

# **SHIVAJI UNIVERSITY, KOLHAPUR.**



**Accredited By NAAC with 'A' Grade**

**National Education**

**Policy (NEP) 2.0**

**Syllabus for**

**B. Sc. Zoology**

**Syllabus to be implemented from**

**June 2024 onwards.**

Shivaji University, Kolhapur  
Bachelor of Science Credit Framework  
First-Year (B. Sc. I-Zoology)

| SEM (Level)  | COURSES   |   |   | OE  | VSC/SEC   | AEC/VEC/IKS   | OJT/FP/CEP /CC/RP | Total Credits | Degree/Cum. Cr. MEME         |
|--------------|---|---|---|---|-----------|---|-------------------|---------------|------------------------------|
|              | Course-1  | Course-2  | Course-3  |   |           |   |                   |               |                              |
| SEM I (4.5)  | ZOO 101<br>Paper I<br>Animal Diversity (2)<br>ZOO 102<br>Paper II<br>Cell Biology (2)<br>ZOO PR 103<br>Practical I (2)                        | DSC I (2)<br><br>DSC II (2)<br><br>DSC P1(2)      | DSC I (2)<br><br>DSC II (2)<br><br>DSC P1 (2)     | ZOOOE 101<br>OE I (2)<br>Diet and Nutrition |           | IKS I (2)<br>Introduction to IKS                          |                   |               | UG Certificate<br>44 Credits |
| Credits      | 4 (T) + 2 (P) = 6   | 4 (T) + 2 (P) = 6                                 | 4 (T) + 2 (P) = 6                                 | 2   |           | 2   |                   | 22            |                              |
| SEM II (4.5) | ZOO 201<br>Paper III<br>Genetics (2)<br>ZOO 202<br>Paper IV<br>ecology, ethology,<br>evolution, entomology (2)<br>ZOO 203<br>Practical II (2) | DSC III (2)<br><br>DSC IV (2)<br><br>DSC P II (2) | DSC III (2)<br><br>DSC IV (2)<br><br>DSC P II (2) | ZOOOE 201<br>OE II (2)<br>Vermiculture      |           | VEC I (2)<br>(Democracy,<br>Election and<br>Constitution) |                   |               |                              |
| Credits      | 4 (T) + 2 (P) = 6   | 4 (T) + 2 (P) = 6                                 | 4 (T) + 2 (P) = 6                                 | 2   |           | 2   |                   | 22            |                              |
| <b>Total</b> | <b>8(T)+4(P)=12</b>   | <b>8(T)+4(P)=12</b>                               | <b>8(T)+4(P)=12</b>                               | <b>2+2=4 (T/P)</b>                          | <b>--</b> | <b>2+2=4</b>  | <b>--</b>         | <b>44</b>     |                              |

Exit Option: If a students choose to exit after B. Sc. I, he/she will be awarded an UG certificate after successful completion of 44 credits + a 4 credits course of NSQF/ Internship / a Skill course

## B. Sc. I Structure in Zoology NEP 2.0

### Discipline-specific Courses

| Sr. No. | Semester | Course Code | Course Title   | Credits | Hours of teaching | Marks |
|---------|----------|-------------|--|---------|-------------------|-------|
| 1.      | I        | ZOO 101     | Paper I Animal Diversity                             | 2       | 30                | 50    |
| 2.      |          | ZOO 102     | Paper II Cell Biology                                | 2       | 30                | 50    |
| 3.      |          | ZOOPR 103   | Practical I  | 2       | 60                | 50    |
| 4.      | II       | ZOO 201     | Paper III Genetics                                   | 2       | 30                | 50    |
| 5.      |          | ZOO 202     | Paper IV Ecology, Ethology, Evolution and Entomology | 2       | 30                | 50    |
| 6.      |          | ZOOPR 203   | Practical II   | 2       | 60                | 50    |

### **Program Outcomes (POs): B. Sc. Zoology**

**PO1:** The students will learn about the basic concepts of Zoology and a platform for the entry of students in post-graduation studies, competitive examinations, paramedical fields, and agricultural business will be prepared.

**PO2:** Students will understand the concepts in zoology and be able to understand, classify, describe, and discuss different aspects of zoology like animal Phyla, conservation of animals, animal physiology, etc.

**PO3:** Students can apply their knowledge to solve problems related to genetics, and ecology and become competent to apply their knowledge of physiology, ethology, and entomology in their day-to-day life.

