

**Ahmednagar Jilha Maratha Vidya Prasarak Samaj's
New Arts, Commerce, and Science College, Ahmednagar
(Autonomous)
(Affiliated to Savitribai Phule Pune University, Pune)**



**National Education Policy (NEP)
Choice Based Credit System (CBCS)**

**Programme Skeleton and Syllabus of
B.Sc. Zoology (Major) - II Year**

Implemented from

Academic Year 2024-25

Credit Distribution: B.Sc. Zoology (Major) including Minor and OE and other courses.

	Type of Courses	III Yr	IV Yrs (Honours)	IV Yrs Research
Major Marathi	Discipline-Specific Courses (DSC)	46	74	66
	Discipline Specific Elective (DSE)	08	16	16
	Skill Enhancement Courses (SEC)	06	06	06
	Vocational Skill Courses (VSC)	08	08	08
	On-Job Training (OJT)	04	08	04
	Field Project (FP)	04	04	04
	Community Engagement and Service (CEP)	02	02	02
	Research project	00	00	12
	Research Methodology	00	04	04
	Indian Knowledge System	02	02	02
	Total (I, II and III Year)	80	124	124
Minor	Minor	20	20	20
Other Courses	Open Elective (OE)/ Multidisciplinary Courses	12	12	12
	Co-Curricular Courses	08	08	08
	Ability Enhancement Courses	08	08	08
	Value Education Courses	04	04	04
	Total	132	176	176

B. Sc. Programme Framework: Credit Distribution

Year	Semester	Level	Major										Minor	OE	CC	ABC	VEC	Total	
			DSC		DSE		SEC		VSC		FP/OJT /IN/CEP								IKS
			T	P	T	P	T	P	T	P	T	P		T/P	-	-	-	-	-
I	I	4.5	4	2	-	-	-	2	-	-	-	-	2	03	3	2	2	2	22
I	II	4.5	6	-	-	-	2	-	2	-	-	-	03	3	2	2	2	2	22
Exit Option: Award of UG Certificate in Major with 44 credits and an additional 4 credit core NSQF course /Internship or Continue with Major and Minor																			
II	III	5.0	6	2	-	-	2	-	-	-	2		03	3	2	2	-	-	22
II	IV	5.0	6	2	-	-	-	-	2	-	2		03	3	2	2	-	-	22
Exit Option: Award of UG Diploma in Major with 88 credits and an additional 4 credit core NSQF course /Internship or Continue with major and minor																			
III	V	5.5	8	2	2	2	-	-	-	2		2	04	-	-	-	-	-	22
III	VI	5.5	6	2	2	2	-	-	-	2		4	04	-	-	-	-	-	22

Exit Option: Award of UG Degree in Major and Minor with 132 credits or continue with Major for a 4-year Degree																			
IV	VII	6.0	8	6	2	2	RM-4	-	-	-	-		-	-	-	-	-	-	22
IV	VII I	6.0	8	6	2	2	-	-	-	-	-	4		-	-	-	-	-	22
Four Year UG Degree(Honours) with Major and Minor with 176 credits																			
IV	VII	6.0	6	4	2	2	RM-4	-	-	-	4		-	-	-	-	-	-	22
IV	VII I	6.0	6	4	2	2	-	-	0	-	-	8		-	-	-	-	-	22
Four Year UG Degree (Honours with Research) with Major and Minor with 176 credits																			

B. Sc. Programme Framework: Course Distribution

Year	Semester	Level	Major											Minor	OE	CC	AEC	VEC	Total	
			DSC		DSE		SEC		VSC		FP/OJT /IN/CEP		IKS							
I	-	-	T	P	T	P	T	P	T	P	T	P		T	P	-	-	-	-	-
I	I	4.5	2	1	-	-	-	1	-	-	-	-	1	1	1	1	1	1	1	10
	II	4.5	2	-	-	-	1	-	1	-	-	-	1	1	1	1	1	1	09	
Exit Option: Award of UG Certificate in Major with 44 credits and an additional 4 credit core NSQF course /Internship or Continue with major and minor																				
II	III	5.0	2	1	-	-	-	1	-	-	-	1	1	1	1	1	1	-	09	
II	IV	5.0	2	1	-	-	-	-	1	-	1	1	1	1	1	1	1	-	09	
Exit Option: Award of UG Diploma in Major with 88 credits and an additional 4 credit core NSQF course /Internship or Continue with major and minor																				
III	V	5.5	2	1	1	1	-	-	-	1	1	1	1	1	-	-	-	-	08	
III	VI	5.5	2	1	1	1	-	-	-	1	1	1	1	1	-	-	-	-	08	
Exit Option: Award of UG Degree in Major and Minor with 132 credits or continue with Major for a 4-year Degree																				

IV	VII	6.0	3	3	1	1	0	1	-	-	-	-	-	-	-	-	-	-	09
IV	VII I	6.0	3	3	1	1	-	-	-	-	-	1	-	-	-	-	-	-	09
Four Year UG Degree(Honours) with Major and Minor with 176 credits																			
IV	VII	6.0	2	2	1	1	0	1	-	-	-	1	-	-	-	-	-	-	08
IV	VII I	6.0	2	2	1	1	-	-	-	-	-	1	-	-	-	-	-	-	07
Four Year UG Degree (Honours with Research) with Major and Minor with 176 credits																			

Programme Framework (Course Distribution): B.Sc. Zoology (Major)

