy Lecturer in Zoology, Government College, Yeleswaram	9703799970	drmtm2011@gmail.com
Dr. P. Raghava Kumari Head of the Department of Zoology, S.K.R College for Women, Rajamahendravaram.	9908542048	raghavakumaripinipey@gmail.com
K. Babu Lecturer In-charge/HOD, Department of Zoology, Government College(A),Rajamahendravaram	9959179928	k.sagar0925@gmail.com
Dr. P. S. CH. P Deepika Rani Lecturer in Zoology, S.K.R College for Women, Rajamahendravaram.	9848539314	drpedapati@gmail.com
D. Mounika Student , Dept of Zoology, Government College(A),Rajamahendravaram	8106135291	mounikad202@gmail.com

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## **1. Resolutions of the Board of Studies**

Meeting held on 22-01-2010

Time: 10:00 AM

At: N.T.R Convention Centre,  
Adikavi Nannaya University, Rajamahendravaram

### **Agenda:**

1. Adoption of revised-common program structure and revising/updating course-wise syllabi (in the prescribed format) as per the guidelines issued by APSCHE
2. Adoption of regulations on scheme of examination and marks/grading system of the UG program
3. Preparation of Model question papers in prescribed format
4. List of equipment / software requirement for each lab/practical
5. Eligibility of student for joining the course
6. Eligibility of faculty for teaching the course
7. Any specific instructions to the teacher/paper-setter/student/ chief-superintendent/ paper-evaluator
8. List of paper-setters/paper evaluator with phone, email-id in the prescribed format

### **Members present:**

1. Dr P. Vijaya Nirmala
2. Dr. N. Srinivas
3. Dr. P. Anil Kumar
4. Dr. M. Tejomurthy
5. Dr. P. Raghava Kumari
6. K. Babu
7. Dr. P.S.CH. P Deepika Rani
8. Lakshmi Kantham
9. D. Mounika

### **Resolutions:**

## 2. DETAILS OF PAPER TITLES & CREDITS

Sem	Course no.	Course Name	Course type (T/L/P)	Hrs./Week (Arts/Commerce: 5 and Science: 4+2)	Credits (Arts/Commerce: 4 and Science: 4+1)	Max. Marks Cont/Internal/Mid Assessment	Max. Marks Sem-end Exam
I	PAPER-I	Animal Diversity – I Biology of Non-Chordates	T/L	4+2	4+1	25	75
II	PAPER-II	Animal Diversity –II Biology of Chordates	T/L	4+2	4+1	25	75
III	PAPER-III	Cell biology, Genetics, Molecular Biology & Evolution	T/L	4+2	4+1	25	75
IV	PAPER-IV	Physiology, Cellular Metabolism & Embryology	T/L	4+2	4+1	25	75
	PAPER-IV	Immunology & Animal Biotechnology	T/L	4+2	4+1	25	75
V							

Note: \*Course type code: T: Theory, L: Lab, P: Problem solving

- a. Proposed combination subjects: **CBZ**
- b. Student eligibility for joining in the course: **10+2 Intermediate qualification Bi.P.C**

### **Vocational courses MLT, MPHWH (Nursing, PT Phytotherapy)**

- c. Faculty eligibility for teaching the course: **PG, M.Phil, PhD in Zoology**
- d. List of Proposed Skill enhancement courses with syllabus, if any
- e. Any newly proposed Skill development/Life skill courses with draft syllabus and required resources
- f. Required instruments/software/ computers for the course (Lab/Practical course-wise required i.e., for a batch of 15 students)

Sem. No.	Lab/Practical Name	Names of Instruments/Software/ computers required with specifications	Brand Name	Qty Required
I	Animal Diversity – I Biology of Non-Chordates			
II	Animal Diversity –II Biology of Chordates			
III	Cell biology, Genetics, Molecular Biology & Evolution			
IV	Physiology, Cellular Metabolism & Embryology			
IV	Immunology &Animal Biotechnology			

g. List of Suitable levels of positions eligible in the Govt/Pvt organizations

Suitable levels of positions for these graduates either in industry/govt organization like. technical assistants/ scientists/ school teachers., clearly define them, with reliable justification

S.No	Position	Company/ Govt organization	Remarks	Additional skills required, if any
1	School Teachers	Private		
2	Technical Assistant	Private		

h. List of Govt. organizations / Pvt companies for employment opportunities or internships or projects

S.No	Company/ Govt organization	Position type	Level of Position			
1						
2.						

i. Any specific instructions to the teacher /paper setters/Exam-Chief Superintendent

### 3. Program objectives, outcomes, co-curricular and assessment methods

BA/BCOM/BSc/BVoc	ZOOLOGY
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1. Aim and objectives of UG program in Subject:
  
2. Learning outcomes of Subject (in consonance with the Bloom's Taxonomy):
  
3. Recommended Skill enhancement courses: (Titles of the courses given below and details of the syllabus for 4 credits (i.e., 2 units for theory and Lab/Practical) for 5 hrs class-cum-lab work
  
4. Recommended Co-curricular activities:(Co-curricular Activities should not promote copying from text book or from others' work and shall encourage self/independent and group learning)
  - A. Measurable:
    1. Assignments on:
    2. Student seminars (Individual presentation of papers) on topics relating to:
    3. Quiz Programmes on:
    4. Individual Field Studies/projects:
    5. Group discussion on:
    6. Group/Team Projects on:
  - B General
    1. Collection of news reports and maintaining a record of paper-cuttings relating to topics covered in syllabus
    2. Group Discussions on:
    3. Watching TV discussions and preparing summary points recording personal observations etc., under guidance from the Lecturers
    4. Any similar activities with imaginative thinking.
  
5. Recommended Continuous Assessment methods:

#### 4. Details of course-wise Syllabus

BSc/BA/BCom	Subject (Semester: I)	Credits:
Paper: 1	Title of Course	Hrs/Wk:

1. Aim and objectives of Course (Title of the course/paper):
6. Learning outcomes of Course (in consonance with the Bloom's Taxonomy):
7. Detailed Syllabus: (Five units with each unit having 12 hours of class work)

Unit-1

Unit-2

Unit-3

Unit-4

Unit-5

Recommended Text Books:

Reference books:

8. Details of Lab/Practical/Experiments/Tutorials syllabus:

Recommended Text books:

Recommended Reference books:

9. Recommended Co-curricular activities:(Co-curricular Activities should not promote copying from text book or from others' work and shall encourage self/independent and group learning)

A. Measurable:

1. Assignments on:
2. Student seminars (Individual presentation of papers) on topics relating to:
3. Quiz Programmes on:
4. Individual Field Studies/projects:
5. Group discussion on:
6. Group/Team Projects on:

B. General

1. Collection of news reports and maintaining a record of paper-cuttings relating to topics covered in syllabus
2. Group Discussions on:
3. Watching TV discussions and preparing summary points recording personal observations etc., under guidance from the Lecturers
4. Any similar activities with imaginative thinking.

