



**Anekant Education Society's**

**Tuljaram Chaturchand College**  
**of Arts, Science & Commerce, Baramati**  
**(Autonomous)**

**Four Year B.Sc. Degree Program in Zoology**  
**(Faculty of Science & Technology)**

**CBCS Syllabus**

**F.Y. B.Sc. (Zoology) Semester -II**

**For Department of Zoology**

**Tuljaram Chaturchand College of Arts, Science & Commerce, Baramati**

**Choice Based Credit System Syllabus (2023 Pattern)**

**(As Per NEP 2020)**

**To be implemented from Academic Year 2023-2024**

**Title of the Programme: F. Y. B. Sc. (Zoology)****Preamble**

AES's Tuljaram Chaturchand College has made the decision to change the syllabus of across various faculties from June, 2023 by incorporating the guidelines and provisions outlined in the National Education Policy (NEP), 2020. The NEP envisions making education more holistic and effective and to lay emphasis on the integration of general (academic) education, vocational education and experiential learning. The NEP introduces holistic and multidisciplinary education that would help to develop intellectual, scientific, social, physical, emotional, ethical and moral capacities of the students. The NEP 2020 envisages flexible curricular structures and learning based outcome approach for the development of the students. By establishing a nationally accepted and internationally comparable credit structure and courses framework, the NEP 2020 aims to promote educational excellence, facilitate seamless academic mobility, and enhance the global competitiveness of Indian students. It fosters a system where educational achievements can be recognized and valued not only within the country but also in the international arena, expanding opportunities and opening doors for students to pursue their aspirations on a global scale.

In response to the rapid advancements in science and technology and the evolving approaches in various domains of Zoology and related subjects, the Board of Studies in Zoology at Tuljaram Chaturchand College, Baramati - Pune, has developed the curriculum for the first semester of **F. Y. B. Sc. Zoology**, which goes beyond traditional academic boundaries. The syllabus is aligned with the NEP 2020 guidelines to ensure that students receive an education that prepares them for the challenges and opportunities of the 21st century. This syllabus has been designed under the framework of the Choice Based Credit System (CBCS), taking into consideration the guidelines set forth by the National Education Policy (NEP) 2020, LOCF (UGC), NCrF, NHEQF, Prof. R.D. Kulkarni's Report, Government of Maharashtra's General Resolution dated 20th April and 16th May 2023, and the Circular issued by SPPU, Pune on 31st May 2023.

After completion of B.Sc. in Zoology enrolled students will acquire complete disciplinary knowledge as well as allied branches of Zoology. At the end of programme, students may possess expertise which will provide them competitive advantage in pursuing higher studies within India or abroad; and seek jobs in academia, civil administration, research or industries. Students will be able to define and explain major concepts in the

biological sciences. They will be able to correctly use biological instrumentation and proper laboratory techniques; to communicate biological knowledge in oral and written form; to identify the relationship between structure and function at all levels: molecular, cellular, tissue, organ, system and organismal.

Students should be able to identify, classify and differentiate diverse non-chordates and chordates based on their basic morphological, anatomical biochemical and molecular characters. They will also be able to describe economic, ecological and medical significance of various animals in human life. This programme will create a curiosity and awareness among students to explore the animal diversity and take up wild life photography or wild life exploration as a career option. The procedural knowledge about identification and classification of animals will provide students professional advantages in seeking the jobs in fields of teaching, research and taxonomy in various private & public organizations; including Zoological Survey of India and National Parks/Sanctuaries. Students will be able to apply the scientific methods to answer questions in biology by formulating testable hypotheses, gathering data that address these hypotheses, and analyzing those data to assess the degree to which their scientific work supports their hypotheses. Students will be able to present scientific hypotheses and data both orally and in writing in the conventional formats that are in practice. Students will be able to access the primary literature, identify relevant works for a particular topic, and evaluate the scientific content of these works. Acquired practical skills in biotechnology, biostatistics, bioinformatics and molecular biology can be used to pursue career as a scientist in drug development industry in India or abroad. The students will be acquiring basic experimental skills in various techniques in the fields of genetics; molecular biology; biotechnology; entomology, physiology, qualitative and quantitative microscopy; and analytical biochemistry. These methodologies will provide an extra edge to our students, who wish to undertake higher studies. Students will be able to use the evidence of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth. They will be able to use specific examples to explicate how descent with modification has shaped animal morphology, physiology, life history, and behaviour. Students will be able to explain how organisms function at the level of the gene, genome, cell, tissue, organ and organ-system. Drawing upon this knowledge, they will be able to give specific examples of the physiological adaptations, development, reproduction and behaviour of different animals. Students will be able to analyse the ecological relationships of life on earth by tracing energy and nutrient flows through the ecosystems. They will be able to establish the relationship between the physical

features of the environment and the structure of populations, communities, and ecosystems. Students undertaking skill enhancement courses like aquaculture, sericulture and apiculture will inculcate skills involved in rearing fish, bees and silk moth which would help them to generate self-employment making them successful entrepreneurs. Acquired skills in diagnostic testing, haematology, histopathology, staining procedures etc. used in clinical and research laboratories will make them eligible to work in diagnostic or research laboratories. B.Sc. Zoology graduates will find opportunities in public services departments, NGOs, environmental agencies, universities, colleges, biotechnological, pharmaceutical, environmental / ecological fields. There are numerous career opportunities for candidates completing their B.Sc, M.Sc and Ph.D. in Zoology in public and private sector. Candidates may find jobs as Animal Behaviourist, Conservationist, Wildlife Biologist, Zoo Curator, Wildlife Educator, Zoology teacher, Forensic experts, Lab technicians, Veterinarians, etc.

Overall, revising the Zoology syllabus in accordance with the NEP 2020 ensures that students receive an education that is relevant, comprehensive, and prepares them to navigate the dynamic and interconnected world of today. It equips them with the knowledge, skills, and competencies needed to contribute meaningfully to society and pursue their academic and professional goals in a rapidly changing global landscape.

### Programme Specific Outcomes (PSOs)

- PSO1. Disciplinary Knowledge:** Understand the basic concepts of various branches of Zoology like Cell Biology, Genetics, Taxonomy, Physiology, Biochemistry, Molecular Biology, Embryology, Developmental Biology, Immunology, Ecology and Applied Zoology.
- PSO2. Critical thinking and problem solving:** Analyse the relationships of animals with abiotic factors and different biotic factors like plants and microbes. They will be able to interpret the pathogen based upon symptoms of disease.
- PSO3. Individual and Teamwork:** Sets up the experiments and performs the same as per laboratory standards in different fields of Zoology like Taxonomy, Physiology, Ecology, Cell biology, Genetics, Applied Zoology, Clinical science, tools and techniques of Zoology, Toxicology, Entomology, Nematology, Sericulture, Biochemistry, Ichthyology, Animal biotechnology, Immunology, Physiology and research methodology.
- PSO4. Research related skills and scientific temper:** Propose hypothesis, formulate tests, use various modern instruments for biological analysis, data collection and field surveys and interprets the data and find answers.
- PSO5. Critical Thinking:** Recognizes the relationships between structure and functions at different levels of biological organization (e.g., molecules, cells, organs, organisms, populations, and species) for animals.
- PSO6. Development of Observation Skills:** Distinguishes different ecosystems (e.g., terrestrial, freshwater, marine) based on biological, chemical, and physical features; Correlates the morphology, physiology, behaviour with the properties of habitat.
- PSO7. Ethics and Effective Citizenship:** Contributes the knowledge for sustainable development and nation building.
- PSO8. Management Skills:** Exhibits management skills in applied branches of Zoology like Apiculture, Sericulture, Aquaculture and Agriculture.
- PSO9. Environmental Ethics and Sustainability:** Explains the broad understanding of ecosystems, biodiversity and their conservation.
- PSO10. Identification of critical problems and issues:** Detect the causes and consequences of biodiversity depletion.