Year	Semester	Level	Major											Total		
			DSC		DSE		SEC		VSC		FP/OJT /IN/CEP/PR		IKS	T	P/PR	
			T	P	T	P	T	P	T	P	T	P	T			
I	I	4.5	2	1	-	-	-	1	-	-	-	-	-	01	03	02
I	II	4.5	2	-	-	-	1	-	1	-	-	-	-	-	02	02
II	III	5.0	2	1	-	-	1	-	-	-	1	-	-	02	03	
II	IV	5.0	2	1	-	-	-	-	1	-	1	-	-	02	03	
III	V	5.5	2	1	1	1	-	-	-	1	-	1	-	03	04	
III	VI	5.5	2	1	1	1	-	-	-	1	-	1	-	03	04	
B.Sc. Honours																
IV	VII	6.0	3	3	1	1	RM-1	-	-	-	-	-	-	05	04	
IV	VIII	6.0	3	3	1	1	-	-	-	-	-	1	-	04	05	
B.Sc. Honours with Research																
IV	VII	6.0	2	2	1	1	RM-1	-	-	-	1	-	-	04	04	
IV	VIII	6.0	2	2	1	1	-	-	-	-	-	1	-	03	04	

Programme Framework (Credit Distribution): B.Sc. Zoology (Major)

Year	Semester	Level	Major											Total	
			DSC		DSE		SEC		VSC		FP/OJT /IN/CEP/RP		IKS		
			T	P	T	P	T	P	T	P	T	P	T		
I	I	4.5	4	2	-	-	-	2	-	-	-	-	-	02	10

I	II	4.5	6	-	-	-		2	-	2	-	-		10
II	III	5.0	6	2	-	-		2	-	-	-	2		12
II	IV	5.0	6	2	-	-		-	-	2	-	2		12
III	V	5.5	8	2	2	2	-	-	-	2		2		18
III	VI	5.5	6	2	2	2	-	-	-	2		4		18
IV	VII	6.0	8	6	2	2	RM-4		-	-	-	-		22
IV	VIII	6.0	8	6	2	2	-	-	-	-	-	4		22
IV	VII	6.0	6	4	2	2	RM-4		-	-	-	4		22
IV	VIII	6.0	6	4	2	2	-	-	-	-	-	8		22

Programme Framework (Courses and Credits): B.Sc. Zoology (Major)

Sr. No.	Year	Semester	Level	Course Type	Course Code	Title	Credits
1.	I	I	4.5	DSC-1	BS-ZO111T	Basic Zoology	02
2.	I	I	4.5	DSC-2	BS-ZO112T	Cell Biology	02
3.	I	I	4.5	DSC-3	BS-ZO113P	Zoology Practical Paper I	02
4.	I	I	4.5	SEC-1	BS-ZO114P	Laboratory Techniques-I	02
5.	I	I	4.5	IKS-1	BS-ZO115T	Animal Husbandry techniques in Ancient India	02
6.	I	II	4.5	DSC-4	BS-ZO121T	Mammalian Physiology	03
7.	I	II	4.5	DSC-5	BS-ZO122T	Genetics	03
8.	I	II	4.5	SEC-2	BS-ZO123P	Zoology Practical Paper - II	02
9.	I	II	4.5	VSC-1	BS-ZO124P	Laboratory Techniques- II	02
10.	II	III	5.0	DSC-6	BS-ZO231T	Animal Systematics and Diversity-I	03
11.	II	III	5.0	DSC-7	BS-ZO232T	Biological Techniques	03
12.	II	III	5.0	DSC-8	BS-ZO233P	Zoology Practical Paper – III	02
13.	II	III	5.0	SEC-3	BS-ZO234P	Zoology Practical Paper - IV	02
14.	II	III	5.0	FP-01	BS-ZO235P	Field Project	02
15.	II	IV	5.0	DSC-9	BS-ZO241T	Animal Systematics and Diversity-II	03
16.	II	IV	5.0	DSC-10	BS-ZO242T	Parasitology	03
17.	II	IV	5.0	DSC-11	BS-ZO243P	Zoology Practical Paper - V	02
18.	II	IV	5.0	VSC-2	BS-ZO244P	Zoology Practical Paper - VI	02
19.	II	IV	5.0	CEP-01	BS-ZO245P	Community Engagement Programme and Service	02
20.	III	V	5.5	DSC-12	BS-ZO351T	Animal Biology & Ecology	04
21.	III	V	5.5	DSC-13	BS-ZO352T	Biochemistry and Molecular Biology	04
22.	III	V	5.5	DSC-14	BS-ZO353P	Zoology Practical Paper - VII	02

23.	III	V	5.5	DSE-01	BS-ZO354T	Applied Zoology	02
24.	III	V	5.5	DSE-02	BS-ZO355P	Zoology Practical Paper – VIII	02
25.	III	V	5.5	VSC-3	BS-ZO356P	Zoology Practical Paper- IX	02
26.	III	V	5.5	FP-02	BS-ZO357P	Field Project	02
27.	III	VI	5.5	DSC-15	BS-ZO361T	Developmental Biology and Evolution	03
28.	III	VI	5.5	DSC-16	BS-ZO362T	Histology and Histochemistry	03
29.	III	VI	5.5	DSC-17	BS-ZO363P	Zoology Practical Paper- X	02
30.	III	VI	5.5	DSE-03	BS-ZO364T	Entomology	02
31.	III	VI	5.5	DSE-04	BS-ZO365P	Zoology Practical Paper- XI	02
32.	III	VI	5.5	VSC-4	BS-ZO366P	Zoology Practical Paper- XII	02
33.	III	VI	5.5	OJT-01	BS-ZO367P	On Job Training	04