10. Recommended Continuous Assessment methods:

**5. MODEL QUESTION PAPER (Sem-end. Exam)**

<b>B.Sc</b>	<b>Subject (Semester: I)</b>	<b>Max. Marks:</b>
<b>Paper: 1</b>	<b>(Course title)</b>	<b>3Hrs</b>

<b>B.Sc</b>	<b>Subject (Semester: V)</b>	<b>Credits:</b>
<b>Paper: 5</b>	<b>(Course title)</b>	<b>Hrs/Wk:</b>

1. Aim and objectives of Course (Title of the course):
2. Learning outcomes of Course (in consonance with the Bloom's Taxonomy):
3. Detailed Syllabus: Five units (i.e., each unit having 12 hours of class work)

Unit-1

Unit-2

Unit-3

Unit-4

Unit-5

Recommended Text Books:

Reference books:

4. Details of Lab/Practical/Experiments/Tutorials syllabus:

Recommended Text books:

Recommended Reference books:



5. Recommended Co-curricular activities:(Co-curricular Activities should not promote copying from text book or from others' work and shall encourage self/independent and group learning)

A. Measurable:

1. Assignments on:
2. Student seminars (Individual presentation of papers) on topics relating to:
3. Quiz Programmes on:
4. Individual Field Studies/projects:
5. Group discussion on:
6. Group/Team Projects on:

B. General

1. Collection of news reports and maintaining a record of paper-cuttings relating to topics covered in syllabus
2. Group Discussions on:
3. Watching TV discussions and preparing summary points recording personal observations etc., under guidance from the Lecturers
4. Any similar activities with imaginative thinking.

6. Recommended Continuous Assessment methods:

## ZOOLOGY – SEMESTER I

w.e.f. 2020-21

### PAPER – I: ANIMAL DIVERSITY – BIOLOGY OF NONCHORDATES

Hours: 60 (5x12)

Max. Marks: 100

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**Course Outcomes:** By the completion of the course the graduate should be able to –

- CO1** Describe general taxonomic rules on animal classification
- CO2** Classify Protozoa to Coelenterata with taxonomic keys
- CO3** Classify Phylum Platyhelminthes to Annelida phylum using examples from parasitic adaptation and vermin composting
- CO4** Describe Phylum Arthropoda to Mollusca using examples and importance of insects and Molluscs
- CO5** Describe Echinodermata to Hemichordata with suitable examples and larval stages in relation to the phylogeny

#### **Learning objectives**

1. To understand the taxonomic position of protozoa to helminthes.
2. To understand the general characteristics of animals belonging to protozoa to hemichordata.
3. To understand the structural organization of animal's phylum from protozoa to hemichordata.
4. To understand the origin and evolutionary relationship of different phyla from protozoa to hemichordata.
5. To understand the origin and evolutionary relationship of different phylum from annelids to hemichordates.

## ZOOLOGY SYLLABUS FOR I SEMESTER

### PAPER – I: ANIMAL DIVERSITY – BIOLOGY OF NONCHORDATES

Hours: 60 (5x12)

Max. Marks: 100

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#### UNIT - I

Principles of Taxonomy – Binomial nomenclature – Rules of nomenclature  
Whittaker's five kingdom concept and classification of Animal Kingdom.

##### **Phylum Protozoa**

General Characters and classification of protozoa up to species level with suitable examples Locomotion, nutrition and reproduction in Protozoan's *Elphidium* (type study)

#### UNIT –II

##### **Phylum Porifera**

General characters and classification up to species level with suitable examples  
Skelton in Sponges

Canal system in sponges

##### **Phylum Coelenterata**

General characters and classification up to species level with suitable examples

Metagenesis in *Obelia*

Polymorphism in coelenterates

Corals and coral reefs formation

##### **Phylum Ctenophore:**

General Characters and Evolutionary significance (affinities)

#### Unit – III

##### **Phylum Platyhelminthes**

General characters and classification up to species level with suitable examples  
Life cycle and pathogen city of *Fasciolahepatica* Parasitic Adaptations in helminthes

##### **Phylum Nemathelminthes**

General characters and classification up to species level with suitable examples

Life cycle and pathogen city of *Ascaris lumbricoides*

## **Unit – IV**

### **Phylum Annelida**

General characters and classification up to species level with suitable examples

*Hirudinaria granulosa*- External characters, digestive system, excretory system and reproductive system

Evolution of Coelom and Coelomoducts

Vermiculture - Scope, significance, earthworm species, processing,

Vermicompost, economic importance of vermin compost

### **Phylum Arthropoda**

General characters and classification up to species level with suitable examples

Prawn- External characters, appendages, respiratory system and circulatory system

Vision and respiration in Arthropoda

Metamorphosis in Insects

*Peripatus*- Structure and affinities

Social Life in Bees and Termites

## **Unit – V**

### **Phylum Mollusca**

General characters and classification up to species level with suitable examples

Pearl formation in Pelecypoda

Sense organs in Mollusca

Torsion in gastropods

### **Phylum Echinodermata**

General characters and classification up to species level with suitable examples

Water vascular system in starfish

Larval forms of Echinodermata

### **Phylum Hemichordate**

General characters and classification up to species level with suitable examples

*Balanoglossus* - Structure and affinities

### **Co-curricular activities (suggested)**

- Preparation of chart/model of phylogenic tree of life, 5-kingdom classification, *Elphidium* life cycle etc.
- Visit to Zoology museum or Coral island as part of Zoological tour
- Charts on life cycle of *Obelia*, polymorphism, spongespicules
- Clay models of canal system in sponges
- Preparation of charts on life cycles of *Fasciola* and *Ascaris*
- Visit to adopted village and conducting awareness campaign on diseases, to people as part of Social Responsibility.
- Plaster-of-Paris or Thermocol model of *Periapert's*
- Construction of a vermicompost in each college, manufacture of manure by students and donating to local farmers
- Models of compound eye, bee hive and terminarium (termitaria) by students
- Visit to apiculture centre and short-term training as part of apprenticeship programme of the govt. of Andhra Pradesh
- Chart on pearl forming layers using clay or Thermocol
- Visit to a pearl culture rearing industry/institute
- Live model of water vascular system
- Phylogeny chart on echinoderm larvae and their evolutionary significance
- Preparation of charts depicting the feeding mechanism, 3coeloms, tornarialarvaetc., of *Balanoglossus*

