



Rayat Shikshan Sanstha's

**Dr. Patangrao Kadam Mahavidyalaya,
Ramanandnagar (Burli)**

Department of Zoology

**Learning Outcomes, Program Outcome, Program Specific
Outcome and Course Outcome**

For those students admitted during the academic year 2023-2024 and after

Table of Contents:

Table of Contents	2
Preamble	3
Vision and Mission Statement	5
Assessment and Evaluation	6
Guidelines for Individual/ Team Projects and Field Reports	7
Graduate Attributes in Zoology.....	8
Learning Outcomes	10
Programme Outcomes	11
Programme Specific Outcomes	12
Course Outcomes	13
Suggested List of Supplementary Web Resources for Laboratory Exercises	19
Keywords	19

PREAMBLE:

Preamble Institutional infrastructures of colleges within the country are incomparable and uneven, and they function with an additional variation of adopting different road maps for teaching and learning process. Thus, we have different syllabi, teaching methods, hands-on-training, and different learning outcomes. Introducing uniformity, whenever and wherever tried, has obviously not worked with the desired outcome. Added to this, failure to keep pace with the advancing knowledge base, half-hearted engagement and integration with other disciplines, and poor-transfer of skill sets to the students to negotiate efficiently with the changing needs, have made it essential to graduate from incremental inputs to syllabi revisions alone, to the use of disruptive approaches to reshape the subjectspecific course structures, with measurable learning outcomes. The approach, if adopted, is bound to generate opinions of teachers and students alike to resist the change. However, the intention is to understand the subject of Zoology in the evolving biological paradigm in modern times; where, living beings need to be understood at the level of atomic interactions; and comparative systems of organisms need to be studied through the prism of integrated chemical, physical, mathematical and molecular entities to appreciate the inner working of different organisms at morphological, cellular, molecular, interactive and evolutionary levels. The syllabi could be shaped with a customised approach depending on the institutional infrastructure and geographical location, yet it should cater, in principle, to the expected learning outcomes more or less uniformly. For example, in diverse geographical domains with diverse skill sets, examples illustrated in detail for teaching and hands on exposure and field work could differ by involving the study of available species across the ladder of evolution, yet the comparative biology taught should provide a uniform level of understanding of the subject. After all, the purpose is to understand inner working of livingbeings by comparing various systems within invertebrates and vertebrates i.e., from a single cell protozoan to multicellular humans, and develop a comprehensive understanding and appreciation of the differences through ICT tools and well-designed hands on practical exposures along with the field work. Added to this, if the same principle is followed to understand different phyla through the ladder of evolution and compare cardinal features for classification involving both morphological and molecular tools, along with associated field and lab work, the final product would be better trained without rote learning. Diversity in the life forms need to be understood by a Zoologist for its socio-economic capital, in case a student is interested in entrepreneurship, through applied aspects of Zoology; and by a career- 7 researcher as a ladder towards multiscale hierarchical systems, where chemical and physical principles would apply from molecules to self-assembled and organized organisms. The vibrancy to synthesize out of the knowledge gained and come out with disruptive outcomes, would define the learning outcomes of the future UG students. Apart from the above mentioned attributes expected of a UG student related to the subject area of Zoology to be studied in an integrated and cross-disciplinary manner with a

comprehensive understanding of all living systems, their relationship with the eco-system, and unravelling of their application value; the scale, character and rigour of which may vary from one institution to the other, it would, however, be mandatory to bring in uniformity in the learning outcomes with respect to the 'broad-range skill sets' related-to-the-discipline of the study and the 'Social skills'. Within the broad-range skill sets related to the discipline, what would be required is to impart and assess the quality of critical thinking, analytical and scientific reasoning, reflective thinking, information and digital literacy, and problem-solving capacity. These are part of the defined characteristic attributes to be demonstrated by a UG in any discipline, as defined by the Core Committee. On similar lines, what is expected of the social skills is to imbibe values for cooperative team work, moral and ethical awareness and reasoning, multicultural competence, leadership readiness and qualities and self- directed and lifelong learning attitude. It is obvious all of us together need to meet the challenge to bring in these attributes within each subject area of study, in the present case the subject of Zoology.

