SOPHIA COLLEGE FOR WOMEN

(EMPOWERED AUTONOMOUS)

Affiliated to the University of Mumbai

Programme: Sciences

Zoology (Minor)

Syllabus for the Academic Year 2025-2026

based on the National Education Policy 2020

SOPHIA COLLEGE FOR WOMEN (AUTONOMOUS)

COURSE DETAILS FOR MINOR:

	SEMESTER 3		SEMESTER 4
TITLE	**Developmental Biology and Economic Zoology-I**		**Cell Biology and Economic Zoology-II**
TYPE OF COURSE - DSC	**Minor**		**Minor**
CREDITS	**4**		**4**

Preamble:

This syllabus of Zoology Program offered by Sophia College for Women, Mumbai has been designed for the academic year 2025-2026; under the National Education Policy 2020 implemented from the academic year 2023-24.

The syllabus tries to encompass fundamental areas such as taxonomy, developmental biology, genetics, physiology, cell biology as well as applied zoology disciplines like ecology and economic zoology that would promote skill enhancement and entrepreneurship. The syllabus is planned such that the learners who are beginning their academic journey opting for the subject of Zoology will be equipped with not only the basic knowledge of the animal world but also the recent trends in the subject.

Learning of the subject would involve various innovative pedagogies such as experiential learning, problem-based learning, collaborative learning in addition to the traditional mode of learning. Besides sensitizing the learners towards environment and sustainability, the subject also offers career opportunities in a variety of fields such as conservation, research, education, and animal management. Due care would be taken to adhere to the directions as given in the UGC Circular F14-4/2006 (CPP-II) while conducting practicals involving animal types.

PROGRAMME OBJECTIVES

PO 1	To provide a holistic knowledge about animal biology such as taxonomy, comparative anatomy and physiology, behaviour, ecology and evolution.
PO 2	To develop experimental and research-oriented skills for future career in academia
PO 3	To gain field-based knowledge through experiential learning
PO 4	To get acquainted with the applied areas of zoology to promote employability and entrepreneurship
PO 5	To encourage understanding about the importance of biodiversity conservation, the threats facing ecosystems and the conservation measures used to preserve wildlife

PROGRAMME SPECIFIC OUTCOMES

PSO 1	Apply the field-based and the in-class knowledge of animal biology to identify and classify the animals in their natural habitat upto class level
PSO 2	Identify the various types of animal behaviour, and animal interactions with the ecosystem
PSO 3	Conduct basic research that involves application of critical thinking and experimental skills
PSO 4	Get career opportunities in a variety of fields such as conservation, research, education, and animal management

SOPHIA COLLEGE FOR WOMEN (AUTONOMOUS)

Programme: Science Zoology Minor	**Semester – 3**
Course Title: Developmental Biology and Economic Zoology-I	**Course Code: SZOO233MN**

COURSE OBJECTIVES:

1. To introduce various processes of embryonic development
2. To gain knowledge about the economic importance of apiculture, sericulture and insect pest management

COURSE OUTCOMES:

The learner will be able to:

1. Describe the different processes of development in various animals
2. Compare the different processes of development in various animals
3. Explain the processes and economic importance of apiculture and sericulture
4. Apply the principles of Insect Pest Management

Lectures per week (1 Lecture is 60 minutes)		**2**	
Total number of Hours in a Semester		**30**	
Credits		**2**	
Evaluation System	**Semester End Examination**	**1 Hour**	**30 marks**
	Internal Assessment	**--**	**20 marks**

UNIT 1 Developmental Biology (1 Credit)	1.1	Gametogenesis - Oogenesis and Spermatogenesis	15 hours
	1.2	Types of Egg - Based on amount and distribution of yolk	

	1.3	Structure and Types of Sperm	
	1.4	Process of fertilization - Activation of sperm, Recognition of sperm and ovum, Acrosomal reaction, Activation of ovum, Cortical reaction	
	1.5	Types of Cleavage	
	1.6	Types of Blastulae	
	1.7	Types of Gastrulae	
UNIT 2 Economic Zoology-I (1 Credit)	2.1	Honeybee – Social life and communication, life history, apiculture, pests, enemies, diseases, commercial importance	15 hours
	2.2	Silk moth – Life history, sericulture, Diseases and control measures, economic importance	
	2.3	Types of insect pests, their life cycle and control measures: *Schistocerca gregaria,* Aphids, *Sitophilus oryzae,* Bed bug	
	2.4	Insect Pest Management - Chemical and biological control: Overview of chemical pesticides- Major classes of chemical pesticides and their mode of action	
	2.5	Biological control agents: Pathogens - Bacteria (*Bacillus thuringiensis*), Fungi, Viruses, Parasitoids	

SOPHIA COLLEGE FOR WOMEN (AUTONOMOUS)

PRACTICAL	**Semester – 3**
Course Title: Developmental Biology and Economic Zoology	**Course Code: SZOO233MNP**

COURSE OUTCOMES:
The learner will be able to:

1. Identify and describe the various stages of development
2. Identify and describe the tools and techniques involved in apiculture, sericulture and pest management
3. Prepare field report based on observations done during field excursions

Lectures per week (1 Lecture is 120 minutes)		**2**	
Total number of Hours in a Semester		**60**	
Credits		**2**	
Evaluation System	**Semester End Examination**	**2 Hours**	**50 marks**
	Internal Assessment	**--**	

	1	Study of the following permanent slides, museum specimens and materials: a) Mammalian sperm and ovum b) Types of egg –fish, frog and hen c) Cleavage, blastula and gastrula (Amphioxus, Frog and Bird)	30 hours
	2	Study of development of zebrafish embryo up to 72 hours (only observation without disturbing larvae)	

	3	Study of development of chick embryo up to 72 hours from permanent slides	
	4	Study of types of legs, sting apparatus and mouthparts in honeybees	
	5	General tools and techniques of apiculture (Study of Bee box)	
	6	Study of insect pests: *Schistocerca gregaria*, Aphids, *Sitophilus oryzae*, *Tribolium confusum*	
	7	Study of insect pest control - chemical and biological	
	8	Life cycle of silk moth and sericulture	
	9	Field visit and report submission	

ASSESSMENT DETAILS:

I. Continuous Assessment (IA): 20 marks

II. Semester End Examination (SEE): 30 marks

REFERENCES:

UNIT 1 :

1. Arora, M. P., & Arora, H. (2017). *Embryology*. Himalaya Publishing House.
2. Balinsky B.I. (2012) An Introduction to Embryology. (5th ed.). Cengage Learning India
3. Gilbert, S. F. (1997). *Developmental Biology* (5th ed.). Sinauer Associates Inc.
4. Johnson, M. H. (2018). *Essential Reproduction*. (8th ed.). Wiley-Blackwell Publication.
5. Knobil, E. K., & Neil, J. D. (2015). *The Physiology of Reproduction (Vol I & II).* (4th ed.). Raven Press, New York

6. Marieb, E. L. (2012). *Human Anatomy and Physiology.* (9th ed.). Pearson Education Low Price Edition.
7. Wolpert L., Tickle C., Arias A.M. (2015). Principles of Development. (5th ed.). Oxford University Press.

UNIT 2:

1. Ahsan J. and Sinha S.P. Prasad () *A handbook on Economic Zoology*. S. Chand & Co.

2. Hassall K.A. (2013). *The Chemistry of Pesticides Their Metabolism, Mode of Action and Uses in Crop Protection*. Scientific Publishers, India.

3. Metcalf, C. L., Metcalf R. L. and Flint W. P. (2018) *Destructive and Useful Insects*. Agri Horti Press.

4. Rahman A. (2017) Apiculture in India. Indian Council of Agricultural Research.

5. Sathe T.V. (2020). Biological Pest Control. Astral Publication.

6. Sehgal P.K. (2018). *Textbook of sericulture, apiculture and entomology.* Kalyani Publishers.

7. Shukla G.S. and Upadhyay V. B. *Economic Zoology*. Rastogi Publication.

SOPHIA COLLEGE FOR WOMEN (AUTONOMOUS)

Programme: Science **Zoology Minor**		**Semester – 4**	
Course Title: Cell Biology and Economic Zoology-II		**Course Code: SZOO244MN**	
COURSE OBJECTIVES: 1. To introduce students to fundamental concepts of cell biology 2. To develop an understanding of the ultrastructure and functions of key cellular components 3. To familiarize learners with major Indian cattle breeds, their origin, characteristics, and economic importance in the livestock sector. 4. To build foundational knowledge of dairy science, including cattle diseases, vaccination, milk processing techniques, and the socio-economic role of dairy development in India.			
COURSE OUTCOMES: The learner will be able to: 1. Explain the cell theory and compare prokaryotic and eukaryotic cells, and describe the structure–function relationship of major cell organelles. 2. Describe the ultrastructure and functional significance of the key cellular components 3. Explain the features, distribution of important Indian cattle breeds and evaluate their economic value in livestock management 4. Analyse the basic dairy processing operations and the role of dairy development in rural economy and women's empowerment.			
Lectures per week (1 Lecture is 60 minutes)		**2**	
Total number of Hours in a Semester		**30**	
Credits		**2**	
Evaluation System	**Semester End Examination**	**2 Hours**	**30 marks**
	Internal Assessment	**--**	**20 marks**

UNIT 1 Cell Biology (1 Credit)	1.1	Introduction to cell biology 1.1.1: Definition and scope 1.1.2: Cell theory 1.1.3: Generalized prokaryotic, eukaryotic cell: size, shape and structure	15 hours
	1.2	Nucleus 1.2.1: Study of Ultrastructure - nuclear membrane and pore complex, nucleolus, structure of a metaphase chromosome, types of chromosomes 1.2.2: Functions	
	1.3	Plasma membrane 1.3.1: Ultrastructure - Fluid Mosaic Model 1.3.2: Junctional complexes - types and functions 1.3.3: Functions of plasma membrane including types transport across membrane	
	1.4	Overview of ultrastructure and functions of cell organelles: 1.4.1: Endoplasmic reticulum 1.4.2: Golgi Complex 1.4.3: Lysosomes 1.4.5: Mitochondria	

UNIT 2 Economic Zoology-II (1 Credit)	2.1	Overview of Indian Cattle Breeds - Origin, distribution, Salient features & Economic significance of: 2.1.1: Gir, Malvi, Hariyana, Deoni, Red Sindhi and Khillari 2.1.2: Nagpuri, Bhadawari, Murrah, Jafrabadi	15 hours
	2.2	Common cattle diseases, vectors of cattle diseases and vaccination	
	2.3	Dairy Processing: Filtration, cooling, chilling, clarification, pasteurization, freezing	
	2.4	Milk and milk products: Composition of milk, Types of milk - Buffalo milk & Cow milk (A1 and A2), Whole milk and toned milk, Milk products	
	2.5	Dairy development in India: Role of dairy development in rural economy, employment opportunities, Women's empowerment through dairy cooperative societies	

SOPHIA COLLEGE FOR WOMEN (AUTONOMOUS)

Programme: Science **Zoology Minor**	**Semester – 4**
PRACTICAL COURSE: Cell Biology and Economic Zoology-II	**Course Code: SZOO244MNP**

COURSE OUTCOMES:

The learner will be able to:

1. Perform experiments based on cell biology
2. Demonstrate dairy science related experiments
3. Prepare the report based on the observations done during field visit

Lectures per week (1 Lecture is 120 minutes)		**2**	
Total number of Hours in a Semester		**60**	
Credits		**1**	
Evaluation System	**Summative Assessment**	**2 Hours**	**50 marks**
	Continuous Assessment	**--**	**--**

Practicals (1 Credit)	1	Study of Barr bodies	60 hours
	2	Study of types of chromosomes based on centromere position	
	3	Study of polytene chromosome	
	4	Study of mitosis- temporary squash preparation of onion root tip	

	5	Extraction of casein from milk and its qualitative test	
	6	Preparation of milk products from given milk sample – paneer	
	7	Determination of quality of milk by MBRT test	
	8	Measurement of density of milk of different samples by Lactometer	
	9	Qualitative tests for detecting adulteration in milk	
	10	Quantitative estimation of lipids from the given samples of milk	
	11	Quantitative estimation of proteins from the given samples of milk	
	12	Breeds of Indian cows and buffaloes	
	13	Field visit and report submission	

ASSESSMENT DETAILS:

I. Internal Assessment (IA): 20 marks

II. Semester End Examination (SEE): 30 marks

REFERENCES:

UNIT 1:

1. De Robertis, E.D.P., & Robertis, E.M.R. (2017). *Cell and Molecular Biology*. Lea & Febiger, U.S.
2. Gupta, P. K. (2021). *Cell and Molecular Biology*. (5th ed.). Rastogi Publication.
3. Pawar, C. B. (2010). *Cell Biology*. Himalaya Publishing House.

4. Verma, P.S., & Agarwal, V. K. (2022) *Cell Biology Genetics, Molecular Biology Evolution and Ecology*. (9th ed.). S. Chand Publication, New Delhi.

UNIT 2:

1. Banerjee G.C. (2021). *A Textbook of Animal Husbandry.* (8th ed.). Oxford & IBH Publishing, New Delhi
2. Candler, W., & Kumar, N. (1998). *India: The dairy revolution: The impact of dairy development in India and the World Bank's contribution*. World Bank Publications.
3. Park, Y. W., & Haenlein, G. F. (Eds.). (2013). *Milk and dairy products in human nutrition: production, composition and health*. John Wiley & Sons,
4. Venkatasubramanian, V., Singh, A. K., & Rao, S. V. N. (2003). *Dairy development in India: An appraisal of challenges and achievements*. Concept Publishing Company,