**Anekant Education Society's  
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**Board of Studies (BoS) in Zoology**

From 2022-23 to 2024-25

Sr. No.	Name	Designation
1.	<b>Mr. Sandip P. Chordiya</b>	Chairman
2.	<b>Dr. Vitthal B. Nale</b>	Member
3.	<b>Dr. Deepali M. Sangale</b>	Member
4.	<b>Dr. Sunil N. Pokale</b>	Vice-Chancellor Nominee
5.	<b>Dr. Gulab D. Khedkar</b>	Expert from other University
6.	<b>Dr. Sanjay K. Gaikwad</b>	Expert from other University
7.	<b>Dr. Yogesh A. Karpe</b>	Industry Expert
8.	<b>Mr. Kishor U. More</b>	Invitee member
9.	<b>Mr. Mayur S. Shitole</b>	Invitee member
10.	<b>Mr. Bipin B. Jagtap</b>	Meritorious Alumni
11.	<b>Ms. Rutuja R. Chavan</b>	Student Representative
12.	<b>Mr. Subodh M. Nikam</b>	Student Representative
13.	<b>Mr. Shubham R. Ghadage</b>	Student Representative
14.	<b>Ms. Tamanna S. Tamboli</b>	Student Representative

## Credit Distribution Structure for F.Y.B.Sc. -2023-2024 (Zoology)

Level	Semester	Major		Minor	GE/OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr./Sem.	Degree/ Cum.Cr.
		Mandatory	Electives							
4.5	I	<b>ZOO-101-MJM:</b> Animal Systematics & Diversity-I  <b>ZOO-102-MJM:</b> Fundamentals of Cell Biology  <b>ZOO-103-MJM:</b> Zoology Practical- I  <b>Credits-2+2+2</b>		--	<b>ZOO-116-OE:</b> <b>Fresh Water Fishery</b> (गोड्या पाण्यातील मत्स्य शेती.)  <b>ZOO-117-OE:</b> <b>Fresh Water Fishery(Practical)</b> (गोड्या पाण्यातील मत्स्यशेती (प्रात्यक्षक) Credit-2+2	<b>ZOO-121-VSC:- Biological Techniques-I</b>  <b>ZOO-126-SEC: Medical Laboratory Technology-I</b>  <b>Credit-2+2</b>	<b>ENG-131-AEC:</b> Functional English-I  <b>ZOO-135-VEC:</b> Environmental Science  <b>ZOO-137-IKS:</b> <b>Animal Diversity &amp; Conservation in Indian Culture</b> Credit-2+2+2	<b>US--CC1:</b> NSS/NCC/Yoga/Cultural Activity/Sports  <b>Credit-2</b>	22	<b>UG Certificate 44</b>
	II	<b>ZOO-151-MJM:</b> Animal Systematics & Diversity-II  <b>ZOO-152-MJM:</b> Genetics  <b>ZOO-153-MJM:</b> Zoology Practical – II <b>Credits-2+2+2</b>		<b>ZOO-161-MN:</b> Apiculture  <b>Credits-2</b>	<b>ZOO-166-OE:</b> <b>Crop pests: Types &amp; management</b> (पकावरील कड: प्रकार व व्यवस्थापन)  <b>ZOO-167-OE:</b> <b>Crop pests: Types &amp; management</b> (पकावरील कड: प्रकार व व्यवस्थापन) (प्रात्यक्षक) Credit-2+2	<b>ZOO-176-SEC: Medical Laboratory Technology-II</b>  <b>ZOO-171-VSC: Biological Techniques-II</b>  <b>Credit-2+2</b>	<b>ENG-181-AEC:</b> English– II  <b>ZOO-185-VEC:</b> Digital and Technological Solutions  <b>Credit-2+2</b>	<b>US--CC2:</b> NSS/NCC/Yoga/Cultural Activity/Sports  <b>Credit-2</b>	22	
	<b>Cum Cr.</b>	<b>12</b>	<b>-</b>	<b>2</b>	<b>8</b>	<b>8</b>	<b>10</b>	<b>4</b>	<b>44</b>	

### Course Structure for F.Y.B.Sc. Zoology (2023 Pattern)

Sem	Course Type	Course Code	Course Name	Theory / Practical	Credits
I	Major Mandatory	ZOO-101-MJM	Animal Systematics & Diversity – I	Theory	02
	Major Mandatory	ZOO-102-MJM	Fundamentals of Cell Biology	Theory	02
	Major Mandatory	ZOO-103-MJM	Zoology Practical – I	Practical	02
	Open Elective (OE)	ZOO-116-OE	Fresh Water Fishery (गोड्या पाण्यातील मत्स्य शेती.)	Theory	02
	Open Elective (OE)	ZOO-117-OE	Fresh Water Fishery (Practical) (गोड्या पाण्यातील मत्स्यशेती (प्रात्य क्षक)	Practical	02
	Vocational Skill Course (VSC)	ZOO-121-VSC	Biological Techniques-I	Theory	02
	Skill Enhancement Course (SEC)	ZOO-126-SEC	Medical Laboratory Technology-I	Practical	02
	Ability Enhancement Course (AEC)	ENG-131-AEC	Functional English-I	Theory	02
	Value Education Course (VEC)	ZOO-135-VEC	Environmental Science	Theory	02
	Indian Knowledge System (IKS)	ZOO-137-IKS	Animal Diversity & Conservation in Indian Culture	Theory	02
	Co-curricular Course (CC)	--	To be selected from the Basket	Theory	02
<b>Total Credits Semester-I</b>					<b>22</b>
II	Major Mandatory	ZOO-151-MJM	Animal Systematics & Diversity – II	Theory	02
	Major Mandatory	ZOO-152-MJM	Genetics	Theory	02
	Major Mandatory	ZOO-153-MJM	Zoology Practical – II	Practical	02
	Minor	ZOO-161-MN	Apiculture	Theory	02
	Open Elective (OE)	ZOO-166-OE	Crop pests: Types & management ( पकावरील कडः प्रकार व व्यवस्थापन)	Theory	02
	Open Elective (OE)	ZOO-167-OE	Crop pests: Types & management ( Practical) ( पकावरील कडः प्रकार व व्यवस्थापन) (प्रात्य क्षक)	Practical	02
	Vocational Skill Course (VSC)	ZOO-171-VSC	Biological Techniques-II	Practical	02
	Skill Enhancement Course (SEC)	ZOO-176-SEC	Medical Laboratory Technology -II	Practical	02
	Ability Enhancement Course (AEC)	ENG-181-AEC	Functional English-II	Theory	02
	Value Education Course (VEC)	ZOO-185-VEC	Digital and Technological Solutions	Theory	02
	Co-curricular Course (CC)	--	To be selected from the Basket	Theory	02
<b>Total Credits Semester-II</b>					<b>22</b>
<b>Cumulative Credits Semester I + Semester II</b>					<b>44</b>



## SYLLABUS (CBCS) FOR F. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2023)

**Name of the Program: B.Sc. Zoology**

**Program Code: ZOO**

**Class: F.Y. B.Sc.**

**Semester: II**

**Course Type: Major (Mandatory) Theory**

**Course Code: ZOO-151-MJM**

**Course Name: Animal Systematics & Diversity-II**

**Number of Credits: 02**

**Number of Teaching hours: 30**

### Course Objectives:

- Understand the diversity of animal life and their evolutionary relationships.
- To explore the evolutionary affinities and relationships of Hemichordata with other phyla.
- Describe the characteristics and classification of different subphyla and classes of animals.
- Explain the processes of metamorphosis in Urochordata and Neoteny in Amphibia.
- Analyze the various forms of fish migration and its ecological importance.
- Comprehend the anatomy and physiological systems of frogs, with a focus on *Hoplobatrachus tigerinus*.
- Develop practical skills in the identification and observation of external and internal structures of animals.

### Course Outcomes:

Student will be able to-

CO 1: classify animals into different subphyla and classes, citing specific examples for each category.

CO 2: recognize the key characteristics of Hemichordata, Urochordata, and Cephalochordata.

CO 3: explain the concept of retrogressive metamorphosis in Urochordata and Neoteny in Amphibia.

CO 4: discuss the significance of migration in fish and its impact on aquatic ecosystems.

CO 5: analyze the anatomy and physiology of the digestive, circulatory, nervous, and reproductive systems in frogs.

CO 6: demonstrate the ability to identify external features and structures of various animals through practical exercises and observations.

CO 7: explore ethical use of animal abilities for environmental sustainability and own economic benefits.

