



**B.Sc. ZOOLOGY: CHOICE BASED CREDIT SYSTEM
LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK (CBCS - LOCF)**

(Applicable to the candidates admitted from the academic year 2022-23 onwards)

Sem .	Part	Course	Title	Ins. Hrs	Credit	Exam Hours	Marks		Total	
							Int.	Ext.		
I	I	Language Course – I (Tamil \$/Other Languages + #)		6	3	3	25	75	100	
	II	English Course - I		6	3	3	25	75	100	
	III		Core Course – I (CC)	Invertebrata	5	5	3	25	75	100
			Core Practical – I (CP)	Invertebrata	4	4	3	40	60	100
			First Allied Course – I (AC)	Botany I	4	4	3	25	75	100
			First Allied Practical (AP)	Botany	3	-	-	-	-	-
	IV	Value Education		2	2	3	25	75	100	
TOTAL				30	21	-	-	-	600	
II	I	Language Course - II (Tamil \$/Other Languages + #)		6	3	3	25	75	100	
	II	English Course - II		6	3	3	25	75	100	
	III		Core Course – II (CC)	Chordata	5	5	3	25	75	100
			Core Practical – II(CP)	Chordata	4	4	3	40	60	100
			First Allied Practical (AP)	Botany	3	2	3	40	60	100
			First Allied Course – II (AC)	Botany II	4	4	3	25	75	100
	IV	Environmental Studies		2	2	3	25	75	100	
TOTAL				30	23	-	-	-	700	

\$ For those who studied Tamil upto 10th +2 (Regular Stream)

+ Syllabus for other Languages should be on par with Tamil at degree level

Those who studied Tamil upto 10th +2 but opt for other languages in degree level under Part I should study special Tamil in Part IV

* Extension Activities shall be outside instruction hours.

List of Allied Courses

Group – I

Botany

Group – II

Chemistry

SUMMARY OF CURRICULUM STRUCTURE OF UG PROGRAMMES

Sl. No.	Part	Types of the Courses	No. of Courses	No. of Credits	Marks
1.	I	Language Courses	4	12	400
2.	II	English Courses	4	12	400
3.	III	Core Courses	9	45	900
4.		Core Practical	6	24	600
5.		Allied Courses I & II	4	16	400
6.		Allied Practical	2	4	200
7.		Major Based Elective Courses	2	8	200
8.		Project	1	3	100
9.	IV	Non-Major Elective Courses	2	4	200
10.		Skill Based Elective Courses	2	4	200
11.		Soft Skills Development	1	2	100
12.		Value Education	1	2	100
13.		Environmental Studies	1	2	100
14.	V	Gender Studies	1	1	100
15.		Extension Activities	1	1	---
16.	Total		41	140	4000

PROGRAMME OUTCOME

The students will be able to:

- Demonstrate (i) advanced and systematic knowledge in the field of biological sciences, specifically in the domain of the animal system, and interdisciplinary subjects; (ii) qualified to pursue their career in research and development, teaching, and government and public service; (iii) technical skills in specialized areas to face the challenges in current developments in the field of biological sciences.
- Hone higher order thinking skills required for identifying and relating problems and issues in Life Sciences.
- Integrate knowledge across the biological science discipline and incorporate it into the existing conceptual framework.
- Communicate effectively in multiple forms, including oral, written, and electronic formats.
- Meet one's own learning needs, drawing on a range of current research and development work and professional materials.
- Able to design conceptual models and explain the advantages/disadvantages to address the biological questions.
- Apply the process of science in evidence-based, formal observation with critical thinking and testing with experimentations.
- Demonstrate subject-related and transferable skills that are relevant to Life Sciences related job trades and employment opportunities.
- Able to work precisely in future careers in agriculture, biotechnology, health sciences, environmental management, teaching, and research.
- Able to apply the principles of physical/ chemical sciences and other related disciplines to test the hypothesis in biological sciences.
- Apply their knowledge in global perspectives in an ethical manner to sustainable environment/ development in human society.

PROGRAMME SPECIFIC OUTCOME

At the successful completion of programme, the students will be able to:

- Understand inter-disciplinary subjects and their wide range of applicability in research.
- Demonstrate integrative thinking ability to apply critically and analyze to solve biological problems.
- Describe the characteristics of major taxa, differences/similarities in their anatomical, physiological characteristics, and adaptation to their habitat.
- Demonstrate comprehensive knowledge across the discipline at varying scales from Ecosystem to Molecule (diversity-evolution-structure and function-information exchange/flow – pathways and transformations of signals/energy).
- Apply the scientific methods to design and conduct biological research.
- Demonstrate knowledge and application of broad-based concepts in an interdisciplinary framework in unifying them in biology.
- Describe the safety procedures for handling the instruments, chemicals, microorganisms, body fluids, and other biological samples.
- Become eligible for eventual employment in teaching and/or research positions in academia, industry, government, or non-profit agencies.

First Year

**CORE COURSE I
INVERTEBRATA
(Theory)**

Semester I

Code:

Credit: 5

COURSE OBJECTIVES:

- To perceive the taxonomic relationship and evolution of species.
- To identify each phylum of invertebrates and discuss their key characters.
- To appraise the diversity of invertebrate species in a phylogenetic context.
- To understand how body organization solves biological problems related to physiological and environmental challenges.
- To develop an appreciation for the role of invertebrates in biological and ecological interactions and its conservation strategies.

UNIT – I PHYLUM – PROTOZOA AND PORIFERA:

Introduction to principles of taxonomy and outline classification of Kingdom Animalia.

General characters and classification of Phylum- Protozoa and Porifera (upto class) with examples.

Detailed study – Protozoa – Amoeba (*Amoeba proteus*) Porifera – Ascon Sponge (Leucosolenia)

General Topic: 1. Parasites of Protozoa
 2. Canal system in Sponges
 3. Economic and ecological importance of Protozoa and Porifera

UNIT – II PHYLUM - COELENTERATA AND PLATYHELMINTHES:

General characters and classification of Phylum Coelenterata and Platyhelminthes (upto class) with examples.

Detailed study – Coelenterata - Aurelia (*Aurelia aurita*), Platyhelminthes – Tapeworm (*Taenia solium*),

General Topic: 1. Polymorphism in Coelenterates
 2. Corals and corals reefs and their importance
 3. Parasitic adaptations of helminth parasites
 4. Invertebrate model organism – *Caenorhabditis elegans*

UNIT – III PHYLUM - ASCHELMINTHES AND ANNELIDA:

General characters and classification of Phylum Aschelminthes and Annelida (upto class) with examples.

Detailed study – Ascaris (*Ascaris lumbricoides*), Nereis (*Neanthes virens*) Earthworm (*Pheretima posthuma*)

- General Topic: 1. Economic importance of Aschelminthes
 2. Vermiculture technology and its economic importance
 3. Adaptive radiation in Annelids

UNIT – IV PHYLUM - ARTHROPODA AND MOLLUSCA:

General characters and classifications of Phylum Arthropoda and Mollusca (upto class) with examples.

Detailed study – Cockroach (*Periplaneta americana*), Prawn (*Penaeus monodon*)
Apple snail (*Pila globosa*)

- General Topic: 1. Mouth parts of insects
 2. Economic importance of Mollusca
 3. Economic and ecological importance of Mollusca

UNIT – V PHYLUM - ECHINODERMATA AND MINOR PHYLA:

General characters and classification of Phylum Echinodermata (upto class) with examples and minor phyla (Mesozoa, Ctenophora, Nemertinea, Acanthocephala, Entoprocta, Rotifera, Gastrotricha and Kinorhyncha)

Detailed study – Starfish (*Asterias rubens*), Crinoids Brief about Branchionus

- General Topic: 1. Larval forms of Echinodermata
 2. Water vascular system in Echinodermata
 3. Economic and ecological importance of Echinodermata

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Recent research/discoveries in Zoology - Identification of new species – evolutionary significance between species - mitogenomics study – invertebrate model organisms - *Drosophila melanogaster* as an animal model in biomedical research - automatic invertebrate detection and identification methods - acoustic and vibration sensing - extinct species – protective measures - applications of biotechnology in conservation of invertebrate species.