VISION AND MISSION STATEMENTS:

Vision:

- ❖ To provide equitable and just access to quality higher education involving the generation, dissemination and a critical application of knowledge.
- ❖ To help students to mould themselves to become model practitioners and contributors in Zoology.
- ❖ Unravel hidden research potentials & Entrepreneurial avenues in Zoology
- ❖ Bring a behavioural change in Course knowledge, scientific aptitude and instrumental skills to attract students with best calibres
- ❖ Raise students to international standards.

Mission:

- ✓ The Mission of B.Sc. Zoology program is to full fill the inquisitiveness of students in areas of Zoology and its allied subjects by giving exposure to cutting edge knowledge.
- ✓ Experiences in practical aspects thereby contributing to personal development and service to society.
- ✓ Strategic plans for translating goals and objectives by curriculum design, good teaching methods and evaluation
- ✓ Academic and research collaborations
- ✓ Bio-track –A forum to update knowledge
- ✓ Hands on training at Bio industries.



Assessment and Evaluation:

Assessment methods

Students' performance in core, discipline electives, generic electives and skill enhancement courses are to be assessed in various ways viz.,

- ❖ The oral and written scheduled or surprise tests,
- ❖ Problem-solving exercises,
- ❖ Closed-book and open-book tests,
- ❖ Practical skills and laboratory reports,
- ❖ Individual and group project reports,
- ❖ Seminar presentations,
- ❖ Group discussions
- ❖ *Viva voce* examinations.
- ❖ The computerized learning, literature surveys and evaluations, peers and self-assessment can be the additional methods used.
- ❖ Regular reading habits in the students need to be inculcated through continuous monitoring and observation about weaker aspect of the students.



Guidelines for Individual/ Team Projects and Field Reports:

- The aim of the individual/ team project/s is to develop an aptitude for research in Zoology and to inculcate proficiency to identify appropriate research topic and presentation.
- The topics of biological interest and significance can be selected for the project. Project is to be done by a group not exceeding 5 students.
- The project report should be submitted on typed A4 paper, 12 Font, 1.5 Space in spirally bound form and duly attested by the supervising teacher and the Head of the Department on the day of practical examination before a board of two Examiners for End Semester.
- The viva-voce based on the project is conducted individually.
- Project topic once chosen shall not be repeated by any later batches of students.
- The project report may have the following sections:
 1. Preliminary (Title page, declaration, certificate of the supervising teacher, content etc.)
 2. Introduction with relevant literature review and objective.
 3. Materials and Methods.
 4. Result
 5. Discussion
 6. Conclusion / Summary
 7. References.

Field Study/ Study tour Students have to visit one research institute and one wild life sanctuary / museum / zoo. Scientifically prepared hand-written study tour report along with photographs of candidate at the places of visit must be submitted by each student for End Semester on the day of the examination of project.



Graduate Attributes in Zoology:

- **Disciplinary knowledge and skills:** Capable of demonstrating (i) comprehensive knowledge and understanding of major concepts, theoretical principles and experimental findings in Zoology and its different subfields (animal diversity, principles of ecology, comparative anatomy and developmental biology of vertebrates, physiology and biochemistry, genetics and evolutionary biology, animal biotechnology, applied Zoology, aquatic biology, immunology, reproductive biology, and insect, vectors and diseases), and other related fields of study, including broader interdisciplinary subfields such as chemistry, physics and mathematics; (ii) ability to use modern instrumentation for advanced genomic and proteomic technology.
- **Skilled communicator:** Ability to impart complex technical knowledge relating to Zoology in a clear and concise manner in writing and oral skills.
- **Critical thinker and problem solver:** Ability to have critical thinking and efficient problem solving skills in the basic areas of Zoology (animal diversity, principles of ecology, comparative anatomy and developmental biology of vertebrates, physiology and biochemistry, genetics and evolutionary biology, animal biotechnology, applied Zoology, aquatic biology, immunology, reproductive biology, insect, vectors and diseases etc.).
- **Sense of inquiry:** Capability for asking relevant/appropriate questions relating to issues and problems in the field of Zoology, and planning, executing and reporting the results of an experiment or investigation.
- **Team player/worker:** Capable of working effectively in diverse teams in both classroom, laboratory and in industry and field-based situations.
- **Skilled project manager:** Capable of identifying/mobilizing appropriate resources required for a project, and manage a project to completion, while observing responsible and ethical scientific conduct; and safety and chemical hygiene regulations and practices.
- **Digitally literate:** Capable of using computers for Bioinformatics and computation and appropriate software for analysis of genomics and proteomics data, and employing modern bioinformatics search tools to locate, retrieve, and evaluate location and biological annotation genes of different species.
- **Ethical awareness/reasoning:** Capable of conducting their work with honesty and precision thus avoiding unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, and appreciating environmental and sustainability issues. Research ethics committee expects them to declare any type of conflict of interest that may affect the research. Any plan to withhold information from researchers should be properly explained with justification in the application for ethical approval.

