



BENGALURU CITY UNIVERSITY

Syllabus for

B.Sc. Zoology (UG)

CHOICE BASED CREDIT SYSTEM (CBCS)

Framed According to the State Educational Policy (SEP 2024)

I & II SEMESTERS

[To be implemented from the academic year 2024-25]

Syllabus for B.Sc. in Zoology

Introduction

The curriculum framework takes into account the need to maintain globally competitive standards of achievement in terms of the knowledge and skills in Zoology and allied courses, as well develop scientific orientation, spirit of enquiry problem solving skills and human and professional values which foster rational and critical thinking in the students. This course serves as plethora of opportunities in different fields right from classical to applied Zoology.

PROGRAM OUTCOMES IN B. Sc Zoology (UG)

- **PO1** - Students gain knowledge and skill in the fundamentals of animal sciences, understands the complex interactions among various living organisms.
- **PO2** – Analyse complex interactions among the various animals of different phyla, their distribution and their relationship with the environment.
- **PO3** – Apply the knowledge of internal structure of cell, its functions in control of various metabolic functions of organisms.
- **PO4** – Understands the complex evolutionary processes and behaviour of animals.
- **PO5** – Correlating the physiological processes and relationship of organ systems.
- **PO6** – Understanding of environmental conservation processes and its importance, pollution control and biodiversity and protection of endangered species.
- **PO7** – Gain knowledge of Agro based Small Scale industries like sericulture, fish farming, butterfly farming and vermicomposting preparation.
- **PO8** – Understands about concepts of genetics and its importance in human health.
- **PO10** – Apply the knowledge and understanding of Zoology to one's own life and work
- **PO11** – Develops empathy and love towards the animals.
- **PO12** – To correlate the relationships among animals, plants and microbes.

Program Specific Outcomes:

- **PSO1.** Understand the nature and basic concepts of cell biology, genetics, taxonomy, physiology, ecology and applied Zoology.
- **PSO2.** Analyse the relationships among animals, plants and microbes.
- **PSO3.** Perform procedures as per laboratory standards in the areas of Taxonomy, Physiology, Ecology, Cell biology, Genetics, Applied Zoology, tools and techniques of Zoology, Toxicology, Entomology, Nematology, Sericulture, Biochemistry, Fish biology, Animal biotechnology, Immunology and research methodology.
- **PSO4.** Understand the applications of biological sciences in Apiculture, Aquaculture, Agriculture and Medicine.
- **PSO5.** Gains knowledge about research methodologies, effective communication and skills of problem solving methods.
- **PSO6.** Contributes the knowledge for Nation building.

GRADUATE ATTRIBUTES IN B.Sc. Zoology

Some of the characteristic attributes a graduate in Zoology should possess are:

- Develop the essential and fundamental skills required to enter the professional world of animal sciences. Tasks, including DNA analysis and trace evidence examination.
- Skilled communication and developing scientific knowledge.
- Critical thinking and problem solving capacity:
- Ethical awareness / reasoning.

I Semester

THEORY PAPER: SYSTEMATICS AND ANIMAL DIVERSITY - I (Protozoa to Hemichordata)

Course Description

Program Name	B.Sc.	I Semester	
Course Title	Systematics and Animal Diversity - I (Protozoa to Hemichordata)		
Course Code:	DSCZOO-T1	No. of Credits	3
Contact hours	60 Hours	Duration of SEA/Exam	3 hrs.
Formative Assessment Marks	20	Summative Assessment Marks	80

Course Out comes (COs): After the successful completion of the course, the student will be able to:

CO1. Group animals on the basis of their morphological characteristics/structures.

CO2. Demonstrate comprehensive identification abilities of Non-Chordate diversity.

CO3. Explain structural and functional diversity of Non-Chordates.

CO4. Develop understanding on the diversity of life with regard to Protists, non-chordates and chordata.

CO5. Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/cladistics tree.

