



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune-1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

F.Y.B.Sc. Zoology (NEP 2026)

Semester	Offered as	Course code	Title of course	No. of credits
I	Minor	26SBZO11MN	Non-Chordate Diversity	02
I	Minor	26SBZO12MN	Practicals in Non-Chordate Diversity	02
I	SEC	26SBZO11SE	Laboratory Skills in Biological Sciences	02
I	SEC	26SBZO12SE	Basic Laboratory Skills in Biology	02



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Course Title	NON-CHORDATE DIVERSITY	
Course Code:	26SBZO11MN	
Semester: I		No. of Credits: 02
Course Type: MN		Total Teaching Hours: 30

Course Objectives	
1.	To build a clear understanding of invertebrate classification principles and evolutionary relationships
2.	To explain the structural features, body plans and ecological roles of Protista and major invertebrate groups
3.	To examine parasites, bioindicator species and economically important invertebrates while considering environmental and ethical aspects
4.	To apply modern systematics, research ethics and recent scientific developments to interpret biodiversity and conservation concerns.

Course Outcome	
1.	Student will be able to describe diagnostic features, body plans and class-level classification of major invertebrate phyla using traditional and modern phylogenies.
2.	Student will be able to explain life cycles, structural adaptations and functional biology of Protista and invertebrates across different habitats.
3.	Student will be able to analyze parasitic adaptations, host–parasite interactions and current issues such as drug resistance and zoonotic risks.
4.	Student will evaluate ecological contributions of invertebrates including nutrient cycling, pollination, coral reef systems and soil health
5.	Student will assess the environmental, biomedical and economic value of invertebrates using scientific evidence and real-world applications
6.	Student will be able to demonstrate awareness of biodiversity laws, invasive species issues, research ethics and climate impacts affecting invertebrate groups.

Syllabus		
Unit I	Introduction to Invertebrates and Classification	04 hours
	<ol style="list-style-type: none"> 1. Concepts of classification, Binomial nomenclature 2. Concepts of symmetry, coelom, and body plan evolution 3. Classification system- two kingdom, five kingdom, three domain 4. Updated classification as per current phylogenetic understanding (Lophotrochozoa, Ecdysozoa, Deuterostomia) 5. General characteristics of invertebrates 6. Recent trends in systematics (molecular taxonomy basics) 	
Unit II	Protista	02 hours
	<ol style="list-style-type: none"> 1. General characters, locomotion, reproduction 2. Parasitic protozoans of human importance: <i>Entamoeba</i>, <i>Plasmodium</i>, <i>Giardia</i> 3. Recent updates in protozoan classification (class level) 	
Unit III	Basal metazoa (Porifera, Cnidaria & Ctenophora)	06 hours
	<ol style="list-style-type: none"> 1. Porifera- Diagnostic characters- Classification up to class level- Calcarea, Hexactinellida, Demospongiae 2. Spicules and regeneration in sponges 3. Ecological significance and biotechnology applications of marine sponge 4. Cnidaria- Diagnostic characters -Classification up to class level- Hydrozoa, Scyphozoa, Anthozoa, Cubozoa 5. Polymorphism, nematocysts 6. Coral reefs: formation, threats (coral bleaching, jellyfish blooms), conservation and ecological concerns 7. Ctenophora- Diagnostic characters – Classification up to Class- Tentaculata, Nuda 8. Comb plates, bioluminescence 	
Unit IV	Platyhelminthes, Nematoda, and Annelida	06 hours
	<ol style="list-style-type: none"> 1. Platyhelminthes- Diagnostic characters, Class-level classification- Turbellaria, Trematoda, Cestoda 2. Nematoda- Diagnostic characters, Classification up to class level- Secernentea, Adenophorea 3. Current issues: drug resistance in parasites, emerging helminth zoonoses 4. Annelida- Diagnostic characters, Classification up to class level- Polychaeta, Oligochaeta, Hirudinea 5. Annelids as bioindicators in pollution studies 	

Unit V	Arthropoda	05 hours
	<ol style="list-style-type: none"> 1. Distinguishing characters, tagmatization 2. Phylum Arthropoda – Classification up to Class- Arachnida, Crustacea, Chilopoda, Diplopoda, Insecta 3. Insect morphology and physiology (respiration, circulation and reproduction in cockroach) 4. Modern updates: decline of pollinators, insect-microbiome studies, invasive species 	
Unit VI	Mollusca and Echinodermata	07 hours
	<ol style="list-style-type: none"> 1. Mollusca- General characteristics 2. Classification up to class level –Gastropoda, Bivalvia, Cephalopoda, Polyplacophora, Scaphopoda 3. Radula, Shell formation, torsion in gastropod 4. Cephalopods: camera-type eye, intelligence and behavior 5. Economic importance: pearls, seafood, pests 6. Echinodermata- General characteristics, body plan, systems overview 7. Classification up to Class- Asteroidea, Ophiuroidea, Echinoidea, Holothuroidea, Crinoidea 8. Role in marine ecosystems and climate change impacts on mollusc and echinoderms. 	

Suggested Readings

1. Anderson, D.T (Ed): Invertebrate Zoology 1988, Oxford University Press
2. Barnes, R.D.: Invertebrate Zoology, V Edition 1982, Holt Saunders International Edition
3. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I.: The Invertebrates: A New Synthesis, III Edition 2002, Blackwell Science
4. Barrington, E.J.W.: Invertebrate Structure and Functions. II Edition 1979, E.L.B.S. and Nelson
5. Boradale, L.A. and Potts, E. A: Invertebrates: A Manual for the use of Students, Asia Publishing Home.
6. Brusca, R.C and Brusca, G. J: Invertebrate (2nd ed.) 2003, Sinauer Associates Inc., Publishers Sunderland.
7. Hadzi, J: The Evolution of Metazoa. 1963, Macmillan New York.
8. Hyman, L. H: Invertebrates Vol I, Protozoa through ctenophore. 1940, McGraw Hill, New York
9. Hyman. L. H: The Invertebrates Vol: IV, Echinodermata, the coelomate, Bilateria, 195 McGraw Hill, New York.
10. Kotpal, RL: Modern Text-Book of zoology, Vertebrates, Rastogi and Co., Meerut

11. Nigam H.C.: Zoology of Chordates, Vishal Publication, Jalandhar-144008.
12. Kotpal, R.L.: Phylum Protozoa to Echinodermata (series), Rastogi and Co., Meerut
13. Parker T.J and W.A Haswell: A textbook of Zoology, Vol –I (7th edition by Marshall and Williams (1972), Macmillan Press Ltd.
14. Jordan, E.L. and P.S. Verma: Invertebrate ZoologyS. Chand and Co., Ltd. Ram Nagar, New Delhi.
15. Russel Hunter :A Biology of higher invertebrates Macmillan and Co., Ltd., London



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Course Title	PRACTICALS IN NON-CHORDATE DIVERSITY		
Course Code	26SBZO12MN		
Semester: I		No. of Credits: 02	
Course Type: MN		Total Teaching Hours: 60	

Course Objectives	
1.	To develop understanding of the diversity, morphology, and life cycles of major invertebrate phyla through museum and laboratory studies
2.	To acquire practical skills in observation, culture, and experimental study of selected invertebrates, including regeneration and reproduction.
3.	To apply digital and field-based tools to identify, document, and analyze local invertebrate biodiversity.
4.	To cultivate critical thinking, ethical reasoning, and awareness of ecological, environmental, and societal roles of invertebrates.

Course Outcome	
1.	Students will be able to identify and classify representative groups and relate their form to function and habitat
2.	Students will demonstrate practical skills in culturing, observing and documenting life cycles and regeneration in simple groups.
3.	Students will analyze parasitic and ecological adaptations in helminths, arthropods and related groups and suggest basic management approaches.
4.	Students will use digital platforms like iNaturalist, NCBI and BOLD along with field observations to document and report biodiversity.
5.	Students will work effectively in teams to perform experiments, prepare reports and present findings clearly and responsibly.
6.	Students will reflect on ecological, ethical and social dimensions of biodiversity studies to develop responsible attitudes and long-term learning habits.