## REFERENCE BOOKS:

1. **L.H. Hyman** '*The Invertebrates*' Vol I, II and V. – M.C. Graw Hill Company Ltd.
2. **Kotpal, R.L. 1988 - 1992** Protozoa, Porifera, Coelenterata, Helminthes, Arthropoda, Mollusca, Echinodermata. Rastogi Publications, Meerut.
3. **E.L. Jordan and P.S. Verma** '*Invertebrate Zoology*' S. Chand and Company.
4. **R.D. Barnes** '*Invertebrate Zoology*' by: W.B. Saunders CO., 1986.
5. **Barrington. E.J.W.**, '*Invertebrate structure and Function*' by ELBS.
6. **P.S. Dhama and J.K. Dhama**. Invertebrate Zoology. S. Chand and Co. New Delhi.
7. **Parker, T.J. and Haswell** '*A text book of Zoology*' by, W.A., Mac Millan Co. London.
8. **Barnes, R.D. (1982)**. *Invertebrate Zoology*, 5<sup>th</sup> Edition"

**ZOOLOGY PRACTICAL SYLLABUS FOR I SEMESTER**  
**ZOOLOGY - PAPER - I**  
**ANIMAL DIVERSITY - BIOLOGY OF NONCHORDATES**

**Periods: 24**

**Max. Marks: 50**

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**Learning Outcomes:**

- To understand the importance of preservation of museum specimens
- To identify animals based on special identifying characters
- To understand different organ systems through demo or virtual dissections
- To maintain a neat, labeled record of identified museum specimens

**Syllabus:**

**1. Study of museum slides / specimens / models (Classification of animals up to orders)**

**Protozoa:** *Amoeba, Paramecium, Paramecium Binary fission and Conjugation, Vorticella, Entamoebahistolytica, Plasmodium vivax*

**Porifera:** *Sycon, Spongilla, Euspongia, Sycon- T.S & L.S, Spicules, Gem mule*

**Coelenterata:** *Obelia – Colony & Medusa, Aurelia, Physalia, Velella, Corallium, Gorgonia, Pennatulav.*

**Platyhelminthes:** *Planaria, Fasciola hepatica, Fasciolalarval forms – Miracidium, Redia, Cercaria, Echinococcusgranulosus, Taeniasolium, Schistosomahaematobiumvii.*

**Nemathelminthes:** *Ascaris (Male & Female), Drancunculus, Ancylostoma, Wuchereria*

**Annelida:** *Nereis, Aphrodite, Chaetopteurs, Hirudinaria, Trochophore larva*

**Arthropoda:** *Cancer, Palaemon, Scorpion, Scolopendra, Sacculina, Limulus, Periap't's, Larvae - Nauplius, Mysis, Zoea, Mouth parts of male & female Anopheles and Culex, Mouthparts of Housefly and Butterfly. xiii.*

**Mollusca:** *Chiton, Pila, Unio, Pteredo, Murex, Sepia, Loligo, Octopus, Nautilus, Glochidium larva*

**Echinodermata:** *Asterias, Ophiothrix, Echinus, Clypeaster, Cucumaria, Ante don, Bipinnaria larva*

**Hemichordata:** *Balanoglossus, Tornaria larva*

## **2. Dissections:**

- 1. Prawn:** Appendages, Digestive system, Nervous system, Mounting of Statocyst
- 2. Insect** Mouth Parts
- 3. Laboratory Record work shall be submitted at the time of practical amination**
- 4.** An “**Animal album**” containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose
- 5. Computer - aided techniques should be adopted or show virtual dissections**

## **REFERENCE MANUALS:**

1. Practical Zoology- Invertebrates S.S.Lal
2. Practical Zoology - Invertebrates P.S.Verma
3. Practical Zoology - Invertebrates K.P.Kurl
4. Ruppert and Barnes (2006) Invertebrate Zoology, 8<sup>th</sup> Edition, Holt Saunders International Edition



## **ZOOLOGY –SEMESTER II**

**w.e.f. 2020-21**

### **PAPER – II: ANIMAL DIVERSITY – BIOLOGY OF CHORDATES**

**Hours: 60 (5x12)**

**Max. Marks: 100**

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#### **Course Outcomes:**

By the completion of the course the graduate should be able to -

- CO1** Describe general taxonomic rules on animal classification of chordates
- CO2** Classify Protochordata to Mammalian with taxonomic keys
- CO3** Understand Mammals with specific structural adaptations
- CO4** Understand the significance of dentition and evolutionary significance
- CO5** Understand the origin and evolutionary relationship of different phyla from Protochordata to mammalian.

#### **Learning objectives**

1. To understand the animal kingdom.
2. To understand the taxonomic position of Protochordata to Mammalian.
3. To understand the general characteristics of animals belonging to Fishes to Reptilians.
4. To understand the body organization of Chordata.
5. To understand the taxonomic position of Protherian mammals.

**ZOOLOGY SYLLABUS FOR II SEMESTER**  
**PAPER – II: ANIMAL DIVERSITY – BIOLOGY OF CHORDATES**

**Hours: 60 (5x12)**

**Max. Marks: 100**

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**Unit - I**

General characters and classification of Chordata upto species level

Protochordata- Salient features of Cephalochordate,

Structure of *Branchiostoma*

Affinities of Cephalochordate.

Salient features of Urochordata

Structure and life history of *Herdmania*

Retrogressive metamorphosis –Process and Significance

**Unit -II**

Cyclostomata, General characters, Comparison of *Petromyzon* and *Myxine*

Pisces: General characters and classification of Fishes upto species level

*Scoliodon*: External features, Digestive system, Respiratory system, Structure and

function of Heart, Structure and functions of the Brain.

Migration in Fishes

Types of Scales

Dipnoi

**Unit - III**

General characters of Amphibian

Classification of Amphibian upto species level with examples.