Course Pre-requisite(s): outcome.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Out comes (POs)

Course Out comes(COs)/(POs)	DSCZOOT1	DSCZOOT2	
I Core competency	X		
II Critical thinking	X		
III Analytical reasoning	X		
IV Research skills	X		
V Team work	X		

Course Articulation Matrix relates course outcomes of course with the corresponding program out comes whose attainment is attempted in this course. Mark 'X' in the inter section cell if a course outcome addresses a particular program

Contents	60 Hrs.
Unit - I	15 hrs.
Chapter 1: Systematics. <ul style="list-style-type: none"> • Concept and significance of taxonomy. • Zoological classification- Uses, kinds of classification and Linnean hierarchy. • Rules and Codes of binomial nomenclature. • ICZN – features, code, ICZN rules, electronic publication. • Phylogenetic tree- Features and types- Dendrogram, phenogram, cladogram, curvogram and phylogram. Significance of phylogram. • Recent trends in taxonomy- bar coding life. • Collection and preservation of natural history specimens. 	08
Chapter 2: Introduction to Animal Architecture. <ul style="list-style-type: none"> • Outline classification of Kingdom Animalia up to the level of phyla. • Body organization: Levels of organization- Protoplasmic, cellular, tissue, and organ. • Body Symmetry - Definition and its types-asymmetry, spherical, radial, biradial and bi-lateral. • Germ layers – Definition and its types- Diploblastic (Apparent and absolute) and Triploblastic • Body Coelom – Definition, origin and its types- a coelom, pseudo coelom, eucoelom (Enterocoelome and schizocoelom). • Metamerism - Definition and its types with suitable examples- pseudometamerism, true metamerism- homonomous and heteronomous. 	07
Unit II	15
Chapter 3: Protozoans, Poriferans and Coelenterates	07
<ul style="list-style-type: none"> • Phylum Protozoa: General characteristics of the phylum; classification up to classes (At least two unique characters for each class) with suitable examples. • Types of nutrition: Autotrophic, holozoic, saprozoic, holophytic and parasitic with an example for each. • Locomotion: Amoeboid (Walking movement and Sol-Gel theory) - <i>Amoeba</i>, <i>Euglena</i> – Flagellar and euglenoid, ciliary movement – <i>Paramecium</i>. • Reproduction: Binary fission and conjugation in <i>Paramecium caudatum</i>; significance of conjugation. 	
<ul style="list-style-type: none"> • Phylum Porifera: General characteristics of the phylum; classification up to classes (At least two unique characters for each class) with suitable examples. • <i>Sycon</i> - Morphology, T.S of body wall. • Canal system and its evolution: Asconoid, Syconoid, Leuconoid and Rhagonoid types. 	03
<ul style="list-style-type: none"> • Phylum Coelenterata: General characteristics of the phylum; classification up to classes (At least two unique characters for each class) with suitable examples. • Polymorphism with reference to <i>Halistemma</i> . • Coral reefs: Definition and its types. • Ctenophora – Salient features and its affinities. 	05

UNIT III

15 hours

Chapter 4: Helminthes

08

- **Phylum Platyhelminthes:** General characteristics of the phylum; classification up to classes (At least two unique characters for each class) with suitable examples.
- **Phylum Nematoda:** General characteristics of the phylum; classification up to classes (At least two unique characters for each class) with suitable examples.

Chapter 5: Annelids

- **Phylum Annelida:** General characteristics of the phylum; classification up to classes (At least two unique characters for each class) with suitable examples.
- Type study of Earthworm (*Pheretima posthuma*)- Morphology, digestive system, and excretory system.
- Trochophore larva and its significance.

07

Chapter 6: Arthropods

- **Phylum Arthropoda:** General characteristics of the phylum; classification up to classes (At least two unique characters for each class) with suitable examples.
- Peripatus: Affinities with Annelida and Arthropoda; systematic position.
- Respiratory organs: Gills, book gills, trachea and book lungs.
- Sense organs: Simple eye and compound eye.
- Metamorphosis in insects and its types.
- Neuro-endocrine regulation of metamorphosis in *Bombyx mori*.

UNIT - IV

15 hours

Chapter 7: Molluscs

08

- Phylum Mollusca:** General characteristics of the phylum; classification up to classes (At least two unique characters for each class) with suitable examples.
- *Unio* - morphology, respiratory system and life cycle.
 - *Unio* shell - sectional view.
 - Modification of the foot: *Chiton*, *Dentalium*, *Pila*, *Aplysia*, *Mytilus*, *Sepia* and Octopus.

Chapter 8: Echinoderms and Hemichordates

- Phylum Echinodermata:** General characteristics of the phylum; classification up to classes (At least two unique characters for each class) with suitable examples.
- *Asterias* – morphology and Water vascular system.
 - Structure and significance of Echinoderm larvae: Bipinnaria, Echinopluteus, Auricularia.
- Phylum Hemichordata:** General characteristics.
- *Balanoglossus*: morphology Modification of the coelom.
 - *Tornaria* larva and its significance.