REFERENCES:

1. Ayyar. E.M. (1966). A Manual of Zoology Part I, Invertebrata, S. Viswanathan Pvt. Ltd., Chennai.
2. Giribet, G. and Edgecombe, G. D. (2020). The Invertebrate Tree of Life. Princeton University Press.
3. Calow, P. (2012). Invertebrate Biology: A Functional Approach. Springer Science & Business Media.
4. Inver Schierwater, B. and DeSalle, R. (2021). Invertebrate Zoology: A Tree of Life Approach. United States: CRC Press.
5. Sandhu, G.S. (2005). Textbook of Invertebrate Zoology. India: Campus Books International.
6. Ruppert, E.E., Fox, R.S. and Barnes, R.D. (2004). Invertebrate Zoology: A Functional Evolutionary Approach. United Kingdom: Thomson-Brooks/Cole.

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8. Pechenik, J.A. (2014). Biology of the Invertebrates. India: McGraw-Hill Education, VII edition.
9. Shuster, S.M., Moore, W. and Brusca, R.C. (2016). Invertebrates. United States: Sinauer.
10. Brusca, G.J. and Brusca, R.C. (2003). Invertebrates. Sinauer Associates, Inc., Publishers
11. <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/porifera>
12. <https://www.differencebetween.com/difference-between-coelenterates-and-vs-platyhelminthes/>
13. https://www.researchgate.net/profile/Anuradha-Sharma-11/publication/311971514_Vermiculture_Technology_A_Novel_Approach_in_Organic_Farming/links/59fae02d458515d20c7d9706/Vermiculture-Technology-A-Novel-Approach-in-Organic-Farming.pdf?origin=publication_detail
14. <https://www.biologydiscussion.com/invertebrate-zoology/phylum-mollusca/economic-importance-of-phylum-molluscs/33025>
15. https://www.researchgate.net/profile/Huajian-Liu-3/publication/307529800_A_review_of_recent_sensing_technologies_to_detect_invertebrates_on_crops/links/5c0faab1299bf139c7509a61/A-review-of-recent-sensing-technologies-to-detect-invertebrates-on-crops.pdf
16. <https://academic.oup.com/ilarjournal/article-pdf/52/2/126/6763915/ilar-52-126.pdf>

COURSE OUTCOMES:

Upon successful completion of this course the students would be able to:

1. Understand the principles of taxonomy and classification of invertebrates.
2. Acquire knowledge on the characteristic features of invertebrates.
3. Identify the any species at basic level of morphology.
4. Aware of the multiparasitism of helminthes and their dynamics in a changing world.
5. Understand the economic and ecological importance of Porifera, Coelenterata and Mollusca.
6. Realize the significance of larval forms of Echinoderms in understanding as model organisms.

COURSE OBJECTIVES:

- To introduce the structure, functions and behavior of specified invertebrate organisms by the observation of both living and preserved specimens.
- To reinforce the student's basic laboratory skills including microscopy, virtual dissection and careful observation.
- To enrich knowledge about the lower invertebrates - used as the model organisms in the scientific research.
- To find the ability to recognize the major species and subspecies of invertebrates.
- To emphasize the investigating methods of evolution of species as well the current state of scientific knowledge.

Major Dissections (Virtual dissection)

Earthworm – Digestive and Nervous system

Cockroach – Digestive and Nervous system

Prawn – Digestive and Nervous system

Minor Dissection

Earthworm – Mounting of body setae and penial setae

Cockroach – Mounting of mouth parts

Honeybee – Mounting of mouth parts

Pila – Mounting of radula

Prawn – Mounting of Appendages

Invertebrata - List of spotters

Protozoa: Amoeba, *Entamoeba histolytica*, *Plasmodium vivax* or any one Plasmodium sp., Euglena – binary fission and conjugation of Paramecium.

Porifera: Sycon sponge, Sponge gemmules, spicules, Hyalonema, Chalina.

Coelenterata: Obelia - entire, Physalia, Hydra, Porpita, Vellela, Aurelia, Ephyra larva, Sea anemone and Corals and Gorgonia (Sea fan).

Platyhelminthes: Planaria - entire, T.S. of Planaria, T.S. of Liver fluke. Miracidium larva, Redia larva, Cercaria larva, Tapeworm - entire, T.S. of scolex of Tape worm.

Aschelminthes: Ascaris – (entire) male and female, T.S. of male and female Ascaris, Filarial worm, Trichuris and Pinworm.

Annelida: Nereis - entire, Nereis - Parapodium, Heteronereis, Earthworm - entire, Leech - entire, T.S. of leech, Trochophore larva and Aphrodite.

Arthropoda: Honeybee: Queen bee, Worker bee, Drone bee, Housefly, Wasp, Rhinoceros beetle, Mosquito – entire - male and female, Peripatus, Limulus, Scorpion, Spider, Daphnia, Cyclops, Nauplius, Zoea, Mysis, Sacculina, *Penaeus monodon* and *Macrobrachium rosenbergii*, Lac insect and Silkworm.

Annelida: Nereis - entire, Nereis - Parapodium, Heteronereis, Earthworm - entire, Leech - entire, T.S. of leech, Trochophore larva and Aphrodite.

Arthropoda: Honeybee: Queen bee, Worker bee, Drone bee, Housefly, Wasp, Rhinoceros beetle, Mosquito – entire - male and female, Peripatus, Limulus, Scorpion, Spider, Daphnia, Cyclops, Nauplius, Zoea, Mysis, Sacculina, *Penaeus monodon* and *Macrobrachium rosenbergii*, Lac insect and Silkworm.

Mollusca: Chank (*Turbinella pyrum*), Murex, Patella (Gastropoda), Pearl Oyster, Chiton, Dentalium, Sepia, Nautilus, Pila, Lamellidens, Octopus and Glochidium larva.

Echinodermata: Starfish, Sea urchin, Sea cucumber, Bipinnaria larva and Auricularia larva, Doliolaria larva.

Minor phyla: Rotifera

REFERENCES:

1. Wallis, C. J. (2013). Practical Biology: For Advanced Level, Medical and Intermediate Students. Netherlands: Elsevier Science.
2. Ayyar. E.M. (1966). A Manual of Zoology Part I, Invertebrata, S. Viswanathan Pvt. Ltd., Chennai.
3. Lal, S. S. (2015). Practical Zoology. India: Rastogi Publications.
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6. De Iuliis, G. and Pulera, D. (2006). The Dissection of Vertebrates: A Laboratory Manual. Netherlands: Elsevier Science.
7. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science.
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9. Verma. P.S (2010). A Manual of Practical Zoology: Invertebrates. S Chand Publishers.
10. Osborn. H.L (2015), Invertebrate Dissections. Sagwan press.
11. Sandhu G. S, (2000), Advanced Practical Invertebrate Zoology. Campus Books International Publisher.
12. Cockroach dissection- www.ento.vt.edu
13. Anatomy of earthworm: The dissection works (CD); Source –
14. www.scienclass.com; www.neosci.com

COURSE OUTCOMES:

Upon successful completion of this course the students would be able to:

- Gain first-hand knowledge to identify and group non-chordate (species of fresh and preserved) along with larval forms.
- Analyze the relationship between organisms and their environment.
- Recognize the diversity from Protozoa to Echinodermata using their morphological structures.
- Virtually visualize and understand the anatomy and functional features of invertebrates.
- Fortify the ecological and economic importance of invertebrate diversity in their habitat.

