



RANI CHANNAMMA UNIVERSITY, BELAGAVI

PROGRAM/COURSE STRUCTURE AND SYLLABUS

**As per the Choice Based Credit System (CBCS) designed in
accordance with Learning Outcomes-Based Curriculum
Framework (LOCF) of National Education Policy (NEP) 2020**

For

Bachelor of Science

Zoology – V and VI Semester

w.e.f.

Academic Year 2023-24 and onwards

RANI CHANNAMMA UNIVERSITY,BELAGAVI

B.Sc. in Zoology Effective from 2023-24

Sem.	Type of Course	Theory/ Practical	Course Code	CourseTitle	Instruc tion hour/ week	Total hours /sem	Duratio nof Exam	Marks			Credits
								Format ive	Sum m ative	Total	
V	DSCC-9	Theory	21BSC5C5ZOO 5L	Non-Chordates and Economic Zoology	04hrs	56	02 hrs	40	60	100	04
	DSCC-10	Practical	21BSC5C5ZO O5P	Non-Chordates and Economic Zoology	04 hrs	56	03 hrs	25	25	50	02
	DSCC-11	Theory	21BSC5C6ZO O6L	Chordates and Comparative Anatomy	04hrs	56	02 hrs	40	60	100	04
	DSCC-12	Practical	21BSC5C6ZO O6P	Chordates and Comparative Anatomy	04 hrs	56	03 hrs	25	25	50	02
	Other subject										04
	Other subject										02
	Other subject										04
	Other subject										02
	SEC-3	Practical		The Bee Keeping	04hrs	56	03 hrs	25	25	50	02
	Total										26
VI	DSCC-13	Theory	21BSC6C7ZO O7L	Evolutionary and Developmental Biology	04hrs	56	02 hrs	40	60	100	04
	DSCC-4	Practical	21BSC6C7ZO O7P	Evolutionary and Developmental Biology	04 hrs	56	03 hrs	25	25	50	02
	DSCC-15	Theory	21BSC6C8ZO O8L	Environmental Biology, Wildlife Management and Conservation	04hrs	56	02 hrs	40	60	100	04
	DSCC-16	Practical	21BSC6C8ZO O8P	Environmental Biology, Wildlife Management and Conservation	04 hrs	56	03 hrs	25	25	50	02
	Other subject										04
	Other subject										02
	Other subject										04
	Other subject										02
	Internship-1	Practical		Internship				50	0	50	02
	Total										26

B.Sc. Semester – V

Discipline Specific Course (DSC)-9

Course Title: Non-Chordates and Economic Zoology (Theory)Course

Code: 21BSC5C5ZOO5L

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-9	Theory	04	04	56 hrs	2hrs	40	60	100

Course Outcomes (COs):At the end of the course students will be able to:

CO1: Understand the evolutionary history and diversity of non-chordates

CO2: Study the external and internal characters of non-chordates

CO3: Expose type, structural and functional organization of non-chordates

CO4: Group the animals on the basis of their morphological characteristics.

CO 5: Understand the economic importance of non-chordates

Units	DSCC-9: Course Title: Non-Chordates and Economic Zoology –Theory (Code: 035 ZOO 011)	56.hrs/sem
Unit- I	Phylum Protozoa: General characters and classification up to classes; Locomotory organelles and locomotion in Protozoa. Type study: Paramecium (Morphology and Reproduction) Phylum Porifera: General characters and classification upto classes; Canal System in poriferans. Type study: Sycon (Morphology and Reproduction) Phylum Cnidaria: General characters and classification upto classes; Polymorphism in Physalia. Type study: Obelia (Morphology and Reproduction) Ctenophora: Salient features	14
Unit- II	Phylum Platyhelminthes: General characters and classification upto classes; Parasitic adaptations (morphological and physiological). Type study: Taenia (Tape worm)- (Morphology and Reproduction) Phylum Nemathelminthes: General characters and classification upto classes; Transmission, pathogenicity and preventive measures of Ascariasis. Type study: Ascaris (Round worm)- (Morphology and Reproduction) Phylum Annelida General characters and classification upto classes; Metamerism in Annelida and external morphology of Leech. Type study: Hirudinaria (Leech) - (Morphology and Reproduction)	14