*Rana hexadactyla*: External features, Digestive system, Respiratory system, Structure and function of Heart, structure and functions of the Brain

Reptilia: General characters of Reptilia, Classification of Reptilia upto species level with

**examples**

*Calotes*: External features, Digestive system, Respiratory system, Structure and

function of Heart, structure and function of Brain

Identification of Poisonous and non-poisonous snakes and Skull in reptiles

#### **Unit - IV**

Aves: General characters and classification of Aves upto species level

*Columba livia*: External features, Digestive system, Respiratory system, Structure and function of Heart, structure and function of Brain

Migration in Birds

Flight adaptation in birds

#### **Unit - V**

General characters of Mammalian

Classification of Mammalian upto species level with examples

Comparison of Prototherians, Metatherians and Eutherians

Dentition in mammals

#### ***Co-curricular activities (suggested)***

- Preparation of charts on Chordate classification (with representative animal photos) and retrogressive metamorphosis
- Thermocol or Clay models of Herdmania and Amphioxus
- Visit to local fish market and identification of local cartilaginous and bony fishes
- Maintaining of aquarium by students
- Thermocol model of fish heart and brain
- Preparation of slides of scales of fishes
- Visit to local/nearby river to identify migratory fishes and prepare study notes
- Preparation of Charts on above topics by students (Eg: comparative account of vertebrate heart/brain/lungs, identification of snakes etc.)
- Collecting and preparation of Museum specimens with dead frogs/snakes/lizards etc., and/or their skeletons
- Additional input on types of snake poisons and their antidotes (student activity).
- Collection of bird feathers and submission of report on Plumology
- Taxidermic preparation of dead birds for Zoology museum
- Map pointing of prototherian and metatherian mammals
- Chart preparation for dentition in mammals

## REFERENCE BOOKS:

- J.Z. Young, 2006. The life of vertebrates. (The Oxford University Press, New Delhi). 646 pages. Reprinted
- Arumugam, N. Chordate Zoology, Vol. 2. Saras Publication. 278 pages. 200 figs.
- A.J. Marshall, 1995. Textbook of zoology, Vertebrates. (The McMillan PressLtd., UK). 852 pages. (Revised edition of Parker & Haswell, 1961).
- M. Ekambaranatha Ayyar, 1973. A manual of zoology. Part II. (S. Viswanathan Pvt. Ltd., Madras).
- P.S. Dhama & J.K. Dhama, 1981. Chordate zoology. (R. Chand & Co.). 550 pages.
- Gurdarshan Singh & H. Bhaskar, 2002. Advanced Chordate Zoology. Campus Books, 6 Vols., 1573 pp., tables, figs.
- A.K. Sinha, S. Adhikari & B.B. Ganguly, 1978. Biology of animals. Vol. II. Chordates. (New Central Book Agency, Calcutta). 560 pages.
- R.L. Kotpal, 2000. Modern textbook of zoology, Vertebrates. (Rastogi Publ., Meerut). 632 pages.
- E.L. Jordan & P.S. Verma, 1998. Chordate zoology. (S. Chand & Co.). 1092 pages.
- G.S. Sandhu, 2005. Objective Chordate Zoology. Campus Books, vii, 169 pp.
- Sandhu, G.S. & H. Bhaskar, H. 2004. Textbook of Chordate Zoology. Campus Books, 2 vols., xx, 964 p., figs.
- Veena, 2008. Lower Chordata. (Sonali Publ.), 374 p., tables, 117 figs.

**ZOOLOGY PRACTICAL SYLLABUS FOR II SEMESTER**  
**ZOOLOGY - PAPER - II**  
**ANIMAL DIVERSITY - BIOLOGY OF CHORDATES**

Periods: 24

Max. Marks: 50

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**Learning Outcomes:**

- To understand the Taxidermic and other methods of preservation of chordates
- To identify chordates based on special identifying characters
- To understand internal anatomy of animals through demo or virtual dissections, thus directing the student for “empathy towards the fellow living beings”
- To maintain a neat, labelled record of identified museum specimens

**Observation of the Following Slides / Spotters / Models**

1. Protochordata: *Herdmania*, *Amphioxus*, *Amphioxus* T.S through pharynx.
2. Cyclostomata: *Petromyzon* and *Myxine*.
3. Pisces: *Pristis*, *Torpedo*, *Hippocampus*, *Exocoetus*, *Echeneis*, *Labeo*, *Catla*, *Claries*, *Channa*, *Anguilla*.
4. Amphibian: *Ichthyophis*, *Amblystoma*, *Axolotl* larva, *Hyla*,
5. Reptilia: *Draco*, *Chameleon*, *Uromastix*, *Testudo*, *Trionyx*, *Russels viper*, *Naja*, *Krait*, *Hydrophis*, *Crocodile*.
6. Aves: *Psittacula*, *Eudynamis*, *Bubo*, *Alcedo*.
7. Mammalian: *Ornithorhynchus*, *Pteropus*, *Funambulus*.

**Dissections-**

1. *Scoliodon* IX and X, Cranial nerves
2. *Scoliodon* Brain
3. Mounting of fish scales

Note: 1. Dissections are to be demonstrated only by the faculty or virtual.

2. Laboratory Record work shall be submitted at the time of practical examination.

**REFERENCE BOOKS:**

1. S.S.Lal, Practical Zoology –Vertebrate
2. P.S.Verma, A manual of Practical Zoology – Chordata

## ZOOLOGY – SEMESTER III

w.e.f. 2020-21

### PAPER – III: CELL BIOLOGY, GENETICS, MOLECULAR BIOLOGY AND EVOLUTION

Hours: 60 (5X12)

Max. Marks: 100

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#### Course Outcomes:

The overall course outcome is that the student shall develop deeper understanding of what life is and how it functions at cellular level. This course will provide students with a deep knowledge in Cell Biology, Animal Biotechnology and Evolution and by the completion of the course the graduate shall able to–

- CO1** To understand the basic unit of the living organisms and to differentiate the organisms by their cell structure.
- CO2** Describe fine structure and function of plasma membrane and different cell organelles of eukaryotic cell.
- CO3** To understand the history of origin of branch of genetics, gain knowledge on heredity, interaction of genes, various types of inheritance patterns existing in animals
- CO4** Acquiring in-depth knowledge on various of aspects of genetics involved in sex determination, human karyo typing and mutations of chromosomes resulting in various disorders
- CO5** Understand the central dogma of molecular biology and flow of genetic information from DNA to proteins.
- CO6** Understand the principles and forces of evolution of life on earth, the process of evolution of new species and apply the same to develop new and advanced varieties of animals for the benefit of the society

## **Learning Objectives**

- To understand the origin of cell and distinguish between prokaryotic and eukaryotic cell
- To understand the role of different cell organelles in maintenance of life activities
- To provide the history and basic concepts of heredity, variations and gene interaction
- To enable the students distinguish between polygenic, sex-linked, and multiple allelic modes of inheritance.
- To acquaint student with basic concepts of molecular biology as to how characters are expressed with a coordinated functioning of replication, transcription and translation in all living beings
- To provide knowledge on origin of life, theories and forces of evolution
- To understand the role of variations and mutations in evolution of organisms

**ZOOLOGY SYLLABUS FOR III SEMESTER**  
**PAPER – III: CELL BIOLOGY, GENETICS, MOLECULAR BIOLOGY AND EVOLUTION**  
**Hours: 60 (5x12) Max. Marks: 100**

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**Unit–I Cell Biology**

Definition, history, prokaryotic and eukaryotic cells, virus, viroids, mycoplasma

Electron microscopic structure of animal cell.

Plasma membrane –Models and transport functions of plasma membrane.

Structure and functions of Golgi complex, Endoplasmic Reticulum and Lysosomes

Structure and functions of Ribosomes, Mitochondria, Nucleus, Chromosomes

**(Note: 1. General pattern of study of each cell organelle – Discovery, Occurrence, Number, Origin, Structure and Functions with suitable diagrams)**

**2. Need not study cellular respiration under mitochondrial functions)**

**Unit–II Genetics - I**

Mendel's work on transmission of traits

Gene Interaction – Incomplete Dominance, Codominance, Lethal Genes

Polygene's (General Characteristics & examples); Multiple Alleles (General Characteristics and Blood group inheritance

Sex determination (Chromosomal, Genic Balance, Hormonal, Environmental and Haplo-diploidy types of sex determination)

Sex linked inheritance (X-linked, Y-linked & XY-linked inheritance)

**Unit–III Genetics - II**

Mutations & Mutagenesis

Chromosomal Disorders (Autosomal and Allosomal)

Human Genetics – Karyo typing, Pedigree Analysis(basics)

Basics on Genomics and Proteomics



## **UNIT- IV: Molecular Biology**

Central Dogma of Molecular Biology

Basic concepts of-

- a. DNA replication – Overview (Semi-conservative mechanism, Semi- discontinuous mode, Origin & Propagation of replication fork)
- b. Transcription in prokaryotes – Initiation, Elongation and Termination, Post-transcriptional modifications(basics)
- c. Translation – Initiation, Elongation and Termination  
Gene Expression in prokaryotes (Lac Operon); Gene Expression in eukaryotes

## **Unit - V**

Origin of life

Theories of Evolution: Lamarckism, Darwinism, Germ Plasm Theory, Mutation Theory

Neo-Darwinism: Modern Synthetic, Theory of Evolution, Hardy-Weinberg Equilibrium

Forces of Evolution: Isolating mechanisms, Genetic Drift, Natural Selection, Speciation

## **Co-curricular activities (Suggested)**

- Model of animal cell
- Working model of mitochondria to encourage creativity among students
- Photo album of scientists of cell biology
- Charts on plasma membrane models/cell organelles
- Observation of Mendelian / Non-Mendelian inheritance in the plants of college botanical garden or local village as a student study project activity
- Observation of blood group inheritance in students, from their parents and grandparents
- Karyo typing and preparation of pedigree charts for identifying diseases in family history
- Charts on chromosomal disorders
- Charts on central dogma/lac Operon/genetic code
- Model of semi-conservative model of DNA replication
- Model of tRNA and translation mechanism
- Power point presentation of transcription or any other topic by students
- Draw geological time scale and highlight important events along the timeline
- Chart on industrial melanism to teach directed selection, Darwin's finches to teach genetic drift, collection of data on weight of children born in primary health centres to teach stabilizing selection etc.

## REFERENCE BOOKS:

1. Lodish, Berk, Zipursky, Matsudaria, Baltimore, Darnell 'Molecular Cell Biology'  
W.H.Freeman and company New York.
2. Cell Biology by DeRobertis
3. Bruce Alberts, Molecular Biology of the Cell
4. Rastogi, Cytology
5. Varma & Aggarwal, Cell Biology
6. C.B. Pawar, Cell Biology
7. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII  
Edition. Wiley India.
8. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley  
and Sons Inc.
9. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition.  
Benjamin Cummings.
10. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin  
Cummings.
11. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to  
Genetic Analysis. IX Edition. W. H. Freeman and Co.
12. Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing
13. Molecular Biology by freifielder
14. Instant Notes in Molecular Biology by Bios scientific publishers and Viva Books  
Private Limited
15. Hall, B. K. and Hallgrimsson, B. (2008). Evolution. IV Edition. Jones and Bartlett  
Publishers
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Cummings.
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19. James D. Watson, Nancy H. Hopkins 'Molecular Biology of the Gene'
20. Jan M. Savage. Evolution, 2nd ed, Oxford and IBH Publishing Co., New Delhi.
21. Gupta P.K.. 'Genetics

**ZOOLOGY PRACTICAL SYLLABUS FOR III SEMESTER**  
**ZOOLOGY - PAPER - III**  
**CELL BIOLOGY, GENETICS, MOLECULAR BIOLOGY AND EVOLUTION**  
Periods: 24 Max. Marks: 50

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**Learning Objectives:**

Acquainting and skill enhancement in the usage of laboratory microscope  
Hands-on experience of different phases of cell division by experimentation  
Develop skills on human Karyo typing and identification of chromosomal disorders  
To apply the basic concept of inheritance for applied research  
To get familiar with phylogeny and geological history of origin & evolution of animals

**I. Cell Biology**

1. Preparation of temporary slides of Mitotic divisions with onion root tips
2. Observation of various stages of Mitosis and Meiosis with prepared slides
3. Mounting of salivary gland chromosomes of *Chironomus*

**II. Genetics**

1. Study of Mendelian inheritance using suitable examples and problems
2. Problems on blood group inheritance and sex linked inheritance
3. Study of human Karyo types (Down's syndrome, Edwards, syndrome, Patau syndrome, Turner's syndrome and Klinefelter syndrome)

**III. Evolution**

1. Study of fossil evidences
2. Study of homology and analogy from suitable specimens and pictures
3. Phylogeny of horse with pictures
4. Study of Genetic Drift by using examples of Darwin's finches(pictures)
5. Visit to Natural History Museum and submission of report