### TOPICS:

Unit No.	Subunit No.	Details	Teaching Hours
<b>1. General &amp; special characters and classification of following subphyla up to order with one Example</b>	1.1	Hemichordata	<b>07</b>
	1.2	Hemichordata: Affinities.	
	1.3	Urochordata	
	1.4	Urochordata: Retrogressive metamorphosis.	
	1.5	Cephalochordata	
<b>2. General &amp; special characters and classification up to</b>	2.1	Pisces - (Chondrichthyes and Osteichthyes )	<b>05</b>
	2.2	Migration in fish	

<b>order with one example of the following Classes</b>	2.3	Amphibia	
	2.4	Neoteny in Amphibia	
<b>3. Study of Frog (<i>Hoplobatrachus tigrinus</i>)</b>	3.1	Systematic position, Habit and habitat	<b>18</b>
	3.2	External characters and sexual dimorphism	
	3.3	Digestive system, food, feeding and physiology of digestion	
	3.4	Circulatory system: <b>Blood, heart, arterial and venous system</b>	
	3.5	Central Nervous system: <b>Brain and spinal cord</b>	
	3.6	Sense organs- <b>Tympanum, eyes, skin, tongue</b>	
	3.7	Reproductive systems (male & female)	

### REFERENCES

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**Course Articulation Matrix of ZOO-151-MJM: Animal Systematics & Diversity-II**  
**Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	1	1	3	1	1	1	1	1	1	1	1	1
CO2	3	1	1	2	1	1	1	1	1	1	1	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	1
CO4	3	1	1	2	2	1	1	1	1	1	1	1	1
CO5	2	2	1	2	1	1	1	1	1	1	1	1	1
CO6	2	2	1	3	1	1	1	1	1	1	1	1	1
CO7	2	1	2	1	1	1	1	1	1	1	2	1	1

Program Outcome (PO)	Correlated Course Outcome (CO)	Justification
PO1: Comprehensive Knowledge and Understanding	CO1, CO2, CO3, CO4	Understanding animal classification, key characteristics of specific phyla, and biological concepts like metamorphosis and migration demonstrates comprehensive knowledge of animal diversity.
PO3: Entrepreneurial Mindset and Knowledge	CO7	Exploring ethical use of animal abilities for economic benefits showcases an entrepreneurial mindset.
PO4: Specialized Skills and Competencies	CO1, CO2, CO6	The ability to classify animals, identify key characteristics, and recognize external features demonstrates specialized skills in animal systematics.
PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning	CO4	Discussing the impact of migration on ecosystems requires applying knowledge to analyze an ecological problem.
PO6: Communication Skills and Collaboration	Not Directly Covered	This course doesn't explicitly target communication or collaboration, however reports or presentations on COs could address this.
PO7: Research-related Skills	Not Directly Covered	This course focuses on foundational knowledge, but research skills could be developed through deeper exploration of COs.
PO9: Digital and Technological Skills	Not Directly Covered	The course doesn't explicitly require digital skills, but these could be integrated for further exploration (e.g., using digital tools for classification).
PO10: Multicultural Competence, Inclusive Spirit, and Empathy	Not Directly Covered	The course content is primarily scientific and doesn't directly address these aspects.
PO11: Value Inculcation and Environmental Awareness	CO7	Exploring ethical use of animals promotes environmental awareness and potentially responsible use of animal resources.
PO12: Autonomy, Responsibility, and Accountability	Not Directly Covered	The course emphasizes knowledge acquisition, but aspects of COs like dissections could be linked to responsible practices.

## SYLLABUS (CBCS) FOR F. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2023)

**Name of the Program: B.Sc. Zoology**

**Program Code: ZOO**

**Class: F.Y. B.Sc.**

**Semester: II**

**Course Type: Major (Mandatory) Theory**

**Course Code: ZOO-152-MJM**

**Course Name: Genetics**

**Number of Credits: 02**

**Number of Teaching hours: 30**

### Course Objectives:

- To introduce students to the basic concepts of classical genetics.
- To provide students with a comprehensive understanding of Mendelian Laws of Inheritance and their practical applications.
- To enable students to learn about different types of gene interaction and their implications.
- To acquaint students with the concept of multiple alleles and polygenic inheritance, and their importance in human genetics.
- To provide students with an overview of chromosome structure, function, and aberrations.
- To familiarize students with the different mechanisms of sex determination and sex-linked inheritance in humans.

### Course Outcomes:

Student will able to

CO1: define and explain the key concepts in classical genetics and applies Mendelian laws of inheritance to solve problems in genetics.

CO2: understand the different types of gene interaction and their effects on inheritance

CO3: explain the concept of multiple alleles and polygenic inheritance and their implications for human health and disease.

CO4: describe the morphology, composition, and classification of chromosomes.

CO5: identify and explain the different types of chromosomal aberrations and their effects on human development.

CO6: understand the chromosomal theory of sex determination and the different mechanisms of environmental sex determination.

CO7: describe the inheritance of sex-linked traits in humans.

### Topics:

Unit No.	Subunit No.	Details	Teaching Hours
<b>1. Introduction to Classical Genetics</b>	1.1	Basic concepts in genetics	4
	1.2	Mendelian Laws of Inheritance and their practical applications	
	1.3	Tests of heredity: <b>Test cross &amp; Back cross</b>	
<b>2. Gene</b>	2.1	Concept of gene interaction, co-dominance and	4

<b>Interaction</b>		incomplete dominance	
	2.2	Complementary factors (9:7)	
	2.3	Supplementary factors (9: 3:4)	
	2.4	Inhibitory factors (13:3)	
<b>3. Multiple Alleles and Polygenic Inheritance</b>	3.1	Concept, characteristics and importance of multiple alleles, ABO & Rh-blood group system and its medico-legal importance	5
	3.2	Pleiotropism and sickle cell anaemia	
<b>4. Chromosomes</b>	4.1	Introduction to morphology and composition	10
	4.2	Classification based on the centromeric position	
	4.3	Types of chromosomes (autosomes and sex chromosomes); Lampbrush and polytene chromosome	
	4.4	Chromosomal aberrations: Structural and numerical changes	
	4.5	Study of human karyotype	
	4.6	Syndromes: a) Autosomal-Down's (Mongolism) b) Sex chromosomal abnormalities in human: Klinefelter's and Turner's syndrome	
	4.7	Inborn errors of metabolism: Albinism and Phenylketonuria	
<b>5. Sex determination</b>	5.1	Introduction	5
	5.2	Chromosomal theory of sex determination (XX-XY, ZZ-ZW, XX-XO & Haploid- Diploid method)	
	5.3	Parthenogenesis and Gynandromorphism.	
	5.4	Environmental Sex Determination	
<b>6. Sex linked inheritance in human</b>	6.1	Inheritance of Colour-blindness, Haemophilia and Hypertrichosis	2

### REFERENCES

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6. Korf, B. R., & Irons, M. B. (2012). Human genetics and genomics. John Wiley & Sons.

**Course Articulation Matrix of ZOO-152-MJM: Genetics****Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	1	1	2	3	1	1	1	1	1	1	1	1
CO2	3	1	1	2	3	1	1	1	1	1	1	1	1
CO3	3	1	1	2	3	1	1	1	1	1	1	1	1
CO4	3	1	1	2	1	1	1	1	1	1	1	1	1
CO5	3	1	1	2	2	1	1	1	1	1	1	1	1
CO6	3	1	1	2	2	1	1	1	1	1	1	1	1
CO7	3	1	1	2	2	1	1	1	1	1	1	1	1

Program Outcome (PO)	Correlated Course Outcome (CO)	Justification
PO1: Comprehensive Knowledge and Understanding	CO1, CO2, CO3, CO4, CO5, CO6, CO7	Understanding core genetics concepts, inheritance patterns, chromosomal structure and abnormalities, and sex determination demonstrates comprehensive knowledge of genetics.
PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning	CO1, CO2, CO3	Applying Mendelian laws, understanding gene interaction, and analyzing the implications of multiple alleles require applying knowledge to solve genetics problems.
PO7: Research-related Skills	Not Directly Covered	The course focuses on foundational knowledge, but research skills could be developed through projects exploring specific genetic concepts.
PO8: Learning How to Learn Skills	CO1	Defining and explaining key concepts demonstrates the ability to learn and retain new information in genetics.
PO9: Digital and Technological Skills	Not Directly Covered	The course doesn't explicitly require digital skills, but these could be integrated for further exploration (e.g., using genetic databases).
PO10: Multicultural Competence, Inclusive Spirit, and Empathy	Not Directly Covered	The course content is primarily scientific and doesn't directly address these aspects.
PO11: Value Inculcation and Environmental Awareness	Not Directly Covered	The course itself doesn't directly address environmental awareness, but the field of genetics can have ethical implications.
PO12: Autonomy, Responsibility, and Accountability	Not Directly Covered	The course emphasizes knowledge acquisition, but responsible conduct in genetics research could be discussed.
PO13: Community Engagement and Service	Not Directly Covered	The course curriculum doesn't explicitly target community engagement, but some projects could be designed to connect with conservation efforts or science education initiatives.

## SYLLABUS (CBCS) FOR F. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2023)

**Name of the Program: B.Sc. Zoology**

**Program Code: ZOO**

**Class: F.Y. B.Sc.**

**Semester: II**

**Course Type: Major (Mandatory) Practical**

**Course Code: ZOO-153-MJM**

**Course Name: Zoology Practical-II**

**Number of Credits: 02**

**Number of Teaching hours: 60**

### Course Objectives:-

- Vertebrate classification system.
- Morphometric analysis & different types of tail fins of the fishes.
- Culturing of *Drosophila*
- Human genetic traits & human karyotype ABO blood group system
- Basic physiology in vertebrate animal
- To provide students with hands-on experience in the study of chordate animals, including their classification, morphology, anatomy, physiology, and genetics.
- To develop students' critical thinking and problem-solving skills by applying their knowledge of chordate biology to real-world examples.
- To prepare students for further study in chordate biology and related fields.

### Course Outcomes:

Student will able to

CO1: classify chordate animals into the appropriate subphyla and classes, and explain the reasons for their classification.

CO2: identify and describe the key morphological and anatomical features of different chordate animals, including fishes, amphibians, and humans.

CO3: understand the basic physiological processes of chordate animals, such as digestion, circulation, and reproduction.

CO4: apply their knowledge of chordate biology to solve problems related to animal diversity, conservation, and human health.

CO5: conduct basic laboratory experiments in chordate biology, including morphometric analysis, dissection, and karyotyping.

CO6: interpret and analyze scientific data, such as images, graphs, and tables.

CO7: communicate their findings effectively in writing and orally.

Practical No.	Name of the practical	E/D	Teaching Hours
1	To study the classification with reasons of the following: a) Hemichordata- <i>Balanoglossus</i> b) Urochordata- <i>Hardmania</i> c) Cephalochordata- <i>Amphioxus</i> d) Cartilaginous fish- <i>Scoliodon</i> e) Bony fish- Sea horse	(D)	4



2	Study of fish scales and chromatophores.	(E)	4
3	Morphometric study of any freshwater fish: Measurements of total length, standard length, weight and length-weight relationship.	(E)	4
4	Study and demonstration of morphological and anatomical structures of preserved frog specimen a. External characters and sexual dimorphism. b. Digestive system and brain.	(D)	4
5	Study of male & female reproductive system of frog.	(D)	4
6	Study of sense organs in frog	(D)	4
7	Collection of any five <b>chordate</b> animals, photographic images and identification with morphological characters ( <b>Activity based learning</b> )	-	4
8	Study of human genetic disorders (any two) hereditary disorders / inborn errors of metabolism.	(D)	4
9	Profile of any two geneticists ( <b>Activity based learning</b> ).	-	4
10	Study of human blood groups: ABO and Rh- factor.	(E)	4
11	Genetical Problems: Based on monohybrid, dihybrid cross & ABO blood groups.	(E)	4
12	Study of Karyotype: Study of normal human karyotype and one abnormal karyotype (any one of Down's, Klinefelter's or Turner's from metaphase chromosomal spread picture (image based learning).	(E)	4
13	Study of human genetical traits: Tongue rolling, widow's peak, ear lobes, colour blindness and PTC tasters/ non tasters (video based practical).	(D)	4
14	Study of <i>Drosophila</i> : A) Culture of <i>Drosophila</i> B) External characters, sexual dimorphism and life cycle. C) Mutants: Eye and wing mutants (any two of each).	(D)	8
15	A visit to natural habitat for biodiversity study or Study visit to a research institute or a zoo and submission of report is essential.	-	4
<b>D- Demonstration; E- Experiment.</b>			



**Course Articulation Matrix of ZOO-153-MJM: Zoology Practical-II****Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	1	1	3	2	1	2	2	1	1	1	2	1
CO2	3	1	1	3	1	1	2	1	1	1	1	1	1
CO3	3	1	1	2	2	1	2	1	1	1	1	1	1
CO4	2	1	1	2	3	1	1	1	1	1	1	1	1
CO5	2	2	1	3	3	1	3	2	1	1	1	2	1
CO6	3	1	1	2	3	2	3	1	2	1	1	1	1
CO7	2	1	1	1	3	3	2	1	1	1	1	1	1

Program Outcome (PO)	Correlated Course Outcome (CO)	Justification
PO1: Comprehensive Knowledge and Understanding	CO1, CO2, CO3	Classifying chordates, identifying morphological features, and understanding basic physiological processes demonstrate comprehensive knowledge of chordate biology.
PO4: Specialized Skills and Competencies	CO1, CO2, CO5	The ability to classify chordates, identify features through dissections, and conduct lab experiments demonstrates practical skills in zoology.
PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning	CO3, CO4	Understanding physiological processes and applying knowledge to solve problems related to animal diversity and conservation requires application and analysis.
PO6: Communication Skills and Collaboration	CO7	Effectively communicating findings through writing and oral reports demonstrates scientific communication skills.
PO7: Research-related Skills	CO5, CO6	Laboratory experiments involve data collection and analysis, which are fundamental research skills.
PO8: Learning How to Learn Skills	CO5	Performing lab experiments requires following protocols, interpreting data, and potentially troubleshooting issues, all of which contribute to learning new scientific techniques.
PO9: Digital and Technological Skills	Not Directly Covered	The course doesn't explicitly require using digital tools, but some labs might utilize them (e.g., digital microscopes, data analysis software).
PO10: Multicultural Competence, Inclusive Spirit, and Empathy	Not Directly Covered	The course content is primarily scientific and doesn't directly address these aspects.
PO11: Value Inculcation and Environmental Awareness	Not Directly Covered	The course itself doesn't directly address environmental awareness, but some labs could be linked to conservation topics (e.g., studying endangered species).
PO12: Autonomy, Responsibility, and Accountability	CO5	Following proper lab procedures and safety protocols demonstrates responsible laboratory practices.
PO13: Community Engagement and Service	Not Directly Covered	The course curriculum doesn't explicitly target community engagement, but some projects could be designed to connect with conservation efforts or science education initiatives.

## SYLLABUS (CBCS) FOR F. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2023)

**Name of the Program: B.Sc. Zoology**

**Program Code: ZOO**

**Class: F.Y. B.Sc.**

**Semester: II**

**Course Type: Minor**

**Theory Course Code: ZOO-161-MN**

**Course Name: Apiculture**

**Number of Credits: 02**

**Number of Teaching hours: 30**

### Course Objectives:

- To disseminate information on economic aspects of zoology like apiculture.
- To encourage young learners for self-employment.
- To comprehend the functioning of apiculture industry and its scope in India.
- To study the honey bee species and bee products
- To study the bee keeping industry.
- To encourage adoption of scientific Apiculture by supply of disease free bee colonies, bee health management, quality honey production and other bee products.
- To critically study the life history and rearing of honey bees, bee behavior and communication, bee diseases and enemies.

### Course Outcomes:

**Students will be able to-**

CO 1: Identify different honey bee species.

CO 2: Explain the tools & techniques used in apiculture.

CO 3: Illustrate the diseases of honey bee.

CO 4: Enumerate the methods of collecting, processing, and utilizing bee products, including honey, wax, bee venom, propolis, royal jelly, and pollen grains and thereby understands the economic importance of apiculture.

CO 5: Get acquainted about communication system among the casts in the colony.

CO 6: Understand the seasonal management of bees for bee keeping.

CO 7: Acquire knowledge about structure of bee colony, functions of each casts in colony

### TOPICS:

Unit No.	Subunit No.	Details	Teaching Hours
<b>1. Introduction, habit, habitat and nesting behavior</b>	1.1	An introduction to Apiculture	<b>05</b>
	1.2	Study of habit, habitat and nesting behavior of <i>Apis dorsata</i> , <i>Apis indica</i> , <i>Apis florea</i> , <i>Apis mellifera</i>	
<b>2. Honey bee life cycle, behaviour and</b>	2.1	Life cycle of honey bee	<b>06</b>
	2.2	Colony organization and division of	

<b>communication.</b>		labour, Polymorphism	
	2.3	Bee behaviour	
	2.4	Bee communication	
<b>3.Bee keeping equipments</b>	3.1	Bee box (Langstroth type)	<b>04</b>
	3.2	Honey extractor	
	3.3	Smoker	
	3.4	Bee-veil	
	3.5	Gloves	
	3.6	Hive tool	
	3.7	Bee Brush	
	3.8	Comb foundation Sheet	
<b>4.Bee products (collection methods, composition and uses)</b>	4.1	Honey	<b>06</b>
	4.2	Wax	
	4.3	Bee Venom	
	4.4	Propolis	
	4.5	Royal jelly	
	4.6	Pollen grains	
<b>5.Diseases and enemies of Bees</b>	5.1	Bee diseases – Protozoan, Bacterial, Fungal – with two examples	<b>07</b>
	5.2	Bee pests – Wax moth (Greater and Lesser), Wax beetle	
	5.3	Bee Enemies – Bee eater, King crow, Wasp, Lizard, Bear, Man	
<b>6. Bee keeping and seasonal management.</b>			<b>02</b>

### REFERENCES

1. Destructive and useful Insects, their habit and Control, 1973. C.L.Metcalf and W. p. Flint, Tata McGraw Hill Publications, New Dehli.
2. A Text Book Of Entomology, 1974. V.K. Mathur and K.D. Upadhayay, Goel Printing Press, Barani.
3. Imm's Text Book of Entomology, Vol I & II, Richard and Owen.
4. Biology of Insects, 1992. S.C. Saxena. Oxford and IBH Publishing Co., New Dehli. Bombay, Calcutta.
5. Bee and Bee Keeping, 1978, Roger A. Morse, Conell University Press, London.
6. The Behaviour & Social Life of Honey Bees, C.R. Ribbandas, Dover Publication inc. Mandal, GoM, Mumbai.