B.Sc. Zoology (Major with Honours)

34.	IV	VII	6.0	DSC-18	BS-ZO471T	Comparative Animal Physiology	03
35.	IV	VII	6.0	DSC-19	BS-ZO472T	Cell and Molecular Biology	03
36.	IV	VII	6.0	DSC-20	BS-ZO473T	Economic Zoology	02
37.	IV	VII	6.0	DSC-21	BS-ZO474P	Zoology Practical Paper - XIII	02
38.	IV	VII	6.0	DSC-22	BS-ZO475P	Zoology Practical Paper - XIV	02
39.	IV	VII	6.0	DSC-23	BS-ZO476P	Zoology Practical Paper - XV	02
40.	IV	VII	6.0	DSE-05	BS-ZO477T	Biochemistry/Metabolic Pathways	02
41.	IV	VII	6.0	DSE-06	BS-ZO478P	Zoology Practical Paper - XVI	02
42.	IV	VII	6.0	RM-01	BS-ZO479T/P	Research Methodology	04
43.	IV	VIII	6.0	DSC-24	BS-ZO481T	Genetics and Biostatistics	03
44.	IV	VIII	6.0	DSC-25	BS-ZO482T	Endocrinology and Bioinformatics	03
45.	IV	VIII	6.0	DSC-26	BS-ZO483T	Developmental Biology	02
46.	IV	VIII	6.0	DSC-27	BS-ZO484P	Zoology Practical Paper - XVII	02

47.	IV	VIII	6.0	DSC-28	BS-ZO485P	Zoology Practical Paper - XVIII	02
48.	IV	VIII	6.0	DSC-29	BS-ZO486P	Zoology Practical Paper - XIX	02
49.	IV	VIII	6.0	DSE-07	BS-ZO487T	Ethology	02
50.	IV	VIII	6.0	DSE-08	BS-ZO488P	Zoology Practical Paper - XX	02
51.	IV	VIII	6.0	OJT-02	BS-ZO489P	On Job Training	04

B.Sc. Zoology (Major Honours with Research)

52.	IV	VII	6.0	DSC-20	BS-ZO471T	Comparative Animal Physiology	03
53.	IV	VII	6.0	DSC-21	BS-ZO472T	Cell and Molecular Biology	03
54.	IV	VII	6.0	DSC-22	BS-ZO473P	Zoology Practical Paper- XIII	02
55.	IV	VII	6.0	DSC-23	BS-ZO474P	Zoology Practical Paper-XIV	02
56.	IV	VII	6.0	DSE-05	BS-ZO475T	Biochemistry / Metabolic Pathways	02
57.	IV	VII	6.0	DSE-06	BS-ZO476P	Zoology Practical Paper- XV	02
58.	IV	VII	6.0	RM-01	BS-ZO477T	Research Methodology	04
59.	IV	VII	6.0	RP-1	BS-ZO478P	Research Project	04
60.	IV	VIII	6.0	DSC-20	BS-ZO481T	Genetics and Biostatistics	03
61.	IV	VIII	6.0	DSC-21	BS-ZO482T	Endocrinology and Bioinformatics	03
62.	IV	VIII	6.0	DSC-22	BS-ZO483P	Zoology Practical Paper- XVI	02
63.	IV	VIII	6.0	DSC-23	BS-ZO484P	Zoology Practical Paper- XVII	02
64.	IV	VIII	6.0	DSE-07	BS-ZO485T	Developmental Biology/ Ethology	02
65.	IV	VIII	6.0	DSE-08	BS-ZO486P	Zoology Practical Paper- XVIII	02
66.	IV	VIII	6.0	RP-02	BS-ZO487P	Research Project	08

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's
New Arts, Commerce and Science College, Ahmednagar
(Autonomous)

Board of Studies in Zoology

Sr. No.	Name	Designation
1.	Prof. Pokale S. N.	Chairman
2.	Dr. Harkal A. D.	Member
3.	Mr. Wakchoure G. G.	Member
4.	Ms. Devdhe G. R.	Member
5.	Ms. Mote S. S.	Member
6.	Ms. Dongare P. N.	Member
7.	Ms. Kalapure P. P.	Member
8.	Prof. R. J. Chavan	Academic Council Nominee
9.	Prof. S. S. Nanware	Academic Council Nominee
10.	Dr. S. S. Teradalkar	Vice-Chancellor Nominee
11.	Prof. B. A. Pawar	Alumni
12.	Mrs. Manjushree Tadvalkar	Industry Expert
13.	Mrs. S. P. Salve	Invitee

1. Prologue

Zoology is one of the major subjects of Basic Sciences and deals with all aspects of animal biology. It includes an interesting range of highly diverse topics. A zoology student needs to understand many areas of the subject to keep pace with advancements in Life Sciences. The Board of Studies has designed this under-graduate degree program in Zoology of New Arts, Commerce and Science College, Ahmednagar (Autonomous) with a substantial component of zoologists' needs as a skilled career zoologists need to pursue post-graduation and further academic studies. It follows the guidelines laid down by the University Grants Commission, New Delhi. This newly designed curriculum under National Education Policy 2020 is a perfect blend of the

classical aspects in Zoology and the advanced and more specialized areas. This degree offers Discipline Specific Core Courses [DSC] in Basic Zoology, Animal Physiology, Cell Biology, Animal Systematics and Diversity, Parasitology and Genetics. In the third year, i.e., Semester V and Semester VI, Discipline-specific Courses [DSC], Discipline Specific Elective [DSE], Skill Enhancement Courses [SEC], Vocational Skill Courses [VSC], Indian Knowledge System [IKS] and Field Project [FP] have been offered. The DSC courses are Animal Biology and Ecology, Mammalian Histology, Applied Zoology, Biochemistry, Developmental Biology, Evolutionary Biology and Entomology. The SEC courses are Medical Laboratory Techniques. According to NEP 2020, IKS is the new introductory course. The IKS course is Animal Husbandry in Ancient India. In Semester II and III, the students also have a course dedicated to Field work and in VI semester the students are also offered for On Job Training programme.