Unit- III	Phylum Arthropoda General characters and classification upto classes; Metamorphosis in Insects and economic importance insects. Type study: Palaemon (Prawn) - (Morphology, Appendages, Nervous system and Reproduction). Phylum Mollusca General characters and classification upto classes; Torsion in gastropods, Pearl	14
	formation. Type study: Pila (morphology, shell, respiration, nervous system and Reproduction) Phylum Echinodermata General characters and classification upto classes; Water-vascular system in Asteroidea. Type study: Pentacerous (Morphology and Reproduction)	
Unit- IV	Economic Zoology: Pests: Life cycle and their control of following pests: Gundhi bug, Leaf hopper. Vectors: Prevention and control of Termites and Mosquitoes Economic Zoology: Economic importance of Lac Culture, Vermiculture and Sericulture.	14

References:

1. Barnes, R.S.K.; Calow,P.; Olive,P.J.W.; Golding,D.W.; Spicer, J.I.(2002) The Invertebrates: Synthesis,BlackwellPublishing.
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
7. Bushbaum, R.(1964)Animals without Back bones.University of Chicago Press

Formative Assessment for Theory	
Assessment Occasion/ type	Marks
Internal Assessment Test 1	10
Internal Assessment Test 2	10
Quiz/ Assignment/ Small Project	10
Seminar	10
Total	40 Marks
<i>Formative Assessment as per guidelines.</i>	

B.Sc. Semester – V
Discipline Specific Course (DSCC)-10
Course Title: Non-Chordates and Economic Zoology (Practical)
CourseCode: 21BSC5C5ZOO5P

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-10	Practical	02	04	56 hrs	3hrs	25	25	50

Course Outcomes (COs):At the end of the course, students will be able to:**CO 1:**

Understand basics of classification of non-chordates.

CO 2: Learn and understand the internal systems of non-chordates.

CO 3: Develop the skills to identify different classes and species of animals.

CO 4: Know uniqueness of a particular animal and economic importance of non-chordates.

CO 5: Enhancement of basic laboratory skill like keen observation and drawing.

CO 6: Study the useful and harmful non-chordates

Expt. No.	DSCC-10: Course Title: Non-Chordates and Economic Zoology –Practical (Code: 035 ZOO 012)	56.hrs/sem
1	Preparation and observation of protozoan culture. Protozoa: Systematics of <i>Amoeba</i> , <i>Euglena</i> , <i>Noctiluca</i> , <i>Paramecium</i> and <i>Vorticella</i> (Permanent slides/ Charts).	4
2	Porifera: Systematics of <i>Sycon</i> , <i>Euplectella</i> , <i>Hyalonema</i> , <i>Spongilla</i> and <i>Euspongia</i> T.S of <i>Sycon</i> , Spicules and Gemmules (Specimens/ Permanent slides/ Charts)	4
3	Cnidaria: Systematics of <i>Aurelia</i> and <i>Metridium</i> (Specimens). Slides/Charts of <i>Hydra</i> , <i>Obelia</i> - polyp and medusa, and <i>Ephyra</i> larva, T.S. of <i>Metridium</i> passing through mesenteries. Study of Corals- <i>Astraea</i> , <i>Fungia</i> , <i>Meandrina</i> , <i>Corallium</i> , <i>Gorgonia</i> , <i>Millepora</i> and <i>Pennatula</i> .	4
4	Helminthes: Systematics of <i>Planaria</i> , <i>Fasciola hepatica</i> and <i>Taenia solium</i> , <i>Ascaris</i> - Male and female (Specimens/Charts). Slides/Charts of T.S. of <i>Planaria</i> , T.S. of male and female <i>Ascaris</i> .	4
5	Annelida: Systematics of <i>Nereis</i> , <i>Heteronereis</i> , <i>Sabella</i> , <i>Aphrodite</i> (Specimens/Charts). Slide/Chart of T.S. of earthworm through typhlosole.	4
6	Arthropoda: Systematics of <i>Panaeus</i> , <i>Palaemon</i> , <i>Astracus</i> , Scorpion, Spider, <i>Limulus</i> , <i>Peripatus</i> , <i>Millipede</i> , <i>Centipede</i> , Praying mantis, Termite Queen, Moth, Butterfly, Dung beetle /Rhinceros beetle (Any six specimens). Slide/Chart of Larvae- Nauplius, Zoea, Mysis.	6

7	Mollusca: Systematics of <i>Chiton</i> , <i>Mytilus</i> , <i>Aplysia</i> , <i>Pila</i> , <i>Octopus</i> , <i>Sepia</i> (Specimens) and Glochidium larva (Slide/Chart). Shell Pattern- <i>Unio</i> , <i>Ostrea</i> , <i>Cypria</i> , <i>Murex</i> , <i>Nautilus</i> , <i>Patella</i> , <i>Dentalium</i> , Cuttle bone	4
8	Echinodermata: Systematics of Sea star, Brittle star, Sea Urchin, Sea Cucumber, Sea lilly (Specimens/Charts). Slides/Charts of Bipinnaria larva, Echinopluteus larva and Pedicellaria.	4
9	Harmful Non-chordates: Soil Nematodes, Agricultural, Veterinary and Human pests (Ticks, Mites and Bugs).	4
10	Beneficial Non-chordates: Sericulture: Life cycle of <i>Bombyx mori</i> , Types of silk Vermiculture: Earthworm species used in Vermiculture and Vermicomposting, Vermi products	6
11	Virtual Dissection/Cultured specimens: Earthworm –Nervous system, Leech-Digestive system	6
12	Virtual Dissection/Cultured specimens: Prawn-Nervous system. Cockroach-Salivary apparatus and Digestive system.	6
13	Any other practical's related to this paper may be added based on the feasibility	

Scheme of Practical Examination (distribution of marks): 25 Marks for Semester end Examination

1. Perform all the experiments as per the instructions in each question

Semester end Examination for Practical	
Assessment	Distribution of Marks
1. Major Experiments	08
2. Minor Experiments	05
3. Identifications (A-D)	08
4. Viva	02
5. Journal	02
Total	25 Marks

Note: Same Scheme may be used for IA (Formative Assessment) examination for 25 marks

B.Sc. Semester – V
Discipline Specific Course (DSCC)-11
Course Title: Chordates and Comparative Anatomy (Theory)
Course Code: 21BSC5C6ZOO6L

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-11	Theory	04	04	56 hrs	2hrs	40	60	100

Course Outcomes (COs): At the end of the course, students will be able to: CO1:

Understand the basic concept, diversity and classification of Chordates CO2:

Demonstrate comprehensive identification abilities of chordate diversity CO3:

Understand evolutionary relationship amongst all chordates

CO4: Understand the external morphology and sexual dimorphism in chordates.

CO5: Understand arrangement of endoskeleton of vertebrates.

CO6: Know the comparative anatomy of various systems, adaptations, physiological mechanisms of vertebrates.

Units	DSCC-11: Course Title: Chordates and Comparative Anatomy-Theory (Code:035 ZOO 013)	56.hrs/sem
Unit-I	Chordates: Origin of Chordates; Basic characters of chordates and classification upto classes. Protochordates: General features and phylogeny of Protochordata, Classification of Protochordates: Hemichordata: Type Study: <i>Balanoglossus</i> - Habit and Habitat, Morphology, Coelom. Tornaria larva and its affinities. Urochordata: Type Study: <i>Herdmania</i> - Habit and Habitat, Morphology, Ascidian tadpole-structure and its retrogressive metamorphosis. Cephalochordata: Type Study: <i>Branchiostoma (Amphioxus)</i> -Habit and habitat, Morphology, Digestive system, Feeding mechanism, excretory and circulatory system. Agnatha: General characters of Agnatha and classification upto classes. Salient features of Cyclostomata and Ostracodermi with examples. Ammocoete larva and its significance.	14
Unit-II	Vertebrates: General characters and Classification of different classes of vertebrates (Pisces - Chondrichthyes and Osteichthyes, Amphibia, Reptilia, Aves, Mammalia) upto the orders with five characters for each order citing examples.	14

Unit-III	<p>Pisces: Osmoregulation, migration and swim bladder in fishes. Types of caudal fins, scales in fishes.</p> <p>Amphibia: Origin of Amphibia, Parental care and Neoteny in Amphibia,</p> <p>Reptilia: Adaptive radiation in extinct reptiles with suitable examples. Temporal fossae in reptiles. Poisonous and non-poisonous snakes, biting mechanism in snakes, types of venom.</p> <p>Aves: Flightless birds and their distribution, Major types of beaks. Kinds of migration in birds. Flight adaptations in birds.</p> <p>Mammals: Distribution of Prototheria and Metatheria with examples. Dentition in mammals and evolution of molar tooth. Adaptive radiation in mammals.</p>	14
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Unit-IV	<p>Comparative Anatomy of Vertebrates:</p> <p>Integumentary System: Structure of skin and its derivatives.</p> <p>Skeletal System: Comparative account of Axial (Skull) and Appendicular (girdles) Skeletal system in Amphibians (Frog), Reptiles (Calotes), Aves (Pigeon) and Mammals (Rabbit).</p> <p>Comparative account of Digestive system (digestive glands and alimentary canal), Respiratory System (gills, lungs, air sacs, swim bladder) Circulatory System (heart and aortic arches) and Nervous system (brain) in Pisces (Scoliodon), Amphibians (Frog), Reptiles (Calotes), Aves (Pigeon) and Mammals (Man).</p> <p>Excretory System: Succession of vertebrate kidney and Evolution of urino-genital ducts in vertebrates</p>	14
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References:

1. Colbert *et al*: Colbert's Evolution of the Vertebrates: A history of the back boned animals through time. (5th ed 2002, Wiley-Liss).
2. Hildebrand: Analysis of Vertebrate Structure (4th ed 1995, John Wiley)
3. Kenneth V. Kardong (20015) Vertebrates: Comparative Anatomy, Function, Evolution Mc Graw Hill
4. Mc Farland *et al.*: Vertebrate Life (1979, Macmillan publishing)
5. Parker and Haswell: Text Book of Zoology, Vol. II (1978, ELBS)
6. Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing, Japan)
7. Young: The Life of Vertebrates (3rd ed 2006, ELBS/Oxford)
8. Weichert C.K. and William Presch (1970). Elements of Chordate Anatomy, Tata Mc Graw Hills

Formative Assessment for Theory	
Assessment Occasion/ type	Marks
Internal Assessment Test 1	10
Internal Assessment Test 2	10
Quiz/ Assignment/ Small Project	10
Seminar	10
Total	40 Marks
<i>Formative Assessment as per guidelines.</i>	

B.Sc. Semester – V

Discipline Specific Course (DSCC)-12

Course Title: Chordates and Comparative Anatomy (Practical)

Course Code: 21BSC5C6ZOO6P

Type of Course	Theory / Practical	Credits		Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-12	Practical	02		04	56 hrs	3hrs	25	25	50

Course Outcomes (COs): At the end of the course, students will be able to: CO

1: Understand the external morphology of proto-chordates and chordates CO

2: Study the cartilaginous, bony and ornamental fishes

CO 3: Understand the systematic position and classification of Chordates

CO 4: Study the comparative anatomy and internal systems of vertebrates

CO 5: Understand the beak and foot modifications in birds.

Expt. No.	DSCC-12: Course Title: Chordates and Comparative Anatomy –Practical (Code:035 ZOO 014)	56.hrs/sem
1	Protochordata: Balanoglossus and T. S through proboscis Ascidian/ <i>Herdmania</i> and <i>Amphioxus</i> , T.S. of <i>Amphioxus</i> through pharynx and intestine. Cyclostomata: <i>Petromyzon</i> , <i>Myxine</i> . Ammocoete larva	04
2	Pisces: Cartilaginous fishes – <i>Narcine</i> , <i>Trygon</i> , <i>Pristis</i> , <i>Myxobatias</i> , <i>Scoliodon</i> . (Any four) Bony fishes– Zebrafish, Hippocampus, Muraena, Ostracion, Tetradon, Pleuronectes, Diodon, Echeneis. (Any six).	05
3	Ornamental fishes: Siamese, Koi, Oscar, Betta Sp., Neon tetra, Guppies, Goldfish, Angle fish, Rainbow fish, Mollies (Any four). Accessory respiratory organs – <i>Saccobranchius</i> , <i>Clarias</i> and <i>Anabas</i> .	04
4	Amphibia: <i>Rana</i> , <i>Bufo</i> , <i>Ambystoma</i> , <i>Axolotl</i> larva, <i>Necturus</i> and <i>Ichthyophis</i> .	04
5	Reptilia: Turtle, Tortoise, <i>Mabuya</i> , <i>Calotes</i> , Chameleon, <i>Varanus</i> . Snakes –Dryophis, Ratsnake, Brahmini, Cobra, Krait, Russell's viper and Hydrophis.	04
6	Aves: Beak and feet modifications in the following examples: Duck, Crow, Sparrow, Parrot, Kingfisher, Eagle or Hawk. Mammalia: Mongoose, Squirrel, Pangolin, Hedge Hog, Rat and Loris, Platypus, Echidna.	05
7	Virtual Dissection/Cultured specimens: Shark/Bony fish: Afferent and efferent branchial systems, glosso-pharyngeal and vagus nerves.	05
8	Virtual Dissection/Cultured specimens: Rat: Dissection (only demonstration)– Circulatory system (Arterial and Venous), Urinogenital system.	05
9	Comparative account of skeletal system: Skull, vertebrae, girdles and limb bones of Shark, Frog, <i>Calotes</i> , Pigeon and Rabbit	05
10	Comparative account of skin in Shark, Frog, <i>Calotes</i> , Pigeon and Man.	05