### **Course Articulation Matrix of ZOO-161-MN: Apiculture**

**Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	2	1	1	2	1	1	1	1	1	1	1	1	1
CO2	2	2	1	3	1	1	1	1	1	1	1	2	1
CO3	2	1	1	2	1	1	1	1	1	1	1	1	1
CO4	2	1	3	3	2	1	1	1	1	1	1	1	1
CO5	2	1	1	2	1	1	1	1	1	1	1	1	1
CO6	2	2	1	3	2	1	1	1	1	1	1	2	1
CO7	2	1	1	3	1	1	1	1	1	1	1	1	1

<b>**Program Outcomes (POs)</b>	<b>Course Outcomes (COs)</b>	<b>Justification**</b>
PO1: Comprehensive Knowledge and Understanding	CO1, CO2, CO3, CO4, CO6, CO7	The course provides a foundation in bee identification, tools & techniques, diseases, products, seasonal management, and colony structure.
PO2: Practical, Professional, and Procedural Knowledge	CO2	Learning apicultural tools & techniques introduces basic professional knowledge.
PO3: Entrepreneurial Mindset and Knowledge	CO4	Understanding the economic importance of bee products (honey, wax, etc.) can foster an entrepreneurial mindset.
PO4: Specialized Skills and Competencies	CO2, CO4, CO6	The course develops beekeeping skills through knowledge of tools (CO2), bee products and their utilization (CO4), and seasonal colony management (CO6).
PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning	Not Directly Covered	While not the main focus, applying knowledge to beekeeping practices might involve some problem-solving.
PO6: Communication Skills and Collaboration	Not Directly Covered	Reports or presentations on beekeeping topics could address communication skills, but the course doesn't explicitly target this.
PO7: Research-related Skills	Not Directly Covered	The course focuses on foundational knowledge, but research skills could be developed through deeper exploration of beekeeping topics.
PO8: Learning How to Learn Skills	CO1, CO2, CO3, CO4, CO5, CO6, CO7	The course content on bee identification, techniques, diseases, products, communication within colonies, seasonal management, and colony structure can contribute to developing self-learning skills in apiculture.
PO9: Digital and Technological Skills	Not Directly Covered	The course doesn't explicitly require digital skills, but these could be integrated for further exploration (e.g., using digital resources for beekeeping information).
PO10: Multicultural Competence, Inclusive Spirit, and Empathy	Not Directly Covered	Not directly addressed in the apiculture curriculum.
PO11: Value Incultation and Environmental Awareness	CO4	Understanding the importance of bees for pollination (through bee products like honey) can promote environmental awareness.
PO12: Autonomy, Responsibility, and Accountability	CO2, CO6	Following proper apicultural techniques (CO2) and understanding seasonal management (CO6) demonstrates responsible management of bee colonies.
PO13: Community Engagement and Service	Not Directly Covered	The course curriculum doesn't explicitly target community engagement, but projects could be designed to connect with beekeeping initiatives.

## SYLLABUS (CBCS) FOR F. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2023)

**Name of the Program:** B.Sc. Zoology

**Program Code:** ZOO

**Class:** F.Y. B.Sc.

**Semester:** II

**Course Type:** Open Elective (Theory)

**Course Code:** ZOO-166-OE

**Course Name:** Crop pest- types and management (पिकांवरील कीड: प्रकार व व्यवस्थापन)

**Number of Credits:** 02

**Number of Teaching hours:** 30

**Course Objectives:-**

- शेतातील वेगवेगळ्या कीड नियंत्रणाच्या पद्धती अभ्यासणे.
- तृणधान्य आणि कडधान्याच्या कीड नियंत्रणाच्या पद्धती अभ्यासणे.
- नगदी पिकांच्या कीड नियंत्रणाच्या पद्धती अभ्यासणे.
- साठविलेल्या धान्याला होणारी किडी समजून घेणे.
- आहारामध्ये वापरल्या जाणाऱ्या शाकभाजावरील किडीचा प्रादुर्भाव अभ्यासणे.
- टोळ आणि गवती टोळचा अभ्यास करणे.
- पिकांचे ईतर शत्रूचा अभ्यास करणे.

**Course Outcomes:-**

सदर विषयाचा अभ्यास केल्यावर विद्यार्थी-

CO1: वेगवेगळ्या कीड नियंत्रणाच्या पद्धती आत्मसात करेल.

CO2: कीड नियंत्रणाच्या माध्यमातून तृणधान्य आणि कडधान्याचे उत्पन्नात वाढ करू शकतो.

CO3: नगदी पिकांसाठी कीड नियंत्रणाच्या योग्य पद्धती शेतात अवलंबू शकतो.

CO4: टोळ आणि गवती टोळ मुळे होणारे नुकसान टाळू शकतो.

CO5: शाकभाजांवरील किडीचा प्रादुर्भाव रोखू शकतो.

CO6: साठविलेल्या धान्याला होणारी किडीचा प्रादुर्भाव रोखू शकतो.

CO7: पिकांचे कीडनियंत्रण करून जास्तीत जास्त उत्पन्न मिळवू शकतो

**Topics:**

अनु. क्र.	घटक आणि उपघटक	तास
1	शेतामध्ये घेतली जाणारी वेगवेगळी पिके आणि त्यावरील कीड नियंत्रणाच्या पद्धती	1L
	1.1 तृणधान्य: ज्वारी, बाजरी आणि गहू या पिकांवरील कीड नियंत्रण.	3L
	1.2 ऊसावरील कीड नियंत्रण.	3L
	1.3 कडधान्य : तूर, हरभरा आणि वाटाणा या पिकांवरील कीड नियंत्रण.	3L
	1.4. तेलबिया : भुईमूग आणि सुर्यफुल या पिकांवरील कीड नियंत्रण.	2L

	1.5. फलझाडे : आंबा, डाळिंब, पेरू, द्राक्षे आणि नारळ या पिकांवरील कीड नियंत्रण.	5L
2	<p>साठविलेल्या धान्यातील कीड नियंत्रण. :</p> <ul style="list-style-type: none"> <li>तांदळांमधील सोंडा, कोठारातील सोंडा नियंत्रण.</li> <li>धान्य पोखरणारा भुंगेरा, पिठातील भुंगेरा, पिठातील लांबशीर्ष भुंगेरा, कडधान्याचा भुंगेरा नियंत्रण.</li> <li>धान्याची साठवण व किडीचे नियंत्रण.</li> </ul>	4L
3	<p>टोळ आणि गवती टोळ:</p> <ul style="list-style-type: none"> <li>टोळ, टोळधाड आणि जीवनक्रम.</li> <li>टोळधाडीच्या नियंत्रणाचे उपाय.</li> <li>गवती टोळ व तिचे नियंत्रण.</li> </ul>	3L
4	<p>वाळवी:</p> <p>1) वाळवीमुळे होणारे नुकसान आणि त्याचे नियंत्रण.</p>	1L
5	<p>उंदीर:</p> <ul style="list-style-type: none"> <li>उंदरांचे प्रकार, शेतातील उंदीर.</li> <li>वास्तव्य आणि सवयी</li> <li>खाद्य व जीवनक्रम</li> <li>नुकसान व त्याचे प्रकार.</li> <li>उंदरांचा बंदोबस्त आणि प्रतिबंधात्मक उपाय.</li> </ul>	3L
6	<p>पिकांचे इतर शत्रू:</p> <ul style="list-style-type: none"> <li>कृमी</li> <li>खेकडे</li> <li>पक्षी</li> <li>रानडुक्कर</li> <li>वटवाघूळ</li> <li>चिंकारा</li> </ul>	2L

**संदर्भसूची:**

- भाजीपाला पिकावरील कीड व्यवस्थापन- डॉ. बस्वराज भेदे
- पिकांवरील कीड-कीटक- डॉ. पुरुषोत्तम जोशी
- कीटक निरीक्षकाचा सोबती- डॉ. पुरुषोत्तम जोशी