**PO4:** The students acquire various practical skills and dissection skills.

**PO5:** The students will be able to diagnose problems related to environmental issues, health and hygiene, agriculture and pest management, conservation of natural resources, etc., and try to solve them with scientific aptitude.

**PO6:** The students will apply their knowledge of zoology for the development of entrepreneurship and also practice it in their day-to-day lives.

### **Program Specific Outcomes (PSOs): B. Sc. I Zoology**

**PSO 1:** The students will learn about animal diversity, cell biology, genetics, ecology, ethology, evolution, and entomology.

**PSO 2:** The students will understand various basic concepts and be able to describe them.

**PSO 3:** The students can apply their knowledge to classify, distribute, and organize the animals.

**PSO 4:** The students can solve the problems related to patterns of heredity, pedigree analysis, etc.

**PSO 5:** The students will acquire skills like sketching the diagrams, karyotype analysis, dissection, and other practical skills.

**B. Sc. Part – I Semester – I**  
**ZOOLOGY Paper - I**  
**ZOO 101 ANIMAL DIVERSITY**

**Theory: 30 hrs.**

**Marks-50 (Credits: 02)**

**Course Objectives (COs): Animal Diversity**

The course on animal diversity is aimed at making the student to:

1. understand the concept and importance of biodiversity
2. Enable the students to identify the similarities and differences among the animals in different Phyla and classes.
3. develop sensitivity for the conservation of biodiversity in their day-to-day life.
4. equip the students with the skills of dissection.

**Unit I**

**(10 Hrs)**

Principles of classification, Five Kingdom classification

Binomial nomenclature

Levels of Organizations in Kingdom Animalia

Germ layers and coelom concept

Different modes of nutrition

Non-chordates concept, Phyla with prominent characters and examples

Phylum Chordata: Characters, subphyla/ classes with prominent characters and examples

Difference between non-chordates and chordates

Generalized body plans of non-chordates (Annelida/Arthropods) and chordates

**Unit II**

**(10 Hrs)**

Diversity concept and its importance

Zoogeographical regions and distribution of animals: Global and Indian biodiversity.

Extinct and threatened animals

Hotspots of biodiversity and Biodiversity Centres

Need for conservation and conservation strategies

**Unit III**

**(10 Hrs)**

Cockroach: a representative of non-chordates

Habit and habitat

Systematic position

Morphology

Anatomy: Digestive system, nervous system, blood vascular system, Respiratory system, excretory system, reproductive system, and receptor organs.

**References:**

- Hyman, L. H. – The invertebrate, Vol. I (McGraw Hill)
- Hyman, L. H. – The invertebrate, Vol. II (McGraw Hill)
- Barnes, R. D. – Invertebrate Zoology (W. B. Saunders Co.). 1987
- Parker and Haswell – A Text Book of Zoology – Invertebrate Vol. I Edited by Marshall and Williams, C. B. S. Publishers and Distributors, New Delhi. 1972
- P.S. Dhami and J. K. Dhami – Invertebrates, S. Chand and Company, New Delhi 1979
- A Text Book of Invertebrates – N. C. Nair, N. Soundara Pandian, S. Leelavathy, T. Murugan Saras Publication 2010
- Invertebrate Zoology by R. L. Kotpal Rastogi Publications 2020

**B. Sc. Part – I Semester – I**  
**ZOOLOGY Paper - II**  
**ZOO 102 CELL BIOLOGY**

**Theory: 30 hrs.**

**Marks-50 (Credits: 02)**

**Course Objectives (COs): Cell Biology**

The Course on cell biology is aimed at making the students to:

1. understand the general organization of cell organelles and their functions.
2. apply their knowledge to study the functioning of a cell and cell divisions and its regulation.
3. analyze the role of cell organelles and cell cycle checkpoints with examples of anemia, diabetic wounds, and cancer.
4. equip the students with skills like handling the microscope, micrometry, staining techniques, etc.

