



SOPHIA COLLEGE FOR WOMEN

(EMPOWERED AUTONOMOUS)

Affiliated to the University of Mumbai

Programme: Sciences

Zoology (Minor)

Syllabus for the Academic Year 2024-2025

based on the National Education Policy 2020



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DEPARTMENT OF ZOOLOGY

COURSE DETAILS FOR MINOR:

	SEMESTER 3	SEMESTER 4
TITLE	Genetics-I, Developmental Biology and Economic Zoology-I	Genetics-II, 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 2024-2025; 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.



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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



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PSO 4	Get career opportunities in a variety of fields such as conservation, research, education, and animal management
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Programme: Sciences Zoology Minor		Semester – 3	
Course Title: Genetics-I, Developmental Biology and Economic Zoology-I		Course Code: SZOO233MN	
<u>COURSE OBJECTIVES:</u> <ol style="list-style-type: none">1. To understand basic concepts of genetics and patterns of inheritance2. To introduce various processes of embryonic development3. To gain knowledge about the economic importance of apiculture, sericulture and insect pest management			
<u>COURSE OUTCOMES:</u> <p>The learner will be able to:</p> <ol style="list-style-type: none">1. Demonstrate the understanding of various inheritance patterns through examples2. Describe and compare the different processes of development in various animals3. Explain the processes and significance of apiculture and sericulture and pest management			
Lectures per week (1 Lecture is 60 minutes)		3	
Total number of Hours in a Semester		45	
Credits		3	
Evaluation System	Semester End Examination	2 Hours	50 marks
	Internal Assessment	--	50 marks



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UNIT 1 Genetics-I (1 Credit)	1.1	Introduction to Genetics 1.1.1: Definition, Scope and Importance of Genetics 1.1.2: Classical and Modern concept of Gene 1.1.3: Brief explanation of the following terms: Allele, Wild type and Mutant alleles, Locus, Dominant and Recessive traits, Homozygous and Heterozygous, Genotype and Phenotype, Genome	15 hours
	1.2	Mendelian Genetics 1.2.1: Mendelian Genetics: Mendel's Laws of Inheritance, Monohybrid & Dihybrid Cross, 1.2.2: Test Cross, Back Cross, Reciprocal cross, significance 1.2.3: Mendelian Traits in humans	
	1.3	Exceptions to Mendelian inheritance 1.3.1: Incomplete dominance and Co-dominance, 1.3.2: Lethal Genes - Dominant, recessive and intermediate 1.3.3.: Epistasis - Recessive, Double recessive, Dominant and Double dominant	
	1.4	Pedigree Analysis: Autosomal dominant and recessive, X- linked dominant and recessive	



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UNIT 2 Developmental Biology (1 Credit)	2.1	Gametogenesis - Oogenesis and Spermatogenesis	15 hours
	2.2	Types of Egg - Based on amount and distribution of yolk	
	2.3	Structure and Types of Sperm	
	2.4	Process of fertilization - Activation of sperm, Recognition of sperm and ovum, Acrosomal reaction, Activation of ovum, Cortical reaction	
	2.5	Types of Cleavage	
	2.6	Types of Blastulae	
	2.7	Types of Gastrulae	
UNIT 3 Economic Zoology-I (1 Credit)	3.1	Honeybee – Social life and communication, life history, apiculture, pests, enemies, diseases, commercial importance	15 hours
	3.2	Silk moth – Life history, sericulture, Diseases and control measures, economic importance	
	3.3	Life history and control measures of insect pests: <i>Schistocerca gregaria</i> , Aphids, <i>Sitophilus oryzae</i>	
	3.4	Insect Pest Management - Chemical and biological control: Overview of chemical pesticides- Major classes of chemical pesticides and their mode of action	
	3.5	Biological control agents: Pathogens - Bacteria (<i>Bacillus thuringiensis</i>), Fungi, Viruses, Parasitoids	