The syllabus has been framed so that the student gains each year a broader perspective of the subject as he/ she progresses towards completion of the degree program. Field trips, educational visits and Project work have been included to experience the applications of the theory learned in the classroom. After completing the program, it is expected that students will understand and appreciate: animal diversity, a few applications of Zoology, the Structure, functions and life processes at cellular, tissue, organ and system levels, the significance of evolution, and basic concepts of human health. The students would also gain an insight into laboratory and fieldwork through the practical course, fieldwork and the project. Presenting this new syllabus to the teachers and students of B.Sc. Zoology I, we are delighted to state that efforts have been made to seek the input of all the stakeholders to make it more relevant. The new course will be effective from 2023-2024 and will follow the National Education Policy 2020 in a Semester mode. It has been primed keeping in view the distinctive requirements of B.Sc. Zoology students. The contents have been drawn up to accommodate the widening prospects of the discipline of Life Sciences. They reflect the changing prerequisites of the students. The B. Sc. Zoology programme will offer 132 credits for three - year degree programme and 176 credits for the 04-year degree programme. This pattern has been specially aimed towards the overall development of the students. The calculation of credits and CGPA will be as per the guidelines of the Academic council. The B.Sc. Zoology program provides an appropriate blend of classical and applied aspects of the subject. This newly designed

curriculum will allow students to acquire the skill in handling scientific instruments, planning and performing in the laboratory and exercising critical judgment, independent thinking and problem-solving skills.

2. Programme Outcomes (POs)

- a. **Disciplinary knowledge and skills:** Capable of demonstrating comprehensive knowledge and understanding of major concepts, theoretical principles and experimental findings in Zoology and its different subfields and other related fields of study, including broader interdisciplinary subfields.
- b. **Skilled communicator:** Ability to impart complex technical knowledge relating to Zoology clearly and concisely in writing and oral skills.
- c. **Critical thinker and problem solver:** Ability to have critical thinking and efficient problem-solving skills in the basic areas of Zoology
- d. **Sense of inquiry:** Capability for asking relevant/appropriate questions relating to issues and problems in the field of Zoology, and planning, executing and reporting the results of an experiment or investigation.
- e. **Team player/worker:** Capable of working effectively in diverse classroom, laboratory, industry, and field-based situations.
- f. **Skilled project manager:** Capable of identifying/mobilizing appropriate resources required for a project and managing a project to completion while observing responsible and ethical scientific conduct; and safety and chemical hygiene regulations and practices.
- g. **Digitally literate:** Capable of using computers for Bioinformatics and computation and appropriate software for analysis of genomics and proteomics data, and employing modern bioinformatics search tools to locate, retrieve, and evaluate the location and biological annotation genes of different species.
- h. **Ethical awareness/reasoning:** Capable of conducting their work with honesty and precision, thus avoiding unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, and appreciating environmental and sustainability issues.
- i. **Lifelong learners:** Capable of self-paced and self-directed learning aimed at personal development and improving knowledge.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's
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(Autonomous)
Syllabus
B.Sc. Zoology (Major)

Title of the Course: Animal Systematics and Diversity-I								
Year: II				Semester: III				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-6	BS-ZO231T	03	00	03	45	30	70	100

Learning Objectives:

1. To learn the distinguishing characteristics of nonchordates.
2. To learn the classification of nonchordates up to class level.
3. To learn economic importance and some special topics of nonchordates

Course Outcomes (Cos)

1. To understand the distinguishing characteristics of nonchordates.
2. To understand the classification of nonchordates up to class level.
3. To understand economic importance and some special topics of nonchordates

Detailed Syllabus: Example

Unit	Topic	Alloted Lectures
1.	Animal Like Protists: Protozoans General Characters of Protista with particular emphasis on Protozoans. Classification: Super Group Excavata, Super Group 'SAR' Clade, Super Group Unikonta. Structural Organization and Function in Protozoa. Body Forms, Nutrition, Osmoregulation and Excretion, Respiration. The Mechanism for Response, Reproduction in Protozoa. Locomotion in Protozoans: Structure and Function of Cilia, Flagella and Pseudopodia. Economic importance of Protozoa.	05
2.	Origin and Diversification of Metazoa: Origin of Multicellularity, Diversification, and Phylogeny of Animals	01
3.	Phylum Porifera Characteristic Features of Phylum Porifera. Classification of Phylum Porifera: Calcarea, Hexactinellida, Demospongiae, and Sclerospongiae.	05