- **Course objectives:**

- To enlighten the students about the diverse forms of vertebrate organisms under five major classes.
- To help the students to distinguish various vertebrate species with key characters.
- To understand the classification of chordate animals up to order with suitable examples.
- To acquire the knowledge on adaptations of vertebrates and their evolution.
- To study the detailed knowledge of protochordates like Amphioxus and Chordates like Shark, Frog, Calotes, Pigeon and Rabbit.

UNIT – I:

Chordata: General characters of Chordata and its outline classification (upto order)- Origin of chordates.

Prochordata: General characters of Prochordata and its classification (upto order) - affinities with invertebrates and chordates.

Detailed Study on Cephalochordata Amphioxus (*Branchiostoma lanceolatum*).

General Topic: Retrogressive metamorphosis in Ascidian.

Vertebrata: General characters of vertebrata and its classification (upto) class with examples.

UNIT – II:

Class Pisces: General characters and classification (upto order) with examples.

Detailed study *Scoliodon sorrakowah* (Shark).

General Topics 1. Migration of fishes

2. Parental care in fishes.

Class Amphibia General characters and classification (upto order) with examples.

Detailed study *Rana hexatactyla* [Frog].

General Topic Parental care in Amphibia.

UNIT – III:

Class Reptilia General characters and classification (upto order) with examples.

Detailed study *Calotes versicolor* [Garden lizard].

General Topics 1. Identification and general characters of poisonous and non-poisonous snakes of South India.

2. Rhynchocephalia – [*Sphenodon punctatus*] - living fossil.

UNIT – III:

Class Reptilia General characters and classification (upto order) with examples.

Detailed study *Calotes versicolor* [Garden lizard].

General Topics 1. Identification and general characters of poisonous and non-poisonous snakes of South India.

2. Rhynchocephalia – [*Sphenodon punctatus*] - living fossil.

UNIT – IV:

Class Aves General characters and classification (upto order) with examples.
Detailed Study *Columba livia* [Pigeon].

General Topics 1. Birds are glorified reptiles.

2. Flightless birds - distribution and adaptations.
3. Migration of birds.

UNIT – V:

Class Mammalia General characters and classification (upto order) with examples.

Detailed Study *Oryctolagus cuniculus* [Rabbit].

General Topics 1. Prototheria, Metatheria and Eutheria (Salient features with examples).

2. Dentition in Mammals.
3. Adaptations of aquatic mammals.

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Zoological survey of India - Role of ZSI - Species conservation status and management - first aid advancement for the venomous snake bite - development of snake venom as antivenoms to treat snakebite envenomation and yielding new drugs. Metabolic fossils from the origin of life.

REFERENCES:

1. Ayyar, E.M. and Anantha Krishnan T.N. (1995). Manual of Zoology Vol.II, Part I & II. (Chordata), S. Viswanathan Pvt. Ltd., Chennai.
2. Satoh, N. (2016). Chordate Origins and Evolution: The Molecular Evolutionary Road to Vertebrates. Netherlands: Elsevier Science.
3. Diogo, R., Siomava, N., Ziermann, J. M., Abdala, V. and Molnar, J. (2018). Muscles of Chordates: Development, Homologies, and Evolution. United States: CRC Press.
4. Wise, J., Roush, R. and Fowler, S. (2018). Concepts of Biology. Hong Kong: Samurai Media Limited.
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8. Kingsley, J. S. (2015). Text Book of Vertebrate Zoology. United States: FB&C Limited.
9. Lydekker, R. (2016). Reptiles, Amphibia, Fishes and Lower Chordata. United States: FB&C Limited.
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12. Pough, F. H. and Janis, C. M. (2019). Vertebrate Life. United Kingdom: Oxford University Press.
13. <https://a-z-animals.com/blog/venomous-vs-non-venomous-snake/>
14. <https://ecoevocommunity.nature.com/posts/54859-the-evolution-of-parental-care-diversity-in-amphibians>
15. <https://www.notesonzoology.com/essay/flightless-birds/essay-on-flightless-birds-vertebrates-chordata-zoology/8284>
16. <http://faunaofindia.nic.in/PDFVolumes/hpg/022/index.pdf>
17. <https://www.cdc.gov/niosh/topics/snakes/symptoms.html>
18. <https://www.sciencedaily.com/releases/2020/03/200312101054.htm>

