

**VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY**

**JNANASAGARA CAMPUS, BALLARI-583 105**



## **Bachelor of Science in Zoology**

### **Syllabus for Semester I**

**(Effective from Academic Year 2021-22)**

*(Revised as per NEP-2020)*

## Preamble

National Education Policy 2020 (NEP 2020) aims at equipping students with knowledge, skills, values, leadership qualities and initiate them for lifelong learning. It is in tune with the global education development agenda reflected in the Goal 4 (SDG4) of the 2030 Agenda for Sustainable Development, adopted by India in 2015, which seeks to —ensure inclusive and equitable quality education and promote lifelong learning opportunities for all|| by 2030. The stated principle of NEP 2020 is to develop —good human beings capable of rational thought and action, possessing compassion and empathy, courage and resilience, scientific temper and creative imagination, with sound ethical moorings and values.|| Higher education institutions (HEIs) must empower students in their contexts and at the same time keep them in phase with the pace of technological developments. Their purpose is to enable students to acquire expertise in specialized areas of interest, mould their character by imparting ethical and Constitutional values, kindle their intellectual curiosity and scientific temper, and create imaginative individuals who are service oriented. Students in HEIs should be able to expose themselves to a range of disciplines and obtain practical knowledge in professional, technical, and vocational subjects. Hence, HEIs must strive to create a space of multidisciplinary exposure. They must offer exposure to a wide range of subjects and skills and the possibility of obtaining deep knowledge or expertise in any of these subjects or skills. A successful HEI is the one that enables its pupils to combine personal fulfilment with societal concerns: a skilled scholar with a proactive interest in engaging with the society constructivel Their students and in this endeavour; it offers a new vision to all its Under-Graduate courses. Imbibes a Learning Outcome-based Curriculum Framework (LOCF) for all its Under Graduate programs.

The LOCF approach is envisioned to provide a focused, outcome-based syllabus at the undergraduate level with an agenda to structure the teaching-learning experiences in a more student-centric manner. The LOCF approach has been adopted to strengthen students' experiences as they engage themselves in the program of their choice. The Under-Graduate Programs will prepare the students for both, academia and employability. Each program vividly elaborates its nature and promises the outcomes that are to be accomplished by studying the courses. The program also states the attributes that it offers to inculcate at the graduation level. The graduate attributes encompass values related to well-being, emotional stability, critical thinking, social justice and also skills for employability. In short, each program prepares students for sustainability and life-long learning.

## **Introduction**

The learning outcomes-based curriculum framework for B.Sc. degree in Zoology is structured to offer a broad outline within which a Zoology program could be developed. The course is upgraded keeping in mind the aspirations of students, changing nature of the subject as well as the learning environment. Courses within Zoology have been revisited to incorporate recent advancements, techniques to upgrade the skills of learners. The new structure is expected to enhance the level of understanding among students and maintain the standard of Zoology degrees/program across the country. Effort has been made to integrate use of recent technology and use of MOOCs to assist teaching-learning process among students.

This framework permits the review of graduate attributes, qualification descriptors, program learning outcomes and course-level learning outcomes periodically. The framework offers flexibility and innovation in syllabi designing and in methods adopted for teaching-learning process and learning assessment. The major objective is to elevate the subject knowledge of the students, making them critical thinkers and able to solve problems and issues related to Zoology logically and efficiently. Overall, this course has been modified to upgrade skills related to biological science and provide our students a competitive edge in securing a career in academia, industry, pharmaceutical research and development in private as well as public sectors. This course serves as plethora of opportunities in different fields right from classical to applied Zoology.

## **Learning Outcome Based Curriculum Framework in Program**

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 rigor 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’ in 21st century. The framework imbibes a Learning Outcome-based Curriculum Framework (LOCF) for all its Under Graduate program in Zoology.

A comprehensive understanding and appreciation of the organismal differences through ICT tools, MOOCs and well-designed hands on practical exposures along with the field work and

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. Syllabi 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. Along with social skills 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.

## **Graduate Attributes in B.Sc. (Hons.) Zoology**

Some of the characteristic attributes of a graduate in Zoology may include the following:

**a. Disciplinary knowledge:** Capable of demonstrating-

(i) Comprehensive knowledge of major concepts, theoretical principles and experimental findings in Zoology and its different subfields including biodiversity, anatomy, physiology, biochemistry, biotechnology, ecology, evolutionary biology, cell biology, molecular biology, immunology and genetics, and some of the other applied areas of study such as wildlife conservation and management, apiculture, sericulture, neurosciences, aquatic biology, fish and fisheries sciences, bioinformatics and research methods;

(ii) Interdisciplinary knowledge of allied biological sciences, environmental science and chemical science;

(iii) Learning of the various techniques, instruments, computational software used for analysis of animal's forms and functions.