- **Lifelong learners:** Capable of self-paced and self-directed learning aimed at personal development and for improving knowledge/skill development and reskilling.

Learning Outcomes:

A graduate of B.Sc. Zoology programme after three years will be able to:

- Develop critical understanding how a single-celled fertilized egg becomes an embryo and then a fully formed adult by going through three important processes of cell division, cell differentiation and morphogenesis.
- Understand how developmental processes and gene functions within a particular tissue or organism can provide insight into functions of other tissues and organisms.
- Realize that very similar mechanisms are used in very diverse organisms; and development is controlled through molecular changes resulting in variation in the expression and function of gene networks.
- Understand how the field of developmental biology has changed since the beginning of the 19th century with different phases of developmental research predominating at different times.
- Examine the evolutionary history of the taxa based on developmental affinities.
- Understand the relevance of developmental biology in medicine or its role in development of diseases.
- Develop an understanding of the characters used to classify besides being able to differentiate the organisms belonging to different taxa.
- Acquire knowledge of the coordinated functioning of complex human body machine.
- Have hands on experience of materials demonstrating the diversity of protists and non-chordates.
- Understand the relative position of individual organs and associated structures through dissection of the invertebrate representatives.
- Realize that very similar physiological mechanisms are used in very diverse organisms.
- Get a flavour of research by working on project besides improving their writing skills. It will further enable the students to think and interpret individually.
- Undertake research in any aspect of animal physiology in future.



Programme Outcomes:

- PO1 - Students gain knowledge and skill in the fundamentals of animal sciences, understands the complex interactions among various living organisms
- PO2 – Analyse complex interactions among the various animals of different phyla, their distribution and their relationship with the environment
- PO3 – Apply the knowledge of internal structure of cell, its functions in control of various metabolic functions of organisms.
- PO4 – Understands the complex evolutionary processes and behaviour of animals
- PO5 – Correlates the physiological processes of animals and relationship of organ systems
- PO6 – Understanding of environmental conservation processes and its importance, pollution control and biodiversity and protection of endangered species
- PO7 – Gain knowledge of Agro based Small Scale industries like sericulture, fish farming, butterfly farming and vermicompost preparation.
- PO8 – Understands about various concepts of genetics and its importance in human health
- PO9 - Apply ethical principles and commit to professional ethics and responsibilities in delivering his duties
- PO10 – Apply the knowledge and understanding of Zoology to one's own life and work
- PO11 – Develops empathy and love towards the animals.



Programme Specific Outcome:

- PSO1. Understand the nature and basic concepts of cell biology, genetics, taxonomy, physiology, ecology and applied Zoology
- PSO2. Analyse the relationships among animals, plants and microbes
- PSO3. Perform procedures as per laboratory standards in the areas of Taxonomy, Physiology, Ecology, Cell biology, Genetics, Applied Zoology, Clinical science, tools and techniques of Zoology, Toxicology, Entomology, Nematology Sericulture, Biochemistry, Fishbiology, Animal biotechnology, Immunology and research methodology
- PSO4. Understand the applications of biological sciences in Apiculture, Aquaculture, Agriculture and Medicine
- PSO5. Gains knowledge about research methodologies, effective communication and skills of problem solving methods
- PSO6. Contributes the knowledge for Nation building.