	Types of Canal System: Asconoid, Syconoid, Leuconoid, and Rhagon Skeleton in Porifera. External Morphology and Cell types in Sycon.	
4.	Phylum Cnidaria Characteristic Features of Phylum Cnidaria. Classification of Phylum Cnidaria: Hydrozoa, Scyphozoa, and Anthozoa. Polymorphism in Cnidaria. External Morphology and Life Cycle of Hydra (Short Introduction) Coral and coral reefs.	05
5.	Phylum Platyhelminthes Characteristic Features of Phylum Platyhelminthes. Classification of Phylum Platyhelminthes: Turbellaria, Trematoda, and Cestoda. External Morphology and Life Cycle of <i>Fasciola hepatica</i> (Short Introduction). Economic importance of Platyhelminthes.	05
6.	Phylum Aschelminthes Characteristic Features of Phylum Aschelminthes. Classification of Phylum Aschelminthes: Introduction to Psuedocoelomates with particular emphasis on Nematodes. External Morphology and Life Cycle of <i>Ascaris lumbricoides</i> (Short Introduction). Economic importance of Nematoda.	04
7.	Phylum Annelida Characteristic Features of Phylum Annelida. Classification of Phylum Annelida. Concept of Coelom (Schizocoelom). Metamerism in Annelida. External morphology and excretion in Earthworm.	05
8.	Phylum Arthropoda Characteristic Features of Arthropoda. Outline classification of Phylum Arthropoda: Subphylum Trilobitomorpha, Chelicerata, Crustacea and Uniramia External morphology and Caste system in Honey Bee Life Cycle of Silkworm (In Short) Ecdysis in Crustacea Economic importance of Arthropoda	05
9.	Phylum Mollusca Characteristics of Mollusca A Generalized Molluscan structure Outline classification of Phylum Mollusca: Class- Monoplacophora, Polyplacophora Aplacophora, Gastropoda, Bivalvia, Scaphopoda, and Cephalopoda Torsion in Mollusca Pearl formation in Mollusca Economic Importance of Mollusca	05
10.	Phylum Echinodermata Characteristic Features of Phylum Echinodermata Outline classification of Phylum Echinodermata: Class- Asteroidea, Ophiuroidea, Echinoidea, Holothuroidea, Crinoidea	05

	External Morphology of Sea Star Water Vascular System in Sea Star Larval forms in Echinodermata	
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Suggested Readings/Material:

1. Barnes, R.D. (1982). Invertebrate Zoology, V Edition. Holt Saunders International Edition.
2. Hadzi, J (1963): The Evolution of Metazoa, Macmillan Newyork.
3. Hyman. L. H (1955): The Invertebrates Vol: I-X, Mcgraw Hill, Newyork.
4. Modern Text-Book of Zoology, Invertebrates. By Kotpal, RL., Rastogi and Co., Meerut.
5. Nigam H.C., Zoology of Nonhordates, Vishal Publication, Jalandhar-144008.
6. Kotpal, RL. Rastogi Phylum Protozoa to Echinodermata (series), Meerut
7. Parker T.J and W.A Haswell (1972): A textbook of Zoology, Vol –I (7th edition by Marshall and Williams) Mcmillan Press ltd.
8. Jordan, E.L. and P.S.Verma Invertebrate Zoology, S. Chand and Co., Ltd. Ram Nagar, New Delhi.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's
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Syllabus
B.Sc. Zoology (Major)

Title of the Course: Biological Technique								
Year: II				Semester: III				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-	BS-ZO 232T	03	00	03	45	30	70	100

Learning Objectives:

1. To learn the basic laboratory skills
2. To learn laboratory tools and techniques in Zoology
3. To learn the use of computers in zoology

Course Outcomes (Cos)

1. To understand the basic laboratory skills
2. To understand laboratory tools and techniques in Zoology
3. To understand the use of computers in zoology

Detailed Syllabus:

Unit	Name of Topic	Lectures Allotted
1.	Introduction to scientific apparatus: Glass apparatus, miscellaneous apparatus, Apparatus for Heating, Types of Volume Measuring Devices, Burette, Pipette, and Volumetric Flask, Balances, Care, and maintenance of laboratory apparatus	(04)
2.	Preparations of solutions: Percent, Molar, Normal solution. PPM, PPB solutions, serial dilution.	(04)
3.	Microscopy and micrometry Introduction to Microscopy. Definitions-Resolving Power, Limit of Resolution and Magnification, Numerical Aperture. Basic principles of Light, Electron, and Fluorescence microscope, Basic	(06)

- Instrumentation of Compound and Electron Microscope (TEM and SEM), Applications of microscopes: Light, Electron, and Fluorescence microscope
4. **Chromatography:** (06)
Principle and Applications of Paper Chromatography, Thin Layer Chromatography, and Column Chromatography (Size Exclusion and Affinity Chromatography).
5. **Electrophoresis:** (06)
Principle and applications of Gel electrophoresis (Agarose and PAGE Electrophoresis).
6. **Colorimetry and Spectrophotometry:** (06)
Principle, instrumentation and Applications colorimeter and Spectrophotometer.
7. **Centrifugation:** (04)
Basic principle and applications of centrifuge.
Type of ultracentrifuge
8. **Hematological techniques:** (04)
RBC counting, WBC counting, and Hb estimation.
9. **Introduction to Bioinformatics** (05)
Basic features and management systems of the following: Nucleic acid sequences databases, Genome databases, Protein sequence, structures and interacting proteins databases, Literature databases, Biodiversity and ecosystem-based databases. Introduction to data retrieval systems, Search engines, Entrez, sequence retrieval system (SRS) and protein identification resource (PIR).