**b. Effective communicator:** Capability to convey the intricate Zoological information effectively and efficiently.

**c. Critical thinker and problem solver:** Ability to rationally analyze and solve the problems related to animal sciences without relying on assumptions and guess work.

**d. Logical thinking and reasoning:** Capability of seeking solutions and logically solving them by experimentation and data processing either manually or through software.

**e. Team spirit:** Ability to work effectively in a heterogeneous team.

**f. Leadership quality:** Ability to recognize and mobilize relevant resources essential for a project, and manage the project in a responsible way by following ethical scientific conduct and bio-safety protocols.

**g. Digitally literate:** Capable of using computers for biological simulation, computation and appropriate software for biostatistics, and employing search tools to locate, retrieve, and evaluate zoology-related data.

**h. Ethical Awareness:** Avoiding unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, as well as appreciate environmental and sustainability issues.

**i. Lifelong learners:** Capable of self-paced and self-directed learning aimed at personal and social development.

## **Program:** Bachelor of Science (B.Sc.) in Zoology

### **Programme Objectives (POs):**

<b>POs1</b>	:	The Programme offers both classical as well as modern concepts of Zoology in higher education.
<b>POs2</b>	:	It enables the students to study animal diversity in both local and global environments.
<b>POs3</b>	:	To make the study of animals more interesting and relevant to human studies more emphasis is given to branches like behavioural biology, evolutionary biology and economic zoology.
<b>POs4</b>	:	More of upcoming areas in cell biology, genetics, molecular biology, biochemistry, genetic engineering and bioinformatics have been also included.
<b>POs5</b>	:	Equal importance is given to practical learning and presentation skills of students.
<b>POs6</b>	:	The lab courses provide the students necessary skills required for their employability.
<b>POs7</b>	:	Skill enhancement courses in classical and applied branches of Zoology enhance enterprising skills of students.
<b>POs8</b>	:	The global practices in terms of academic standards and evaluation strategies.
<b>POs9</b>	:	Provides opportunity for the mobility of the student both within and across the world.
<b>POs10</b>	:	The uniform grading system will benefit the students to move across institutions within India to begin with and across countries.
<b>POs11</b>	:	It will also enable potential employers in assessing the performance of the candidates across the world.

### **Assessment:**

#### **Weightage for assessments (in percentage)**

<b>Type of Course</b>	<b>Formative Assessment / IAMarks</b>	<b>Summative Assessment Marks</b>
<b>Theory</b>	<b>40</b>	<b>60</b>
<b>Practical</b>	<b>25</b>	<b>25</b>

## Course Wise Content Details for B.Sc. Zoology Programme

### Semester – I

<b>Course: Cytology, Genetics and Infectious Diseases</b>	<b>Course code:</b>
<b>L-T-P per week: 4-0-0</b>	<b>No. of Credits: 04</b>
<b>Internal Assessment: 40 marks</b>	<b>Semester End Examination: 60 marks</b>
<b>Total Contact Hours: 56</b>	

### Course Outcomes (COs):

At the end of the course the student should be able to understand:

CO1	The structure and function of the cell organelles
CO2	The chromatin structure and its location
CO3	The basic principle of life, how a cell divides leading to the growth of an organism and also reproduces to form a new organisms.
CO4	How a cell communicates with its neighbouring cells.
CO5	The principles of inheritance, Mendel's laws and the deviations.
CO6	How environment plays an important role by interacting with genetic factors.

Course Content	Hrs
<b>Module-1</b>	<b>12</b>
<b>Chapter-1: Structure and Function of Cell Organelles I in Animal cell</b> <b>Chapter-2:</b> Plasma membrane: chemical structure—lipids and proteins <b>Chapter-3:</b> Endomembrane system: protein targeting and sorting, transport, endocytosis and exocytosis <b>Chapter 4. Structure and Function of Cell Organelles II in Animal Cell</b> Cytoskeleton: microtubules, microfilaments, intermediate filaments Mitochondria: Structure, oxidative phosphorylation; electron transport system Peroxisome and Ribosome: structure and function	
<b>Module-2</b>	<b>12</b>
<b>Chapter 5. Nucleus and Chromatin Structure</b> Structure and function of nucleus in eukaryotes Chemical structure and base composition of DNA and RNA DNA supercoiling, chromatin organization, structure of chromosomes Types of DNA and RNA <b>Chapter 6. Cell cycle, Cell Division and Cell Signaling</b> Cell division: mitosis and meiosis	

