Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science & Commerce, Baramati

(Empowered Autonomous)

Three / Four Year Honours / Honours with Research B.Sc. Degree Program in Zoology (Faculty of Science)

CBCS Syllabus

SYBSc (Zoology) Semester-IV

For Department of Zoology

Choice Based Credit System Syllabus

(2024 Pattern)

(As Per NEP-2020)

To be implemented from Academic Year 2025-2026

Title of the Programme: SYBSc (Zoology)

Preamble

AES's Tuljaram Chaturchand College has decided to change the syllabus of various faculties from June, 2023 by taking into consideration the guidelines and provisions given 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 outcomes for the development of the students. The credit structure and the courses framework provided in the NEP are nationally accepted and internationally comparable.

The rapid changes in science and technology and new approaches in different areas of Zoology and related subjects, Board of Studies in Zoology of Tuljaram Chaturchand College, Baramati - Pune has prepared the syllabus of FYBSc Zoology Semester - I under the Choice Based Credit System (CBCS) by following the guidelines of NEP 2020, NCrF, NHEQF, Prof. R.D. Kulkarni's Report, GR of Gov. of Maharashtra dated 20th April, 16th May 2023 and 13th March, 2024 and Circular of SPPU, Pune dated 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 toapply 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 andquantitative 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 indiagnostic 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 academicand professional goals in a rapidly changing global landscape.

Anekant Education Society's

Tuljaram Chaturchand College

of Arts, Science & Commerce, Baramati

(Empowered Autonomous)

Board of Studies (BoS) in Zoology

From 2025-26 to 2027-28

Sr. No.	Name of Member	Designation
1.	**Dr. Chordiya Sandip Popatlal**	**Chairperson**
2.	**Dr. Nale Vitthal Baban**	Member
3.	**Dr. Manoorkar Poojawati**	Member
4.	**Dr. Sangale Deepali Maruti**	Member
5.	**Mr. More Kishor U.**	Member
6.	**Dr. Jadhav Sameer Sadashiv**	Member
7.	**Mr. Kare Samadhan**	Member
8.	**Mr. Awaghade Yugandhar**	Member
9.	**Dr. Ravindra D. Chaudhari**	Vice-Chancellor Nominee Subject Expert from SPPU, Pune
10.	**Dr. Gaikwad Sanjay K.**	Subject Expert from Outside the Parent University
11.	**Dr. Deshmukh A. A.**	Subject Expert from Outside the Parent University
12.	**Dr. Karpe Yogesh**	Representative from Industry/Corporate Sector/Allied areas
13.	**Ms. Kumbhar Kamal**	Member of the College Alumni
14.	**Ms. Sakshi Sawant**	UG Student
15.	**Ms. Sanika Nikhale**	PG Student

Department of Zoology

S.Y.B.Sc. Semester-IV

Course and Credit Distribution Structure for B.Sc. (Zoology) 2024-2025

Level/ Difficulty	Sem	Subject DSC-1				Subject DSC-2	Subject DSC-3	GE/OE	SEC	IKS	AEC	VEC	CC	Total
4.5/100	I	2(T)+2(P)				2(T)+2(P)	2(T)+ 2(P)	2(T)	2 (T/P)	2(T) (Generic)	2(T)	2(T)	--	22
	II	2(T)+2(P)				2(T)+2(P)	2(T)+2(P)	2(P)	2 (T/P)	--	2(T)	2(T)	2(T)	22
Exit option: Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course/Internship OR Continue with Major and Minor **Continue option**: Student will select one subject among the (subject 1, subject 2 and subject 3) as major and other as minor and third subject will be dropped.														
Level/ Difficulty	**Sem**	**Credits Related to Major**				**Minor**	--	**GE/OE**	**SEC**	**IKS**	**AEC**	**VEC**	**CC**	**Total**
		Major Core	**Major Elective**	**VSC**	**FP/OJT/CEP/RP**									
5.0/200	III	4(T)+2(P)	--	2 (T/P)	2(FP)	2(T)+2(P)	--	2(T)	--	2(T)	2(T)	--	2(T)	22
	IV	4(T)+2(P)	--	2 (T/P)	2(CEP)	2(T)+2(P)	--	2(P)	2 (T/P)	--	2(T)	--	2(T)	22
Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4credits core NSQF course/Internship OR Continue with Major and Minor														
5.5/300	V	8(T)+4(P)	2(T)+2(P)	2 (T/P)	2(FP/CEP)	2(T)	--	--	--	--	--	--	--	22
	VI	8(T)+4(P)	2(T)+2(P)	2 (T/P)	4 (OJT)	--	--	--	--	--	--	--	--	22
Total 3Years		**44**	**8**	**8**	**10**	**18**	**8**	**8**	**6**	**4**	**8**	**4**	**6**	**132**
Exit option: Award of **UG Degree in Major** with 132 credits OR Continue with Major and Minor														
6.0/400	VII	6(T)+4(P)	2(T)+2 (T/P)	--	4(RP)	4(RM)(T)	--	--	--	--	--	--	--	22
	VIII	6(T)+4(P)	2(T)+2 (T/P)	--	6(RP)	--	--	--	--	--	--	--	--	22
Total 4Years		**64**	**16**	**8**	**22**	**22**	**8**	8	**6**	**4**	**8**	**4**	**6**	**176**
Four Year **UG Honours with Research Degree** in Major and Minor with 176 credits														
6.0/400	VII	10(T)+4(P)	2(T)+2 (T/P)	--	--	4(RM) (T)	--	--	--	--	--	--	--	22
	VIII	10(T)+4(P)	2(T)+2 (T/P)	--	4 (OJT)	--	--	--	--	--	--	--	--	22
Total 4Years		**72**	**16**	**8**	**14**	**22**	**8**	8	**6**	**4**	**8**	**4**	**6**	**176**
Four Year **UG Honours Degree** in Major and Minor with 176 credits														

*** T = Theory** *** P = Practical** *** DSC = Discipline Specific Course**

*** OE = Open Elective** *** SEC = Skill Enhancement Course** *** IKS = Indian Knowledge System**

*** AEC = Ability Enhancement Course** *** VEC = Value Education Course** *** CC = Co-curricular Courses**

***VSC= Vocational Skill Course** ***OJT = On Job Training** ***CEP = Community Engagement Project**

***FP = Field Project** ***RP = Research Project**

Course Structure for B.Sc. Zoology (2024 Pattern)

FYBSc

Sem	Course Type	Course Code	Course Title	Theory / Practical	Credits
I	DSC-I (General)	ZOO-101-GEN	Non-chordates	T	02
		ZOO-102-GEN	Zoology Practical-I	P	02
	DSC-II (General)	-101-GEN		T	02
		-102-GEN		P	02
	DSC-III (General)	-101-GEN		T	02
		-102-GEN		P	02
	Open Elective (OE)	ZOO-103-OE	Fresh Water Fishery (गोड्या पाण्यातील मत्स्यशेती)	T	02
	Skill Enhancement Course (SEC)	ZOO-104-SEC	Medical Laboratory Technology-I	P	02
	Ability Enhancement Course (AEC)	ENG-104-AEC		T	02
	Value Education Course (VEC)	ENV-105-VEC		T	02
	Generic Indian Knowledge System (GIKS)	GEN-106-IKS		T	02
				Total Credits Semester-I	**22**
II	DSC-I (General)	ZOO-151-GEN	Fundamentals of Cell Biology	T	02
		ZOO-152-GEN	Zoology Practical-II	P	02
	DSC-II (General)	-151-GEN		T	02
		-152-GEN		P	02
	DSC-III (General)	-151-GEN		T	02
		-152-GEN		P	02
	Open Elective (OE)	ZOO-153-OE	Fresh Water Fishery (गोड्या पाण्यातील मत्स्यशेती- प्रात्यक्षिक)	P	02
	Skill Enhancement Course (SEC)	ZOO-154-SEC	Medical Laboratory Technology-II	P	02
	Ability Enhancement Course (AEC)	ENG-154-AEC		T	02
	Value Education Course (VEC)	COS-155-VEC		T	02
	Co-curricular Course (CC)	YOG/PES/CUL/NSS/NCC-156-CC	To be selected from the CC Basket	T	02
				Total Credits Semester-II	**22**
				Cumulative Credits Semester I + Semester II	**44**

Course Structure for B.Sc. Zoology (2024 Pattern)

SYBSc

Sem	Course Type	Course Code	CourseName	Theory / Practical	Credits
III	Major Mandatory	ZOO-201-MRM	Chordates	Theory	02
	Major Mandatory	ZOO-202-MRM	Applied Zoology-I	Theory	02
	Major Mandatory	ZOO-203-MRM	Zoology Practical – III	Practical	02
	Vocational Skill Course (VSC)	ZOO-204-VSC	Biological Techniques	Practical	02
	Field Project (FP)	ZOO-205-FP	Field Project	Practical	02
	Minor	ZOO-206-MN	Apiculture	Theory	02
	Minor	ZOO-207-MN	Practicals in Apiculture	Practical	02
	Open Elective (OE)	ZOO-208-OE	Crop Pests: Types & Management पिकावरील कीड: प्रकार व व्यवस्थापन	Theory	02
	Subject specific Indian Knowledge System (IKS)	ZOO-209-IKS	Animal Diversity & Conservation in Indian Culture	Theory	02
	Ability Enhancement Course (AEC)	MAR-210-AEC /HIN-210-AEC /SAN-210-AEC		Theory (Any one)	02
	Co-curricular Course (CC)	YOG/PES/CUL/ NSS/NCC -211-CC	To be continued from the semester-II		02
				Total Credits Semester-III	**22**
IV	Major Mandatory	ZOO-251-MRM	Introduction to Genetics	Theory	02
	Major Mandatory	ZOO-252-MRM	Applied Zoology-II	Theory	02
	Major Mandatory	ZOO-253-MRM	Zoology Practical – IV	Practical	02
	Vocational Skill Course (VSC)	ZOO-254-VSC	Medical Laboratory Techniques	Theory	02
	Community Engagement Project (CEP)	ZOO-255-CEP	Community Engagement Project	Practical	02
	Minor	ZOO-256-MN	Sericulture	Theory	02
	Minor	ZOO-257-MN	Practicals in Sericulture	Practical	02
	Open Elective (OE)	ZOO-258-OE	Crop pests: Types & management(Practical) (पिकावरील किड: प्रकार व व्यवस्थापन) (प्रात्यक्षिक)	Practical	02
	Skill Enhancement Course (SEC)	ZOO-259-SEC	Practicals in Dairy Science	Practical	02
	Ability Enhancement Course (AEC)	MAR-260-AEC /HIN-260-AEC /SAN-260-AEC		Theory (Any one)	02
	Co-curricular Course (CC)	YOG/PES/CUL/ NSS/NCC -261-CC	To be continued from the semester-III		02
				Total Credits Semester-IV	**22**
				Cumulative Credits Semester III + Semester IV	**44**

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 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, usevarious 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.

SYLLABUS (CBCS) FOR S. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: S.Y.B.Sc.
Semester: IV
Course Type: Major (Mandatory) Theory
Course Code: ZOO-251-MRM
Course Name: Introduction to Genetics
Number of Credits: 02
Number of Teaching hours: 30

Course Objectives:-

- To develop foundational knowledge of Mendelian inheritance laws and gene interactions.
- To introduce principles and practical applications of test crosses and back crosses.
- To explain mechanisms of gene interactions including co-dominance, incomplete dominance, and ratios in genetic crosses.
- To explore the significance of multiple alleles and polygenic inheritance, particularly human blood groups and traits.
- To enhance understanding of chromosome morphology, classification, and aberrations.
- To familiarize students with major topics in human genetics, including karyotyping, syndromes, and inborn errors of metabolism.
- To examine and compare various methods of sex determination in animals and the influence of environmental factors.

Course Outcomes:-

Student will be able to-

CO1. : describe and apply the fundamental laws of heredity and analyze genetic crosses using Mendel's principles.
CO2. : interpret and perform test crosses and back crosses to determine genotype and phenotype ratios.
CO3. : analyze different types of gene interactions and predict outcomes using genetic ratios (e.g., complementary, supplementary, inhibitory, duplicate dominance).
CO4. : explain the workings and importance of multiple alleles, ABO and Rh-blood group systems, and discuss medical and legal implications.
CO5. : identify chromosomal structures, distinguish between autosomes and sex chromosomes, and recognize common chromosomal aberrations.
CO6. : classify and describe key human genetic syndromes as well as evaluate the concept and significance of genetic counselling.
CO7. : compare mechanisms of sex determination (chromosomal, environmental, parthenogenesis, gynandromorphism) in various animal species.

TOPICS:

UNIT	SUB UNITS	SYLLABUS	NO. OF LECTURES
1	**Introduction to Classical Genetics**		04
	1.1	Mendelian Inheritance: Laws of heredity and their practical applications	
	1.2	Test cross and back cross	
2	**Gene Interactions**		06
	2.1	Concept of gene interaction, co-dominance and incomplete dominance	
	2.2	Complementary factors (9:7)	

	2.3	Supplementary factors (9: 3:4)	
	2.4	Inhibitory factors (13:3)	
	2.5	Duplicate dominant factors (15:1)	
3	**Multiple Alleles and Polygenic Inheritance:**		05
	3.1	Concept, characteristics and importance of Multiple alleles, ABO & Rh-blood group system and its medico-legal importance.	
	3.2	Concept of polygenic inheritance with Reference to skin Colour in Human being.	
	3.3	Pleiotropism and Sickle cell Anemia	
4	**Study of Chromosome:**		05
	4.1	Introduction to morphology and composition	
	4.2	Classification based on the centromeric position	
	4.3	Types of chromosomes (autosomes and sex chromosomes)	
	4.4	Chromosomal aberrations: Structural and Numerical Changes.	
5	**Human Genetics**		08
	5.1	Study of human karyotype	
	5.2	Syndromes: a) Autosomal- Down's (Mongolism) and Cri-du-chat. b) Allosomal: Klinefelter's and Turner's syndrome	
	5.3	Inborn errors of metabolism: Albinism, Phenylketonuria and Alkaptonuria.	
	5.4	Sex-linked inheritance: Haemophilia	
	5.5	Genetic Counselling and its importance	
6	**Methods of Sex-determination in animals**		02
	6.1	Introduction	
	6.2	Chromosomal theory of sex determination (XX-XY, ZZ-ZW, XX-XO & Haploid-Diploid method)	
	6.3	Parthenogenesis and Gynandromorphism	
	6.4	Environmental Sex Determination	

REFERENCES

1. Dnyanasagar, V. R. (2002). Cytology and genetics. New Delhi: Tata McGraw Hill Publishing Co. Ltd.
2. Gardner, E. J. (1995). Principles of genetics (8th ed.). New York: John Wiley & Sons.
3. Gardner, E. J., Simmons, M. J., & Snustad, D. P. (1998). Principles of genetics. New York: John Wiley and Sons.
4. Gupta, P. K. (1999). Genetics. Meerut: Rastogi Publications.
5. Klug, W. S., Cummings, M. R., Spencer, C., & Palladino, M. A. (2011). Concepts of genetics (9th ed.). Boston: Benjamin Cummings.
6. Lewin, B. (2008). Genes IX. Boston: Jones and Bartlett Publishers Inc.
7. Russell, P. J. (2010). iGenetics: A molecular approach (3rd ed.). Boston: Pearson.
8. Sarin, C. (2002). Genetics. New Delhi: Tata McGraw Hill.
9. Sinnott, E. W., Dunn, L. C., & Dobzhansky, T. (1958). Principles of genetics. New York: McGraw Hill.
10. Snustad, D. P., & Simmons, M. J. (2010). Principles of genetics (4th ed.). Hoboken, NJ: John Wiley and Sons, Inc.
11. Snyder, L. A., Freifelder, D., & Hartl, D. L. (2001). General genetics. Boston: Jones and Bartlett.
12. Strachan, T., & Read, A. P. (2010). Human molecular genetics (4th ed.). New York: Garland Publishers.
13. Strickberger, M. W. (1985). Genetics (3rd ed.). New York: Macmillan Publishing Co.
14. Verma, P. S., & Agarwal, V. K. (2004). Cell biology, genetics, molecular biology, evolution and ecology. New Delhi: S. Chand & Co.
15. Watson, J. D. (2004). Molecular biology of the gene (5th ed.). Upper Saddle River, NJ: Pearson Education, Inc. and Dorling Kindersley Publishing, Inc.

Course Articulation Matrix of ZOO-251-MRM: Introduction to Genetics
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

- CO1: Strongly supports PO1 (Comprehensive Knowledge), PO5 (Analytical Reasoning), and PO4 (Specialized Skills), by equipping students to describe and apply genetic principles and analyze genetic crosses.
- CO2: Deepens PO1, PO2 (Practical Knowledge), and PO5, focusing on practical implementation through test and back crosses and analytical reasoning about genetic ratios.
- CO3: Advances PO1, PO5, and PO4, teaching analytical problem-solving on gene interactions and reinforcing theoretical and applied knowledge.
- CO4: Enhances PO1, PO4, and PO11 (Value and Awareness) by teaching ABO/Rh blood groups, linking genetics to medical/legal applications and ethical awareness.
- CO5: Links strongly to PO1, PO2, PO9 (Technology Skills), PO11, by identifying chromosomal structures and understanding genetic aberrations.
- CO6: Reinforces PO2, PO6 (Communication & Collaboration), PO12 (Responsibility), and PO13 (Community Service) through the study of human syndromes and genetic counselling—applying genetics to societal well-being, ethical practice, and communication skills.
- CO7: Connects PO1, PO8 (Learning Skills), PO10 (Multicultural Competence), by comparing sex determination mechanisms, since students understand species diversity and genetic

SYLLABUS (CBCS) FOR S. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: S.Y.B.Sc.
Semester: IV
Course Type: Major (Mandatory) Theory
Course Code: ZOO-252-MRM
Course Name: Applied Zoology-II
Number of Credits: 02
Number of Teaching hours: 30

Course Objectives:-

- To disseminate information on economic aspects of zoology like apiculture, sericulture.
- To encourage young learners for self-employment.
- To comprehend the functioning of apiculture sericulture industry and its scope in India.
- To study the honey bee species and bee products
- To study the varieties of silk-worms and host plants.
- To critically study the life history and rearing of *Bombyx mori*.
- To study the post harvesting processes in sericulture

Course Outcomes:-

Student will be able to-

CO1: acquire sound knowledge on different components of sericulture & bee keeping industry
CO2: identify different honey bee & silkworm species.
CO3: explain the tools & techniques used in apiculture & sericulture.
CO4: illustrate the diseases of honey bee & silkworm.
CO5: explain the economic importance of apiculture & sericulture.
CO6: get acquaint about communication system among the casts in the colony.
CO7: gain insights of post harvesting processes in sericulture and startup their small business.

TOPICS:

Unit No.	Subunit No.	Details	Teaching Hours
1. Apiculture	1.1	Study of habit, habitat and nesting behaviour of *Apis dorsata, Apis indica, Apis florae* and *Apis mellifera*	**02**
	1.2	Life cycle, colony organization and division of labour, Polymorphism	**02**
	1.3	Bee behaviour and bee communication.	**02**
	1.4	Bee keeping equipments: a) Bee box (Langstroth type) b) Honey extractor c) Smoker d) Bee-veil e) Gloves f) Hive tool g) Bee Brush h) Queen excluder	**02**
	1.5	Bee products (collection methods, composition and uses): a) Honey b) Wax c) Bee Venom d) Propolis e) Royal jelly f) Pollen grains	**03**
	1.6	Diseases and enemies of Bees: a) Bee diseases – Protozoan, Bacterial, Fungal – with one example. b) Bee pests – Wax moth (Greater and Lesser), Wax beetle.	**03**

		c) Bee Enemies – Bee eater, King crow, Wasp, Lizard, Bear, Man.	
	1.7	Government schemes for apiculture and success stories	**01**
2. Sericulture	2.1	Study of different types of silk moths, their distribution and varieties of silk produced by Mulberry, Tasar, Eri and Muga silk worms in India.	**02**
	2.2	External morphology and life cycle of *Bombyx mori*.	**02**
	2.3	Cultivation of mulberry (moriculture): a) Varieties for cultivation, b) Rain-fed and irrigated mulberry cultivation – Fertilize schedule, Pruning.	**02**
	2.4	Harvesting of mulberry: a) Leaf plucking b) Branch cutting c) Whole shoot cutting.	**02**
	2.5	Silk worm rearing: a) Types of rearing b) Rearing house c) Rearing techniques d) Important diseases and pests	**04**
	2.6	Post-harvest processing of cocoons: a) Harvesting and Preparation of cocoons for marketing b) Stifling, Sorting, Storage, De-flossing and Riddling c) Cocoon cooking, Reeling and Re-reeling, Washing and Polishing.	**03**
	2.7	Government schemes for sericulture & success stories	

REFERENCES

1. Shukla, G. S., & Upadhyay, V. B. (2010). Economic zoology. Rastogi Publications.
2. Pillay TVR & Kutty MN. (2005). Aquaculture- Principles and Practices. Blackwell.
3. Nayar, K. K., Ananthakrishnan, T. N., & David, B. V. (1976). General and applied entomology.
4. Romoser, W. S. (1981). The science of entomology (Ed. 2). Macmillan Publishing Co. Inc.
5. Srivastava, K. P., & Dhakiwal, G. S. (1993). A Text Book of Applied Entomology, Vol-I & II. Kalyani Pub.
6. Bee and Bee Keeping, (1978). Roger A. Morse, Conell University Press, London.
7. Principal of Sericulture, (1994). Hisao Arguo, Oxford & Co.
8. An Introduction of Sericulture, (1995). G.Ganga, J. Sulochana, Oxford & IBH Publication Co. Bombay.
9. Saxena C. (1992). Biology of Insects. Oxford and IBH Publishing Co. New Delhi. Bombay. Calcutta
10. Mathur V. K., Upadhayay K. & Goel A. (1974). Text Book of Entomology. Barani.

Course Articulation Matrix of ZOO-252-MRM: Applied Zoology- II
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

PO1: Comprehensive knowledge and understanding
All COs strongly map with PO1 as each outcome requires a solid foundational understanding of concepts in apiculture and sericulture.

PO2: Practical, professional, and procedural knowledge
CO3, CO4, and CO7 strongly map with PO2 as they involve hands-on techniques and practical applications essential to apiculture and sericulture.

PO3: Entrepreneurial mindset and knowledge
CO5 and CO7 strongly map with PO3 since they focus on the economic importance and the potential for starting a small business in the field.

PO4: Specialized skills and competencies
CO4 and CO7 map strongly with PO5 as they require applying knowledge to solve problems and make informed decisions, particularly in disease management and post-harvesting processes.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO6 maps strongly with PO6 because understanding the communication system among honey bee casts can enhance collaborative efforts in beekeeping.

PO6: Communication skills and collaboration
CO4 and CO7 have a strongly connection with PO7 as they involve critical analysis and potentially research-oriented tasks related to disease control and business development.

PO7: Research-related skills
CO4 and CO7 have a strongly connection with PO7 as they involve critical analysis and potentially research-oriented tasks related to disease control and business development.

PO8: Learning how to learn skills
All COs map moderately with PO8 because the course encourages students to independently acquire new knowledge and skills related to apiculture and sericulture.

PO9: Digital and technological skills
This PO maps poorly with all COs, as the course does not heavily emphasize digital skills or technology**.**

PO10: Multicultural competence, inclusive spirit, and empathy
This PO has a moderate mapping, particularly in CO5 and CO6, as the subjects may relate to community-based agricultural practices, though not directly focused on multicultural aspects.

PO11: Value inculcation and environmental awareness
COs map moderately with PO11 since understanding species and environmental conservation are inherent to the course.

PO12: Autonomy, responsibility, and accountability
CO7 maps strongly with PO12 because starting a business or managing post-harvesting processes requires a high level of responsibility and independence.

PO13: Community engagement and service
Most COs have a moderate mapping to PO13, as aspects of the course could involve community interactions, especially in educating or engaging with local beekeepers or farmers.

SYLLABUS (CBCS) FOR S. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: S.Y.B.Sc.
Semester: IV
Course Type: Major (Mandatory) Practical
Course Code: ZOO-253-MRM
Course Name: Zoology Practical - IV
Number of Credits: 02
Number of Teaching hours: 60

Course Objectives:-

- Develop fundamental and applied skills in classical and human genetics through hands-on problem solving and observation.
- Foster analytical and critical thinking by analyzing inheritance patterns and solving genetic problems.
- Instill competence in identifying human genetic traits, disorders, and population-level variations.
- Provide proficiency in laboratory techniques relating to blood group identification, karyotyping, and pedigree analysis.
- Encourage application of genetics to real-world contexts, including medical, forensic, and biodiversity fields.
- Integrate activity-based and field learning experiences, involving local biodiversity, apiculture, and sericulture industries.
- Build communication, collaboration, and reporting skills through presentations, profile writing, and report submissions.

Course Outcomes:-

Student will be able to-

CO1. : solve and interpret Mendelian and non-Mendelian genetic problems including blood group inheritance.
CO2. : identify and evaluate common human genetic traits and phenotypes through observation and testing.
CO3. : analyze and construct pedigree charts to determine inheritance patterns and diagnose genetic conditions.
CO4. : demonstrate proficiency in practical analysis of human blood groups (ABO, Rh) and infer their clinical significance.
CO5. : investigate, recognize, and explain hereditary disorders and principles using case studies from real populations.
CO6. : prepare and interpret human karyotypes; distinguish chromosomal structures in health and disease.
CO7. : apply genetic knowledge to apiculture and sericulture, including insect biology, equipment usage, and fieldwork; communicate findings via reports and presentations.

PRACTICALS:

Practical No.	Name of the practical	E/D	Teaching Hours
1.	**Hypothetical problems:** Based on Monohybrid, Dihybrid Cross & ABO Blood Group system.	E	4
2.	**Study of Human Genetic traits:**	E	4

	Tongue: roller / non-roller, widow's peak: present / absent, ear lobes – Attached / free, colour vision: normal / colorblind, and PTC: tasters/ non-tasters.		
3.	**Pedigree Analysis** Study of inheritance of Haemophilia with the help of pedigree chart	E	4
4.	**Study of Karyotype** Study of normal & abnormal human karyotype from metaphase chromosomal spread picture	D	8
5.	**Study of Human Genetic Disorders:** Study of any two hereditary disorders / inborn errors of metabolism from human population.	D	4
6.	**Study of *Drosophila* mutants:** Study of eye mutants (white & bar eye) and wing mutants (curly and vestigeal) in *Drosophila*	D	4
7.	Study and identification of castes in honey bee	D	4
8.	Study of life cycle of Honey bee	D	4
9.	Study of mouth parts, thoracic appendages (legs and wings) and sting apparatus of honey bee	E	4
10.	Study of various bee keeping equipments (any five equipments)	D	4
11.	Study of: a) bee products b) bee pests c) bee enemies	D	4
12.	Study of life cycle of *Bombyx mori*	D	4
13.	Study of any five equipments in sericulture	D	4
14.	Study Tour: Visit to biodiversity spot/sea shore/apiculture/sericulture farm and submit report of the same	E	4
D*: Demonstration E*: Experiment			

REFERENCES

1) Lal, S. S. (2019). *Practical zoology of invertebrates* (12th ed.). Meerut: Rastogi Publications.
2) Lal, S. S. (2020). *Practical zoology of vertebrates* (12th ed.). Meerut: Rastogi Publications.
3) Arumugam, N., & Mani, A. (2024). *Practical zoology: Vol. 3*. Chennai: Saras Publication.
4) Jordan, E. L., & Verma, P. S. (1977). *Manual of practical zoology: Invertebrate*. New Delhi: S. Chand & Company.
5) Jordan, E. L., & Verma, P. S. (2014). *A manual of practical zoology: Chordates.* New Delhi: S. Chand & Company.
6) Lal, S. S. (2018). *Practical zoology of cell biology.* Meerut: Rastogi Publications.
7) Russell, P. J. (2016). *iGenetics: A molecular approach* (3rd ed.). Chennai: Pearson.
8) Abrol, D. P. (2013). *Beekeeping: A comprehensive guide to bees and beekeeping*. Scientific Publishers.
9) David, B. V., & Kumari, T. V. R. (2008). *Elements of economic entomology* (6th ed.). Popular Book Depot.
10) Gatoria, G. S., & Singh, N. P. (2015). *Practical manual on beekeeping and apiculture technology*. Kalyani Publishers.
11) Rahmathulla, V. K. (2012). *Sericulture: Silkworm rearing and management practices*. Agrotech Publishing Academy.
12) Shukla, G. S., & Upadhyay, V. B. (2017). *Economic zoology* (5th ed.). Rastogi Publications.

Course Articulation Matrix of ZOO-253-MRM: Zoology Practical – IV
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

CO1: Highly aligns with PO1, PO2, PO4, PO5, and PO7, building foundational, practical, analytical, and research skills through solving genetic problems and critical data interpretation.

CO2: Reinforces PO1, PO2, PO5, and PO7 by facilitating recognition of human genetic traits in practical and collaborative settings.

CO3: Strengthens PO1, PO2, PO4, PO5, PO7, and PO11, as students create pedigree charts, fostering both technical and ethical awareness regarding genetic conditions.

CO4: Directly aligns with PO1, PO2, PO4, PO5, PO7, and PO11, developing laboratory precision and understanding of clinical and societal implications.

CO5: Connects with PO1, PO2, PO5, PO7, and PO11, encouraging exploration of genetic disorders with a focus on population impact and ethical decisions.

CO6: Mapped to PO1, PO2, PO4, PO5, and PO7, since it enables detailed chromosomal analysis, linking theory with real-world applications in health science.

CO7: Bridges PO1, PO2, PO4, PO5, PO6, PO8, PO10, PO12, and PO13 by emphasizing fieldwork, communication, technology use, lifelong learning, value inculcation, teamwork, and community engagement through active participation in apiculture, sericulture, and biodiversity studies.

SYLLABUS (CBCS) FOR S. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: S.Y.B.Sc.
Semester: IV
Course Type: Vocational Skill Course
Course Code: ZOO-254-VSC
Course Name: Medical Laboratory Techniques
Number of Credits: 02
Number of Teaching hours: 30

Course Objectives:-

- To provide a fundamental understanding of the role and importance of medical laboratory technology in clinical diagnosis.
- To familiarize students with basic laboratory techniques, including the structure and working of the compound microscope, and the safe handling and maintenance of hematology glassware and equipment.
- To develop knowledge of blood sample collection, preservation, processing, and preparation of blood films for diagnostic purposes.
- To impart theoretical knowledge of hematological parameters, cell morphology, and staining techniques used in hematology.
- To explain the principles and clinical applications of hematological investigations, including cell counts, erythrocyte indices, and differential leucocyte count.
- To introduce the physiological mechanisms and clinical significance of hemostasis, bleeding/clotting time, and blood grouping with their genetic basis and applications in transfusion medicine.
- To provide an understanding of hemoglobin estimation techniques and cardiovascular monitoring concepts, particularly blood pressure and its physiological significance.

Course Outcomes:-

Student will be able to-

CO1. Explain the role and importance of medical laboratory technology in clinical diagnosis and its contribution to patient care.

CO2. Operate the compound microscope effectively and demonstrate skills in handling and maintaining hematology laboratory glassware and equipment safely.

CO3. Collect, preserve, and process blood samples, and prepare accurate blood films for microscopic examination

CO4. Identify and describe hematological parameters, including cell morphology, and apply staining techniques (Leishman, Giemsa) in blood analysis.

CO5. Perform calculations for hematological investigations such as cell counts and erythrocyte indices, and interpret their diagnostic significance.

CO6. Analyze the physiological mechanisms of hemostasis, bleeding/clotting time, and apply knowledge of blood grouping and agglutination in transfusion medicine.

CO7. Demonstrate knowledge of hemoglobin estimation methods (Sahli's method) and interpret results in relation to cardiovascular monitoring, particularly blood pressure assessment.

TOPICS:

UNIT	SUB UNITS	SYLLABUS	NO. OF LECTURES
1	**Introduction to Medical Laboratory Techniques**		
	1.1	Introduction to laboratory techniques: importance of medical laboratory technology in diagnosis	4
	1.2	Instruments in haematology: Autoanalyzer	
2	**Haematology**		16
	2.1	Blood composition: Plasma constituents and their normal values with clinical significance	
	2.2	Blood composition: Formed elements - Morphology of RBC, WBC & platelets	
	2.3	Counting of blood cells and clinical significance: Total and differential count of WBCs, total count of RBCs, counting of platelets	
	2.4	Mechanism of blood clotting; bleeding and clotting time: clinical significance and disorders	
3	**Hematological Investigations**		02
	3.1	Erythrocyte Indices and clinical significance: Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC)	
4	**Blood group systems & significance:**		08
	4.1	ABO and Rh system, Bombay blood group, MNS blood group	
	4.2	Blood transfusion: Selection and registration of donor	
	4.3	Collection and preservation of blood samples	
	4.4	Significance	

REFERENCES

1. Godkar, P. B., & Godkar, D. P. (2006). *Textbook of medical laboratory technology*. Bhalani publishing house. Clinical Hematology: by Todd and Sanford
2. Chandy, M., Radhakrishnan, V. S., & Sukumaran, R. K. (Eds.). (2021). *Contemporary bone marrow transplantation*. Cham: Springer International Publishing.
3. Ananthanarayan, R. (2006). *Ananthanarayan and Paniker's textbook of microbiology*. Orient Blackswan.
4. Bain, B. J., Bates, I., Laffan, M. A., & Lewis, S. M. (2016). *Dacie and Lewis practical haematology: expert consult: online and print*. Elsevier Health Sciences.
5. Bain, B. J., & Gupta, R. (2003). *A–Z of Haematology*. Malden, Mass.: Blackwell Pub.
6. Williams, L., & McKenzie, S. B. (2015). *Clinical laboratory hematology*. Pearson Higher Ed.
7. Hall, J. E., & Guyton, A. C. (2006). *Pocket companion to Guyton & Hall textbook of medical physiology*. Elsevier Health Sciences TW.

Course Articulation Matrix of ZOO-254-VSC: Medical Laboratory Techniques
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

PO1 (Comprehensive knowledge and understanding): All COs strongly mapped (3) as the course builds fundamental understanding of haematology, lab technology, and diagnostic principles.

PO2 (Practical, professional, and procedural knowledge): CO2, CO3, CO5, CO6, CO7 strongly relate as they involve direct lab skills (microscope use, sample handling, staining, cell counts, haemoglobin estimation).

PO3 (Entrepreneurial mind-set and knowledge): CO3, CO4, and CO7 moderately mapped as practical knowledge of haematological analysis may be applied in diagnostic labs, research, or healthcare entrepreneurship.

PO4 (Specialized skills and competencies): CO1, CO2, CO3, CO5, and CO6 strongly mapped as they demand specialized haematological techniques, accurate analysis, and procedural expertise.

PO5 (Application, problem-solving, analytical reasoning): CO1, CO2, CO4, CO5, CO6 strongly mapped since interpreting diagnostic data, analysing blood indices, and solving lab errors require problem-solving.

PO6 (Communication skills and collaboration): CO4, CO6, and CO7 moderately mapped as lab professionals must communicate results clearly to clinicians and collaborate in healthcare teams.

PO7 (Research-related skills): CO2, CO3, CO4, CO5, CO6, CO7 strongly mapped as haematology labs contribute to diagnostic research, method validation, and case studies.

PO8 (Learning how to learn skills): CO1, CO2, CO5, CO6, and CO7 moderately mapped since evolving laboratory technologies require continuous learning and adaptation.

PO9 (Digital and technological skills): CO7 mapped (1–2) since modern Hb estimation and BP monitoring may involve automated analysers and digital devices.

PO10 (Multicultural competence, empathy): CO1–CO6 moderately mapped as haematology practice fosters ethical handling of patient samples and empathy for diverse patient populations.

PO11 (Value inculcation & environmental awareness): CO1–CO6 moderately mapped since safe disposal of biohazardous waste and ethical lab practice in still responsibility.

PO12 (Autonomy, responsibility, accountability): CO1–CO6 moderately mapped as laboratory technologists must maintain accuracy, accountability, and ethical reporting of results.

PO13 (Community engagement and service): All COs mapped since haematology knowledge contributes to healthcare services, blood donation camps, screening programs, and public health initiatives.

SYLLABUS (CBCS) FOR S. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2024)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: S.Y. B.Sc. Semester: IV

Course Type: Community Engagement Program (CEP)

Course Code: ZOO-255-CEP

Course Name: Community Engagement Program

Number of Credits: 02

Number of Teaching hours: 60

Course Objectives:-

The Community Engagement Program aims to:

- Develop awareness and understanding of social, cultural, economic, and environmental issues within the local community.
- Enable students to apply classroom knowledge and disciplinary concepts to address real-world community challenges.
- Build skills in project planning, fieldwork, data collection, and evidence-based analysis.
- Encourage participatory learning, teamwork, and leadership through collaborative engagement with communities.
- Inculcate empathy, civic responsibility, and ethical sensitivity in interacting with diverse social groups.
- Strengthen students' ability to communicate effectively through report writing, documentation, and oral presentation of field-based findings.
- Promote reflective and experiential learning that inspires lifelong commitment to social development and nation-building.

Course Outcomes:-

After successful completion of this course, the student will be able to:

CO 1: Identify and describe key socio-economic, cultural, or environmental issues within a selected community through systematic field engagement.
CO 2: Design appropriate questionnaires or field tools to collect relevant qualitative and quantitative data ethically.
CO 3: Conduct effective fieldwork individually or in groups, demonstrating teamwork, discipline, and professional conduct.
CO 4: Analyze the collected data using suitable methods and draw meaningful conclusions or insights.
CO 5: Prepare a structured project report following academic norms, integrating data interpretation and references.
CO 6: Present project findings coherently before faculty and peers, exhibiting confidence and clarity in communication.
CO 7: Reflect critically on community experiences to evaluate personal growth, ethical values, and social responsibility.

In NEP 2020 (2023 Pattern) we are offering to UG (Second Year -Fourth Semester) students **Community Engagement Project (CEP)** for **TWO (2)** credits i.e. **50 Marks**. The total time allocation for the student to carry out Community Engagement Project is **60 hours**. The actual field work should be carried out after college hours or on holidays or during summer vacation.

To carry out the Community Engagement Project work following guidelines should be used:

1. Community based learning: Students should participate in community-based Community based field projects under the supervision of faculty.
2. A minimum of **60 hours of learning per credit** in a semester is required.
3. Assignment of project topics to individual student or groups of students (2 or 3 students in one group / Commerce faculty can have 5 students per group) and one faculty member from the department will act as GUIDE for the student or group of students.
4. Preparation of a questionnaire (20 -30 questions or more) related to their project topic (in Marathi or English). If the project is related to work that does not involve SURVEY work, then the questionnaire part can be replaced accordingly.
5. The departmental coordinator/guide should check the questions and finalize the questionnaire. The question that may create unnecessary complications should be avoided. The questions should be qualitative as well as quantitative.
6. Students should go to their chosen field with the questionnaire and collect the information regarding the questions asked to the concerned people. Collect as much information as possible by collecting 25 or more questionnaires or related data. The more the data, the better it will be for analysis.
7. The student should compile all the relevant data and carry out its analysis.
8. Write a project report in the standard format (2 Copies): Index, Chapter-1, Chapter-2, ….. Conclusion, References etc. The report should mention the clear **OUTPUT** drawn from the study. The typed project report should have minimum 25 pages, with font size 12 and line spacing of 1.5.
9. Submit the project report with the Guide's signature to the department (To the Departmental CEP coordinator).
10. The Oral presentation for all the projects in the department should be arranged in the department. To evaluate the project, TWO examiners from the department should be appointed by HoD. There will be NO external examiner appointed for the evaluation of projects. Also, there will be NO internal and external marks.
11. The total project work including preparation of questionnaire to oral presentation should be evaluated for 2 credits (50 Marks). The details about the allocation of time, marks and scheme of examination for Community Engagement Project are given in Table. The departmental CEP coordinator / HoD should submit the marks as per regular procedure to the examination section.
12. Since it is a compulsory subject in our syllabus, passing students in this **Community Engagement Project** is **MUST** to complete their degree.

Typical Time and marks allocation for the different stages of the Community Engagement Project is:

Typical Time and marks allocation for the different stages of the Community Engagement Project is: Step of Project	**Individual students work in hours**	**Marks**
Topic Selection/ Study Design	5	5
Survey preparation / Fieldwork	25	20
Analysis	10	5
Report writing	20	10
Oral Presentation		10
Total	**60**	**50**

Course Articulation Matrix of ZOO-255-CEP: Community Engagement Program
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

CO1: Identify and describe key socio-economic, cultural, or environmental issues. Strongly supports PO1 (Comprehensive Knowledge) and PO11 (Environmental Awareness) by fostering awareness of real-world community contexts. Connects with PO13 (Community Engagement) as it involves direct community interaction and understanding.

CO2: Design appropriate questionnaires or field tools ethically. Aligns with PO2 (Professional Knowledge) and PO5 (Analytical Reasoning) through the application of research design principles. Reinforces PO7 (Research Skills) via development of data collection tools.

CO3: Conduct effective fieldwork and demonstrate teamwork. Directly supports PO6 (Communication & Collaboration), PO12 (Responsibility & Accountability), and PO13 (Community Engagement) through cooperative field activities. Also relates to PO2 (Professional Knowledge) for adherence to ethical fieldwork norms.

CO4: Analyze collected data and draw conclusions. Reflects PO5 (Analytical Reasoning) and PO7 (Research Skills) as it involves data analysis and critical thinking. Connects with PO4 (Specialized Skills) through use of analytical and interpretative skills.

CO5: Prepare a structured project report. Tied to PO6 (Communication Skills) and PO7 (Research Skills) due to focus on writing, presentation, and documentation. Supports PO5 (Problem-Solving) and PO12 (Accountability) by demonstrating systematic reporting of findings.
CO6: Present project findings coherently. Directly contributes to PO6 (Communication) and PO4 (Leadership) through oral presentation and teamwork. Also ties with PO13 (Community Engagement) by communicating outcomes to benefit communities.

CO7: Reflect critically on community experiences. Strongly supports PO10 (Empathy), PO11 (Values & Environment), PO12 (Responsibility), and PO13 (Community Engagement) through reflection, ethics, and social awareness. Encourages lifelong learning (PO8) and moral reasoning.

SYLLABUS (CBCS) FOR S. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2024)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: S.Y. B.Sc.
Semester: IV
Course Type: Minor Theory
Course Code: ZOO-256-MN
Course Name: Sericulture
Number of Credits: 02
Number of Teaching hours: 30

Course Objectives:-

- Develop a comprehensive understanding of the diversity of silk moths, their distribution patterns, and the varieties of silk
- Describe the external morphology and life cycle of Bombyx mori (silkworm) to facilitate effective management practices during its different developmental stages.
- Gain practical knowledge of moriculture techniques
- Acquire proficiency in silkworm rearing, encompassing various rearing methods, management of rearing houses, techniques for bed cleaning, mounting, and harvesting.
- Identify and assess the management strategies for prevalent diseases and pests affecting sericulture, ensuring effective disease and pest control measures.
- Learn the post-harvest processing procedures for cocoons.
- Explore the utilization of by-products generated in the sericulture industry and their diverse applications.

Course Outcomes:-

Student will be able to-

CO1: develop a comprehensive understanding of the diversity of silk moths, their distribution patterns, and the varieties of silk, enhancing knowledge of sericulture practices and silk production.

CO2: describe the external morphology and life cycle of Bombyx mori (silkworm), enabling effective management strategies at different developmental stages to optimize silk production.

CO3: gain practical knowledge of moriculture techniques, including mulberry cultivation and maintenance, fertilization schedules, and harvesting methods, fostering competency in sericulture practices.

CO4: acquire proficiency in silkworm rearing, encompassing various rearing methods, maintenance of rearing houses, and efficient techniques for bed cleaning, mounting, and harvesting, ensuring successful silk production.

CO5: identify and assess management strategies for prevalent diseases and pests affecting sericulture, enabling implementation of effective disease and pest control measures to safeguard silk production.

CO6: learn post-harvest processing procedures for cocoons, including harvesting techniques and processing methods such as stiffling, sorting, and reeling, ensuring quality silk production and processing.

CO7: explore the utilization of by-products generated in the sericulture industry and their diverse applications, enhancing understanding of the economic and environmental aspects of sericulture practices and by-product utilization.

Topics:

UNIT	SUB UNITS	SYLLABUS	NO. OF LECTURES
1.	**Introduction to Sericulture**		03
	1.1	Definition, history and its scope	
	1.2	Study of different types of silk moths, their distribution and varieties of silk produced by Mulberry, Tassar, Eri and Muga silk worms in India	
2.	***Bombyx mori*: External morphology and life cycle**		03
3.	**Moriculture**		06
	3.1	Cultivation of mulberry	
	3.2	Harvesting of mulberry: a) Leaf plucking b) Branch cutting c) Whole shoot cutting	
4.	**Silkworm rearing**		08
	4.1	a) Types b) Rearing house c) Rearing techniques d) Bed cleaning e) Mounting and harvesting	
	4.2	Quality of silk, factors influencing the silk quality, market value, commercial aspects	
5.	**Important diseases and pests.**		04
	5.1	Protozoan, fungal, bacterial and viral diseases (each one)	
	5.2	Pests: a) Dermestid beetles b) Uzi-fly	
6.	**Post-harvest processing of cocoons**		03
	a) Harvesting and preparation of cocoons for marketing b) Stiffling, sorting, storage, deflossing and riddling c) Cocoon cooking, reeling and rereeling, washing and polishing.		
7.	**By-products and applications of sericulture**		02
8.	**Government schemes & success stories**		01

REFERENCES

1. Shukla, G. S., & Upadhyay, V. B. (2010). *Economic zoology.* Rastogi Publications.
2. Nayar, K. K., Ananthakrishnan, T. N., & David, B. V. (1976). *General and applied entomology.* Tata McGraw-Hill.
3. Romoser, W. S. (1981). *The science of entomology* (2nd ed.). Macmillan Publishing Co. Inc.
4. Srivastava, K. P., & Dhakiwal, G. S. (1993). *A textbook of applied entomology* (Vols. 1–2). Kalyani Publishers.
5. Ganga, G., & Sulochana, J. (1995). *An introduction to sericulture.* Oxford & IBH Publishing Co.
6. Central Silk Board. (N.A.). *FAQ manual of sericulture* (Vol. 1, *Mulberry cultivation*; Vol. 2, *Silkworm rearing*). Central Silk Board.
7. Saxena, C. (1992). *Biology of insects.* Oxford & IBH Publishing Co.
8. Mathur, V. K., & Upadhyay, K. (1974). *A textbook of entomology.* Goel Printing Press.

Course Articulation Matrix of ZOO-256-MN: Sericulture
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

PO1: Comprehensive knowledge and understanding

All of the course outcomes (COs) are directly mapped to PO1 because; each CO provides specific knowledge and skills that contribute to a holistic understanding of sericulture

PO2: Practical, professional, and procedural knowledge

All of the course outcomes (COs) are directly mapped to PO2 because; each CO offers specific skills and competencies required for various aspects of sericulture, such as cultivation, rearing, disease management, post-harvest processing, and by-product utilization.

PO3: Entrepreneurial mindset and knowledge

All of the course outcomes (COs) are indirectly mapped to PO3 because each CO contributes to building skills and knowledge essential for sericulture, which could be applied in entrepreneurial endeavors within the industry. For instance, CO4 and CO5 provide proficiency in silkworm rearing and disease management, crucial for successful sericulture businesses.

PO4: Specialized skills and competencies

All of the course outcomes (COs) are directly mapped to PO4 as they collectively contribute to the development of specialized skills and competencies essential for sericulture.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning

All of the course outcomes (COs) are directly mapped to PO5 All COs correlate strongly with PO5 as they collectively contribute to enhancing the capacity for application, problem-solving, and analytical reasoning in the context of sericulture.

PO6: Communication skills and collaboration

All of the course outcomes (COs) are directly mapped to PO6 as they collectively contribute to developing communication skills and fostering collaboration within the context of sericulture.

PO7: Research-related skills

All Cos are indirectly mapped to PO7 as each CO indirectly supports the development of research-related skills within the context of sericulture. For instance, CO1 enhances understanding of silk moth diversity, which could lay the groundwork for conducting research on silk moth behavior or genetics.

PO8: Learning how to learn skills

All Cos are directly mapped to PO8 as they collectively contribute to the development of adaptive learning abilities within the context of sericulture.

PO9: Digital and technological skills

All of the COs are mapped to PO9 as they collectively contribute to the integration of technology and digital tools within the context of sericulture practices. For instance, CO1 enhances understanding of silk moth diversity, which could involve utilizing digital resources such as databases or online platforms for species identification and research.

PO10: Multicultural competence, inclusive spirit, and empathy

All of the COs are directly mapped to PO10 as they collectively contribute to fostering understanding and collaboration within diverse cultural contexts in the field of sericulture.

PO11: Value inculcation and environmental awareness

All COs are strongly mapped to PO11 which focuses on value inculcation and environmental awareness, as they collectively contribute to promoting sustainable practices and environmental stewardship within the field of sericulture.

PO12: Autonomy, responsibility, and accountability

All COs are strongly mapped to PO12 which emphasizes autonomy, responsibility, and accountability, as they collectively contribute to fostering independent decision-making, accountability for actions, and responsible stewardship within the field of sericulture.

PO13: Community engagement and service

All of the COs are mapped to PO13 which focuses on community engagement and service, as they collectively contribute to fostering community involvement and addressing societal needs within the field of sericulture.

SYLLABUS (CBCS) FOR S. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2024)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: S.Y. B.Sc.
Semester: III
Course Type: Minor Practical
Course Code: ZOO-257-MN
Course Name: Practical in Sericulture
Number of Credits: 02
Number of Teaching hours: 60

Course Objectives:-

- Develop proficiency in identifying different types of raw silk produced by various silk moth species, their characteristics and applications in sericulture practices.
- Gain practical knowledge and comprehension of the life cycle of *Bombyx mori*, to facilitate effective management and rearing techniques in sericulture.
- Acquire skills in sex separation techniques for silkworm larvae, pupae, and adults, enabling the identification and selection of desired sexes for controlled breeding and improved silk production.
- Develop competency in temporary mountings of silkworm larval structures
- Understand the characteristics of cocoon structures in popular uni-, bi-, and multivoltine races of silkworms
- Familiarize with different types of rearing houses used in sericulture to comprehend their design, functionality, and suitability for silk production.
- Learn methods for determining the percentage of good and defective cocoons, enabling assessment of cocoon quality and production efficiency in sericulture practices.

Course Outcomes:-

Student will be able to-

CO1: demonstrate proficiency in accurately identifying and distinguishing different types of raw silk produced, along with an understanding of their unique characteristics and applications within sericulture practices.

CO2: acquire practical knowledge and comprehension of the complete life cycle of *Bombyx mori*, enabling the effective implementation of management and rearing techniques essential for successful sericulture operations.

CO3: develop skills in employing sex separation techniques for silkworm larvae, pupae, and adults

CO4: attain competency in performing temporary mountings of silkworm larval structures, enhancing understanding of their morphology and functional significance in silk production processes.

CO5: explain distinct characteristics of cocoon structures present in popular uni-, bi-, and multivoltine races of silkworms.

CO6: familiarize oneself with the various types of rearing houses utilized in sericulture, including their design, functionality, and suitability for silk production, to effectively manage and optimize rearing environments.

CO7: apply methods for accurately determining the percentage of good and defective cocoons, facilitating the assessment of cocoon quality and overall production efficiency within sericulture practices.

Practicals:

Sr. No.	Title of the Practical	E/D	Teaching hours
1	Identification of Mulberry, Tasar, Eri and Muga raw silk	(D)	4
2	Study of life cycle of *Bombyx mori*.	(D)	4
3	Study of sex separation in larva, pupa and adult of silkworm *Bombyx mori*	(E/D)	4
4	Temporary mountings of larva: a) Mouth parts b) Spiracles c) Silk gland	(E/D)	4
5	Study of cocoon characters of popular uni-, bi- and multivoltine races	(D)	4
6.	Study of rearing houses: Model rearing house and low-cost rearing house	(D)	4
7.	Determination of good cocoon and defective cocoon percentage	(E)	4
8.	Determination of soil pH and water holding capacity for mulberry cultivation	(E)	4
9.	Study of morphology of haemocytes in silkworm	(E)	4
10.	Study of various diseases in silkworm	(D)	4
11.	Study of pests in sericulture: Dermestid beetle and Uzi fly	(D)	4
12	Study of any five equipments in sericulture	(D)	4
13	Study of handicrafts made from cocoons	(E)	4
14	Submission of short project report on Economics of sericulture (Activity based practical) (With necessary pictures).	(E)	4
15	Visit to sericulture farm and submission of report.	(E)	4
***D- Demonstration; E- Experiment.**			

References

1. Tripathi, P. N., & Tiwari, R. N. (2021). *Sericulture in India: A bioecological approach.* Scientific Publishers.
2. Das, J. (n.d.). *A textbook on sericulture: Rearing and management of silkworm.* IPBooks.
3. Mukerji, N. G. (1919). *Handbook of sericulture.* Bengal Secretariat Book Depot.
4. Bukhari, R., & Bhat, R. A. (2021). *Fundamentals of sericulture.* National Publishing House.
5. Rao, M. M. (2019). *An introduction to sericulture.* B S Publications.
6. Bhat, M. A., Chanotra, S., Iqbal, Z., Aziz, A., & Azam, M. (2024). *A textbook on entrepreneurship development programme in sericulture.* IP Innovative Publication Pvt. Ltd.

Course Articulation Matrix of ZOO-257-MN: Practical in Sericulture
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

PO1: Comprehensive knowledge and understanding

All of the course outcomes (COs) are directly mapped to PO1 because; because the objectives of each practical exercise focus on developing a deep understanding of various aspects related to sericulture.

PO2: Practical, professional, and procedural knowledge

All of the course outcomes (COs) are directly mapped to PO2 because; because the practical exercises are designed to impart hands-on skills and procedural knowledge essential for sericulture practices.

PO3: Entrepreneurial mindset and knowledge

All of the course outcomes (COs) are mapped to PO3 because the practical exercises in sericulture involve aspects of entrepreneurship such as understanding market value, assessing quality factors influencing silk, and exploring commercial aspects.

PO4: Specialized skills and competencies

All of the course outcomes (COs) are directly mapped to PO4 because the practical exercises are specifically designed to develop specialized skills and competencies relevant to sericulture.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning

All of the course outcomes (COs) are directly mapped to PO5 because the practical exercises in sericulture require students to apply their knowledge and problem-solving skills to various real-world scenarios.

PO6: Communication skills and collaboration

All of the course outcomes (COs) are directly mapped to PO6 because the practical exercises in sericulture often involve collaborative learning environments where students work together to achieve common objectives.

PO7: Research-related skills

All Cos are indirectly mapped to PO7 because the practical exercises in sericulture involve elements of research methodology and data analysis.

PO8: Learning how to learn skills

All Cos are directly mapped to PO8 because the practical exercises in sericulture are designed to enhance students' ability to learn independently and adapt to new challenges.

PO9: Digital and technological skills

All of the COs are mapped to PO9 because the practical exercises in sericulture often involve the use of digital tools and technologies.

PO10: Multicultural competence, inclusive spirit, and empathy

All of the COs are directly mapped to PO10 because the practical exercises in sericulture often involve interactions with diverse stakeholders, including farmers, researchers, and industry professionals from different cultural backgrounds.

PO11: Value inculcation and environmental awareness

All COs are strongly mapped to PO11 because the practical exercises in sericulture involve understanding the importance of environmental sustainability and ethical practices in silk production.

PO12: Autonomy, responsibility, and accountability

All COs are strongly mapped to PO12 which emphasizes autonomy, responsibility, and accountability, as they collectively contribute to fostering independent decision-making, accountability for actions, and responsible stewardship within the field of sericulture.

PO13: Community engagement and service

All of the COs are mapped to PO13 because the practical exercises in sericulture often involve engaging with various stakeholders within the community, such as local farmers, researchers, and industry professionals. By participating in activities, students contribute to the broader community by sharing knowledge and expertise in sericulture practices.

SYLLABUS (CBCS) FOR S. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: S.Y.B.Sc.
Semester: IV
Course Type: Open Elective (Practical)
Course Code: ZOO-258-OE
Course Name: Crop pests: Types & management(Practical) (पिकावरील किड: प्रकार व व्यवस्थापन) (प्रात्यक्षिक)
Number of Credits: 02
Number of Teaching hours: 60

Course Objectives:-

- To understand various methods of pest control used in agricultural fields for effective crop protection.
- To identify common pests and diseases affecting cereal, pulse, fruit, and vegetable crops, and study their symptoms.
- To learn and evaluate control measures for managing crop pests and minimizing crop loss.
- To study the impact of storage pests on stored grains and explore effective prevention and control techniques.
- To examine the damage caused by locusts and rodents in the field and understand the preventive and control strategies.
- To understand the role of other crop enemies (non-insect pests) and develop appropriate countermeasures.
- To develop field survey and reporting skills by observing pest problems in nearby farms and documenting control practices

Course Outcomes:-

Student will be able to-

CO1: Explain various pest control methods and apply them appropriately in different field conditions.
CO2: Identify major pests and diseases in cereals, pulses, fruits, and vegetables based on their symptoms.
CO3: Suggest suitable preventive and curative measures for controlling pests and minimizing crop damage.
CO4: Recognize pests affecting stored grains and recommend proper storage and control practices.
CO5: Assess the damage caused by locusts and rodents and propose effective management strategies.
CO6: Evaluate the impact of non-insect crop enemies and plan suitable control measures.
CO7: Conduct field surveys and prepare pest management reports based on real-life observations from nearby farms.

PRACTICALS:

Practical No.	Name of the Practical	E/D	Teaching Hours
1.	Study of different methods of pest control in the field	D	4
2.	Study of pests and diseases affecting cereal crops, their symptoms, and control measures: i. Jowar stem borer ii. Leaf folder	D	4
3.	Study of pests of sugar cane: identification, symptoms, and control measures: *i. Pyrilla purpusilla*	D	4

	ii. Sugar cane mealy bug		
4.	Study of pests and diseases affecting fruit crops and their control measures i. Lemon Butterfly *ii. Virachola isocrates*	D	4
5.	Study of pests and diseases affecting pulse crops, their symptoms, and control measures *i. Helicoverpa armigera* (Gram pod borer) ii. Thrips	D	4
6.	Study of storage pests in grains and their control measures: i. Rice weevil ii. Pulse beetle iii. Red floor beetle iv. Lesser grain borer	D	8
7.	Study of pests of oilseeds: i. Aphids ii. Jassids	D	4
8.	Study of integrated pest management in sugarcane	D	4
9.	Study of integrated pest management in pomegranate	D	4
10.	Study of life cycle, nature of damage and control measures of locust.	D	4
11.	Study of termites: life cycle, nature of damage to crops & control measures	D	4
12.	Collection, identification and preservations of any two crop pests from nearby agricultural field. (Activity-based practical)	E	4
13.	Study of pest control appliances: i. Knapsack sprayer ii. Shoulder rotary duster	D	4
14.	Study of non-insect pests of crops, the damage they cause, and control measures: i. Rat ii. Snail	D	4
15.	Survey of pests affecting different crops in the farms around your home and prepare a report on the control measures being used (Activity Based Practical)	E	4
16.	Visit to nearby Krishi Vidnyan Kendra	E	4

Practical No.	Name of the Practical	E/D	Teaching Hours
1.	शेतातील कीड नियंत्रणाच्या वेगवेगळ्या पद्धती अभ्यासणे	D	4
2.	तृणधान्यावर होणारे किडीचे रोग, त्याची लक्षणे आणि उपायांचा अभ्यास करणे. i. ज्वारीवरील खोडकिडा ii. पाने गुंडाळणारी अळी	D	4
3.	उसावर होणारे किडीचे रोग, त्याची लक्षणे आणि उपायांचा अभ्यास करणे *i. उसावरील तुडतुडा* *ii. उसावरील पिठ्या ढेकूण (mealy bug)*	D	4
4.	फळ पिकांवर होणारे किडीचे रोग, त्याची लक्षणे आणि उपायांचा अभ्यास करणे i. लिंबू फुलपाखरू (Lemon butterfly) ii. *डाळिंबावरील फुलपाखरू (Virachola Isocrates)*	D	4
5.	कडधान्यावर होणारे किडीचे रोग, त्याची लक्षणे आणि उपायांचा अभ्यास करणे *i. घाटी अळी (Helicoverpa armigera)* (Gram pod borer)	D	4

	ii. *फुलकिडे* (Thrips)		
6.	साठवलेल्या धान्यावर होणारे किडीचे रोग, त्याची लक्षणे आणि उपायांचा अभ्यास करणे i. सोंडकिडा (Rice weevil) ii. भुंगेरा (Pulse beetle) iii. लाल भुंगेरा (Red floor beetle) iv. धान्य किडा (Lesser grain borer)	D	8
7.	तेल बियावर होणारे किडीचे रोग, त्याची लक्षणे आणि उपायांचा अभ्यास करणे i. मावा ii. तुडतुडे	D	4
8.	उसावरील किडीचे एकात्मिक कीड व्यवस्थापनाचा अभ्यास करणे.	D	4
9.	डाळिंबावरील किडीचे एकात्मिक कीड व्यवस्थापनाचा अभ्यास करणे.	D	4
10.	टोळधाडीचे जीवनचक्र, पिकाचे नुकसान आणि त्याचे नियंत्रण.	E	4
11.	वाळवी: जीवन चक्र, पिकाचे नुकसान आणि नियंत्रण याचा अभ्यास करणे	E	4
12.	आपल्या जवळील शेतातून कोणत्याही दोन किडी गोळा करणे, त्यांची ओळख पटवणे आणि त्यांचा संग्रह करणे. (Activity-based practical)	E	4
13.	कीड नियंत्रणात वापरल्या जाणाऱ्या अवजारांचा अभ्यास करणे: i. फवारणी यंत्र (Knapsack sprayer) ii. धुरळणी यंत्र (Shoulder rotary duster)	E	4
14.	किटकांव्यतीरिक्त पिकांचे नुकसान करणारे प्राणी, त्यांनी केलेल्या नुकसाणीचे स्वरूप आणि त्यांचे नियंत्रण: i. उंदीर ii. पक्षी	E	4
15.	परिसरातील शेतात असणाऱ्या किडींचे सर्वेक्षण करून त्याचा अहवाल सादर करणे. (Activity Based Practical)	E	4
16.	कृषि विज्ञान केंद्रास भेट	E	4

1. Shukla, G. S., & Upadhyay, V. B. (2010). *Economic zoology.* Rastogi Publications.
2. Nayar, K. K., Ananthakrishnan, T. N., & David, B. V. (1976). *General and applied entomology.* Tata McGraw-Hill.
3. Romoser, W. S. (1981). *The science of entomology* (2nd ed.). Macmillan Publishing Co. Inc.
4. Srivastava, K. P., & Dhakiwal, G. S. (1993). *A textbook of applied entomology* (Vols. 1–2). Kalyani Publishers.
5. Ganga, G., & Sulochana, J. (1995). *An introduction to sericulture.* Oxford & IBH Publishing Co.
6. Central Silk Board. (n.d.). *FAQ manual of sericulture* (Vol. 1, *Mulberry cultivation*; Vol. 2, *Silkworm rearing*). Central Silk Board.
7. Saxena, C. (1992). *Biology of insects.* Oxford & IBH Publishing Co.
8. Mathur, V. K., & Upadhyay, K. (1974). *A textbook of entomology.* Goel Printing Press.
9. Deshmukh, R. N. (2013). Krushi Kit Patyancha Aarthik Aabhav [Economic importance of agricultural pests]. Maharashtra Krushi Vishwa Vidyalaya.
10. Jadhav, M. R. (2015). *Pest Management in Maharashtra Agriculture [In Marathi]*. Sahyadri Prakashan.

11. Kamble, S. D. (2010). *Krantikari Paryavaran Ani Pest Control [Environmental aspects and pest control]*. Pune Prakashan.
12. Nikam, R. R., & Waghmare, V. D. (2012). *Krushi Jivanjantuncha Shodh Ani Niyantran [Study and control of agricultural pests]*. Krishi Ratan Publications.

Course Articulation Matrix of ZOO-258-OE (Crop pests: Types & management(Practical)
(पिकावरील किड: प्रकार व व्यवस्थापन) (प्रात्यक्षिक)
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

PO1: Comprehensive knowledge and understanding
All COs are mapped to PO1, as they involve identification, classification, and understanding of pests, crop diseases, and control methods—fundamental to pest management and agricultural science.

PO2: Practical, professional, and procedural knowledge
CO1, CO2, CO3, CO5, CO6, and CO7 align with PO2 as they include practical aspects such as pest identification in field conditions, application of control techniques, and survey-based learning.

PO3: Entrepreneurial mind-set and knowledge
CO3, CO4, and CO7 relate to PO3 as they focus on crop protection strategies, economic impact of pests, and pest control in post-harvest and storage systems—key areas for agri-based entrepreneurship.

PO4: Specialized skills and competencies
CO1, CO2, CO3, CO5, and CO6 are mapped to PO4 due to their emphasis on specialized pest and disease management knowledge, such as biological control, chemical methods, and storage pest management.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO1, CO2, CO4, CO5, and CO6 are strongly mapped to PO5 as they involve field observation, problem-solving related to pest outbreaks, and evaluating appropriate control methods based on pest type and crop.

PO6: Communication skills and collaboration
CO6 and CO7 contribute to PO6 by involving field data collection, report writing, farmer interaction, and team-based survey work on pest control practices in local agricultural communities.

PO7: Research-related skills
CO3, CO4, CO5, CO6, and CO7 align with PO7 as they involve systematic study of pest life cycles, survey methodologies, effectiveness of control measures, and preparation of detailed pest management reports.

PO8: Learning how to learn skills
CO1, CO2, CO3, CO4, CO5, CO6, and CO7 support PO8 by encouraging self-directed field study, observation of local pest issues, and continual updating of knowledge on evolving pest control technologies.

PO9: Digital and technological skills
CO6 and CO7 relate to PO9 as they involve data recording, use of digital tools for pest identification, and application of technology in pest monitoring, storage protection, and report documentation.

PO10: Multicultural competence, inclusive spirit, and empathy
CO3 and CO4 support PO10 by promoting understanding of the impact of pest outbreaks on farming communities, food supply, and the importance of inclusive pest control practices adaptable to different socio-economic conditions.

PO11: Value inculcation and environmental awareness
CO1 to CO7 contribute to PO11 by promoting integrated pest management (IPM), responsible chemical use, environmental safety, and awareness of ecological balance in pest control practices.

PO12: Autonomy, responsibility, and accountability
CO1 to CO7 align with PO12 by developing responsible handling of pesticides, ethical practices in pest management, and accountability in implementing sustainable and effective crop protection strategies.

PO13: Community engagement and service
CO3, CO4, and CO7 map to PO13 as they include outreach to farmers, community-based pest surveys, and promoting safe and economical pest control solutions that benefit rural agricultural communities.

SYLLABUS (CBCS) FOR S. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2024)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: S.Y.B.Sc.
Semester: IV
Course Type: Skill Enhancement Course
Course Code: ZOO-259-SEC
Course Name: Practicals in Dairy Science
Number of Credits: 02
Number of Teaching hours: 60

Course Objectives:

- Classify and describe various cattle breeds relevant to the dairy industry.
- Conduct sensory evaluations of milk and ghee to assess quality.
- Perform experiments to measure milk density and detect adulterants such as cane sugar, starch, cellulose, and urea.
- Isolate casein from milk and conduct confirmatory tests to verify its presence.
- Evaluate the efficiency of sterilization processes in dairy products using turbidity tests.
- Learn the operation of dairy equipment, including cream separators, and design layouts for dairy plants.
- Analyze the impact of diseases in cattle and understand the economics of the dairy industry through field visits and project reports.

Course Outcomes:

Student will be able to-

CO1: identify and describe key dairy cattle breeds and their characteristics.
CO2: evaluate the quality of milk and ghee through sensory analysis.
CO3: measure milk density and detect adulterants, including cane sugar, starch, cellulose, and urea, using specified experiments.
CO4: isolate casein from milk and confirm its presence through appropriate tests.
CO5: assess the effectiveness of sterilization methods in dairy products using turbidity tests.
CO6: demonstrate proficiency in operating dairy equipment and designing efficient dairy plant layouts.
CO7: analyze cattle diseases and their impact on the dairy industry, and evaluate industry economics through field visits and project reports.

Sr. No.	Title of the Practical	E/D
1	Study of cattle breeds	D
2	Sensory evaluation of milk	E
3	Measurement of milk density using Lactometer	E
4	Isolation of casein from milk and its confirmatory tests	E
5	Detection of cane sugar in milk	E
6	Detection of starch in milk	E
7	Detection of cellulose in milk	E
8	Detection of added urea in milk	E
9	Sensory evaluation of ghee	E
10	Determination of sterilization efficiency by turbidity test	E
11	Study of cream separator	D
12	Design and layout of a dairy plant	D
13	Study of diseases in cattles (Brucellosis, Lumpy skin disease, Dermatophytosis)	D
14	Visit to a dairy industry and submission of the report	E
15	Submission of short project report on economics of dairy industry	E
***D- Demonstration; E- Experiment.**		

1. Biswas, S. (2013). *Dairy production and management*. New India Publishing Agency.
2. Clark, S., Costello, M., Drake, M. A., & Bodyfelt, F. (2009). T*he sensory evaluation of dairy products* (2nd ed.). Springer.
3. Fox, P. F., Uniacke-Lowe, T., McSweeney, P. L. H., & O'Mahony, J. A. (2015). *Dairy chemistry and biochemistry* (2nd ed.). Springer.
4. Goff, H. D., & Hartel, R. W. (2013). *Ice cream* (7th ed.). Springer.
5. Gupta, R. D., & Mathur, O. N. (2016). *Dairy science and technology*. Agrobios.
6. Marth, E. H., & Steele, J. L. (2001). *Applied dairy microbiology* (2nd ed.). Marcel Dekker.
7. McSweeney, P. L. H., & Fox, P. F. (Eds.). (2013–2020). *Advanced dairy chemistry* (Vol. 1: *Proteins*, 4th ed.; Vol. 2: Lipids, 4th ed.; Vol. 3: *Lactose, water, salts and minor constituents*, 3rd ed.). Springer.
8. Ogunwale, F. (2018). *A report on milk and dairy technology practical*. Afribary. https://afribary.com/works/a-report-on-milk-and-dairy-technology-practical-7856
9. Purohit, G. N., & Patil, S. R. (2012). *Milk and milk products technology*. Agrobios.
10. Suneja, S. P., & Suneja, S. (2017). *Fundamentals of dairy science*. Kalyani Publishers.
11. Tetra Pak Processing Systems. (n.d.). *Tetra Pak dairy processing handbook* (2nd ed.). https://dairyprocessinghandbook.tetrapak.com
12. Walstra, P., Wouters, J. T. M., & Geurts, T. J. (2006). *Dairy science and technology* (2nd ed.). CRC Press.

Articulation Matrix of ZOO-259-SEC: Practicals in Dairy Science
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

PO1: Comprehensive knowledge and understanding
All COs strongly maps as these outcomes require a thorough understanding of dairy cattle breeds, milk quality, adulteration detection, casein isolation, dairy equipment operation, and cattle disease analysis.
PO2: Practical, professional, and procedural knowledge
All COs strongly maps as performing sensory analysis, detecting adulterants, isolating casein, and operating dairy equipment, which demand hands-on skills and professional knowledge.
PO3: Entrepreneurial mindset and knowledge
All COs moderately maps as where designing dairy plant layouts aligns with entrepreneurial skills.
PO4: Specialized skills and competencies
All COs strongly maps as each outcome involves acquiring specialized skills like evaluating milk quality, detecting adulterants, isolating casein, operating dairy equipment, and analyzing cattle diseases.
PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
All COs strongly maps as they require analytical reasoning, problem-solving, and application of knowledge in practical settings, such as evaluating milk quality, detecting adulterants, and analyzing cattle diseases.
PO6: Communication skills and collaboration
All COs poorly maps as communication and collaboration are not the primary focus of these outcomes.
PO7: Research-related skills
All COs moderately maps as they involves research through field visits and project reports on cattle diseases and dairy industry economics.
PO8: Learning how to learn skills
All COs moderately maps as indicating the need for continuous learning, especially in dairy science,

equipment operation, and disease analysis

PO9: Digital and technological skills

CO3, CO4, and CO5 moderately maps as where detecting adulterants and isolating casein might involve some technological skills.

PO10: Multicultural competence, inclusive spirit, and empathy

All COs poorly maps as these outcomes do not explicitly involve multicultural competence or empathy.

PO11: Value inculcation and environmental awareness

CO7 moderately maps where understanding cattle diseases and their impact on the dairy industry aligns with environmental awareness.

PO12: Autonomy, responsibility, and accountability

All COs moderately maps as these outcomes require independent learning, responsibility in practical tasks, and accountability in dairy industry practices.

PO13: Community engagement and service

CO7 strongly maps where field visits and project reports directly contribute to community engagement and service.