Suggested Readings/Material:

1. Upadhyay & Nath Biophysical Chemistry (Principles and Techniques) - Himalaya Publishing House.
2. D. Freifelder. Biophysical chemistry. W.H. Freeman
3. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology.
4. Ghatak K. L. Techniques and Methods in Biology: Prentice Hall India Learning Private Limited.

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Title of the Course: Zoology Lab-I								
Year: II				Semester: III				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-8	BS-ZO233P	00	02	02	60	15	35	50

Learning Objectives:

1. To learn the classification and diversity of nonchordates
2. To learn the principles of tools and techniques in zoology
3. To learn the applications of tools and techniques in zoology

Course Outcomes (Cos)

1. To understand the classification and diversity of nonchordates
2. To understand the principles of tools and techniques in zoology
3. To understand the applications of tools and techniques in zoology

Detailed Syllabus: (Any 12)

Unit	Name of Topic	Lectures Allotted
1.	Museum Study of phylum Protista: <i>Paramecium</i> , <i>Plasmodium</i> , <i>Amoeba</i>	01
2.	Museum Study of Phylum Porifera: <i>Leucosolenia</i> , <i>Sycon</i> and <i>Spongilla</i>	01
3.	Museum study of phylum Cnidaria: <i>Hydra</i> , <i>Obelia</i> and <i>Madripora</i>	01
4.	Museum Study of phylum Platyhelminthes: <i>Planaria</i> , <i>Fasciola hepatica</i> , <i>Taenia solium</i>	01
5.	Museum Study of phylum Aschelminthes: <i>Ascaris lumbricoides</i>	01
6.	Museum Study of phylum Annelida: <i>Nereis</i> , Earthworm and <i>Hirudinaria</i>	01

7. Museum Study of Phylum Arthropoda: *Peripatus*, Honey bee, Centipede, Millipede, Crab. **01**
8. Museum study of Phylum Mollusca: Pila, Chiton, Bivalve, Octopus. **01**
9. Museum study of Phylum Echinodermata: Sea Star, Sea Urchin, Brittle Star, Sea Cucumber. **01**
10. Introduction and applications of glass apparatus in laboratory **(01)**
11. Demonstration of DNA separation by gel Electrophoresis **(01)**
12. Preparation of solution and its standardization by acid-base titration **(01)**
13. Instrumentation and applications of Gel Electrophoresis: **(01)**
14. Instrumentation and applications of Column Chromatography **(01)**
15. Separation of amino acids by paper chromatography/thin layer chromatography **(01)**
16. Instrumentation and applications of Colorimeter and Spectrophotometer **(01)**
17. Estimation of Hemoglobin by haemoglobinometer **(01)**
18. WBC counting by hemocytometer method **(01)**
19. Principle and operation of Centrifuge **(01)**

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Title of the Course: Zoology Lab-II								
Year: II				Semester: III				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
SEC-3	BS-ZO 234P	00	02	02	60	15	35	50

Learning Objectives:

1. To learn skills in analyzing abiotic factors of aquatic ecosystems.
2. To learn skills in analyzing abiotic factors of terrestrial ecosystems.
3. To learn skills in applications of basic statistical tools in research.

Course Outcomes (Cos)

1. To understand skills in analyzing abiotic factors of aquatic ecosystems.
2. To understand skills in analyzing abiotic factors of terrestrial ecosystems.
3. To understand skills in applications of basic statistical tools in research.

Detailed Syllabus: (Any 12)

Unit	Name of Topic	Lectures Allotted
1.	Water Sample Analysis: Temperature, pH, Turbidity	01
2.	Water Sample Analysis: Dissolved Oxygen	01
3.	Water Sample Analysis: Dissolved Co ₂	01
4.	Water Sample Analysis: Hardness	01
5.	Water Sample Analysis: Alkalinity	01
6.	Water Sample Analysis: Primary Productivity	01

7.	Water Sample Analysis: Zooplankton	01
8.	Soil Analysis: pH and Water Holding Capacity	01
9.	Soil Analysis: Calcium	01
10.	Soil Analysis: Magnesium	01
11.	Determination of population density, frequency and abundance in a natural/hypothetical community by quadrat method	01
12.	measures of central tendency (Mean, median and mode)	01
13.	Measures of dispersion (range, quartile deviation, mean deviation and standard deviation)	01
14.	Hypothesis and hypothesis testing using t-test	01
15.	Hypothesis and hypothesis testing using the Chi-square test	01
16.	Graphical representation of data (Frequency polygon and Histogram).	01

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Title of the Course: Field Project								
Year: II				Semester: III				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
FP-1	BS-ZO235P	00	02	02	30	15	35	50

Note: The Field Project will be implemented as per the guidelines given by the college. A separate committee is constituted for developing guidelines for Filed Projects(FP), Community Engagement Projects (CEP) and Research Projects (RP).