**Course Articulation Matrix of ZOO-166-OE: Crop pest- types and management (पिकांवरील कीड: प्रकार व व्यवस्थापन) Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	3	2	3	3	2	2	2	2	2	3	3	2
CO2	3	3	3	2	3	2	2	2	2	2	3	3	2
CO3	3	3	2	3	3	2	2	2	2	2	3	3	2
CO4	3	2	2	3	3	2	2	2	2	2	3	3	2
CO5	3	2	2	3	3	2	2	2	2	2	3	3	2
CO6	3	3	2	3	3	2	2	2	2	2	3	3	2

PO1: Comprehensive Knowledge and Understanding	CO1, CO2, CO3, CO4, CO5, CO6, CO7	The course provides a comprehensive understanding of various pest control methods (CO1), their impact on crop yield (CO2), their application in different crops (CO3), protection against specific pests (CO4, CO5), and storage pest management (CO6), ultimately leading to increased crop production (CO7).
PO2: Practical, Professional, and Procedural Knowledge	CO1, CO2, CO3, CO4, CO5, CO6	The course equips students with practical knowledge of pest control techniques (CO1) and their application in various crops (CO2, CO3, CO4, CO5, CO6), enabling them to make informed decisions for effective pest management.
PO3: Entrepreneurial Mindset and Knowledge	CO2, CO7	Understanding the impact of pest control on crop yield (CO2) and the potential for increased production (CO7) can foster an entrepreneurial mindset in agriculture.
PO4: Specialized Skills and Competencies	CO1, CO2, CO3, CO4, CO5, CO6	The course develops specialized skills in pest identification, selection of appropriate control methods, and their implementation in different crop settings (CO1, CO2, CO3, CO4, CO5, CO6).
PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning	CO1, CO2, CO3, CO4, CO5, CO6, CO7	Students learn to identify pest problems, analyze their impact, and apply appropriate control measures, demonstrating problem-solving and analytical skills (CO1, CO2, CO3, CO4, CO5, CO6, CO7).
PO6: Communication Skills and Collaboration	CO1, CO2, CO3, CO4, CO5, CO6	Effective communication of pest control strategies to farmers and stakeholders is crucial for successful implementation (CO1, CO2, CO3, CO4, CO5, CO6).
PO7: Research-related Skills	CO1, CO2, CO3, CO4, CO5, CO6	The course introduces students to research methodologies in pest control, enabling them to stay updated on new techniques and adapt their practices accordingly (CO1, CO2, CO3, CO4, CO5, CO6).
PO8: Learning How to Learn Skills	CO1, CO2, CO3, CO4, CO5, CO6	The dynamic nature of pest management requires continuous learning and adaptation. The course instills self-learning skills through exposure to diverse pest control methods and their applications (CO1, CO2, CO3, CO4, CO5, CO6).
PO9: Digital and Technological Skills	CO1, CO2, CO3, CO4, CO5, CO6	Digital tools can be utilized for pest monitoring, data collection, and dissemination of information. The course encourages the integration of digital technologies into pest management practices (CO1, CO2, CO3, CO4, CO5, CO6).
PO10: Multicultural Competence, Inclusive Spirit, and Empathy	CO1, CO2, CO3, CO4, CO5, CO6	Pest management practices should consider cultural and social contexts, including the impact on local communities and ecosystems. The course promotes sensitivity to these aspects (CO1, CO2, CO3, CO4, CO5, CO6).
PO11: Value Inculcation and Environmental	CO1, CO2, CO3, CO4,	Sustainable pest management practices are essential for environmental protection. The course emphasizes the importance of



Awareness	CO5, CO6	eco-friendly approaches (CO1, CO2, CO3, CO4, CO5, CO6).
PO12: Autonomy, Responsibility, and Accountability	CO1, CO2, CO3, CO4, CO5, CO6	Informed decision-making and responsible implementation of pest control measures are crucial for environmental protection and human safety. The course instills a sense of responsibility in students (CO1, CO2, CO3, CO4, CO5, CO6).
PO13: Community Engagement and Service	CO1, CO2, CO3, CO4, CO5, CO6	Sharing knowledge and skills with farmers and communities can contribute to improved pest management practices and agricultural productivity. The course encourages community engagement (CO1, CO2, CO3, CO4, CO5).

### SYLLABUS (CBCS) FOR F. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2023)

**Name of the Program:** B.Sc. Zoology

**Program Code:** ZOO

**Class:** F.Y. B.Sc.

**Semester:** II

**Course Type:** Open Elective (Practical)

**Course Code:** ZOO-167-OE

**Course Name:** Crop pest- types and management (पिकांवरील कीड: प्रकार व व्यवस्थापन)

(प्रात्यक्षिक)

**Number of Credits:** 02

**Number of Teaching hours:** 60

**Course Objectives:-**

- शेतातील कीड नियंत्रणाच्या पद्धती समजून घेणे.
- फळझाडांवरील कीड नियंत्रणाच्या पद्धती अभ्यासणे.
- तृणधान्य आणि कडधान्याना होणारी कीड अभ्यासणे.
- ऊस या प्रमुख नगदी पिकांच्या कीड नियंत्रणाच्या पद्धती अभ्यासणे.
- घरामध्ये साठविलेल्या धान्याला होणारी किडी समजून घेणे.
- आहारामध्ये वापरल्या भाजांवरील किडीचा प्रादुर्भाव रोखणे.
- शेतातील वेगवेगळ्या कीड प्रकरांची माहिती करून घेणे.

**Course Outcomes:-**

सदर विषयाचा अभ्यास केल्यावर विद्यार्थी-

CO1: वेगवेगळ्या कीड नियंत्रणाच्या पद्धतीचे अवलोकन करेल.

CO2: कीड नियंत्रणाच्या माध्यमातून फळझाडांचे संगोपन आणि उत्पन्न घेऊ शकतो.

CO3: तृणधान्य आणि कडधान्याचे संगोपन आणि उत्पन्न घेऊ शकतो.

CO4: ऊस या प्रमुख नगदी पिकांच्या कीड नियंत्रणाच्या पद्धती शेतात अवलंबू शकतो.



CO5: घरामध्ये साठविलेल्या धान्याला होणारी किडी रोखू शकतो.

CO6: आहारामध्ये वापरल्या भाजांवरील किडीचा प्रादुर्भाव रोखून जास्त उत्पन्न घेऊ शकतो.

CO7: पिकांचे कीडनियंत्रण करून जास्तीत जास्त उत्पन्न मिळऊ शकतो.

प्रात्य क्षके:

अनुक्रमांक	प्रात्य क्षकाचे नाव	E/D	Teaching hours
1	शेतातील कीड नियंत्रणाच्या वेगवेगळ्या पद्धती अभ्यासने.	D	04
2	तृणधान्यावर होणारे किडीचे रोग, त्याची लक्षणे आणि उपायांचा अभ्यास करणे.	D	08
3	कडधान्यावर होणारे किडीचे रोग, त्याची लक्षणे आणि उपायांचा अभ्यास करणे.	D	08
4	फळझाडांवर होणारे किडीचे रोग आणि त्यावरील उपायांचा अभ्यास करणे.	D	08
5	शाकभाज्यांवर होणारे किडीचे रोग आणि त्यावरील उपायांचा अभ्यास करणे.	D	04
6	साठविलेल्या धान्यातील किडी आणि त्यांच्या नियंत्रणाचे उपाय अभ्यासने.	D	08
7	टोळधाडमुळे होणारे नुकसान आणि नियंत्रणाचे उपाय अभ्यासने.	D	04
8	शेतातील उंदीरांमुळे होणारे नुकसान आणि त्याचे प्रतिबंधात्मक उपाय अभ्यासने.	D	04
9	पिकांचे इतर शत्रू त्यांच्यामुळे होणारे नुकसान आणि त्यावरील उपाययोजना अभ्यासने.	D	04
10	तुमच्या घराच्या आसपासच्या शेतातील वेगवेगळ्या पिकांवर होणाऱ्या किडीचा आणि त्यावर केल्या जाणाऱ्या उपायांचा सर्वे करा आणि त्याचा एक अहवाल तयार करा.	E	08

संदर्भसूची:

- भाजीपाला पिकांवरील कीड व्यवस्थापन- डॉ. बस्वराज भेदे
- पिकांवरील कीड-कीटक- डॉ. पुरुषोत्तम जोशी
- कीटक निरीक्षकाचा सोबती- डॉ. पुरुषोत्तम जोशी

**Course Articulation Matrix of ZOO-167-OE: Crop pest- types and management (पिकांवरील कीड : प्रकार व व्यवस्थापन) Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	3	2	3	3	2	2	2	2	2	3	3	2
CO2	3	3	3	2	3	2	2	2	2	2	3	3	2
CO3	3	3	2	3	3	2	2	2	2	2	3	3	2
CO4	3	2	2	3	3	2	2	2	2	2	3	3	2
CO5	3	2	2	3	3	2	2	2	2	2	3	3	2
CO6	3	3	2	3	3	2	2	2	2	2	3	3	2

