

**VIJAYANAGARA SRI KRSHNADEVARAYA UNIVERSITY  
JNANASAGARA CAMPUS, BALLARI-583105**

**BACHELOR OF SCIENCE IN ZOOLOGY**

**SYLLABUS FOR V<sup>TH</sup> SEMESTER**

**2023-2024 Onwards**

Program Name	<b>B.Sc.</b>	V Semester	
Course Title	<b>Non-Chordates and Economic Zoology (Theory)</b>		
Course Code:	21BSC5C5ZOL	No. of Credits	<b>4</b>
Contact hours	<b>60 Hours</b>	Duration of SEA/Exam	<b>3 hours</b>
Formative Assessment Marks	<b>40</b>	Summative Assessment Marks	<b>60</b>

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

Course Outcomes (COs) / (POs)	ZOO C9T	ZOO C10P	ZOO C11T	ZOO C12P	ZOO C13T	ZOO C14P	ZOO C15T	ZOO C16P	ZOO C17T	ZOO C18P
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.

<b>Course Pre-requisite(s):</b>	
<p><b>Course Outcomes (COs):</b> 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, nonchordates and chordates. CO 5. Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/ cladistics tree.</p>	
<b>Contents</b>	<b>60 Hrs</b>
<b>Unit-I</b>	<b>15</b>
<p><b>1. Protozoa to Coelenterate</b></p> <ul style="list-style-type: none"> <li>• Protozoa- General Characters and classifications up classes with examples- <i>Paramecium</i> (Morphology and Reproduction)</li> <li>• Porifera- General Characters and classifications up classes with examples (Canal System in porifers)</li> <li>• Coelenterata – General Characters and classifications up classes with examples</li> </ul>	

<i>Obelia</i> (Morphology and Reproduction)	
<b>1.Ctenophora to Nematheiminthes</b> General Characters and classifications up classes with examples <ul style="list-style-type: none"> <li>• Ctenophora – Salient feature</li> <li>• Platyhelminthes- <i>Taenia</i> (Tape worm) (Morphology and Reproduction)</li> <li>• Nematelminthes-<i>Ascarislumbricoides</i> (Morphology and Reproduction)</li> </ul>	
<b>Unit-II</b>	<b>15</b>
<b>3. Annelida</b> General Characters and classifications up classes with examples <ul style="list-style-type: none"> <li>• Annelida – <i>Hirudinaria</i> (Leech) (Morphology and Reproduction)</li> </ul>	
<b>4. Arthropoda:</b> General Characters and classifications up classes with examples <ul style="list-style-type: none"> <li>• Arthropoda – <i>Palaemon</i> (Prawn) Morphology, Appendages, Nervous System and Reproduction)</li> </ul>	
<b>Unit-III</b>	<b>15</b>
<b>6. Mollusca to Echinodermata:</b> General Characters and classifications up classes with examples <ul style="list-style-type: none"> <li>• Mollusca – <i>Pila</i> (Morphology, Shell, Respiration, Nervous System and Reproduction)</li> <li>• Echinodermata – <i>Pentoceros</i> (Morphology and Water Vascular System)</li> </ul>	
<b>Unit-IV</b>	<b>15</b>
<b>7. Economic Zoology :Vectors and Pests</b> <ul style="list-style-type: none"> <li>• Life cycle and their control of following pests: Gundhi</li> <li>• Bug. Sugarcane leafhopper, Rodents. Termites and Mosquitoes and their control</li> </ul>	
<b>8. Economic Zoology:</b> Lac-culture, Vermiculture, Apiculture	

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-15)**

Course Outcomes (COs) / Program Outcomes (POs)	Program Outcomes (POs)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					X										
					X										
					X										
					X										
					X										

**Pedagogy:** .....

**Formative Assessment for Theory**

<b>Assessment Occasion/ type</b>	<b>Marks</b>
House Examination/Test	15
Written Assessment/Presentation/Project/Term Papers/Seminars	15
Class room Performance/Participation	10
<b>Total</b>	<b>40 Marks</b>

*Formative Assessment as per NEP guidelines are compulsory*

Course Title	<b>Non-Chordates and Economic Zoology (Practical)</b>	Practical Credits	<b>2</b>
Course Code	<b>ZOO C10-P</b>	Contact Hours	
Formative Assessment	<b>25 Marks</b>	Summative Assessment	<b>25 Marks</b>

**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

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

Course Outcomes (COs)/(POs)	ZOO C9T	ZOO C10P	ZOO C11T	ZOO C12 P	ZOO C13T	ZOO C14P	ZOO C15T	ZOO C16P	ZOO C17T	ZOO C18P
I Core competency		X								
II Critical thinking		X								
III Analytical		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. Preparation and observation of protozoan culture.
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.

<p>of <i>Metridium</i> passing through mesenteries.</p> <p>5. <b>Study of Corals</b>-<i>Astraea, Fungia, Meandrina, Corallium, Gorgonia, Millepora</i> and <i>Pennatula</i>.</p> <p>6. <b>Helminthes</b>: Systematics of <i>Planaria, Fasciola hepatica</i> and <i>Taenia solium</i>, Ascaris- Male and female (Specimens). Slides of T.S. of <i>Planaria</i>, T.S of male and female Ascaris.</p> <p>7. <b>Annelida</b>: Systematics of <i>Nereis, Heteronereis, Sabella, Aphrodite</i> (Specimens). Slide of T.S. of Earth worm through typhlosole.</p> <p>8. <b>Arthropoda</b>: Systematics of <i>Panaeus, Palaemon, Astracus</i>, Scorpion, Spider, <i>Limulus, Peripatus, Millipede, Centipede</i>, Praying mantis, Termite Queen, Moth, Butterfly, Dung beetle/Rhinoceros beetle (Any six specimens). Slide of Larvae- Nauplius, Zoea, Mysis.</p> <p>9. <b>Mollusca</b>: Systematics of <i>Chiton, Mytilus, Aplysia, Pila, Octopus, Sepia</i> (Specimens) and Glochidium larva (Slide).</p> <p>10. <b>Shell Pattern</b>-<i>Unio, Ostrea, Cyprina, Murex, Nautilus, Patella, Dentalium</i>, Cuttle bone.</p> <p>11. <b>Echinodermata</b>: Systematics of Sea star, Brittle star, Sea Urchin, Sea cucumber, Sea lilly (Specimens). Slides of Bipinnaria larva, Echinopluteus larva and Pedicellaria.</p> <p>12. <b>Harmful Nonchordates</b>: Soil Nematodes. Agricultural, veterinary and human pests of Arachnida and Arthropoda.</p> <p>13. <b>Beneficial Nonchordates</b>:</p> <ul style="list-style-type: none"> <li>• <b>Sericulture</b>: Life cycle of <i>Bombyx mori</i>, Uzi fly, Cocoon, Raw silk.</li> <li>• <b>Apiculture</b>: Any 2 Species of honey bee and bee wax.</li> <li>• <b>Pearl Culture</b>: Pearl Oyster and Natural Pearls.</li> </ul> <p>14. <b>Virtual Dissection/Cultured specimens</b>: Earthworm/leech – Nervous system and Digestive System</p> <p>15. <b>Virtual Dissection/Cultured specimens</b>: Prawn - Nervous system. Cockroach- Salivary Apparatus and Digestive system.</p>	
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**Pedagogy:** Lectures, Presentations, Videos, Assignments and Weekly Formative Assessment Tests

<b>Formative Assessment for Practical</b>	
<b>Assessment Occasion/ type</b>	<b>Marks</b>
House Examination/Test	10
Written Assessment/Presentation/Project/Term Papers/Seminars	10
Class room Performance/Participation	5
<b>Total</b>	<b>25 Marks</b>
<i>Formative Assessment as per NEP guidelines are compulsory</i>	

<b>References</b>	
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 (4thedition), 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 Backbones. University of Chicago Press.

Program Name	<b>B.Sc.</b>	Semester	<b>V</b>
Course Title	<b>Chordates and Comparative Anatomy (Theory)</b>		
Course Code:	21BSC5C6ZOL	No. of Credits	<b>4</b>
Contact hours	<b>60 Hours</b>	Duration of SEA/Exam	<b>2 hours</b>
Formative Assessment Marks	<b>40</b>	Summative Assessment Marks	<b>60</b>

**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)	ZOO C9T	ZOO C10P	ZOO C11T	ZOO C12 P	ZOO C13T	ZOO C14P	ZOO C15T	ZOO C16P	ZOO C17T	ZOO C18P
I Core competency			X							
II Critical thinking			X							
III Analytical			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.