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Title of the Course: Animal Systematics and Diversity-II								
Year: II				Semester: IV				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-9	BS-ZO241T	03	00	03	45	30	70	100

Learning Objectives:

1. To learn the distinguishing characteristics of chordates.
2. To learn the classification of chordates up to class and subclass level.
3. To learn economic importance and some special topics of chordates

Course Outcomes (Cos)

1. To understand the distinguishing characteristics of nonchordates.
2. To understand the classification of nonchordates up to class level.
3. To understand economic importance and some special topics of nonchordates

Detailed Syllabus:

Unit	Name of Topic	Lectures Allotted
1.	Phylum Hemichordata: Characteristic features of Hemichordates External morphology of <i>Balanoglossus</i> Introduction to Classification of Phylum Hemichordata: Enteropneusta and Pterobranchia	(02)
2.	Introduction to phylum Chordata: Origin and Ancestry of Chordates. General features of Phylum Chordata Comparative features of Non-chordates and Chordates. Classification of Phylum Chordata upto Class level.	(06)
3.	Group Protochordata Introduction and characters of Group Protochordata. Classification of Group Protochordata: Subphylum Urochordata,	(04)

- Subphylum Cephalochordata.
External Morphology of *Herdmania*.
4. **Introduction to Subphylum Vertebrata** (01)
5. **Division Agnatha: Jawless Fishes** (05)
Introduction to division Agnatha. Ancestry and affinities of Agnatha. Living Jawless fishes: General Characters
External Morphology of *Petromyzon*
6. **Introduction to Gnathostomata: Jawed Vertebrates** (01)
7. **Superclass: Pisces** (06)
Introduction and Characters to Superclass Pisces.
Classification of Class Chondrichthyes, Class Osteichthyes.
External morphology of *Scoliodon*
Osmoregulation in fishes,
Migration in fishes, Economic Importance of Pisces
8. **Class: Amphibia** (07)
Introduction and general characters of class Amphibia.
External morphology and life cycle of frog
Classification of Order Amphibia: Anura, Gymnophiona and Caudata.
Parental care in Amphibia.
Neoteny and Paedogenesis in Amphibia
9. **Class: Reptilia** (08)
Characteristic features of Reptiles.
Classification of Reptiles.
Characteristic features of Order Testudines, Order Sphenodonta, Order Squamata and Order Crocodylia with one example of each.
External morphology of *Calotes*
Adaptive radiation of reptiles, temporal vacuities in reptiles.
Identification key of Venomous and Non-Venomous Snakes
10. **Class: Aves** (08)
Characteristic features of Aves.
Classification of Class Aves.
Flight adaptations in Birds
Migrations in Birds
External Morphology of *Pigeon*

11. Class: Mammalia (12)

Salient features of Mammalia. Classification
of Mammalia Adaptive radiation in Mammals
Dentition in Mammals
Economic Importance of Mammals
External morphology of Rat
Digestive System of Rat
Reproductive System (Male and Female)

Suggested Readings/Material:

1. **Modern Text-Book of Zoology, vertebrates.** By Kotpal, R.L., Rastogi and Co.,
2. **Nigam H.C., Zoology of Chordates,** Vishal Publication, Jalandhar
3. **Jordan, E.L. and P.S.Verma Chordate Zoology,** S. Chand and Co., Ltd. Ram
4. Nagar, New Delhi.
5. **Fundamentals of Zoology** Ghosh, Manna NCBA
6. **Biology of Vertebrate H.C. Nigam** Vishal Publishers
7. **Biology of Chordate H.C. Nigam** Vishal Publishers

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Title of the Course: Parasitology								
Year: II				Semester: IV				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-10	BS-ZO242T	03	00	03	45	30	70	100

Learning Objectives:

1. To learn basic concepts in parasitology
2. To learn about parasites of humans and economically important animals.
3. To learn about basic concepts in immunology

Course Outcomes (Cos)

- 1 To understand basic concepts in parasitology
2. To understand about parasites of humans and economically important animals.
3. To understand about basic concepts in immunology

Detailed Syllabus:

Unit	Name of Topic	Lectures Allotted
1.	Introduction Definition: host, parasite, vector, commensalism, mutualism and parasitism	(03)
2.	Types of Parasites and Hosts: Ectoparasites. Endoparasites and their subtypes. Types of hosts - Intermediate, definitive, paratenic and reservoir. Host-Parasite relationship	(04)
3.	Host specificity. Types of host specificity: structural specificity, physiological specificity and ecological specificity.	(05)

Effects of parasites on the host.

- Immunity to parasites
4. **Study of Parasitic Protists:** (06)
- Entamoeba histolytica* - Morphology, Life Cycle, Prevalence
Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment.
- Plasmodium vivax* - Morphology, Life Cycle Prevalence Epidemiology,
Pathogenicity, Diagnosis, Prophylaxis and Treatment
5. Study of Parasitic worms: (07)
- Taenia solium* (Tapeworm) - Study of Morphology, Life Cycle,
Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and
Treatment.
- Ascaris lumbricoides* - Study of Morphology, Life Cycle, Prevalence.
Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment.
6. Study of Parasitic Arthropoda: (12)
- Morphology, pathogenicity and control measures of –
- Soft tick. (*Argas persicus*)
- Head louse. (*Pediculus humanus*)
- Rat flea. (*Xenopsylla cheopis*)
- Bed bug. (*Cimex lectularius*)
- Mite (*Sarcoptes scabiei*).
7. Parasitological significance of domestic, wildlife and (03)
zoonosis: Bird flu, Anthrax, Rabies and Toxoplasmosis
8. Introduction to Immune System: (05)
- Overview of the Immune System
- Introduction to basic concepts in immunology
- Components of the immune system
- Principles of innate and adaptive immune system
- Cells and organs of the immune system. Haematopoiesis

Suggested Readings/Material:

1. Parasitology: K. D. Chatterjee.
2. Parasites: ecology, diseases, and management (2013).
3. Parasitic Helminths: Targets, Screens, Drugs, and Vaccines, 201.
4. Parasitism: The Diversity and Ecology of Animal Parasites (2014) Tim Goater, Timothy M. Goater, Cameron P. and Esch, Gerald W. Cambridge University Press.
5. Principles of Veterinary Parasitology (2016), 1 st Edn, Dennis E. Jacobs, Mark Fox, Lynda M. Gibbons, Carols Hermosilla, John Wiley & Sons.
6. Veterinary Parasitology (2013), Hany M. Elsheikha, Jon S. Patterson, CRC Press Taylor & Francis Group
7. Textbook of medical parasitology – C. K. Jayaram Panikar.
8. Textbook of medical parasitology – Arora & Arora.
9. Textbook of medical parasitology – S. C. Parija.
10. Veterinary Parasitology, 2013 - (Taylor, M. A.).