Course Outcome (CO):

B.Sc. Part – I Semester I Animal Diversity – I [P-I]

- CO1. Describe general taxonomic rules on animal classification
- CO2. Classify Protista up to phylum using examples from parasitic adaptation
- CO3. Classify Phylum Porifera to Echinodermata with taxonomic keys
- CO4. Describe Phylum Nematoda and give examples of pathogenic Nematodes
- CO5. Distribution of fauna in different realms interaction
- CO6. Understand Animal behaviour and response of animals to different instincts
- CO7. Interaction of biota abiota
- CO8. Various kinds of Animal adaptations
- CO9. Imparts conceptual knowledge of vertebrates, their adaptations and associations in relation to their environment

B.Sc. Part – I Semester I Cell Biology & Evolutionary Biology [P-II]

- CO10. Structural and functional aspects of basic unit of life i.e. cell concepts
- CO11. Inculcate knowledge on working principles of microscopes, cell fractionation, staining and identification of cell types.
- CO12. Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles
- CO13. Students will understand how these cellular components are used to generate and utilize energy in cells
- CO14. Students will understand the cellular components underlying mitotic cell division.
- CO15. Students will apply their knowledge of cell biology to selected examples of changes or losses in cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.
- CO16. Students will understand Theories of Evolution.
- CO17. Knowledge of eras and evolution of species.
- CO18. Understand the evidence that living species share descent from common ancestry and how this fact explains the traits of living species

B.Sc. Part – I Semester II Animal Diversity & Insect Vector [P-III]

- CO19. Classify phylum Protochordates to Mammalia
 - CO20. Complex Vertebrate interactions
 - CO21. Describe the basic biology (life cycle, reproduction, host-seeking behavior) of major insect
- ABM/ ZOO/ CO PO PSOs

vectors and pests.

CO22. Describe the major diseases caused by vector borne pathogens.

CO23. Explain major concepts in vector biology including vector competence, extrinsic/intrinsic incubation period, entomological inoculation rate and vectorial capacity.

CO24. Explain the transmission cycles of pathogens vectored by major arthropod vectors including mosquitoes and ticks.

CO25. Explain the role of ecology and environmental factors (including climate change) on vector borne disease transmission.

CO26. Explain and discuss the main findings and implications from scientific publications in the field of public health entomology.

CO27. Infer probable effects of vector control methods on vector borne disease transmission rates.

B.Sc. Part – I Semester II Genetics [P-IV]

CO28. Students will learn the basic principles of inheritance at the molecular, cellular and organismal levels.

CO29. Students will understand causal relationships between molecule/cell level phenomena ("modern" genetics) and organism-level patterns of heredity ("classical" genetics)

CO30. Students will test and deepen their mastery of genetics by applying this knowledge in a variety of problem-solving situations.

CO31. To enable the students, understand Mendelian inheritance.

CO32. To learn the concepts of Linkage.

CO33. To know the significance of organellar inheritance.

CO34. To understand the concept of sex determination and sex linked inheritance.

B.Sc. Part – II Semester III Animal Diversity – II [P-V] (NEP-2020)

CO35. Classify Hemichordates up to phylum using examples.

CO36. Classify Phylum Protochordates with taxonomic keys

CO37. Describe Phylum Agnatha and give examples.

CO35. Classify Pisces up to phylum using examples.

CO36. Classify Phylum Amphibia with taxonomic keys.

CO36. Classify Phylum Reptiles with taxonomic keys.

CO36. Classify Phylum Aves with taxonomic keys.

CO37. Explain the physiological systems in frog.

**B.Sc. Part – II Semester III
Biochemistry (NEP-2020) [P-VI]**

- CO38. Understand the structure and biological significance of carbohydrates, amino acids, proteins, lipids and nucleic acids.
- CO 39. Understand the structure and function of immunoglobulins.
- CO40. Understand the concept of enzyme, its mechanism of action and regulation.
- CO41. Learn measurement of enzyme activity and its kinetics.
- CO42. Learn the preparation of models of peptides and nucleotides.
- CO43. Learn biochemical tests for amino acids, carbohydrates, proteins and nucleic acids.