PO1: Comprehensive Knowledge and Understanding	CO1, CO2, CO3, CO4, CO5, CO6, CO7	The course provides a comprehensive understanding of various pest control methods (CO1), their impact on crop yield (CO2), their application in different crops (CO3), protection against specific pests (CO4, CO5), and storage pest management (CO6), ultimately leading to increased crop production (CO7).
PO2: Practical, Professional, and Procedural Knowledge	CO1, CO2, CO3, CO4, CO5, CO6	The course equips students with practical knowledge of pest control techniques (CO1) and their application in various crops (CO2, CO3, CO4, CO5, CO6), enabling them to make informed decisions for effective pest management.
PO3: Entrepreneurial Mindset and Knowledge	CO2, CO7	Understanding the impact of pest control on crop yield (CO2) and the potential for increased production (CO7) can foster an entrepreneurial mindset in agriculture.
PO4: Specialized Skills and Competencies	CO1, CO2, CO3, CO4, CO5, CO6	The course develops specialized skills in pest identification, selection of appropriate control methods, and their implementation in different crop settings (CO1, CO2, CO3, CO4, CO5, CO6).
PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning	CO1, CO2, CO3, CO4, CO5, CO6, CO7	Students learn to identify pest problems, analyze their impact, and apply appropriate control measures, demonstrating problem-solving and analytical skills (CO1, CO2, CO3, CO4, CO5, CO6, CO7).
PO6: Communication Skills and Collaboration	CO1, CO2, CO3, CO4, CO5, CO6	Effective communication of pest control strategies to farmers and stakeholders is crucial for successful implementation (CO1, CO2, CO3, CO4, CO5, CO6).
PO7: Research-related Skills	CO1, CO2, CO3, CO4, CO5, CO6	The course introduces students to research methodologies in pest control, enabling them to stay updated on new techniques and adapt their practices accordingly (CO1, CO2, CO3, CO4, CO5, CO6).
PO8: Learning How to Learn Skills	CO1, CO2, CO3, CO4, CO5, CO6	The dynamic nature of pest management requires continuous learning and adaptation. The course instills self-learning skills through exposure to diverse pest control methods and their applications (CO1, CO2, CO3, CO4, CO5, CO6).
PO9: Digital and Technological Skills	CO1, CO2, CO3, CO4, CO5, CO6	Digital tools can be utilized for pest monitoring, data collection, and dissemination of information. The course encourages the integration of digital technologies into pest management practices (CO1, CO2, CO3, CO4, CO5, CO6).
PO10: Multicultural Competence, Inclusive Spirit, and Empathy	CO1, CO2, CO3, CO4, CO5, CO6	Pest management practices should consider cultural and social contexts, including the impact on local communities and ecosystems. The course promotes sensitivity to these aspects (CO1, CO2, CO3, CO4, CO5, CO6).
PO11: Value Incultation	CO1, CO2,	Sustainable pest management practices are essential for

and Environmental Awareness	CO3, CO4, CO5, CO6	environmental protection. The course emphasizes the importance of eco-friendly approaches (CO1, CO2, CO3, CO4, CO5, CO6).
PO12: Autonomy, Responsibility, and Accountability	CO1, CO2, CO3, CO4, CO5, CO6	Informed decision-making and responsible implementation of pest control measures are crucial for environmental protection and human safety. The course instills a sense of responsibility in students (CO1, CO2, CO3, CO4, CO5, CO6).
PO13: Community Engagement and Service	CO1, CO2, CO3, CO4, CO5, CO6	Sharing knowledge and skills with farmers and communities can contribute to improved pest management practices and agricultural productivity. The course encourages community engagement (CO1, CO2, CO3, CO4, CO5).

## SYLLABUS (CBCS) FOR F. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2023)

**Name of the Program: B.Sc. Zoology**

**Program Code: ZOO**

**Class: F.Y. B.Sc.**

**Semester: II**

**Course Type: Vocational Skill Courses (Practical)**

**Course Code: ZOO-171-VSC**

**Course Name: Biological Techniques-II**

**Number of Credits: 02**

**Number of Teaching hours: 60**

### Course Objectives: -

- Understand and apply Good Laboratory Practices (GLP) to ensure safety, accuracy, and reliability in laboratory work.
- Develop the skills necessary for laboratory sterilization procedures to maintain aseptic conditions.
- Gain knowledge of basic laboratory tools and glassware and learn to select and use them appropriately.
- Demonstrate proficiency in the sterilization of laboratory glassware and equipment to prevent contamination.
- Acquire the ability to prepare normal (N) solutions with precise concentrations for various laboratory applications.
- Master the techniques for preparing molar (M) solutions to work with different chemicals effectively.
- Learn to prepare and work with percent solutions for specific laboratory experiments.

### Course Outcomes: -

Student will able to:

- CO1: Apply Good Laboratory Practices (GLP) consistently to ensure safety, precision, and reliability in laboratory work.
- CO2: Demonstrate proficiency in laboratory sterilization techniques to maintain sterile conditions and minimize contamination risks.
- CO3: Identify, select, and effectively utilize basic laboratory tools and glassware, adhering to best practices for their care and maintenance.
- CO4: Successfully sterilize laboratory glassware and equipment, creating a contamination-free environment for experiments.
- CO5: Prepare and work with normal (N) and molar (M) solutions, accurately calculating concentrations and volumes for specific applications.
- CO6: Create and utilize percent solutions, showing a sound understanding of their preparation and application in laboratory experiments.
- CO7: Perform serial dilution methods and conduct acid-base titrations with precision, achieving accurate results in chemical analyses.

Practical No	Title of practical	E/D	Teaching Hours
1.	Good Laboratory Practices (GLP)	D	04
2	To perform laboratory sterilization	D	04
3.	To study the basic tools and glassware's of laboratory	D	04

4.	Sterilization of laboratory glassware and equipment	D	08
5.	Preparation of normal (N) solution	E	04
6.	Preparation of molar (M) solution	E	04
7.	Preparation of percent solution	E	04
8.	Study of serial dilution method	E	04
9.	Preparation of PPM and PPB solutions	E	04
10.	Acid-base titration	E	04
11.	To study the camera lucida	D	04
12.	To study the working mechanism of laminar air flow	D	04
13.	To Study the principal and working of pH meter	E	04
14.	To Study the principal and working of Centrifugation	D	04
15.	To Study the principal and working of Colorimeter	E	04
<b>D- Demonstration; E- Experiment.</b>			

**References:**

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2. Christopher.F Forster, D.A. John Wase, (1987) Environmental Biotechnology, Ellis Harwood.
3. Arms, K. (1990) Environmental Science, Saunders College Publishing
4. Cheesbrough, M. 1998. District Laboratory Practice in Tropical Countries. Part I. Cambridge University Press, UK.
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6. Cappuccino, J.G. and Sherman, N. (1996) Microbiology a Laboratory Manual. The Benjamin Cummings Publishing Co. Inc., San Francisco.
7. Dubey, R.C. and Maheshwari, D.K (2002) Practical Microbiology S.Chand & Company Ltd.
8. Principles and Techniques of Biochemistry and Molecular Biology, 6th edition (2008), Keith Wilson and John Walker, Publisher–Cambridge University Press.

**Course Articulation Matrix of ZOO-171-VSC: Biological Techniques-II**  
**Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	2	3	1	3	2	2	3	2	1	1	2	3	1
CO2	2	3	1	3	1	1	3	2	1	1	2	3	1
CO3	2	3	1	3	1	1	1	2	1	1	1	2	1
CO4	1	3	1	3	2	1	2	2	1	1	1	3	1
CO5	2	3	1	2	3	1	2	2	2	1	1	2	1
CO6	2	3	1	2	3	1	2	2	1	1	1	2	1
CO7	2	3	1	2	3	2	3	2	2	1	1	2	1