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Title of the Course: Zoology Lab-III								
Year: II				Semester: IV				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-11	BS-ZO123P	00	02	02	60	15	35	50

Learning Objectives:

1. To learn the classification and diversity of chordates
2. to learn the dissection of a hen for gut parasites
3. To learn the life cycle, pathogenicity and treatment for parasites of human and domestic animals.
- 3.

Course Outcomes (Cos)

1. To understand the classification and diversity of chordates
2. to understand the dissection of a hen for gut parasites
3. To understand the life cycle, pathogenicity and treatment for parasites of human and domestic animals.

Detailed Syllabus:

Sr. No.	Practical	Practicals
1.	Museum study of Phylum Hemichordata: <i>Balanoglossus</i> ,	01
2.	Museum study of Phylum Hemichordata of group Protochordata: <i>Herdmania</i> , and division Agnatha: <i>Petromyzon</i> . (D)	01
3.	Museum study of Superclass Pisces: <i>Labeo</i> , <i>Scoliodon</i> , <i>Hippocampus</i> .	01
4.	Museum study of Class Amphibia: <i>Salamandra</i> , <i>Rana</i> , <i>Ichthyophis</i> . (D)	01
5.	Study of types of scales in fishes: Placoid scale, Cycloid scale, Ctenoid scale & Ganoid scale.	01
6.	Study of types of tail in fishes: Homocercal, Heterocercal & Diphycercal.	01
7.	Museum Study of Class Reptilia	01
8.	Identification of Venomous & Non – venomous snakes with the help of pictorial taxonomic keys (D)	01

- | | | |
|-----|---|----|
| 9. | Museum study of Class Aves: Crow, Kingfisher & Duck (D) | 01 |
| 10. | Study of types of beaks & feet in birds – Any two each (D) | 01 |
| 11. | Museum study of class Mammalia: Rat, Shrew & Bat. (D) | 01 |
| 12. | Study of morphology and life cycle of <i>Entamoeba histolytica</i> through permanent slides or photographs and study of their pathogenicity, diagnosis and treatment methods. (D) | 01 |
| 13. | Study of morphology and life cycle of <i>Plasmodium vivax</i> through permanent slides or photographs and study of their pathogenicity, diagnosis and treatment methods. (D) | 01 |
| 14. | Study of morphology and life cycle of <i>Taenia solium</i> through permanent slides or photographs and study of their pathogenicity, diagnosis and treatment methods. (D) | 01 |
| 15. | Study of morphology and life cycle of <i>Ascaris lumbricoides</i> through permanent slides or photographs and study of their pathogenicity, diagnosis and treatment methods. (D) | 01 |
| 16. | Study of insect vector-Mosquito, Head louse, Bed bug through permanent slides or photographs. | 01 |
| 17. | Study of the pathogenicity and control measures of - Tick (soft tick and hard tick) and Mite (<i>Sarcoptes scabiei</i>). | 01 |
| 18. | Study of parasites from the gut of hen. | |

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Title of the Course: Zoology Lab-IV								
Year: II				Semester: IV				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
VSC-2	BS-ZO244P	00	02	02	60	15	35	50

Learning Objectives:

1. To learn skills in preparation of histological slides of animal tissues
2. To learn skills in quantitative estimation techniques of biomolecules
3. To learn skills in the demonstration of biomolecules in animal tissues.

Course Outcomes (Cos)

1. To understand skills in the preparation of histological slides of animal tissues
2. To understand skills in quantitative estimation techniques of biomolecules
3. To understand skills in the demonstration of biomolecules in animal tissues.

Detailed Syllabus:

Sr. No.	Title	Allotted Practicals
1.	Collection and Fixation of any one animal tissues	01
2.	Dehydration, Clearing and Embedding of any one animal tissues	01
3.	Block Preparation and Microtomy of any one animal tissues	01
4.	Staining of any one animal tissues	01
5.	Determination of Lambda Max for glucose and BSA	01
6.	Preparation of Standard Curve for Glucose	01
7.	Preparation of Standard Curve for Protein	01
8.	Preparation of Standard Curve for DNA	01
9.	Preparation of Standard Curve for RNA	01
10.	Protein Separation by Ammonia Sulphate precipitation	01
11.	Preparation of permanent slide to demonstrate DNA by Feulgen reaction	01

12.	Preparation of permanent slide to demonstrate DNA and RNA by MGP	01
13.	Preparation of permanent slide to demonstrate mucopolysaccharides by PAS reaction	01
14.	Preparation of permanent slide to demonstrate Proteins by Mercuric bromophenol blue/Fast Green	01

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Title of the Course: Community Engagement Project (CEP)								
Year: II				Semester: IV				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
CEP-1	BS-ZO245P	00	02	02	60	15	35	50

Note: The Field Project will be implemented as per the guidelines given by the college. A separate committee is constituted for developing guidelines for Filed Projects (FP), Community Engagement Projects (CEP) and Research Projects (RP).