07

PRACTICAL PAPER: Systematics and Animal Diversity - I
(Protozoa to Hemichordata)

Course Title	Systematics and Animal Diversity - I (Practical)	Practical Credits	2
Course Code	DSCZOO-P1	Contact Hours	45 hrs.
Formative Assessment	10 Marks	Summative Assessment	40 Marks

Course Pre-requisite(s):

Course Outcomes(COs):

At the end of the course the student should be able to:

1. Understand basics of classification of non-chordates.
2. Learn the diversity of habit and habitat of these species.
3. Develop the skills to identify different classes and species of animals.
4. Know uniqueness of a particular animal and its importance.
5. Enhancement of basic laboratory skill like keen observation and drawing.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Out comes (POs)

Course Out comes(COs)/(POs)	DSCZOO P1	DSCZOO P2
I Core competency	X	
II Critical thinking	X	
III Analytical reasoning	X	
IV Research skills	X	
V Team work	X	

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Practical Content

1. Scientific drawing using camera lucida.
2. **Protozoa:** Systematics of *Amoeba*, *Euglena*, *Noctiluca*, *Paramecium* and *Vorticella* (Permanent slides).
3. **Porifera:** Systematics of *Sycon*, *Euplectella*, *Hyalonema*, *Spongilla* and *Euspongia* (Specimens). Study of permanent slides of T.S of *Sycon*, spicules and gemmules.
4. **Cnidaria:** Systematics of *Aurelia* and *Metridium* (Specimens). Slides of *Hydra*, *Obelia*-polyp and medusa, and *Ephyra* larva, T.S. of *Metridium* passing through mesenteries.
5. **Study of Corals** - *Astraea*, *Fungia*, *Meandrina*, *Corallium*, *Gorgonia*, *Millepora* and *Pennatula*.
6. **Helminthes:** Systematics of *Planaria*, *Fasciola hepatica* and *Taenia solium*, *Ascaris*-Male and female (Specimens). Slides of T.S. of *Planaria*, T.S of male and female *Ascaris*.

7. **Annelida:** Systematics of *Nereis*, *Sabella*, *Aphrodite* and Leech (Specimens) Slide of T.S. of Earthworm through typhlosole.
8. **Arthropoda:** Systematics of *Panaeus*, *Palaemon*, *Astracus*, Scorpion, Spider, *Limulus*, *Peripatus*, *Millipede*, *Centipede*, Prayingmantis, Termite Queen, Moth, Butterfly, Dung beetle / Rhinoceros beetle (Any six specimens). Slide of Larvae-Nauplius, Zoea and Mysis.
9. **Mollusca:** Systematics of *Chiton*, *Mytilus*, *Aplysia*, *Pila*, *Octopus*, *Sepia* (Specimens) and Glochidium larva (Slide).
10. **Shell Pattern-***Unio*, *Ostrea*, *Cypria*, *Murex*, *Nautilus*, *Patella*, *Dentalium*, Cuttlebone. (Any four).
11. **Echinodermata:** Systematics of Seastar, Brittlestar, Sea Urchin, Sea cucumber, Scalilly (Specimens). Slides of Bipinnaria larva, Echinopluteus larva and Pedicellaria.
12. **Harmful Non chordates:** Soil Nematodes. Agricultural, veterinary and human pests of Arachnida and Arthropoda.
13. **Beneficial Non-chordates:**
 - **Sericulture:** Lifecycle of *Bombyx mori*, Uzi fly, Cocoon, Raw silk.
 - **Apiculture:** Any 2 Species of honeybee and bee wax.
 - **Pearl Culture:** Pearl Oyster and Natural Pearls.
14. **Virtual Dissection/Cultured specimens:** Earthworm – Nervous system, Leech-Digestive System.
15. **Virtual Dissection/Cultured specimens:** Prawn-Nervous system. Cockroach-Salivary Apparatus and Digestive system.

Pedagogy: Lectures, Presentations, Videos, Assignments and Weekly Formative Assessment Tests

Note: Field visit to nearby National park/ Wildlife sanctuary/ any National laboratory at the end of semester is compulsory and the report of this is to be submitted along with practical record as a part of practical examination.

Formative Assessment for Practical

Assessment Occasion/type	Marks
House Examination/Test	05
Class room Performance/Participation	05
Total	10 Marks

References

- 1 Barnes, R.S.K.; Calow, P.; Olive, P.J.W.; Golding, D.W.; Spicer, J.I. (2002) The Invertebrates: Synthesis, Blackwell Publishing.
- 2 Hickman, C.; Roberts, L.S.; Keen, S.L.; Larson, A. and Eisenhour, D. (2018) Animal Diversity, McGraw-Hill.
- 3 Holland, P. (2011) The Animal Kingdom: A Very Short Introduction, Oxford University Press.
- 4 Kardong, K.V. (2006) Vertebrates: Comparative Anatomy, Function, Evolution (4th edition), McGraw-Hill.
- 5 Barrington, E.J.W. (1979) Invertebrate Structure and Functions. II Edition. E.L.B.S. and Nelson.
- 6 Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
- 7 Bushbaum, R. (1964) Animals without Back bones. University of Chicago Press.