COURSE OUTCOMES:

Upon successful completion of this course the students would be able to:

- Understand about the vertebrates up to order level with suitable examples.
- Gain knowledge about the adaptation and migration of important tetrapods.
- Understand about the vertebrates in the food web and its diversity.
- Relate about the adaptations of flightless birds and migration of birds.
- Perceive information on the evolutionary relationships of tetrapods.

First Year

**CORE PRACTICAL II
CHORDATA
(Practical)**

Semester II

Code:

Credit: 4

COURSE OBJECTIVES:

- To impart training on the identification the vertebrate species by observing key characters.
- To make them understand the various systems of vertebrate animals.
- To demonstrate the technique of *in silico* dissection of vertebrate animals.
- To highlight on studying the importance of chordate animals as spotters.
- To emphasize the role and evolution of exo- and endo-skeleton in vertebrates.

VIRTUAL DISSECTIONS:

Fish / Frog / Rat – Digestive, arterial, venous, cranial nerves and reproductive systems.

Mountings: Placoid / Cycloid / Ctenoid scales of fishes Brain of fish and Rat.

Spotters:

1. Protochordata: Amphioxus, Balanoglossus and Ascidia.
2. Pisces: Shark, Ray, Echeneis, Hippocampus, Exocoetus, Catla, Rohu, Mrigal and Tilapia, Dugong, Dolphin.
3. Amphibia: Frog, Tadpole larva, Axolotl larva, Hyla, Salamander, Ichthyophis.
4. Reptilia: Calotes, Sandbow, Hydrophis, Naja, Viper, Draco, Chamaeleon, Phrynosoma, Sphenodon.
5. Aves: Pigeon, Parrot, Kingfisher, Owl, Quill and all types of feathers, Eagle, Vulture.
6. Mammalia: Bat, Loris, Rabbit, Rat, Echidna, Duck-billed Platypus, Kangaroo.
7. Dentition: Rabbit, Dog and Man.
8. Osteology: Pigeon – Synsacrum, Rabbit – Pectoral and Pelvic girdles, Forelimb and Hind limb bones

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1. Ayyar. E.M. and Anantha Krishnan T.N. (1995). Manual of Zoology Vol.II, Part I & II. (Chordata), S. Viswanathan Pvt. Ltd., Chennai.
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6. Kent, G. C. and Carr R. K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.

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9. Arumugam. N, Thangamani. A, Prasanna kumar. S, Narayanan.L.M, Jayasurya, (2013), Practical Zoology Volume 2 Chordata. Saras publications.
10. Anatomy of Frog: Pro Dissector (CD)- www.prodissector.com
11. Physiology of Frog: Physio Ex 4.0 (CD)- www.physioex.com
12. Anatomy of shark: Shark dissection and anatomy (video)- www.neosci.com
13. Mammalian Physiology- www.biopac.com

COURSE OUTCOMES:

Upon successful completion of this course the students would be able to:

- Understand the classification of vertebrates.
- Identify and recognize the organisms by key characters.
- Integrate the ecological adaptation of the studied species.
- Relate the adaptive behaviour of vertebrates.
- Virtually clarify the functional structure in tetrapods.