<b>Contents</b>	<b>60 Hrs</b>
<b>Unit-I</b>	<b>13 hrs</b>
<p><b>Chapter 1: Chordates:</b> Origin of Chordates. Basic characters of chordates and classification upto classes.</p> <p><b>Chapter 2: Hemichordata:</b> Type Study of <i>Balanoglossus</i> – Habit and Habitat, Morphology, Coelom. Tornaria larva and its affinities. Affinities and systematic position of Hemichordata.</p> <p><b>Chapter 3: Urochordata :</b> Type Study of <i>Herdmania</i>-Habit and Habitat, Morphology, Ascidian tadpole- structure and its retrogressive metamorphosis.</p> <p><b>Chapter 4: Cephalochordata :</b> Type Study of <i>Branchiostoma (Amphioxus)</i>-Habit and Habitat, Morphology, Digestive system, Feeding mechanism, excretory and circulatory system.</p> <p><b>Chapter 5: Agnatha</b> General characters of Agnatha and classification upto classes. Salient features of Cyclostomata and Ostracodermi with orders and examples. Ammocoete larva and its significance.</p>	
<b>Unit-II</b>	<b>13</b>
<p><b>Chapter 6: Vertebrates:</b> General characters and Classification of different classes of vertebrates (Pisces, Amphibia, Reptilia, Aves, Mammalia) up to the order with characters for each order citing examples. General characters of Chondrichthyes and Osteichthyes. Interesting features and evolutionary significance of Dipnoi. Salient features of Placodermi with examples. Interesting features of <i>Sphenodon</i>, crocodile and <i>Archaeopteryx</i>. Salient features of Ratitae and Carinatae with examples.</p>	
<b>Unit-III</b>	<b>14</b>
<p><b>Chapter 7. General account of Chordates:</b> Types of caudal fins, scales and swim bladder in fishes. Origin of Amphibia. Neoteny and Paedogenesis. Adaptive radiation in extinct reptiles with suitable examples. Temporal fossae in reptiles. Poison apparatus and biting mechanism in snakes. Parental care in Pisces and Amphibians. Flight adaptations in birds. Dentition in mammals. Evolution of molar tooth. Migration in Pisces, Birds and Mammals.</p>	
<b>Unit-IV</b>	<b>20</b>

**Comparative Anatomy of Vertebrates:**

**Chapter 8. Integumentary System:** Structure of skin and its derivatives.

**Chapter 9. Skeletal System**

- Comparative account of Axial Skeletal system in vertebrates; Skull-Amphibian (Frog), Reptiles (Lizard), Aves (Pigeon) and Mammals (Man).
- Comparative account of Appendicular skeletal system in vertebrates- Pectoral and Pelvic girdles of Amphibian (Frog), Reptiles (Lizard), Aves (Pigeon) and Mammals (Man).

**Chapter-7 Respiratory system**

- Comparative account of respiratory system in vertebrates: Pisces (Scoliodon), Amphibian (Frog), Reptiles (Lizard), Aves (Pigeon) and Mammals (Man).

**Chapter-8 Circulatory System**

- Comparative account of heart and aortic arches in vertebrates: Pisces (Scoliodon), Amphibian (Frog), Reptiles (Lizard), Aves (Pigeon) and Mammals (Man).

**Chapter-9 Excretory System**

- Succession of kidney in vertebrates.

**Chapter-9 Nervous system**

- Comparative account of brain in vertebrates: Pisces (Scoliodon), Amphibian (Frog), Reptiles (Lizard), Aves (Pigeon) and Mammals (Man).

Course Title	<b>Chordates and Comparative Anatomy Zoology (Practical)</b>	Practical Credits	<b>2</b>
Course Code	21BSC5C6ZOP	Contact Hours	
Formative Assessment	<b>25 Marks</b>	Summative Assessment	<b>25 Marks</b>

**Course Pre-requisite(s):**

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

Course Outcomes (COs)/(POs)	ZOO C9T	ZOO C10P	ZOO C11T	ZOO C12 P	ZOO C13T	ZOO C14P	ZOO C15T	ZOO C16P	ZOO C17T	ZOO C18P
I Core competency				X						
II Critical thinking				X						
III Analytical				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.