THEORY PAPER: Diversity of Life-II (PROTOCHORDATA TO MAMMALIA)

Program Name	B.Sc.	Semester	II
Course Title	Animal Diversity - II (PROTOCHORDATA TO MAMMALIA)		
Course Code:	DSCZOO-T2	No. of Credits	3
Contact hours	60 Hours	Duration of SEA/Exam	3 hrs.
Formative Assessment Marks	20	Summative Assessment Marks	80

Course Pre-requisite(s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

CO1. To demonstrate comprehensive identification abilities of chordate diversity.

CO2. Able to explain structural and functional diversity of chordate diversity.

CO3. To understand evolutionary relationship amongst chordates.

CO4. To take up research in biological sciences.

CO5. To realize that very similar physiological mechanisms are used in very diverse organisms.

CO6. To Get a flavor of research by working on project besides improving their writing skills. It will further enable the students to think and interpret individually.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes(COs)/(POs)	DSCZOOT1	DSCZOOT2	
I Core competency		X	
II Critical thinking		X	
III Analytical reasoning		X	
IV Research skills		X	
V Team work		X	

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Contents	60Hrs
Unit -I	15
Chapter: I	10
<ul style="list-style-type: none"> General characters of chordates. Origin of chordates. Basic Chordate characters and outline classification up to classes. 	
Protochordata:	
a. Cephalochordata: <ul style="list-style-type: none"> <i>Amphioxus</i> – Morphology, digestive system, feeding mechanism and circulatory system. 	
b. Urochordata: <ul style="list-style-type: none"> Type study of <i>Herdmania</i>- Morphology, tadpole of <i>Herdmania</i> and retrogressive metamorphosis. 	

Chapter 2: Agnatha <ul style="list-style-type: none"> • General characters and classification up to classes. • Salient features of Cyclostomata with examples. • Differences between lampreys and hag fishes. • Ammocoete larva and its significance. 	05
Unit - II	15 hrs
Chapter 3: Super class: Pisces <ul style="list-style-type: none"> • Salient features and classification up to subclasses- • Differences between Chondrichthyes and Osteichthyes. • <i>Scoliodon</i>: Morphology, digestive system, circulatory system – afferent arterial system, neuromast organs (Lateral line sensory system and Ampullae of Lorenzini) and urinogenital system. • Parental care in fishes – (<i>Hippocampus, Tilapia, Betta and Arius jella</i>) • Salient features of Placodermi and Ostracodermi with examples. • <i>Dipnoi</i>: Interesting features and their evolutionary significance. 	10
Chapter 4: Class Amphibia <ul style="list-style-type: none"> • General characters and classification of class Amphibia up to living orders, with suitable examples. • Neoteny and Paedogenesis • Parental care in Amphibia – (<i>Pipa, Ichthyophis, Alytes, Gastrothecus</i>) • Origin of Amphibia. 	05
Unit - III	15 hrs
Chapter 5: Class Reptilia <ul style="list-style-type: none"> • General characters and outline classification of modern reptiles with suitable examples. • Adaptive radiation in extinct reptiles with suitable examples • Temporal fossae in reptiles. • Poisonous and non-poisonous snakes, Poison apparatus in snakes, venom and its types. Common poisonous snakes of India. Anti-venom. • Interesting features of <i>Sphenodon</i>. 	08
Chapter 6: Class Aves <ul style="list-style-type: none"> • General characters and classification up to orders with examples. • Differences between Ratitae and Carinatae. • Interesting features of <i>Archaeopteryx</i>. • Flight adaptations in birds (Morphological, anatomical and physiological) • Migration in Birds – Types, causes and theories. 	07
Unit: IV	15 hrs
Chapter 7: Class Mammalia <ul style="list-style-type: none"> • General characters and classification up to subclasses (Prototheria, Metatheria and Eutheria) with suitable examples. • Interesting features of mammalian orders- Insectivora, Carnivora (Pinnipedia and Fissipedia), Chiroptera (Mega and Micro), Cetacea (Mystoceti and Odontoceti), Proboscidea (Indian Elephant and African Elephant), Ungulata (Perissodactyla and Artiodactyla) and Primates (Platyrrhini and Catarrhini) with examples. 	10

Chapter 8: Dentition in mammals

- Definition, structure of molar tooth.
- Types – Morphological, based on attachment, succession and kinds of teeth. Significance of teeth.
- Dental formula (Horse, Dog, Man, Cat, Rabbit and Elephant)
- Pattern of cheek teeth (Bunodont, Secodont, Selenodont and Lophodont).
- Evolution of molar tooth.