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PRACTICAL	Semester – 3		
Course Title: Genetics-I, Developmental Biology and Economic Zoology	Course Code: SZOO233MNP		
<p><u>COURSE OUTCOMES:</u> The learner will be able to:</p> <ol style="list-style-type: none"> 1. Identify and predict the various patterns of inheritance 2. Identify and describe the various stages of development 3. Identify and describe the tools and techniques involved in apiculture, sericulture and pest management 4. Prepare field report based on observations done during field excursions 			
Lectures per week (1 Lecture is 120 minutes)		1	
Total number of Hours in a Semester		30	
Credits		1	
Evaluation System	Semester End Examination	2 Hours	50 marks
	Internal Assessment	--	

	1	Problems in genetics - Monohybrid and Dihybrid cross	30 hours
	2	Pedigree analysis	
	3	Survey of some hereditary characteristics in human population	



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4	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)	
5	Study of development of zebrafish embryo upto 72 hours (only observation without disturbing larvae)	
6	Study of development of chick embryo upto 72 hours	
7	Study of types of legs, sting apparatus and mouthparts in honeybees	
8	General tools and techniques of apiculture (Study of Bee box)	
9	Study of insect pests: <i>Schistocerca gregaria</i> , Aphids, <i>Sitophilus oryzae</i> , <i>Tribolium confusum</i>	
10	Study of insect control - chemical and biological	
11	Life cycle of silk moth	
12	Field visit and report submission	

ASSESSMENT DETAILS:

I. Internal Assessment (IA): 50 marks

II. Semester End Examination (SEE): 50 marks



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REFERENCES:

UNIT 1:

1. Gardner, E. J., Simmons, M.J. and Snustad, D.P. (2006) *Principles of Genetics*. (8th ed.). John Wiley and Sons.
2. Tamarin R.H. (2001). *Principles of Genetics*. (4th ed.). McGraw-Hill
3. Weaver R.F., Hedrick P.W. (1992). *Genetics* (2nd ed.). W.C. Brown.

UNIT 2:

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 3:

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 Publications.



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Programme: Sciences		Semester – 4	
Zoology Minor			
Course Title: Genetics-II, Cell Biology and Economic Zoology-II		Course Code: SZOO244MN	
<u>COURSE OBJECTIVES:</u>			
<ol style="list-style-type: none"> 1. To introduce the concepts of linkage, crossing over, sex determination, sex linkage, and multiple alleles and polygenic inheritance 2. To understand the cellular organization and the role played by various cell organelles 3. To gain knowledge about various cattle breeds and scope of dairy industry 			
<u>COURSE OUTCOMES:</u>			
The learner will be able to:			
<ol style="list-style-type: none"> 1. Describe the various mechanisms of linkage, crossing over, sex related inheritance patterns, and multiple allelic and polygenic inheritance 2. Explain the ultrastructure and functions of various cell organelles 3. Describe various cattle breeds and relate the knowledge of scope of dairy industry in the Indian context 			
Lectures per week (1 Lecture is 60 minutes)		3	
Total number of Hours in a Semester		45	
Credits		3	
Evaluation System	Semester End Examination	2 Hours	50 marks
	Internal Assessment	--	50 marks



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UNIT 1 Genetics-II (1 Credit)	1.1	Linkage and Crossing Over 1.1.1: Linkage in Drosophila 1.1.2: Crossing over: Process of crossing over, cytological basis of crossing over, types of crossing over	15 hours
	1.2	Sex- determination 1.2.1: Chromosomal Mechanisms: XX-XO, XX-XY, ZZ-ZO, ZZ-ZW. 1.2.2: Sex determination in Drosophila - Genic balance theory, intersex, gynandromorphs. 1.2.3: Sex determination in honey bees - Haplodiploidy, 1.2.4: Hormonal influence on sex determination-Freemartin and sex reversal 1.2.5: Role of environmental factors- Bonellia and Crocodile 1.2.6: Barr bodies and Lyon hypothesis	
	1.3	Sex linked, sex influenced and sex-limited inheritance. 1.3.1: X-Linked: Colourblindness, Haemophilia 1.3.2: Y-linked: Hypertrichosis 1.3.3: Sex-influenced inheritance 1.3.4: Sex limited inheritance	
	1.4	Multiple Alleles and Polygenic Inheritance 1.4.1: Concept of Multiple Alleles, Coat colour in	