**Unit I**

**General organization of cell**

**(10 Hrs)**

1. Organization of prokaryotic and eukaryotic cells
2. Nucleus: nuclear membrane, nucleoplasm, chromatin, and nucleolus
3. Chromosome: morphology of metaphase chromosome and its organization (Solenoid model)
4. Cytoskeleton

**Unit II**

**(10Hrs)**

**Ultra-structure and functions of**

1. Plasma membrane (Fluid Mosaic Model)
2. Mitochondria
3. Endoplasmic reticulum
4. Golgi complex
5. Lysosome
6. Ribosome

**Unit III**

**(10 Hrs)**

1. Concept of Cell cycle and its regulation
2. Mitosis
3. Meiosis
4. Abnormalities in cell division: Hypoproliferation (Anemia and diabetic wound) and Hyperproliferation (Cancer)

**References:**

- Cell and Molecular Biology by De Robertis EDP and De Robertis EME VIII ED ©1997
- Principles of Cell and Molecular Biology by Kleinsmith and Kish Pearson Publisher ©1997
- Molecular cell biology by Harvey Lodish, Berk A, Matsudaira P., Baltimore, D & Darnel I . W. H. Freeman and Co. © 2001
- Becker's World of the Cell by Jeff Hardin and James P. Lodolce, Pearson Publisher © 2020
- Molecular biology of the cell by Bruce Alberts, Johnson A., Lewis J., Raff M., Roberts K & Walter P., 4<sup>th</sup> Ed. Garland Science Publishing, New York© 2002
- The Cell: A molecular approach by Geoffrey Cooper. OUP USA, © 2019

**B. Sc. Part – I Semester – I**  
**ZOOLOGY Practical– I**  
**ZOOPR 103 (ANIMAL DIVERSITY AND CELL BIOLOGY)**

**Practical: 60 hrs.**

**Marks-50 (Credits: 02)**

**I: Practical course based on Animal Diversity**

1. One example of each non-chordate phyla
2. One example of each chordate subphyla/class
3. One example of each mode of nutrition
4. Dissection of cockroach digestive system
5. Dissection of cockroach nervous system
6. Placing the animals on a world map according to zoo-geographical distribution
7. One example of each rare, endangered, critically endangered, and extinct animal as per the red data book.
8. DIGI studio

**II: Practical course based on Cell Biology**

**9. Cytological experiments**

- a. Study of light microscope: Principles of microscopy; study of its parts; focusing of a slide at low power and high power and study of Image Formation.
- b. Study of cells by micrometry.
- c. Isolation of Nucleus and Staining of the nucleus by any nuclear stain

**10. Cytological Preparations:**

- a. Study of constitutive heterochromatin (Barr body)
  - b. Staining of mitochondria by Janus green B in oral mucosa or any suitable tissue.
  - c. Study of osmosis using salt solutions
11. Study of mitosis in onion root tips
  12. Study of meiosis – observation of permanent slides
  13. Study of anemia and diabetic wound and histology of cancerous tumor



**B. Sc. Part – I Semester – II**  
**ZOOLOGY Paper - III**  
**ZOO 201 GENETICS**

**Theory: 30 hrs.**

**Marks-50 (Credits: 02)**

**Course Objectives (COs): Genetics**

The course in Genetics is aimed to make the students to:

1. understand heredity and variation.
2. apply their knowledge to draw the genetic crosses based on patterns of heredity.
3. Culture the *Drosophila* and handling skills among the students.
4. enable the students to develop
  - a. a gene map using data of crossing over and linkage study,
  - b. draw, and analyze pedigree
  - c. analyze karyotypes.

**Unit I**

**(10 Hrs)**

Molecular Basis of Genetic Information (Central Dogma)

Mendel's work and Principles of Inheritance

Test cross, back cross, and reciprocal cross

Incomplete dominance and co-dominance,

**Unit II**

**(10 Hrs)**

Gene interaction (Epistasis): Supplementary gene interaction. Complementary gene interaction

Multiple alleles: definition, ABO blood group system, and coat colour in rabbit,

Sex-linked inheritance: definition, Haemophilia, and colour blindness

Linkage and crossing over: Linkage, types of linkage and process of crossing over, Cytological evidence of crossing over.

**Unit III**

**(10 Hrs)**

**Chromosomal Abnormalities**

Human karyotype analysis

Numerical abnormalities: Aneuploidy and Polyploidy,

Chromosomal aberrations: Deletion, Duplication, Inversion, Translocation,

Pedigree analysis

## **Sex determination**

Chromosomal theory of sex determination, Genic balance theory, Haploidy-Diploidy mechanism, Environmental sex determination.

## **References**

- Genetics by Strickberger, M.W. 3<sup>rd</sup> Edition Pearson Education India, © 2015
- Human Genetics by Winchester A.M. Charles E.Merrill Publishing International; 4th Revised edition© 1983
- Concepts of Genetics by Klug, Cummings, Spencer, and Palladino. Pearson Education India, 2015
- Principles of Genetics by Tamarin, R. H. McGraw-Hill Education © 2001
- Fundamental of Genetics by B. D. Singh. Medtech Science Press © 2022

**B. Sc. Part – I Semester – II**  
**ZOOLOGY Paper - IV**  
**ZOO 202 (ECOLOGY, ETHOLOGY, EVOLUTION, AND ENTOMOLOGY)**

**Theory: 30 hrs.**

**Marks-50 (Credits: 02)**

**Course Objectives (COs): Ecology, Ethology, Evolution, and Entomology**

The Course in ecology, ethology, evolution, and entomology is aimed to make the students to:

1. understand the basic concepts.
2. enable the students to identify the amazing features of the insect world.
3. train students to arrange the animals on a geological time scale.
4. mold the student to apply their knowledge to construct food chains, food webs, and ecological pyramids.

**Unit 1**

**2. Ecology (10 hrs.)**

- a. Introduction and Scope of Ecology
- b. Basic concepts in ecology: Biosphere, biome, Species, Population, Community, Niche
- c. Ecosystem: Definition, concept, types, pond ecosystem, and grassland ecosystem
- d. Food chain, food web
- e. Ecological pyramids
- f. Ecological adaptations
- g. Symbiotic relationships

**Unit 2**

**3. Ethology and Evolution (10 hrs.)**

**Ethology**

- a. Introduction to the study of animal behavior
- b. Mimicry in Monarch butterfly and stick insect
- c. Camouflage in chameleon and Leaf insect
- d. Courtship behavior in scorpion and weaver birds
- e. Social behavior in honeybee

**Evolution**

- a. Types of fossils, Formation and dating of fossils
- b. Incompleteness of Fossil record
- c. Geological time scale

**Unit 3**

**4. Entomology– (10 hrs.)**

- a. Introduction to Entomology

- b. Brief morphology of insects and types of mouth parts
- c. Entomophagy: Introduction, Nutritional value, economic importance, Examples.
- d. Wonders in insects
  - i. Mud wasp
  - ii. Praying mantis
  - iii. Giant cockroach
  - iv. Ladybird beetle
  - v. Firefly
  - vi. Parasitoids- *Apanteles* in *Helicoverpa*

### References

- Environmental Studies – Based on UGC Syllabus – N. Arumugam and V. Kumaresan. Saras Publisher 2014
- Organic Evolution – N. Arumugam. Saras Publisher ©2019
- Organic Evolution – Lul. Forgotten Books ©2018
- Ecology by E. P. Odum. Oxford and LBH 2008
- Fundamentals of Ecology – Odum – Saunders Publisher ©1971
- Ecology – Rickelfs. W. H. Freeman Publisher ©1999
- Immelmann- Introduction to Ethology. Plenum Press, ©1980
- The Foundations of Ethology. Springer Verlag, ©1981
- Economic Zoology – Shukla and Upadhyaya – Rastogi Publications
- Economic Zoology – Venkitaraman (Sudarshana Publishers)
- The Insect structure function and biodiversity by Ambrose P. Kalyani Publisher ©2015

**B. Sc. Part – I Semester – II**  
**ZOOLOGY Practical– II**  
**ZOOPR 203 (GENETICS AND ECOLOGY, ETHOLOGY, EVOLUTION,**  
**AND ENTOMOLOGY)**

**Practical: 60 hrs.**

**Marks-50 (Credits: 02)**

**I. Practical based on Genetics**

1. Study Mendel's work with the help of different coloured beads and other simulations.
2. Examples based on Gene mapping using data of crossing over and linkages
3. Study of sex-linked inheritance by pedigree study.
4. Study of normal human spread chromosomes and sex determination
5. Identification of genetic syndrome by karyotype analysis
6. Identification of chromosomal aberration by studying karyotype
7. Identification ABO blood group
8. *Drosophila* culture, handling, Life cycle, and identification of male and female *Drosophila* and mutants (After induction of mutation)
9. Examples based on Gene interactions and Multiple alleles

**II. Practical based on Ecology, Ethology, Evolution, and Entomology**

10. **Ecology** – Preparation of the following about pond and grassland ecosystems.
  - a. Arranging the organisms in the Food chain and food web
  - b. Arranging the organisms in different trophic levels of Ecological Pyramids
11. **Ethology** –
  - a. Mimicry in – monarch butterfly and stick insect
  - b. Castes of Honey bee
12. **Evolution** –
  - a. Types of fossils
  - b. Arrangement of the animals as per the Geological Time Scale
13. **Entomology** –
  - a. Morphology of insects (Typical body parts of Grasshopper)
  - b. Entomophagy – Examples of edible insects according to theory
  - c. Wonders in insects (Based on theory)

Visit to sea shore or any suitable place to study the Ecosystem, Animal diversity, Animal Behavior, etc

### EXAMINATION PATTERN FOR DSC ZOOLOGY

1) **PATTERN:** Theory and practical examinations will be conducted at the end of each semester. Internal examinations will be conducted after completing about half of the syllabus.

2) **MEDIUM OF INSTRUCTION:** The medium of instruction shall be in English.

3) **STRUCTURE OF COURSE:** B.Sc. I – Zoology theory and practical and Internal Assessments as per the Framework Set by the Shivaji University

#### SEMESTER-I (Theory and Practical)

| Sr. No. | Subject               | Internal Exam | University Exam | Total     | Credits |
|---------|-----------------------|---------------|-----------------|-----------|---------|
| 1       | ZOO 101 Paper - I     | 10            | 40              | 50        | 2       |
| 2       | ZOO 102 Paper - II    | 10            | 40              | 50        | 2       |
| 3       | ZOOPR 103 Practical I | --            | 50              | 50        | 2       |
|         |                       |               |                 | Total=150 | 6       |

#### SEMESTER-II (Theory and Practical)

| Sr. No. | Subject               | Internal Exam | University Exam | Total     | Credits |
|---------|-----------------------|---------------|-----------------|-----------|---------|
| 1       | ZOO 201 Paper - I     | 10            | 40              | 50        | 2       |
| 2       | ZOO 202 Paper – II    | 10            | 40              | 50        | 2       |
| 3       | ZOOPR 203 Practical I | --            | 50              | 50        | 2       |
|         |                       |               |                 | Total=150 | 6       |

Minimum Marks required for passing

|               | Internal Exam | Theory | Practical |
|---------------|---------------|--------|-----------|
| Maximum Marks | 10            | 80     | 50        |
| Minimum Marks | 04            | 28     | 18        |

## **SCHEME OF EXAMINATION**

The question paper will be set on the entire syllabus and preferably covering each unit of syllabi.

### **COMMON NATURE OF QUESTION FOR THEORY PAPER:**

SEMESTER – I Zoology Paper (I, II)

SEMESTER – II Zoology Paper (III, IV)

|      |   |    |
|------|---|----|
| Q. 1 | Multiple Choice Questions (Eight questions) | 08 |
|      | a.  |    |
|      | b.  |    |
|      | c.  |    |
|      | d.  |    |
|      | e.  |    |
|      | f.  |    |
|      | g.  |    |
|      | h.  |    |
| Q. 2 | Long answer questions (Attempt any two)     | 16 |
|      | a.  |    |
|      | b.  |    |
|      | c.  |    |
| Q. 3 | Short Notes (Attempt any four)              | 16 |
|      | a.  |    |
|      | b.  |    |
|      | c.  |    |
|      | d.  |    |
|      | e.  |    |
|      | f.  |    |

**SKELETON PAPER FOR PRACTICAL EXAMINATION**

**B. Sc. Part – I Semester – I**

**ZOOLOGY Practical - I**

**ZOOPR 103 (Animal Diversity and Cell Biology)**

**Marks-50**

|  |    |
|--|----|
| Que No. 1 Dissect ..... to expose its ..... system                             | 10 |
| Que No. 2 Cytological experiments  | 08 |
| Que No. 3 Cytological Preparation  | 07 |
| Que No. 4 Distribution of animals with their zoogeographical regions           | 05 |
| Que No. 5 Categorization of animals as per the abundance                       | 05 |
| Que No. 6 Preparation of stained slide of mitosis and identification of stages | 10 |
| Que No. 7 Journal  | 05 |

**B. Sc. Part – I Semester – II**

**ZOOLOGY Practical - II**

**ZOO PR 203 (Genetics, Ecology, Ethology, Evolution and Entomology) Marks-50**

|  |    |
|--|----|
| Que No. 1 Determination of blood group according to ABO blood group system/ Drosophila culture-related experiments | 07 |
| Que No. 2 Questions based on karyotype study/ Gene Mapping/construction of pedigree                                | 06 |
| Que No. 3 Construction of food chain/food web/ Ecological Pyramids from the given data                             | 04 |
| Que. No. 4 Experiments based on monohybrid/ dihybrid cross   | 06 |
| Que No. 5 Example in Genetics  | 07 |
| Que No. 6 Identification   | 10 |
| Que No. 7 Excursion Report   | 05 |
| Que No. 8 Certified Journal  | 05 |