Syllabus	
Sr. No	Title with Contents
1.	Museum Study of phylum Protozoa: <i>Euglena</i> , <i>Amoeba</i> and <i>Plasmodium</i>
2.	Study of <i>Paramecium</i> : Culture, External morphology
3.	Study of <i>Paramecium</i> : Conjugation and Binary fission
4.	Museum study of Phylum Porifera: <i>Sycon</i> , <i>Euplectella</i> , and <i>Spongilla</i> .
5.	Observation of Gemmules and Canal Architecture in Sponges.
6.	Museum study of phylum Cnidaria: <i>Hydra</i> , <i>Physalia</i> , <i>Aurelia</i> and <i>Metridium</i> .
7.	Laboratory culture of <i>Hydra</i> and experimental observation of Regeneration
8.	Museum Study of phylum Platyhelminthes: <i>Planaria</i> , <i>Faciola</i> and <i>Taenia</i> Museum study of phylum Nematoda: <i>Ascaris</i>
9.	Study of parasitic adaptations in Helminths with examples (Tapeworm, Liver Fluke, <i>Ascaris</i> , filarial worm)
10.	Museum study of phylum Annelida: <i>Nereis</i> , Earthworm and Leech
11.	Model demonstration of earthworm- External characters and digestive system
12.	Museum study of phylum Arthropoda: Cockroach, Centipede, Millipede, Crab, spider
13.	Mouthparts of Insects -Mandibulate, Piercing and sucking, Chewing and Lapping
14.	Identification and study of Beneficial Insects (Lac insect, Cochineal insect), Concept of IPM (Red cotton bug) Arthropods of medical Importance (<i>Anopheles</i> , ticks)
15.	Museum study of phylum Mollusca: <i>Pila</i> , <i>Chiton</i> , Oysters and <i>Octopus</i> , <i>Dentalium</i>
16.	Museum study of phylum Echinodermata: Sea star, Sea urchin, Brittle star and Sea cucumber, Sea lilies
17.	Demonstration of the water vascular system in Sea star (Museum/Model Study)
18.	Study of pedicellariae types: Straight, Crossed, Tridactylous and Globigerous.
19.	Identification of aquatic invertebrates from freshwater samples
20.	Hands-on digital activity using online tools (iNaturalist, NCBI, BOLD, GBIF) to understand molecular identification in invertebrates.
21.	Visit to Zoological survey of India/ Museum/National Park/biodiversity spot.(2P) OR Collection and identification of insect pest from your locality/nearby area (2P) OR Short field activity documenting local invertebrates using mobile photography; preparation of a checklist. (2P)



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Course Title	LABORATORY SKILLS IN BIOLOGICAL SCIENCES		
Course Code	26SBZO11SE		
Semester: I		No. of Credits: 02	
Course Type: SEC		Total Teaching Hours: 30	

Course Objectives	
1.	To develop fundamental skills in handling, operating, and maintaining core laboratory instruments for accurate observation and analysis of biological specimens
2.	To acquire proficiency in microscopic techniques, specimen preparation, and quantitative laboratory methods for studying cells, microorganisms, and invertebrates.
3.	To apply laboratory techniques in biochemical assays, solution preparation, centrifugation, and chromatography to analyze biological samples effectively
4.	To cultivate awareness of laboratory safety, ethical practices, and effective documentation through research visits, reporting, and collaborative activities

Course Outcome	
1.	Student will be able to demonstrate proper handling, operation, and maintenance of laboratory instruments for accurate results.
2.	Student will be able to prepare temporary and permanent slides, blood smears, and tissue specimens to observe and analyze structural features of cells and invertebrates.
3.	Student will apply micrometry, pH measurement, and volumetric techniques to quantify and interpret biological parameters with precision.
4.	Student will perform biochemical assays such as enzyme activity determination, glucose quantification, and amino acid separation using colorimetry and chromatography
5.	Student will be able to demonstrate knowledge of laboratory safety, good practices, and equipment handling through practical exercises and research laboratory
6.	Student will be able to collaborate effectively in teams to conduct experiments, document procedures, and present findings, fostering communication, teamwork, and critical thinking

Syllabus	
Sr. No	Title with Contents
1.	Microscope handling and operation for accurate visualization of biological specimens
2.	Using a stereo microscope for live specimen observation and photomicrography
3.	Micrometry techniques for measuring cells and microorganisms using ocular micrometers
4.	Preparation of temporary protozoan mounts for structural study.
5.	Preparation of temporary blood smear for study of blood cell types
6.	Preparation of squamous epithelium specimens for microscopic observation
7.	Preparation of permanent slides of invertebrates for microscopic study
8.	Taxidermy techniques for collection, preservation and display of zoological specimens
9.	Operation and care of core laboratory instruments: balance, autoclave, oven, water bath, magnetic stirrer and microtome
10.	Working principles and applications of laminar flow cabinets, shaking incubators, biosafety hoods and fume hoods
11.	Preparation of laboratory solutions: normality, molarity, buffers and serial dilutions
12.	Basic quantitative laboratory techniques: volumetric measuring, micropipette calibration and accuracy testing
13.	Calibration and use of a pH meter for accurate pH measurement in biological samples
14.	Demonstration of centrifugation for separation of biological and chemical components
15.	Quantification of glucose by standard curve method using a colorimeter.
16.	Separation and identification of amino acids by paper chromatography
17.	Determining enzyme activity: amylase action on starch
18.	Visit to research laboratory and report writing on equipment, techniques and safety practices observed (2P)



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Course Title	BASIC LABORATORY SKILLS IN BIOLOGY	
Course Code	26SBZO12SE	
Semester: I		No. of Credits: 02
Course Type: MN		Total Teaching Hours: 30

Course Objectives	
1.	To develop confidence in using basic laboratory instruments and following safe practices.
2.	To apply essential measurement, observation, and analytical skills in preparing reagents, solutions, and temporary mounts.
3.	To practice ethical, responsible data handling and adopt sustainable approaches in laboratory work.
4.	To communicate observations effectively and develop habits of continuous learning and technological updating.

Course Outcome	
1.	Students will be able to Demonstrate correct handling, calibration, and basic maintenance of common biological instruments
2.	Students will perform routine measurements, prepare mounts, and follow standard laboratory protocols with accuracy.
3.	Students will analyze experimental outcomes, identify possible sources of error, and suggest simple corrective steps
4.	Students will use Follow ethical guidelines, maintain proper documentation, and practice safe and responsible laboratory behavior..
5.	Students will interpret basic biological data and communicate observations clearly through written or oral formats.
6.	Students will work effectively in groups, show responsibility in shared tasks, and relate laboratory skills to real-world biological and societal applications.

Syllabus		
Unit I	Laboratory Foundation Skills	04 hours
	<ol style="list-style-type: none"> 1. Purpose of laboratory skills in modern biological sciences 2. Layout of a contemporary bioscience lab 3. Updated safety rules, hazard symbols, digital MSDS use 4. Emergency response: eye-wash, spill management, electrical safety 5. Ethics in data recording, image integrity, and plagiarism awareness 6. Digital lab notebooks and structured documentation formats 	
Unit II	Microscopy and Imaging Tools	04 hours
	<ol style="list-style-type: none"> 1. Principles, parts, and handling of compound and stereo microscopes 2. LED illumination and contrast control 3. Digital microscope cameras 4. Basics of image capture and simple image enhancement 5. Care, cleaning, and routine calibration of optical instruments 	
Unit III	Analytical and Measurement Instruments	04 hours
	<ol style="list-style-type: none"> 1. Principles and operation of pH meters with auto-calibration 2. Preparing and checking pH for simple reagents 3. Colorimeter and introduction to basic spectrophotometry 4. Microcentrifuge: balancing, rpm–g conversion, safety features 5. Automated pipettes: settings, accuracy checks, common errors 6. Mini vortex mixer: safe handling and applications 	
Unit IV	Measurement and Analytical Skills	06 hours
	<ol style="list-style-type: none"> 1. Precision, accuracy, reproducibility, and common student errors 2. Use of micropipettes (P20, P200, P1000) and calibration checks 3. Preparation of dilutions using $C_1V_1 = C_2V_2$ 4. Preparing buffers: concept of pKa, buffer capacity 5. Adjusting pH using a digital pH meter 6. Demonstration of absorbance reading using colorimeter / micro-spectrophotometer 7. Introduction to cloud-based data plotting tools (Excel, Google Sheets) 	

Unit V	Basic Microscopy & Imaging Techniques	06 hours
	<ol style="list-style-type: none"> 1. Magnification, resolution, contrast, and illumination controls 2. Use of ocular and stage micrometers for simple measurements 3. Preparation of temporary mounts from safe teaching specimens 4. Safe stains and modern low-toxicity alternatives 5. Basics of digital photomicrography 6. Introduction to image enhancement (brightness, contrast, scale bars) 	
Unit VI	Professional & Digital Skills for Laboratory Work	06 hours
	<ol style="list-style-type: none"> 1. Teamwork, lab roles, and task sharing 2. Writing clear short reports, maintaining digital formats 3. Basic data interpretation with simple graphs and tables 4. Linking skills to research labs, diagnostic labs, ecological surveys, and biotech workflows 5. Introduction to digital literacy tools: QR-based lab manuals, online databases, virtual microscopy 6. Understanding the need for continuous training in emerging technologies 	