## REFERENCE BOOKS:

1. Burns GW. 1972. *The Science of Genetics. An Introduction to Heredity*. Mac Millan Publ.Co.Inc.
2. Gardner EF. 1975. *Principles of Genetics*. John Wiley & Sons, Inc. NewYork.
3. Harth and Jones EW. 1998. *Genetics – Principles and Analysis*. Jones and BarHett Publ. Boston.
4. Levine L. 1969. *Biology of the Gene*.Toppan.
5. Pedder IJ. 1972. *Genetics as a Basic Guide*. W. Norton & Company,Inc.
6. Rastogi VB. 1991. *A Text Book of Genetics*.KedarNath Ram Nath Publications, Meerut, Uttar Pradesh,India.
7. Rastogi VB. 1991. *Organic Evolution*.KedarNath Ram Nath Publications,Meerut,Uttar Pradesh,India.
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**ZOOLOGY – SEMESTER IV**

**w.e.f. 2020-21**

**PAPER – IV: ANIMAL PHYSIOLOGY, CELLULAR METABOLISM AND EMBRYOLOGY**

**Hours: 60 (5X12)**

**Max. Marks: 100**

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**Course Outcomes:**

This course will provide students with a deep knowledge in Physiology, Cellular metabolism and Molecular Biology and by the completion of the course the graduate shall able to –

**CO1** Understand the functions of important animal physiological systems including digestion, cardio-respiratory and renal systems.

**CO2** Understand the muscular system and the neuro-endocrine regulation of animal growth, development and metabolism with a special knowledge of hormonal control of human reproduction.

**CO3** Describe the structure, classification and chemistry of Biomolecules and enzymes responsible for sustenance of life in living organisms

**CO4** Develop broad understanding the basic metabolic activities pertaining to the catabolism and anabolism of various Biomolecules

**CO5** Describe the key events in early embryonic development starting from the formation of gametes upto gastrula ion and formation of primary germ layers.

## **Learning Objectives**

- To achieve a thorough understanding of various aspects of physiological systems and their functioning in animals.
- To instil the concept of hormonal regulation of physiology, metabolism and reproduction in animals.
- To understand the disorders associated with the deficiency of hormones
- To demonstrate a thorough knowledge of the intersection between the disciplines of Biology and Chemistry.
- To provide insightful knowledge on the structure and classification of carbohydrates, proteins, lipids and enzymes
- To demonstrate an understanding of fundamental biochemical principles such as the function of Biomolecules, metabolic pathways and the regulation of biochemical processes
- To make students gain proficiency in laboratory techniques in biochemistry and orient them to apply the scientific method to the processes of experimentation and hypothesis testing.

## ZOOLOGY SYLLABUS FOR IV SEMESTER

### PAPER – IV: ANIMAL PHYSIOLOGY, CELLULAR METABOLISM AND EMBRYOLOGY

Hours: 60 (5x12)

Max. Marks: 100

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#### **UNIT - I Animal Physiology -I**

Process of digestion and assimilation

Respiration - Pulmonary ventilation, transport of oxygen and CO<sub>2</sub>

(Note: Need not study cellular respiration here)

Circulation - Structure and functioning of heart, Cardiac cycle

Excretion - Structure and functions of kidney urine formation, counter current

Mechanism

#### **UNIT- II Animal Physiology -II**

Nerve impulse transmission - Resting membrane potential, origin and propagation of action potentials along myelinated and non-myelinated nerve fibers

Muscle contraction - Ultra structure of muscle, molecular and chemical basis of muscle contraction

Endocrine glands - Structure, functions of hormones of pituitary, thyroid, parathyroid, adrenal glands and pancreas

Hormonal control of reproduction in a mammal

#### **UNIT- III Cellular Metabolism – I(Biomolecules)**

Carbohydrates - Classification of carbohydrates. Structure of glucose

Proteins - Classification of proteins. General properties of amino acids

Lipids - Classification of lipids

Enzymes: Classification and Mechanism of Action

#### **UNIT- IV Cellular Metabolism –II**

Carbohydrate Metabolism - Glycolysis, Krebs cycle, Electron Transport Chain, Glycogen metabolism, Gluconeogenesis

Lipid Metabolism – Synthesis of fatty acids,  $\beta$ -oxidation of palmitic acid

Protein metabolism - Transamination, Deamination and Urea Cycle

## **Unit–V Embryology**

Gametogenesis

Fertilization

Types of eggs

Types of cleavages

Development of Frog upto formation of primary germ layers

### **Co-curricular activities (Suggested)**

- Chart on cardiac cycle, human lung, kidney/nephron structure etc.
- Working model of human / any mammalian heart.
- Chart of sarcomere/location of endocrine glands in human body
- Chart affixing of photos of people suffering from hormonal disorders
- Student study projects such as identification of incidence of hormonal disorders in the local primary health centre, studying the reasons thereof and measures to curb or any other as the lecturer feels good in nurturing health awareness among students
- Chart on structures of Biomolecules/types of amino acids (essential and non- essential)  
Chart preparation by students on Glycolysis / kerb's cycle/urea cycle etc.
- Model of electron transport chain
- Preparation of models of different types of eggs in animals
- Chart on frog embryonic development, fate map of frog blastula, cleavage etc.



## REFERENCE BOOKS:

1. Eckert H. *Animal Physiology: Mechanisms and Adaptation*. W.H. Freeman & Company.
2. Flöray E. *An Introduction to General and Comparative Animal Physiology*. W.B. Saunders Co., Philadelphia.
3. Goel KA and Satish KV. 1989. *A Text Book of Animal Physiology*, Rastogi Publications, Meerut, U.P.
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9. *Chordate embryology* by Varma and Agarwal
10. *Embryology* by V.B. Rastogi
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**ZOOLOGY PRACTICAL SYLLABUS FOR IV SEMESTER**  
**ZOOLOGY - PAPER - IV**  
**ANIMAL PHYSIOLOGY, CELLULAR METABOLISM AND EMBRYOLOGY**  
Periods: 24 Max. Marks: 50

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**Learning Objectives:**

- Identification of an organ system with histological structure
- Deducing human health based on the information of composition of blood cells
- Demonstration of enzyme activity *invitro*
- Identification of various Biomolecules of tissues by simple colorimetric methods and also quantitative methods
- Identification of different stages of earl embryonic development in animals

**I. Animal physiology**

1. Qualitative tests for identification of carbohydrates, proteins and fats
2. Study of activity of salivary amylase under optimum conditions
3. T.S. of duodenum, liver, lung, kidney, spinal cord, bone and cartilage
4. Differential count of human blood

**II. Cellular metabolism**

1. Estimation of total proteins in given solutions by Lowry's method.
2. Estimation of total carbohydrate by Anthrone method.
3. Qualitative tests for identification of ammonia, urea and uric acid
4. Protocol for Isolation of DNA in animal cells