Introduction to Cell cycle and its regulation, apoptosis Signal transduction: intracellular 11 signalling and cell surface receptors, via G-protein linked receptors Cell-cell interaction: cell adhesion molecules, cellular junctions	
<b>Module-3</b>	<b>10</b>
<b>Chapter 7. Mendelism and Sex Determination</b> Basic principles of heredity: Mendel's laws- monohybrid cross and hybrid cross Complete and Incomplete Dominance Penetrance and expressivity Genetic Sex-Determining Systems, Environmental Sex Determination, Sex Determination and mechanism in <i>Drosophilamelanogaster</i> . Sex-linked characteristics in humans and dosage compensation	
<b>Module-4</b>	<b>10</b>
<b>Chapter 8. Extensions of Mendelism, Genes and Environment</b> Extensions of Mendelism: Multiple Alleles, Gene Interaction. The Interaction Between Sex and Heredity: Sex-Influenced and Sex-Limited Characteristics Cytoplasmic Inheritance, Genetic Maternal Effects. Interaction between Genes and Environment: Environmental Effects on Gene Expression, Inheritance of Continuous Characteristics.	
<b>Module-5</b>	<b>12</b>
<b>Chapter 9. Human Chromosomes and Patterns of Inheritance</b> Patterns of inheritance: autosomal dominance, autosomal recessive, X-linked recessive, X-linked dominant. Chromosomal anomalies: Structural and numerical aberrations with examples. Human karyotyping and Pedigree analysis. <b>Chapter 10. Infectious Diseases</b> Introduction to pathogenic organisms: viruses, bacteria, fungi, protozoa and worms. Structure, life cycle, pathogenicity, including diseases, causes, symptoms and control of common parasites: <i>Trypanosoma, Giardia and Wuchereria</i> .	

### **Text Books:**

1. S.C. Rastogi, Cell Biology. New Age International Publisher, 2019.
2. P.K. Gupta, Cell Biology and Genetics. 2016
3. S.D. Gangane, Human Genetics. Elsevier; 6e edition, 2021.
4. P.S. Verma and V.K. Agarwal, Genetics. 9<sup>th</sup> Edition. S. Chand Publishing, 2009.
5. M.I. Shadulla and Sayenna A. Uduman, Comprehensive Textbook of Infectious Diseases. Jaypee Brothers Medical Publishers.

### **Reference Books:**

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA(2004).
2. Alberts et al: Molecular Biology of the Cell: Garland(2002).



3. Cooper: Cell: A Molecular Approach: ASM Press(2000).
4. Karp: Cell and Molecular Biology: Wiley (2002). Pierce B. Genetics. Freeman(2004).
5. Lewin B. Genes VIII. Pearson (2004).
6. Watson et al. Molecular Biology of the Gene. Pearson(2004).
7. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby- Kuby Immunology. W H Freeman (2007).
8. Delves Peter J., Martin Seamus J., Burton Dennis R., Roitt Ivan M. Roitt's Essential Immunology, 13th Edition. Wiley Blackwell(2017).
9. Principles of Genetics by B. D. Singh
10. Cell-Biology by C. B. Pawar, Kalyani Publications

**Pedagogy:** Assignments/presentation/project/term papers/seminars

<b>Course: Cell Biology and Genetics Lab</b>	<b>Course code:</b>
<b>L-T-P per week: 0-0-4</b>	<b>No. of Credits: 02</b>
<b>Internal Assessment: 25 marks</b>	<b>Semester End Examination: 25 marks</b>
<b>Total Contact Hours: 56</b>	

### Course Outcomes (COs):

At the end of the course the student should be able to:

CO1	Use simple and compound microscopes
CO2	Prepare stained slides to observe the cell organelles.
CO3	be familiar with the basic principle of life, how a cell divides leading to the growth of an organism and also reproduces to form new organisms.
CO4	The chromosomal aberrations by preparing karyotypes.
CO5	How chromosomal aberrations are inherited in humans by pedigree analysis in families. The antigen-antibody reaction.

<b>Lab 1 Course Content</b>	<b>Hrs</b>
<b>List of labs to be conducted</b>	<b>56</b>
<ol style="list-style-type: none"> <li>1. Understanding of simple and compound microscopes.</li> <li>2. To study different cell types such as buccal epithelial cells, neurons, striated muscle cells using Methylene blue/any suitable stain (virtual/ slaughtered tissue).</li> <li>3. To study the different stages of Mitosis in root tip of <i>Allium cepa</i>.</li> <li>4. To study the different stages of Meiosis in grasshopper testis (virtual).</li> <li>5. To check the permeability of cells using salt solution of different concentrations.</li> <li>6. Study of parasites in humans (e.g. Protozoans, Helminthes in compliance with examples being studied in theory) permanent microslides.</li> <li>7. To learn the procedures of preparation of temporary and permanent stained slides, with available mounting material.</li> <li>8. Study of mutant phenotypes of <i>Drosophila</i> sp. (from Cultures or Photographs).</li> <li>9. Preparation of polytene chromosomes (<i>Chironomus</i> larva or <i>Drosophila</i> larva).</li> <li>10. Preparation of human karyotype and study the chromosomal structural and numerical aberrations from the pictures provided. (Virtual/optional).</li> </ol>	

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| <ol style="list-style-type: none"> <li>11. To prepare family pedigrees.</li> <li>12. <a href="https://www.vlab.co.in">https://www.vlab.co.in</a></li> <li>13. <a href="https://zoologysan.blogspot.com">https://zoologysan.blogspot.com</a></li> <li>14. <a href="http://www.vlab.iitb.ac.in/vlab">www.vlab.iitb.ac.in/vlab</a></li> <li>15. <a href="http://www.onlinelabs.in">www.onlinelabs.in</a></li> <li>16. <a href="http://www.powershow.com">www.powershow.com</a></li> <li>17. <a href="https://vlab.amrita.edu">https://vlab.amrita.edu</a><a href="https://sites.dartmouth.edu/">https://sites.dartmouth.edu/</a></li> </ol> |  |
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### **Text Books:**

1. P.K. Gupta, Cell Biology and Genetics. 2016
2. S.D. Gangane, Human Genetics. Elsevier; 6e edition, 2021.
3. P.S. Verma and V.K. Agarwal, Genetics. 9<sup>th</sup> Edition. S. Chand Publishing, 2009.
4. M.I. Shadulla and Sayenna A. Uduman, Comprehensive Textbook of Infectious Diseases. Jaypee Brothers Medical Publishers.

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3. Cooper: Cell: A Molecular Approach: ASM Press(2000).
4. Karp: Cell and Molecular Biology: Wiley (2002). Pierce B. Genetics. Freeman(2004).
5. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby- Kuby Immunology. W H Freeman(2007).
6. Kesar, Saroj and Vasishta N.2007 Experimental Physiology: Comprehensive Manual. Heritage Publishers, NewDelhi.

**Pedagogy: Written Assignment/Presentation/Project / Term Papers/Seminar**

<b>Course:</b> Economic Zoology	<b>Course code:</b>
<b>L-T-P per week:</b> 4-0-0	<b>No. of Credits:</b> 03
<b>Internal Assessment:</b> 40 marks	<b>Semester End Examination:</b> 60 marks
<b>Total Contact Hours:</b> 42	

### Course Outcomes (COs):

At the end of the course the student should be able to:

CO1	Gain knowledge about silkworms rearing and their products.
CO2	Gain knowledge in Bee keeping equipment and apiary management.
CO3	Acquaint knowledge on dairy animal management, the breeds and diseases of cattle and learn the testing of egg and milk quality.
CO4	Acquaint knowledge about the culture techniques of fish and poultry.
CO5	Acquaint the knowledge about basic procedure and methodology of vermiculture.
CO6	Learn various concepts of lac cultivation.
CO7	Students can start their own business i.e. self-employments
CO8	Get employment in different applied sectors

Course Content	Hrs
<b>Module-1</b>	<b>8</b>
<b>Chapter 1. Sericulture:</b> <ul style="list-style-type: none"> <li>• History and present status of sericulture in India</li> <li>• Mulberry and non-mulberry species in Karnataka and India</li> <li>• Mulberry cultivation</li> <li>• Morphology and life cycle of <i>Bombyxmori</i></li> <li>• Silkworm rearing techniques: Processing of cocoon, reeling</li> <li>• Silkworm diseases and pest control</li> </ul>	
<b>Module-2</b>	<b>8</b>
<b>Chapter 2. Apiculture:</b> <ul style="list-style-type: none"> <li>• Introduction and present status of apiculture</li> <li>• Species of honey bees in India, life cycle of <i>Apisindica</i></li> <li>• Colony organization, division of labour and communication</li> <li>• Bee keeping as an agro based industry; methods and equipments: indigenous methods, extraction appliances, extraction of honey from the comb and processing</li> <li>• Bee pasturage, honey and bees wax and their uses</li> <li>• Pests and diseases of bees and their management</li> </ul>	

<b>Module-3</b>	<b>9</b>
<p><b>Chapter 3. Live Stock Management:</b></p> <ul style="list-style-type: none"> <li>● <b>Dairy:</b> Introduction to common dairy animals and techniques of dairy management</li> <li>● Types, loose housing system and conventional barn system; advantages and limitations of dairy farming</li> <li>● Establishment of dairy farm and choosing suitable dairy animals-cattle</li> <li>● Cattle feeds, milk and milk products</li> <li>● Cattle diseases</li> <li>● <b>Poultry:</b> Types of breeds and their rearing methods</li> <li>● Feed formulations for chicks</li> <li>● Nutritive value of egg and meat</li> <li>● Disease of poultry and control measures</li> </ul>	
<b>Module-4</b>	<b>8</b>
<p><b>Chapter 4. Aquaculture:</b></p> <ul style="list-style-type: none"> <li>● Aquaculture in India: An overview and present status and scope of aquaculture</li> <li>● Types of aquaculture: Pond culture: Construction, maintenance and management; carp culture, shrimp culture, shellfish culture, composite fish culture and pearl culture</li> </ul> <p><b>Chapter 5. Prawn culture:</b></p> <ul style="list-style-type: none"> <li>● Culture of fresh and marine water prawns.</li> <li>● Preparation of farm.</li> <li>● Preservation and processing of prawn, export of prawn.</li> </ul>	
<b>Module-5</b>	<b>9</b>
<p><b>Chapter 6. Fish culture:</b></p> <ul style="list-style-type: none"> <li>● Common fishes used for culture.</li> <li>● Fishing crafts and gears.</li> <li>● Ornamental fish culture: Fresh water ornamental fishes- biology, breeding techniques</li> <li>● Construction and maintenance of aquarium: Construction of home aquarium, materials used, setting up of freshwater aquaria, aquarium plants, ornamental objects, cleaning the aquarium, maintenance of water quality. control of snail and algal growth.</li> <li>● Modern techniques of fish seed production</li> </ul> <p><b>Chapter 7. Vermiculture:</b></p> <ul style="list-style-type: none"> <li>● Scope of vermiculture.</li> <li>● Types of earthworms.</li> <li>● Habit categories - epigeic, endogeic and anecic; indigenous and exotic species.</li> <li>● Methodology of vermicomposting: containers for culturing, raw materials</li> </ul>	

## **Text Books:**

1. Jaiswal Vinita and Jaiswal Kamal Kumar, Economic Zoology. Prentice Hall India Learning Private Limited, 2014.
2. Aminul Islam, A Textbook of Economic Zoology. Wiley.
3. Parul Yadav, Applied and Economic Zoology. KEDAR NATH RAM NATH; 2021st edition (1 January 2020)

## **Reference Books:**

1. Eikichi, H. (1999). Silkworm Breeding (Translated from Japanese). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Ganga, G. (2003). Comprehensive Sericulture Vol-II: Silkworm Rearing and Silk Reeling.
3. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Mahadevappa, D., Halliyal, V.G., Shankar, D.G. and Bhandiwad, R., (2000). Mulberry Silk Reeling Technology Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
5. Roger, M (1990). The ABC and Xyz of Bee Culture: An Encyclopedia of Beekeeping, Kindle Edition.
7. Shukla and Upadhyaya (2002). Economic Zoology, Rastogi Publishers
8. YadavManju (2003). Economic Zoology, Discovery Publishing House.
9. JabdePradip V (2005). Textbook of applied Zoology, Discovery Publishing House, New Delhi.
10. Cherian & Ramachandran Bee keeping in-South Indian Govt. Press, Madras.
11. Sathe, T.V. Vermiculture and Organic farming.
12. Bard. J (1986). Handbook of Tropical Aquaculture.
13. Santhanam, R. A. Manual of Aquaculture.
14. Zuka. R.1 and Hamiyn (1971). Aquarium fishes and plants
15. Jabde, P.V. (2005) Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac culture.
16. Animal Disease- Bairagi K. N. Anmol Publications Pvt.Ltd 2014
17. Economics Of Aquaculture - Singh(R.K.P) - Danika Publishing Company 2003
18. Applied and Economic Zoology (SWAYAM) web  
[https://swayam.gov.in/nd2\\_cec20\\_ge23/preview](https://swayam.gov.in/nd2_cec20_ge23/preview)

**Pedagogy:** Chalk and Talk, PPT, Group discussion, Seminar, Field visit