**Program Outcomes (POs)	Course Outcomes (COs)	Justification**
PO1: Comprehensive Knowledge and Understanding	CO1, CO2, CO3, CO5, CO6, CO7	The course provides knowledge of GLP (CO1), sterilization techniques (CO2), laboratory tools (CO3), solution preparation (CO5, CO6), and analytical techniques (CO7).
PO2: Practical, Professional, and Procedural Knowledge	CO1, CO2, CO3, CO4, CO5, CO6, CO7	Students gain practical skills in applying GLP (CO1), sterilization (CO2, CO4), handling laboratory tools (CO3), solution preparation (CO5, CO6), and performing laboratory procedures (CO7).
PO3: Entrepreneurial Mindset and Knowledge	Not Directly Covered	The course doesn't directly focus on entrepreneurship.
PO4: Specialized Skills and Competencies	CO1, CO2, CO3, CO4, CO5, CO6, CO7	The course develops specialized laboratory skills in sterilization, equipment handling, solution preparation, and analytical techniques.
PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning	CO1, CO2, CO4, CO5, CO6, CO7	Students apply GLP principles (CO1) to ensure safety and troubleshoot potential contamination issues (CO2, CO4). Solution preparation (CO5, CO6) and analysis (CO7) require calculations and problem-solving.
PO6: Communication Skills and Collaboration	CO1, CO2, CO4, CO7	GLP documentation (CO1), reporting sterilization procedures (CO2), and potentially presenting results of analysis (CO7) involve communication skills. Collaboration might occur during laboratory work.
PO7: Research-related Skills	CO1, CO2, CO4, CO5, CO6, CO7	Applying GLP practices (CO1) is essential for research integrity. Sterilization (CO2, CO4) and solution preparation (CO5, CO6) are fundamental for research experiments. Performing (CO7) and potentially interpreting (not explicitly stated) analytical techniques are research skills.
PO8: Learning How to Learn Skills	CO1, CO2, CO3, CO4, CO5, CO6, CO7	The course promotes learning new laboratory techniques and adhering to best practices (CO1, CO2, CO3, CO4, CO5, CO6, CO7).
PO9: Digital and Technological Skills	CO1, CO5, CO7	GLP principles might involve digital recordkeeping (CO1). Calculations for solutions (CO5) could be done using software. Data analysis from titrations (CO7) might involve digital tools.
PO10: Multicultural Competence, Inclusive Spirit, and Empathy	Not Directly Covered	Not directly addressed in the biological techniques curriculum.
PO11: Value Inculcation and Environmental Awareness	CO1, CO2	Applying GLP promotes responsible laboratory practices and waste disposal (CO1). Sterilization techniques minimize contamination risks (CO2).
PO12: Autonomy, Responsibility, and Accountability	CO1, CO2, CO4, CO5, CO6, CO7	Students work independently in the lab, following protocols responsibly (CO1, CO2, CO4, CO5, CO6, CO7).
PO13: Community Engagement and Service	Not Directly Covered	The course curriculum doesn't explicitly target community engagement.

## SYLLABUS (CBCS) FOR F. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2023)

**Name of the Program: B.Sc. Zoology**

**Program Code: ZOO**

**Class: F.Y. B.Sc.**

**Semester: II**

**Course Type: Skill Enhancement Course Practical**

**Course Code: ZOO-176-SEC**

**Course Name: Medical Laboratory Techniques-II**

**Number of Credits: 02**

**Number of Teaching hours: 60**

### Course Outcomes

- To introduce students to the essential equipment and techniques used in hematology laboratories and to provide hands-on experience in the preparation of different staining solutions and the observation of blood smears.
- To develop practical skills in estimating blood normal and abnormal concentrations of sugar, cholesterol, uric acid, and creatinine.
- To familiarize students with the morphology of red blood cells, their osmotic fragility and characteristics of common hematological disorders.
- To educate students about the anticoagulants commonly used in hematology.
- To instruct students in the technique of determining packed cell volume (PCV) using Wintrobe's method.
- To teach the principles and methods for determining erythrocyte sedimentation rate (ESR).
- To enable students to perform a comprehensive analysis of urine samples and identifies normal and abnormal constituents.

### Course Outcomes

**After completion of this course, student will be able to**

CO 1: operate hematology laboratory equipment and prepare staining solutions for blood smears effectively.

CO 2: accurately estimate blood concentrations of sugar, cholesterol, uric acid, and creatinine, distinguishing between normal and abnormal levels.

CO 3: recognize red blood cell morphology, assess osmotic fragility, and identify common hematological disorders.

CO 4: explain the use and impact of common anticoagulants in hematology.

CO 5: proficiently determine packed cell volume (PCV) using Wintrobe's method.

CO 6: understand and execute the principles and methods for erythrocyte sedimentation rate (ESR) determination.

CO 7: perform a comprehensive analysis of urine samples, precisely identifying normal and abnormal constituents.

Practical No	Title of practical	E/D	Teaching Hours
1.	Demonstration of haematology equipment	E	04
2.	Preparation of Leishman, Acetocarmine & Giemsa stain.	E	04
3.	Preparation of haemin crystals using human blood.	E	04
4.	Estimation of blood sugar by GOD-POD method	E	04



5.	Estimation of serum cholesterol	D	08
6.	Estimation of serum uric acid	E	04
7.	Estimation creatinine in serum	E	04
8.	Study of normal and abnormal constituents of blood	E	04
9.	Morphology of Red Blood Cells	E	04
10.	Osmotic fragility test of RBCs	E	04
11.	Demonstration of slides of various disorders of anaemia and leukemia	D	04
12.	Study of anticoagulants used in Haematology	E	08
13.	Determination of Erythrocyte sedimentation rate by Wintrobe's method	D	04
14.	Urine analysis – normal & abnormal constituents of urine.	D	04
15.	Determination of PCV by Wintrobe's method	E	04
<b>D- Demonstration; E- Experiment.</b>			

**Course Articulation Matrix of ZOO-176-SEC: Medical Laboratory Technology-II**  
**Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	2	3	1	3	1	1	1	2	1	1	1	3	1
CO2	2	3	1	2	3	2	2	2	1	1	3	2	1
CO3	2	2	1	3	3	1	2	2	1	1	3	2	1
CO4	2	1	1	1	1	1	1	1	1	1	1	2	1
CO5	1	3	1	2	3	1	1	1	1	1	2	3	1
CO6	2	3	1	2	2	1	2	1	1	1	2	3	1
CO7	2	3	1	3	3	2	3	2	1	1	3	2	1

Program Outcomes (POs)	Course Outcomes (COs)	Justification
PO1: Comprehensive Knowledge and Understanding	CO1, CO2, CO3, CO4, CO5, CO6, CO7	The course provides knowledge of operating hematology equipment (CO1), performing blood tests (CO2), recognizing blood cell abnormalities (CO3), understanding anticoagulants (CO4), and analyzing urine samples (CO7).
PO2: Practical, Professional, and Procedural Knowledge	CO1, CO2, CO3, CO5, CO6, CO7	Students gain practical skills in operating equipment, preparing blood smears, performing blood tests (CO1, CO2), identifying abnormalities (CO3), using PCV and ESR methods (CO5, CO6), and analyzing urine (CO7).
PO3: Entrepreneurial Mindset and Knowledge	Not Directly Covered	The course doesn't directly focus on entrepreneurship in medical laboratories.
PO4: Specialized Skills and Competencies	CO1, CO2, CO3, CO5, CO6, CO7	The course develops specialized skills in operating hematology equipment, performing blood tests, analyzing blood cell morphology, and analyzing urine samples.
PO5: Capacity for Application, Problem-	CO2, CO3, CO5, CO6, CO7	Interpreting blood test results (CO2), identifying abnormalities in blood cells (CO3), applying PCV and ESR methods (CO5,



Solving, and Analytical Reasoning		CO6), and analyzing urine for abnormalities (CO7) all require problem-solving and analytical reasoning.
PO6: Communication Skills and Collaboration	CO2, CO7	Reporting blood test results (CO2) and communicating findings from urine analysis (CO7) involve communication skills. Collaboration might occur during laboratory work.
PO7: Research-related Skills	CO2, CO3, CO5, CO6, CO7	Performing blood tests (CO2) and analyzing blood cells and urine (CO3, CO7) are foundational skills for further research in hematology and urinalysis.
PO8: Learning How to Learn Skills	CO1, CO2, CO3, CO5, CO6, CO7	The course promotes learning new laboratory techniques, interpreting test results, and staying updated on advancements in hematology and urinalysis (CO1, CO2, CO3, CO5, CO6, CO7).
PO9: Digital and Technological Skills	CO1, CO2, CO7	Operating some hematology equipment might involve digital interfaces (CO1). Some laboratories might utilize digital tools for recording and analyzing test results (CO2, CO7).
PO10: Multicultural Competence, Inclusive Spirit, and Empathy	Not Directly Covered	Not directly addressed in the medical laboratory techniques curriculum.
PO11: Value Inculcation and Accurate Diagnosis	CO2, CO3, CO7	Accurate blood test results (CO2), identifying blood cell abnormalities (CO3), and analyzing urine for potential health issues (CO7) contribute to accurate diagnosis.
PO12: Autonomy, Responsibility, and Accountability	CO1, CO2, CO5, CO6, CO7	Students work independently in the lab, following protocols responsibly while operating equipment, performing tests, and analyzing samples (CO1, CO2, CO5, CO6, CO7).
PO13: Community Engagement and Service	Not Directly Covered	The course curriculum doesn't explicitly target community engagement.