<b>Practical Content</b>		
<ol style="list-style-type: none"> <li>1. <b>Protochordata:</b> Balanoglossus and its T. S through proboscis Ascidian/ <i>Herdmania</i> and <i>Amphioxus</i>, T.S. of <i>Amphioxus</i> through pharynx and intestine.</li> <li>2. <b>Cyclostomata:</b> -<i>Petromyzon</i>, Ammocoete larva and <i>Myxine</i>.</li> <li>3. <b>Pisces:</b></li> <li>4. Cartilaginous Fishes – <i>Narcine</i>, <i>Trygon</i>, <i>Pristis</i>, <i>Myxobatias</i></li> <li>5. Bony Fishes – Zebra fish, Hippocampus, Muraena, Ostracion, Tetradon, Pleuronectus, Diodon, Echeneis. (Any six).</li> <li>6. <b>Ornamental fishes:</b> -Siamese, Koi, Oscar, Betta Sp., Neon tetra, Guppies, Gold fish, Angle fish, Rainbow fish, Mollies (Any four).</li> <li>7. <b>Accessory respiratory organs</b> – <i>Saccobranthus</i>, <i>Clarias</i> and <i>Anabas</i>.</li> <li>8. <b>Amphibia:</b> -<i>Rana</i>, <i>Bufo</i>, <i>Ambystoma</i>, <i>Axolotl</i> larva, <i>Necturus</i> and <i>Ichthyophis</i>.</li> <li>9. <b>Reptilia:</b> -Turtle, Tortoise, <i>Mabuya</i>, <i>Calotes</i>, Chameleon, <i>Varanus</i>. snakes – <i>Dryophis</i>, Rat snake, Brahmini, Cobra, Krait, Russell’s viper and <i>Hydrophis</i>;</li> <li>10. <b>Aves:</b> Beak and feet modifications in the following examples: Duck,</li> </ol>		<b>15 units</b>

<p>Crow, Sparrow, Parrot, King fisher, Eagle or Hawk.</p> <p>11. <b>Mammalia:</b> Mongoose, Squirrel, Pangolin, Hedge Hog, Rat and Loris.</p> <p>12. <b>Virtual Dissection/Cultured specimens:</b> Shark/Bony fish: Afferent and efferent branchial systems, glossopharyngeal and vagus nerves.</p> <p>13. <b>Virtual Dissection/Cultured specimens:</b> Rat: Dissection (only demonstration) – Circulatory system (arterial and venous), urinogenital system.</p> <p>14. <b>Skeletal System in man:</b> Skull, vertebrae, girdles and limb bones (Except hands and feet)</p> <p>15. <b>Comparative account</b> of skin in shark, frog, calotis, pigeon and Man.</p> <p>16. <b>Comparative account</b> of heart in shark, frog, calotis, pigeon and Man.</p> <p>17. <b>Comparative account</b> of brain in frog, calotis, pigeon and Man.</p>	
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**Pedagogy:** .....

<b>Formative Assessment for Practical</b>	
<b>Assessment Occasion/ type</b>	<b>Marks</b>
House Examination/Test	10
Written Assessment/Presentation/Project/Term Papers/Seminars	10
Class room Performance/Participation	5
<b>Total</b>	<b>25 Marks</b>
<i>Formative Assessment as per NEP guidelines are compulsory</i>	

<b>References</b>	
1	Colbert <i>et al</i> : Colbert’s Evolution of the Vertebrates: A history of the backboned animals through time. (5 <sup>th</sup> ed 2002, Wiley – Liss).
2	Hildebrand: Analysis of vertebrate Structure (4 <sup>th</sup> 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	Romer and Parsons: The Vertebrate Body (6 <sup>th</sup> ed 1986, CBS Publishing Japan)

7	Young: The Life of vertebrates (3 <sup>rd</sup> ed 2006, ELBS/Oxford)
8	Weichert C.K. and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills

**CBCS Question Paper Pattern for UG Semester**  
**DSC, DSEC & OEC**

Paper Code:	Paper Title:		
Duration of Exam	2 Hours	Max Marks	60
Instruction:	Answer all the sections		

**Section-A**

.....	<b>15 Marks</b>
I. Answer any Five of the following questions (5x3=15)	
1. 2. 3. 4. 5. 6. 7.	

**Section-B**

.....	<b>25 Marks</b>
II. Answer any <b>FIVE</b> of the following questions (5X5=25)	
8. 9. 10. 11. 12. 13. 14.	

**Section-C**

.....	<b>20 Marks</b>
III. Answer any <b>TWO</b> of the following questions (2X10=20)	
15. 16. 17. 18.	