**B.Sc. Part – II Semester III
Reproductive Biology (NEP-2020) [P-VII]**

- CO44. Observe clean sexual habits thereby warding off sexually transmitted diseases.
- CO45. Understand the importance of good health.
- CO46. Identify structures and function of reproductive anatomy in the male and female
- CO47. Identify hormones, their production site, physiology impacts and how to manipulate specific hormones to control reproduction either positively or negatively.
- CO48. Summarize critical components of reproductive technologies involved in breeding, semen collection, gamete biology and embryonic development.
- CO49. Communicate via oral, written, podcast, and website modalities.
- CO50. Recognize how differences based on cultural and ethnicity impact individuals.

**B.Sc. Part – II Semester IV
Applied Zoology-I (NEP 2020)[P-VIII]**

- CO51. Students feel confident in teaching Medical Entomology as well as executing research project
- CO52. Gives knowledge of silk worm rearing, mulberry cultivation, pests and diseases associated with silk worm, mulberry and various process involved in silk production.
- CO53. It is an agro based cottage industry in India that enables them to get self-employment
- CO54. Sericulture is a comprehensive subject that gives in depth knowledge of the study of silkworms both physiological as well as commercial purposes including the various processes involved in the formation of silk.
- CO55. Students gain knowledge about various systems study of silkworms and cocoons, other defective cocoons
- CO56. Reeling and significant diseases seen in the silkworms
- CO57. Students feel confident in teaching Sericulture as well as executing research projects
- CO58. It gives insight into various cell/tissues culture techniques

- CO59. Understanding of in vitro culturing of organisms and production of transgenic animals.
- CO60. Understanding of cloning of mammals, large scale culture and production from recombinant microorganisms.
- CO61. Gains skills in medical, environmental biotechnology, bio pesticides, Biotechnology of aquaculture and use of animals as bioreactors.

B.Sc. Part – III Semester V
Comparative Anatomy of Vertebrates [P-IX]

- CO62. Develop an understanding of the characters used to classify besides being able to differentiate the organisms belonging to different taxa.
- CO63. Acquire knowledge of the coordinated functioning of complex human body machine.
- CO64. Have hands on experience of materials demonstrating the diversity of protists and non-chordates.
- CO65. Understand the relative position of individual organs and associated structures through dissection of the invertebrate representatives.
- CO65. Realize that very similar physiological mechanisms are used in very diverse organisms.
- CO67. Get a flavour of research by working on project besides improving their writing skills. It will further enable the students to think and interpret individually.

B.Sc. Part – III Semester V
Molecular Cell Biology & Animal Biotechnology [P-X]

- CO68. Understand how DNA encodes genetic information and the function of mRNA and tRNA
- CO69. Understand the cause and effect of alterations in chromosome number and structure.
- CO70. Relate the conventional and molecular methods for gene manipulation in other biological systems.
- CO71. Discuss and analyse the epigenetic modifications and imprinting and its role in diseases.
- CO72. Get new avenues of joining research in related areas such as genetic engineering of cells, cloning, genetic disorders, human fertility programme, genotoxicity, etc.
- CO73. Understand the concept of enzyme, its mechanism of action and regulation.
- CO74. Understand the process of DNA replication, transcription and translation.
- CO75. Learn the preparation of models of peptides and nucleotides.

B.Sc. Part – III Semester V
Biotechnology & Biostatistics [P-XI]

- CO76. Get well versed in recombinant DNA technology which holds application in biomedical & genomic science, agriculture, environment management, etc. Therefore, a fundamental understanding of Molecular Biology will help in career building in all these fields.
- CO77. Understand the purpose of the technique, its proper use and possible modifications/ improvement.
- CO78. Learn the theoretical basis of technique, its principle of working and its correct application.

- CO79. Learn the construction repair and adjustment of any equipment required for a technique.
- CO80. Learn the accuracy of technique.
- CO81. Learn the maintenance laboratory equipments/ tools, safety hazards and precautions.
- CO82. Understand the technique of cell and tissue culture. Learn the preparation of solution of given percentage and molarity.
- CO83. Understand the process of preparation of buffer. Learn the techniques of separation of amino acids, proteins and nucleic acids.
- CO84. Know basic concepts of probability and statistics.
- CO85. Describe statistical methods and probability distributions relevant for molecular biology data.
- CO86. Know the applications and limitations of different bioinformatics and statistical methods.
- CO87. Perform and interpret bioinformatics and statistical analyses with real molecular biology data.