05

Practical Paper: Animal Diversity - II (PROTOCHORDATA TO MAMMALIA)

Course Title	Animal Diversity - II (PROTOCHORDATA TO MAMMALIA)	Practical Credits	2
Course Code	DSCZOO-P2	Contact Hours	45 hrs.
Formative Assessment	10 Marks	Summative Assessment	40 Marks

Course Pre-requisite(s):**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)**

Course Out comes(COs)/(POs)	DSCZOOP1	DSCZOOP2	
I Core competency		X	
II Critical thinking		X	
III Analytical reasoning		X	
IV Research skills		X	
V Team work		X	

Course Articulation Matrix relates course out comes of course with the corresponding program out comes whose attainment is attempted in this course. Mark 'X' in the inter section cell if a course outcome addresses a particular program outcome.

Practical Content

- a. **Protochordata:** *Herdmania* and *Amphioxus*, T.S. of *Amphioxus* through pharynx and intestine.
b. **Cyclostoma:** *Petromyzon*, *Anmocoete larva* and *Myxine*.

Pisces:

- a. Cartilaginous Fishes: *Narcine*, *Trygon*, *Pristis*, *Mylobatis*.
b. Bony Fishes: Zebra fish, *Hippocampus*, *Muraena*, *Ostracion*, *Tetradon*, *Pleuronectus*, *Diodon* and *Echeneis* (Any four).
c. Ornamental fishes: *Siamese*, *Koi*, *Oscar*, *Betta Sp.* *Neon tetra*, *Guppies*, Goldfish, Angel fish, Rainbow fish, *Molliesese*.
d. Accessory respiratory organs: *Saccobranchus*, *Clarias* and *Anabas*.

Amphibia:

- a. *Rana*, *Bufo*, *Ambystoma*, *Axolotl larva*, *Necturus* and *Ichthyophis*.

Reptilia:

a. *Turtle, Tortoise, Mabuya, Calotes, Chameleon, Varanus.*

snakes – *Dryophis, Rat snake, Brahmini, Cobra, Krait, Russell's viper and Hydrophis* (Any four).

Aves:

a. Beak and feet modification in Duck, Crow, Sparrow, Parrot, Kingfisher, Eagle or Hawk. (Any four).

Mammalia:

a. *Mongoose, Squirrel, Pangolin, Hedge Hog, Rat, Loris* (Any four).

Mounting: Preparation of whole mount of fish scale.

Virtual dissection/Cultured specimens: (Use of Dissected Animal or Photograph or Model)

a. Shark/Bony fish: Afferent and Efferent branchial systems, glosso-pharyngeal and vagus nerves.

b. Rat: Dissection (only demonstration)- Circulatory system (arterial and venous), Urinogenital system of both male and female rat.

Note: Field visit to nearby National park/ Wildlife sanctuary/ any National laboratory at the end of semester is compulsory and the report of this is to be submitted along with practical record as a part of practical examination.

Pedagogy:**Formative Assessment for Practical**

Assessment Occasion/type	Marks
House Examination/Test	5
Written Assessment/Presentation/Project/Term Papers/Seminars	5
Total	10 Marks

Formative Assessment as per NEP guidelines are compulsory

References

1	Colbert <i>et al.</i> : Colbert's Evolution of the Vertebrates: A history of the back boned animals through time. (5 th ed. 2002, Wiley-Liss).
2	Hildebrand: Analysis of vertebrate Structure (4 th ed 1995, John Wiley)
3	Kenneth V. Kardong (20015) Vertebrates: Comparative Anatomy, Function, Evolution McGraw Hill
4	McFarland <i>et al.</i> - Vertebrate Life (1979, Macmillan publishing)
5	Parker and Haswell: Text Book of Zoology, Vol. II(1978,ELBS)
6	Romerand Parsons: The Vertebrate Body (6 th ed1986, CBS Publishing Japan)
7	Young: The Life of vertebrates (3 rd ed 2006,ELBS/Oxford)
8	Weichert C. K. & William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills