



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

S.Y.B.Sc. Zoology (NEP Pattern)

Semster	Offered as	Course code	Title of course	No. of credits
III	Minor	23SBZO231MN	Introduction To Non-Chordates -II	02
III	Minor	23SBZO232MN	Practical Course On Non-Chordates	02
III	VSC	23SBZO231VC	Identification Of Non-Chordates And Ecological Studies	02
IV	Minor	23SBZO241MN	Introduction To Chordates I	02
IV	Minor	23SBZO242MN	Practical Course On Chordates I	02
IV	SEC	23SBZO241SC	Sericulture And Apiculture	02

S.Y.B.Sc. Zoology (NEP Pattern)

Course Title	INTRODUCTION TO NON-CHORDATES -II		
Course Code	23SBZO231MN		
Semester: III		No. of Credits: 02	
Course Type: MN		Total Teaching Hours: 30	

Course Objectives	
1.	To understand the Invertebrate animal diversity around us.
2.	To understand the underlying principles and terminology needed in classification of animals.
3.	To understand the differences and similarities in the various aspects of classification.
4.	To be able to understand the possible group of the invertebrates observed in nature and classify them.
5.	To understand our role as a caretaker and promoter of life around us.
6.	To understand the economic importance of various invertebrates

Course Outcome	
1.	The student will be able to understand classify and identify diverse invertebrates.
2.	The student understands the importance of classification can effectively use the six levels of classification.
3.	The student knows the general characters of kingdom Animalia, phylum Protozoa, Porifera, Coelenterata, and Platyhelminthes.
4.	The student can describe habit, habitat, external morphology, feeding and reproduction in <i>Paramecium</i> .
5.	The student understands the economic importance of various invertebrates and can use it judiciously for the betterment of mankind.

Syllabus		
Unit I	Phylum Aschelminthes:	04 hours
	<ol style="list-style-type: none"> 1. Introduction and salient features of phylum Aschelminthes 2. Classification of Phylum Aschelminthes (Class Nematoda) only with two examples – <i>Ascaris</i>, <i>Wuchereria</i> 3. Type Study: <i>Ascaris lumbricoides</i>: Habit, habitat, lifecycle, pathogenicity, treatment and control 4. Economic importance of class Nematoda. 	
Unit II	Phylum Annelida	03 hours
	<ol style="list-style-type: none"> 1. Introduction and salient features to Phylum Annelida 2. Classification of Phylum Annelida up to classes with examples of following classes. Class Polychaeta e.g: <i>Nereis</i>, <i>Aphrodita</i> Class Oligochaeta e.g.: <i>Pheritima</i> Class Hirudinea e.g: <i>Hirudinaria</i> 3. Economic importance of Annelida with reference to vermicomposting. 	
Unit III	Phylum Arthropoda	03 hours
	<ol style="list-style-type: none"> 1. Introduction and salient features of Phylum Arthropoda 2. Classification of Phylum Arthropoda with specific classes and mentioned examples Class: Crustacea e.g. <i>Palaemon</i>, <i>Brachyura</i> Class: Chilopoda e.g. <i>Scolopendra</i> Class: Diplopoda e.g. <i>Julus</i> Class Insecta e.g. <i>Periplaneta</i>, <i>Anopheles</i> Class: Arachnida e.g. Spiders, <i>Buthus</i> 3. Economic importance of Arthropoda. 	
Unit IV	Phylum Mollusca	03 hours
	<ol style="list-style-type: none"> 1. Introduction and salient features of Phylum Mollusca 2. Classification of Phylum Mollusca with specific classes Class Gastropoda e.g. <i>Pila</i> Class Pelecypoda e.g. <i>amellidens</i> Class Polyplacophora e.g. <i>Chiton</i> Class: Cephalopoda e.g. <i>Octopus</i>, <i>Sepia</i> 3. Economic importance of Mollusca. 	

Unit V	Study of Phylum Echinodermata	7 hours
	<ol style="list-style-type: none"> 1. Introduction and salient features of Phylum Echinodermata. 2. Classification of Phylum Echinodermata with specific classes Class Asteroidea e.g. <i>Asterias rubens</i> Class: olothuroidea e.g. <i>Holothuria</i> Class: Echinoidea e.g. <i>Echinus</i> Class: Crinoidea: <i>Ophiothrix</i> 3. Type study: <i>Asterias rubens</i> (Sea Star): <ol style="list-style-type: none"> i. Classification, Habit Habitat and External Morphology ii. Digestive system iii. Water vascular System iv. Autotomy and regeneration 4. Economic importance of Echinodermata. 	
Unit VI	Apiculture	05 hours
	<ol style="list-style-type: none"> 1. Biology of Bees: An introduction to Apiculture 2. Bee behaviour and bee communication 3. Bee keeping equipments 4. Management of bee colony 5. Bee products 6. Bee diseases and enemies; control and preventive 7. Bee: The greatest pollinators 	
Unit VII	Sericulture	05 hours
	<ol style="list-style-type: none"> 1. An introduction to sericulture and life cycle of silk worm 2. Silk worm rearing 3. Post-harvest processing of cocoons 4. Biotechnological and biomedical applications of silk 5. Bee diseases and bee enemies 	

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

S.Y.B.Sc. Zoology (NEP Pattern)

Course Title	PRACTICAL COURSE ON NON-CHORDATES		
Course Code	23SBZO232MN		
Semester: III		No. of Credits: 02	
Course Type: MN		Total Teaching Hours: 60	

Course Objectives

1.	To understand the Invertebrate animal diversity around us
2.	To understand external and internal morphology of invertebrates
3.	To understand the economic importance of various invertebrate
4.	To make biocontrol instruments for capturing .insect pests.
5.	To extend to the knowledge of practical handelling of invertebartes.

Course outcome

1.	The student will be able prepare Paramoecium culture to study their structure and reproduction
2.	The student can interpret the body organization through permanent slides.
3.	The student can maintain Hydra and Drosophila culture in laboratory
4.	The student can interpret the role of insects w.r.t. human beings
5.	The student can evaluate the economic importance of various invertebrates from phyla
6.	Discuss the importance of earthworm as friend of farmer w.r.t vermicomposting

	Syllabus
Sr. No	Title with Contents
1.	Study of Paramecium: Culture, External morphology, Conjugation and Binary fission.
2.	Study of Paramecium: Conjugation and Binary fission.
3.	Food feeding behaviour of Paramecium
4.	Vital staining of protozoans.
5.	Study of permanent slides: i. Spicules and Gemmules in Sponges ii. T.S. of Sycon and T.S. of Hydra iii. Taenia solium: Scolex and Gravid proglottid
6.	Identification of any three museum specimen with help of taxonomic identification key.
7.	Culture and maintenance of Hydra.
8.	Regeneration and Foot staining in Hydra
9.	Study of permanent slides: Mouthparts of Insects -Mandibulate, Piercing and sucking, Chewing and Lapping
10.	Types of foot and shell in Mollusca: Pila, Bivalve, Chiton and Sepia.
11.	Pedicellaria in Echinodermata: Straight, Crossed, Valvate, Tridactylous, and Globigerous.
12.	Economic importance of honey bees, Lac insects silk worms, Red cotton bug, Anopheles mosquito and Pearl oyster
13.	Collection and identification of insect pest from your locality/nearby area
14.	Use of Stereo microscope to dissect, observe, measure and take photographs of body parts of arthropods.
15.	Drosophila culturing and maintenance.
16.	Preparation of biocontrol instruments for insect pests (2P)
17.	Visit to Zoological survey of India/ Museum/National Park.(2P)
18.	Visit to a vermicomposting unit / preparation and maintenance of vermicomposting bin (2P)

S.Y.B.Sc. Zoology (NEP Pattern)

Course Title	IDENTIFICATION OF NON-CHORDATES AND ECOLOGICAL STUDIES		
Course Code	23SBZO231VC		
Semester: III		No. of Credits: 02	
Course Type: MN		Total Teaching Hours: 60	

Course Objectives	
1.	To understand the Invertebrate animal diversity around us.
2.	To understand the underlying principles and terminology needed in classification of animals.
3.	To understand the differences and similarities in the various aspects of classification.
4.	To be able to understand the possible group of the invertebrates observed in nature and classify them.
5.	To know the basic concepts of ecosystem, population, community, biodiversity and conservation.
6.	To Know the wild life of India and latest technology used for conservation.
7.	To estimate different parameters of water and soil in ecological studies.
8.	To investigate current environmental problem and relate it to classroom concepts.

Course Outcome	
1.	The student will be able to understand classify and identify diverse invertebrates.
2.	The student understands the importance of classification can effectively use the six levels of classification.
3.	The student knows the general characters of phylum Protozoa, Porifera, Coelenterata, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, Echinodermata
4.	The student can analyze and estimate physicochemical parameters of water and soil.
5.	The student can calculate and analyze various components of biodiversity such as density and abundance.
6.	The student can maintain and use basic equipments needed in wildlife studies.

Syllabus	
Sr. No	Title with Contents
1.	Collection, preservation, care of non-chordates specimens, and instruction to draw museum specimens.
2.	Museum Study of phylum Protozoa: <i>Euglena</i> , <i>Paramecium</i> , <i>Amoeba</i> and <i>Plasmodium</i> sp.
3.	Museum study of Phylum Porifera: <i>Sycon</i> , <i>Euplectella</i> , <i>Chalina</i> and <i>Spongilla</i> .
4.	Museum study of phylum Cnidaria: <i>Hydra</i> , <i>Physalia</i> , <i>Aurelia</i> and <i>Metridium</i> .
5.	Museum Study of phylum Platyhelminthes: <i>Planaria</i> , <i>Faciola hepatica</i> and <i>Taenia saginata</i>
6.	Museum study of Phylum Aschelminthes: <i>Ascaris lumbricoides</i> Museum study of phylum Annelida: <i>Nereis</i> , Earthworm and Leech
7.	Museum study of phylum Arthropoda: Prawn, Cockroach, Centipede, Millipede, Crab, spider
8.	Museum study of phylum Mollusca: <i>Pila</i> , <i>Chiton</i> , Bivalve and <i>Octopus</i> .
9.	Museum study of phylum Echinodermata: Sea Star, Sea urchin, Brittle Star and sea cucumber
10.	Estimation of Dissolved oxygen from given water sample
11.	Estimation of Water Alkalinity from given water sample
12.	Study of animal community structure by quadrat method (Field or Simulation) and determination of density, frequency and abundance of species
13.	Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses)
14.	Estimation of water holding capacity of given soil sample.
15.	Estimation of Dissolved Carbon dioxide in water.
16.	Study of microscopic fauna of freshwater ecosystem (from pond).
17.	Study of Eutrophication in lake/river. OR Study of polluted site to check the impact of human activities. (2P)

S.Y.B.Sc. Zoology (NEP Pattern)

Course Title	INTRODUCTION TO CHORDATES I	
Course Code:	23SBZO241MN	
Semester: IV		No. of Credits: 02
Course Type: MN (Minor)		Total Teaching Hours: 30

Course Objectives	
1.	To understand the chordate diversity around us.
2.	To understand the underlying principles and terminology needed in classification of chordates.
3.	To able to understand the possible group of vertebrates observes in nature and classify them based on general characters.
4.	To understand parental care in Amphibia.
5.	To understand the anatomy and physiology of organs systems of vertebrate.
6.	To understand the basic information about fishery, cultural and harvesting methods of fishes
7.	To understand fish preservation techniques

Course Outcome	
1.	The students will be able to understand, classify and identify the diversity of Chordates.
2.	The students will able to understand the complexity and difference of Chordates.
3.	The students will be able to understand different life functions of vertebrates.
4.	The students will be able to understand the linkage among different groups of vertebrates
5.	The students will be able to identify types of scales and fin in fishes
6.	The student will be able to explain habit, habitat, anatomy and physiology of Scoliodon.
7.	The learner understands the basic information about fishery, cultural and harvesting methods of fishes and fish preservation techniques.
8.	The learner will be able to link the intricacies of fishery, cultural and harvesting methods of fishes and fish preservation and use it for developing his/her own business.

Syllabus		
INTRODUCTION TO CHORDATES I		
Unit I	Introduction to Phylum Chordata –	05 hours
	<ol style="list-style-type: none"> 1. Salient features of Phylum Chordata and outline of classification 2. Classification of Phylum Chordata upto class – Pisces, Amphibia, Reptilia, Aves, Mammalia. 3. Comparison of characters of chordates with non-chordates 4. Salient features of Hemichordata with examples- Balanoglossus 5. Salient features of following subphyla with two examples each: Urochordata and Cephalochordata 	
Unit II	Introduction to subphylum vertebrata	02 hours
	<ol style="list-style-type: none"> 1. Salient features of vertebrata. 2. Introduction and general characters and classification upto class with two examples. i. Agnatha ii. Gnathostomata 	
Unit III	Introduction to Class – Pisces	06 hours
	<ol style="list-style-type: none"> 1. Salient features of class Pisces. 2. Introduction and salient features of following sections with examples: Chondrichthyes and Osteichthyes 3. Types of scales in fishes. 4. Types of fins in fishes. 5. Migration, osmoregulation and swim bladder in fishes 	
Unit IV	Introduction to class – Amphibia	03 hours
	<ol style="list-style-type: none"> 1. Salient features of class Amphibia. 2. Introduction to order - Apoda–Ichthyophis, Urodela– Salamandra, Annura - Rana 3. Parental care in Amphibia. 	
Unit V	Study of Scoliodon	07 hours
	<ol style="list-style-type: none"> 1. Systematic position, geographical distribution, habit, habitat and external characters 2. Digestive system, food and feeding mechanism. 3. Respiratory system – Structure of holobranch only. 4. External morphology, internal structure and working of heart of Scoliodon. 5. Nervous System (Brain). 6. Male urinogenital system & Female reproductive System. 7. Yolk sac placenta. 	
Unit VI	Fisheries	07 hours
	<ol style="list-style-type: none"> 1. A brief introduction to fisheries and its types 2. Rearing of freshwater fishes 3. Harvesting of few marine fishes 4. Crafts and gears in Indian Fishery 5. Fishery byproducts 	

	6. Fish preservation technique	
	7. Advanced technologies in Fishery development	

Suggested Readings

1. T.J. Parker and W.A. Haswel, Edited by Marshall and Williams, (1992), Text Books of Zoology, Invertebrates Vol- II, CBS publications and distribution, New Delhi.
2. Hickman CP, Roberts LS & Larson A., Integrated Principles of Zoology, Eleventh Edition International Edition, The McGraw-Hill Companies, Inc.,
3. R. L. Kotpal, 3rd edn. Modern Text Book of Zoology, Vertebrates Rastogi Publications, Meerut.
4. P. S. Dhami and J.K.Dhami, (1982), Chordate Zoology, R. Chand and Co., New Delhi.
5. Campbell and Reece. 7th Edn. Biology, Pearson Education in South Asia, Delhi.
6. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
7. Pough H., (2018), Vertebrate life, X Edition, Pearson International.
8. Hickman C. P., Roberts L. S.& Larson A. Integrated Principles of Zoology, Eleventh Edition, International Edition, The McGraw-Hill Companies, Inc.,
9. Arora M.P. Chordates I. Himalaya Publications.
10. R.S. Lull. Organic Evolution. Light & Life Publishers.
11. Jordan E. L. & Verma P. S. (2003), Chordates Zoology. S. Chand & Company Ltd. New Delhi.
12. Campbell Nand Reece Biology, 7th Edn. Pearson Education in South Asia, Delhi
13. Fishes. Mary Chandy. N.B.T. India, 2005.
14. Economic Zoology, Shukla Upadhyay, Rastogi Publication, Meerut, India, 1998.
15. Fisheries Developments, K.K. Trivedi, Oxford and IBH Pub. Co.
16. Marine Fishes in India, 1990, D.V. Bal & K. Virabhdra, tata McGraw Hill Publication.
17. Fishery Management, 1990, S.C.Agarwal, Avinash Publication House, New Dehli.

S.Y.B.Sc. Zoology (NEP Pattern)

Course Title	PRACTICAL COURSE ON CHORDATES I		
Course Code	23SBZO242MN		
Semester: IV		No. of Credits: 02	
Course Type: MN (Minor)		Total Teaching Hours: 60	

Course Objectives	
1.	To understand the underlying principles and terminology needed in classification of chordates.
2.	To able to understand the possible group of vertebrates observes in nature and classify them based on general characters.
3.	To understand the anatomy and physiology of organs systems of vertebrate.
4.	To understand the basic information about fishery, cultural and harvesting methods of fishes

Course outcome	
1.	The student will be able to identify and classify animals based on their characters of Hemichordata, Protochordata, Pisces and Amphibia.
2.	The student will be able to understand anatomy of organ system of vertebrates with reference fish.
3.	The learner understands the basic information about fishery, cultural and harvesting methods of fishes and fish preservation techniques.
4.	The learner will be able to link the intricacies of fishery, cultural and harvesting methods of fishes and fish preservation and use it for developing his/her own business