B.Sc. Part – III Semester V Aquatic Biology [P-XII]

- CO88. Employ scientific methodologies such as experimentation and data analysis in the area of aquatic biology
- CO89. Critically analyse, interpret and evaluate information relevant to aquatic biology
- CO90. Appreciate the multidisciplinary nature of the study of aquatic biology and engage positively with people and ideas beyond their own discipline.
- CO91. Explore some of the unique environmental problems dealing with aquatic environments.
- CO92. Develop *employable skills* in freshwater biological water quality analysis.

B.Sc. Part – III Semester VI Developmental Biology of Vertebrates [P-XIII]

- CO93. Develop critical understanding how a single-celled fertilized egg becomes an embryo and then a fully formed adult by going through three important processes of cell division, cell differentiation and morphogenesis.
- CO94. Understand how developmental processes and gene functions within a particular tissue or organism can provide insight into functions of other tissues and organisms.
- CO95. Realize that very similar mechanisms are used in very diverse organisms; and development is controlled through molecular changes resulting in variation in the expression and function of gene networks.
- CO96. Understand how the field of developmental biology has changed since the beginning of the 19th century with different phases of developmental research predominating at different times.
- CO97. Examine the evolutionary history of the taxa based on developmental affinities.
- CO98. Understand the relevance of developmental biology in medicine or its role in development of diseases.

B.Sc. Part – III Semester VI
Immunology [P- XIV]

- CO99 Know how resistance development and resistance transfer occur.
- CO100. Identify the major cellular and tissue components which comprise the innate and adaptive immune system.
- CO101. Understand how are immune responses by CD4 and CD8 T cells, and B cells, initiated and regulated.
- CO102. Understand how does the immune system distinguish self from non-self .
- CO103. Gain experience at reading and evaluating the scientific literature in the area.
- CO104. Types of immunity, antigens-antibodies and their properties
- CO105. Complement system,MHC's and immune responses

B.Sc. Part – III Semester VI
Applied Zoology- II [P- XV]

- CO106. Understand the culture techniques of prawn, pearl and fish.
- CO107. Understand silkworms rearing and their products.
- CO108. Understand the Bee keeping equipments and apiary management.
- CO109. Understand dairy animals' management, the breeds and diseases of goats and learn the testing of egg and milk quality.
- CO110. Learn various concepts of lac cultivation.
- CO111. Be aware of a broad array of career options and activities in human medicine, • biomedical research and allied health professions

B.Sc. Part – III Semester VI
Insect Vectors & Histology [P-XVI]

- CO112. Develop awareness about the causative agents and control measures of many commonly occurring diseases.
- CO113. Develop understanding about the favourable breeding conditions for the vectors.
- CO114. Devise strategies to manage the vectors population below threshold levels, public health importance.
- CO115. Undertake measures or start awareness programmes for maintenance of hygienic conditions, avoidance of contact from vector, destruction of breeding spots in the vicinity of houses

Suggested List of Supplementary Web Resources for Laboratory Exercises

1. Anatomy of Frog: Pro Dissector (CD) - www.prodissector.com
2. Physiology of Frog: Physiology Ex 4.0 (CD) - www.physioex.com
3. Anatomy of Chordates: The Vertebrate Dissection Guide Series (CD)–Learning Development Centre, University of Portsmouth
4. Anatomy of earthworm: The dissection works (CD); Source – www.scienclass.com; www.ncosci.com
5. Anatomy of shark: Shark dissection and anatomy (video)- www.ncosci.com
6. Cockroach dissection- www.ento.vt.edu
7. Mammalian Physiology– www.biopac.com

Keywords:

Zoology, Systematics, Chordates & Non-Chordates, Developmental biology, Comparative anatomy, Physiology, Genetics, Evolution. Cell Biology, Biochemistry, Molecular biology, Ecology, Behaviour, Parasitology, Immunology, Biotechniques, Bioinformatics, Applied Zoology etc.


Head of Dept.
Department of Zoology
Dr. Patangrao Kadam Mahavidyalaya,
Ramanandnagar (Burli)




Principal,
Dr. Patangrao Kadam Mahavidyalaya,
Ramanandnagar (Burli)
Tal. Palus, Dist. Sangli.