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		<p>rabbit, ABO and Rh blood group system</p> <p>1.4.2: Polygenic inheritance with reference to skin colour and eye colour in humans, Pleiotropy</p>	
UNIT 2 Cell Biology (1 Credit)	2.1	<p>Introduction to cell biology</p> <p>2.1.1: Definition and scope</p> <p>2.1.2: Cell theory</p> <p>2.1.3: Generalized prokaryotic, eukaryotic cell: size, shape and structure</p>	15 hours
	2.2	<p>Nucleus</p> <p>2.2.1: Study of Ultrastructure - nuclear membrane and pore complex, nucleolus, structure of a metaphase chromosome, types of chromosomes</p> <p>2.2.2: Functions</p>	
	2.3	<p>Plasma membrane</p> <p>2.3.1: Ultrastructure - Fluid Mosaic Model</p> <p>2.3.2: Junctional complexes - types and functions</p> <p>2.3.3: Functions of plasma membrane including types transport across membrane</p>	
	2.4	<p>Overview of ultrastructure and functions of cell organelles:</p> <p>2.4.1: Endoplasmic reticulum</p> <p>2.4.2: Golgi Complex</p> <p>2.4.3: Lysosomes</p> <p>2.4.5: Mitochondria</p>	



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UNIT 3 Economic Zoology-II (1 Credit)	3.1	Overview of Indian Cattle Breeds - Origin, distribution, Salient features & Economic significance of: 3.1.1: Gir, Malvi, Hariyana, Deoni, Red Sindhi and Khillari 3.1.2: Nagpuri, Bhadawari, Murrah, Jafrabadi	15 hours
	3.2	Common cattle diseases and vaccination	
	3.3	Dairy Processing: Filtration, cooling, chilling, clarification, pasteurization, freezing	
	3.4	Milk and milk products: Composition of milk, Types of milk - Buffalo milk & Cow milk (A1 and A2), Whole milk and toned milk, Milk products	
	3.5	Dairy development in India: Role of dairy development in rural economy, employment opportunities	



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Programme: Sciences		Semester – 4	
Zoology Minor			
PRACTICAL COURSE: Genetics-II, Cell Biology and Economic Zoology-II		Course Code: SZOO244MNP	
<u>COURSE OUTCOMES:</u>			
The learner will be able to :			
<ol style="list-style-type: none"> 1. Solve problems based on sex linked and multiple allele inheritance 2. Perform experiments based on cell biology 3. Demonstrate dairy science related experiments 4. 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		30	
Credits		1	
Evaluation System	Summative Assessment	2 Hours	50 marks
	Continuous Assessment	--	--

Practicals (1 Credit)	1	Problems in genetics - X- linked inheritance and Multiple alleles	30 hours
	2	Study of inheritance in Drosophila - eye colour and wing morphology	
	3	Detection of blood groups	
	4	Temporary preparation of Barr bodies	



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5	Study of polytene chromosome
6	Study of mitosis- temporary squash preparation of onion root tip
7	Extraction of casein from milk and its qualitative test
8	Preparation of milk products from given milk sample
9	Determination of quality of milk by MBRT test
10	Measurement of density of milk of different samples by Lactometer
11	Breeds of Indian cows and buffaloes
12	Field visit and report submission

ASSESSMENT DETAILS:

I. Internal Assessment (IA): 50 marks

II. Semester End Examination (SEE): 50 marks

REFERENCES:

UNIT 1:

1. Hartwell, L. H., Hood, L., Goldberg, M. L., Reynolds, A. E., & Silver, L. M. (2021). *Genetics: From Gene to Genome* (7th ed.). McGraw Hill Education.
2. Gardner, E. J., Simmons, M. J., & Snustad, D. P. (2006). *Principles of Genetics*. (8th ed.). John Wiley and Sons.
3. Pierce, B. A. (2017). *Genetics: A Conceptual Approach*. (6th ed.). W.H. Freeman and Company, New York.



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4. Russel, P. J. (2006). *Genetics: A Mendelian Approach*. Pearson Benjamin Cummings.
5. Strickberger, M. W. (2015). *Genetics*. (3rd ed.). Pearson Education India
6. Weaver, K. F., & Hedrick. (1992). *Genetics*. (2nd ed.). McGraw Hill Education.

UNIT 2:

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 3:

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,