**III. Embryology**

1. Study of T.S. of testis, ovary of a mammal
2. Study of different stages of cleavages (2, 4, 8 cell stages)
3. Construction of fate map of frog blastula

**REFERENCE BOOKS:**

- Harper's Illustrated Biochemistry
- Cell and molecular biology: Concepts & experiments. VI Ed. John Wiley &sons. Inc.
- Lab Manual on Blood Analysis and Medical Diagnostics, S. Chand and Co. Ltd.
- Laboratory techniques by Plummer

## ZOOLOGY – SEMESTER IV

w.e.f. 2020-21

### COURSE – 5: IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY

Hours: 60 (5x12)

Max. Marks: 100

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#### Course Outcomes:

This course will provide students with a deep knowledge in immunology, genetics, embryology and ecology and by the completion of the course the graduate shall able to –

- CO1** To get knowledge of the organs of Immune system, types of immunity, cells and organs of immunity.
- CO2** To describe immunological response as to how it is triggered (antigens) and regulated (antibodies)
- CO3** Understand the applications of Biotechnology in the fields of industry and agriculture including animal cell/tissue culture, stem cell technology and genetic engineering.
- CO4** Get familiar with the tools and techniques of animal biotechnology.

#### Learning Objectives

- To trace the history and development of immunology
- To provide students with a foundation in immunological processes
- To be able to compare and contrast the innate versus adaptive immune systems and humoral versus cell-mediated immune responses
- Understand the significance of the Major Histocompatibility Complex in terms of immune response and transplantation
- To provide knowledge on animal cell and tissue culture and their preservation
- To empower students with latest biotechnology techniques like stem cell technology, genetic engineering, hybridoma technology, transgenic technology and their application in medicine and industry for the benefit of living organisms
- To explain *in vitro* fertilization, embryo transfer technology and other reproduction manipulation methodologies.
- To get insight in applications of recombinant DNA technology in agriculture, production of therapeutic proteins.
- To understand principles of animal culture, media preparation.

**ZOOLOGY SYLLABUS FOR SEMESTER - IV**  
**COURSE – 5: IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY**  
**Hours: 60 (5x12) Max. Marks: 100**

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**Unit–I Immunology – I (Overview of Immune system)**

Introduction to basic concepts in Immunology  
Innate and adaptive immunity, Vaccines and Immunization programme  
Cells of immune system  
Organs of immune system

**Unit – II Immunology – II (Antigens, Antibodies, MHC and Hypersensitivity)**

Antigens: Basic properties of antigens, B and T cell epitomes, happens and adjuvant; Factors influencing immunogenicity  
Antibodies: Structure of antibody, Classes and functions of antibodies  
Structure and functions of major his to compatibility complexes  
Exogenous and Endogenous pathways of antigen presentation and processing  
Hypersensitivity – Classification and Types

**Unit – III Techniques**

Animal Cell, Tissue and Organ culture media: Natural and Synthetic media,  
Cell cultures: Establishment of cell culture (primary culture, secondary culture, types of cell lines; Protocols for Primary Cell Culture); Established Cell lines (common examples such as MRC, HeLa, CHO, BHK, Vero); Organ culture; Cryopreservation of cultures  
Stem cells: Types of stem cells and applications  
Hybridoma Technology: Production & applications of Monoclonal antibodies (mAb)

**Unit – IV Applications of Animal Biotechnology**

Genetic Engineering: Basic concept, Vectors, Restriction Endo nucleases and Recombinant DNA technology  
Gene delivery: Microinjection, electroporation, biolistic method (gene gun), liposome and viral-mediated gene delivery  
Transgenic Animals: Strategies of Gene transfer; Transgenic - sheep, fish; applications  
Manipulation of reproduction in animals: Artificial Insemination, *Invitro* fertilization, super ovulation, Embryo transfer, Embryo cloning

## **Unit - V**

PCR: Basics of PCR.

DNA Sequencing: Sanger's method of DNA sequencing- traditional and automated sequencing (2hrs)

Hybridization techniques: Southern, Northern and Western blotting

DNA fingerprinting: Procedure and applications

Applications in Industry and Agriculture: Fermentation: Different types of Fermentation and

Downstream processing; Agriculture: Monoculture in fishes, polyploidy in fishes

### **Co-curricular activities (suggested)**

- Organizing awareness on immunization importance in local village in association with NCC and NSS teams
- Charts on types of cells and organs of immune system
- Student study projects on aspects such as – identification of allergies among students (hypersensitivity), blood groups in the class (antigens and antibodies duly reported) etc., as per the creativity and vision of the lecturer and students
- Visit to research laboratory in any University as part of Zoological tour and exposure and/ or hands-on training on animal cell culture.
- Visit to biotechnological laboratory in University or any central/state institutes and create awareness on PCR, DNA finger printing and blot techniques or Visit to a fermentation industry or Visit to a local culture pond and submit report on culture of fishes etc.

### **REFERENCE BOOKS:**

1. Immunology by Ivan M. Riott
2. Immunology by Kubey
3. Sree krishna V. 2005. *Biotechnology –I, Cell Biology and Genetics*. New Age International Publ. New Delhi, India.

**ZOOLOGY PRACTICAL SYLLABUS FOR V SEMESTER**  
**COURSE – 5: IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY**

**Periods: 24**

**Max. Marks: 50**

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**Learning Objectives:**

- a. Acquainting student with immunological techniques vis-à-vis theory taught in the classroom
- b. Interconnect the theoretical and practical knowledge of immunity with the outer world for the development of a healthier life.
- c. Demonstrate basic laboratory skills necessary for Biotechnology research
- d. Promoting application of the lab techniques for taking up research in higher studies

**I. Immunology**

1. Demonstration of lymphoid organs (as per UGC guidelines)
2. Histological study of spleen, thymus and lymph nodes (through prepared slides)
3. Blood group determination
4. Demonstration of
  - a. ELISA
  - b. Immune electrophoresis

**II. Animal biotechnology**

1. DNA quantification using DPA Method.
2. Techniques: Western Blot, Southern Hybridization, DNA Fingerprinting
3. Separation, Purification of biological compounds by paper, Thin-layer and Column chromatography
4. Cleaning and sterilization of glass and plastic wares for cell culture.
5. Preparation of culture media.

**REFERENCE BOOKS:**

1. Immunology Lab Biology 477 Lab Manual; Spring 2016 Dr. Julie Jameson
2. Practical Immunology A Laboratory Manual; **LAP LAMBERT Academic Publishing**
3. Manual of laboratory experiments in cell biology by Edward
4. Laboratory Techniques by Plummer

**ZOOLOGY MODEL PAPER FOR I SEMESTER**  
**ZOOLOGY - PAPER - I**  
**ANIMAL DIVERSITY – BIOLOGY OF NONCHORDATES**

**Time: 3hrs.**

**Max. Marks: 75**

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**I. Answer any FIVE of the following:**

**5x5=25**

**Draw labeled diagrams wherever necessary**

1. Binomial nomenclature
2. Whittaker's concept
3. Hexactinellida
4. Polymorphism
5. Parasitic adaptations
6. Coelom and coelomic ducts
7. Cephalic appendages in Prawn
8. Pearl formation

**II. Answer any FIVE of the following:**

**5x10=50**

**Draw labeled diagrams wherever necessary**

9. a. Describe the structure and life history of *Elphidium*.  
OR  
b. Classify the phylum Protozoa with suitable examples up to species level.
10. a. Describe various types of canal systems in sponges.  
OR  
b. Write an essay on corals and coral reef formation.
11. a. Write in detail about the life history of *Fasciola hepatica*.  
OR  
b. Discuss the life cycle of *Ascaris lumbricoides*. Add a note on its Pathogenicity.
12. a. Explain the process and economic importance of vermiculture.  
OR  
b. Describe the structure of *Peripatus*. Add a note on its affinities.
13. a. Give an account on water vascular system in star fish.  
OR  
b. Write in detail about the structure and affinities of *Balanoglossus*.

**ZOOLOGY MODEL PAPER FOR II SEMESTER**  
**ZOOLOGY - PAPER - II**  
**ANIMAL DIVERSITY – BIOLOGY OF CHORDATES**

**Time: 3hrs**

**Max. Marks: 75**

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**I. Answer any FIVE of the following:**

**5x5=25**

**Draw labeled diagrams wherever necessary**

1. *Amphioxus*
2. Placoidscale
3. Quillfeather
4. Prototheria
5. Anadromousmigration
6. *Draco*
7. Emu
8. Apoda

**II. Answer any FIVE of the following:**

**5x10=50**

**Draw labeled diagrams wherever necessary**

9. a. Explain the life history of *Herdmania*  
OR  
b. Explain the origin and general characters of chordates
10. a. Compare the characters of *Petromyzon* and *Myxine*  
OR  
b. Describe the structure of heart in *Scoliodon*
11. a. Describe the brain of *Ranahexadactyla*  
OR  
b. Explain the external features of *Calotes*
12. a. Write an essay on flight adaptations in birds  
OR  
b. Explain the respiratory system of *Columba livia*
13. a. Compare the characters of Metatheria and Eutheria  
OR  
b. Write an essay on dentition in mammals



**ZOOLOGY MODEL PAPER FOR III SEMESTER**  
**ZOOLOGY - PAPER - III**  
**CELL BIOLOGY, GENETICS, MOLECULAR BIOLOGY AND EVOLUTION**

**Time: 3hrs.**

**Max. Marks: 75**

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**I. Answer any FIVE of the following:**

**5x5=25**

**Draw labeled diagrams wherever necessary**

1. Prokaryotic cell
2. Golgi complex
3. Polygenes
4. Multiple alleles
5. Mutations
6. Karyotyping
7. Lac operon concept
8. Genetic drift

**II. Answer any FIVE of the following:**

**5x10=50**

**Draw labeled diagrams wherever necessary**

9. a. Describe the ultra structure of animal cell  
OR  
b. Explain the structure of mitochondria. Add a note on its functions.
10. a. Write an essay on gene interactions  
OR  
b. Discuss sex linked inheritance.
11. a. What are chromosomal disorders? Explain various types of autosomal and allosomal disorders  
OR
12. a. Give an account of DNA replication.  
OR  
b. Explain the mechanism of Prokaryotic transcription.
13. a. An essay on modern synthetic theory of evolution.  
OR  
b. Define isolation. Discuss various isolating mechanisms.

**ZOOLOGY MODEL PAPER FOR IV SEMESTER**  
**ZOOLOGY - PAPER - IV**  
**ANIMAL PHYSIOLOGY, CELLULAR METABOLISM AND EMBRYOLOGY**  
**Time: 3hrs. Max. Marks: 75**

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**I. Answer any FIVE of the following:**

**5x5=25**

**Draw labeled diagrams wherever necessary**

1. Assimilation
2. Cardiac cycle
3. Ultra structure of muscle
4. Pancreas
5. Structure of glucose
6. Lipids
7. Gluconeogenesis
8. Types of eggs

**II. Answer any FIVE of the following:**

**5x10=50**

**Draw labeled diagrams wherever necessary**

9. a. Explain the process of digestion.  
OR  
b. Describe the structure and function of heart
10. a. Give an account of nerve impulse transmission.  
OR  
b. Write an essay on the hormonal control of reproduction in mammals
11. a. Write an essay on the classification of carbohydrates  
OR  
b. Classify the enzymes. Discuss the mechanism of enzyme action.
12. a. Write an account on Krebs's cycle.  
OR  
b. Explain B- oxidation of palmitic acid
13. a. Discuss the process of fertilization.  
OR  
b. Write an essay on gameto genesis.

**ZOOLOGY MODEL PAPER FOR V SEMESTER**  
**COURSE – 5: IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY**  
**Time: 3hrs** **Max. Marks: 75**

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**I. Answer any FIVE of the following:**

**5x5=25**

**Draw labeled diagrams wherever necessary**

1. Vaccines
2. Primary lymphoid organs
3. Hapten
4. Hypersensitivity
5. Natural media
6. Cell lines
7. Endo nucleases
8. Polyploidy in fishes

**II. Answer any FIVE of the following:**

**5x10=50**

**Draw labeled diagrams wherever necessary**

9. a. Define immunity. Write in detail about innate immunity.  
OR  
b. Explain various cells of immune system
  
10. a. Describe the structure of antibody. Add a note on their functions.  
OR  
b. Describe the structure of MHC molecules. Discuss their role in the mechanism of exogenous and endogeneous pathway of antigen processing and presentation
  
11. a. Write an essay on different types of stem cells and their applications  
OR  
b. Explain the production and applications of monoclonal antibodies.
  
12. a. Write an account on recombinant DNA technology.  
OR  
b. Write an essay on transgenic animals
  
13. a. Explain hybridization techniques.  
OR  
b. Write an essay on PCR