Syllabus	
Sr. No	Title with Contents
1.	Collection, preservation, care of chordates specimens, and instruction to draw museum specimens.
2.	Museum study of Hemichordata- Balanoglossus, Group Protochordata: Herdmania, Amphioxus
3.	Museum study of Class Pisces: Labeo, Scoliodon, Hippocampus
4.	Museum study of Class Amphibia: Salamandra, Rana, Ichthyophis
5.	Study of types of scales in fishes: Placoid scale, Cycloid scale, Ctenoid scale & Ganoid scale.
6.	Study of types of tail fins in fishes: Homocercal, Heterocercal & Diphycercal
7.	Study of external characters & digestive system of locally available fish. (E) - Compulsory
8.	Temporary preparation of ampullae of lorenzini from locally available fish
9.	Study of brain of locally available fish.
10.	Temporary preparation of scales & its identification from locally available fish. - (E) Compulsory
11.	Compulsory field visit to study pond ecosystem with reference to pisces and amphibians, report writing and submission OR Power point presentation on study of any two animals from two different classes by students.
12.	Identification, Classification and study of habit, habitat and economic importance of a) Rohu (Labeo rohita), b) Catla (Catla catla), c) Mrigal (Cirrhinus mrigala). (D)
13.	Study and maintenance of Aquarium. (D) - Compulsory
14.	Study of crafts: a) Catamaran, b) Machwa, c) Dinghi (Photographs/models/line drawings). (D)
15.	Study of gears in fishing: a) Gill net, b) Dol net, c) Rampani net, d) Cast net. (Photographs/models/line drawings). (D)
16.	Study of nutritional value of fish: Biochemical estimation of fish muscle proteins by using Biuret method. (E) - Compulsory
17.	Compulsory visit to Fish market and report writing (three photographs of freshwater and marine water fishes each). (E) (2 P).
18.	Compulsory study tour/field visit to Fish farm/ RAS plant/Aquarium. (E) (2 P).

S.Y.B.Sc. Zoology (NEP Pattern)

Course Title	SERICULTURE AND APICULTURE		
Course Code	23SBZO241SC		
Semester: IV		No. of Credits: 02	
Course Type: SEC (MN)		Total Teaching Hours: 60	

Course Objectives	
1.	To understand the basic information about apiculture and bee products.
2.	To understand the basic life cycle of the honeybees, beekeeping tools and equipments
3.	To learn for managing beehives for honey production and pollination
4.	To understand the basic information about sericulture practices
5.	To understand the biology, varieties of silkworms and the basic techniques of silk production and harvesting of cocoons
6.	To learn the different silkworm species, diseases and pests.

Course outcome	
1.	The learner is able to distinguish different types of honey bees, their habit and habitat
2.	The learner understands the basics about beekeeping tools, equipment, and managing beehives.
3.	The learner understands the biology, varieties of silkworms and the basic techniques of silk production.
4.	The learner can apply the knowledge about apiculture and sericulture for further learning and starting small scale business
5.	The learner will be able to take down observation of morphological changes due to toxic chemicals on organism.

	Syllabus
Sr. No	Title with Contents
1.	Study of external morphology, life cycle of Honey Bee. (D)
2.	Identify different castes of honey bees.
3.	Temporary mounting of mouth parts, legs, wings and sting apparatus of worker bee. (E)
4.	Study of Bee keeping Equipment: Bee box, Honey extractor, Smoker, Bee-veil, queen excluder. (D)- Compulsory
5.	Study of Bee products: Honey, Wax, Venom, Royal jelly, Pollen. (D)
6.	Determination of honey purity and quality. (D)- Compulsory
7.	Diseases and pests of honeybee
8.	Study of Bee enemies: Wax moth, Bee eater, ant. (D)
9.	Compulsory visit to Apiculture Institute/ Power point presentation of different types of bees found in India and their importance in increasing crop production (2P)
10.	Study of external morphology and life-cycle of Bombyx mori. (D)
11.	Study of five equipments in Sericulture. (E) - Compulsory
12.	Preparation of a map showing distribution of silk moth and rearing/ sericulture practices in India. (E)
13.	Compulsory submission of Photographs/ sketches of Mulberry, Tassar, Eri and Muga silk moths. (E)
14.	Visit to Sericulture Institute/Virtual visit/ Poster making of layout of sericulture farm and process of silkworm rearing (2P)
15.	Seminar on Biotechnological and biomedical applications of silk (2P)
16.	Identification of major Silkworm pests
17.	Calculation of fecundity and percentage of hatching
18.	Identification of different silkworm diseases and method of their disposal