11	Comparative account of heart in Shark, Frog, Calotes, Pigeon and Man.	05
12	Comparative account of brain in Shark, Frog, Calotes, Pigeon and Man.	05
13	Any other practical's related to this paper may be added based on the feasibility	

Scheme of Practical Examination (distribution of marks): 25 Marks for Semester end Examination

1. Perform all the experiments as per the instructions in each question

Semester end Examination for Practical	
Assessment	Distribution of Marks
1. Major Experiments	08
2. Minor Experiments	05
3. Identifications (A-D)	08
4. Viva	02
5. Journal	02
Total	25 Marks

Note: Same Scheme may be used for IA (Formative Assessment) examination for 25 marks

B.Sc. Semester – V
Skill Enhancement Course: SEC-3
Course Title: The Bee Keeping (Practical) Course Code:

Type of Course	Theory / Practical	Credits	Instruction hour/ week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
SEC-3	Practical	02	04	56 hrs	3hrs	25	25	50

Course Outcomes (COs): At the end of the course students will be able to:

CO 1: Explain what the prerequisite to get started in beekeeping

CO 2: Discuss the responsibilities of urban beekeepers.

CO 3: Identify where to purchase equipment and demonstrate how to assemble it.

CO 4: Name and identify major parts of the honeybee such as mouth parts, sting apparatus and mandibular parts.

CO5: Describe bee biology and anatomy from the perspective of managing bees.

CO 6: Describe the importance and usage of honey and bee wax.

Expt. No.	SEC-3: Course Title: The Bee Keeping-Practical (Code:035 ZOO 061)	56.hrs/ sem
1	Study of general characters and anatomy of honey bee	6
2	Systematic position and classification of honey bee	2
3	Study of life cycle of honey bee	4
4	Mounting of mouth parts/sting apparatus of honey bee	4
5	Study of castes in honey bees	4
6	Identification of honey bee species	4
7	Study of social organization in honey bees	4
8	Requirements of bee keeping: Hive, Protective gear, smoker, hive tool and other equipments (Charts)	4
9	Study of honey bee by-products and their uses (Charts)	4
10	Study of diseases of honeybees (Charts)	4
11	Study of pests of honeybees (Charts)	4
12	Field study/Project report on nearby Apiary/bee keeping unit and submit a report	12
13	Any other practical's related to this paper may be added based on the feasibility	

References:

1. Abrol , D. P. (1997) Bees and Beekeeping. Kalyani Publisher, New Delhi. 173
2. Abrol, D. P. (2010) A Comprehensive guide to Bees and Beekeeping. Scientific Publisher, New Delhi.
3. Withhead, S. B. (2010) Honey bees and their management Axis books Publisher, Jodhpur.
4. Nagaraja, N. and Rajagopal, D. (2013) Honey bees: Diseases, Parasites, Pests, Predator and their management. M.J.P Publisher, Chennai.
5. Dharamsing and Singh, D. P. A Handbook of Beekeeping, Agrobios India (Publisher), Jodhpur.
6. Prost, P. J. Apiculture. Oxford and IBH, New Delhi.
7. Bisht D.S. Apiculture, ICAR Publication.
8. Bisht, D.S. Agricultural Development in India, Anmol Pub. Pvt. Ltd.
9. Singh S. Beekeeping in India, Indian council of Agricultural Research, New Delhi
10. Mehrotra, K.N. Bisht, D.S. Twenty-five years of apiculture research at IARI.

**Scheme of Practical Examination (distribution of marks): 25 Marks
for Semester end Examination**

1. Perform all the experiments as per the instructions in each question

Semester end Examination for Practical	
Assessment	Distribution of Marks
1. Major Experiments	06
2. Minor Experiments	04
3. Identifications (A-C)	06
4. Viva	02
5. Journal	02
6. Field visit report	05
Total	25 Marks

Note: Same Scheme may be used for IA (Formative Assessment) examination for 25 marks

B.Sc. Semester – VI
Discipline Specific Course (DSCC)-13
Course Title: Evolutionary and Developmental Biology (Theory)
CourseCode: 21BSC6C7ZO07L

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-13	Theory	04	04	56 hrs	2hrs	40	60	100

Course Outcomes (COs):At the end of the course students will be able to:

- CO 1:** Understand that by biological evolution we mean that many of the organisms that inhabit the earth today are different from those that inhabited it in the past.
- CO 2:** Understand that natural selection is one of several processes that can bring about evolution, although it can also promote stability rather than change.
- CO 3:** Understand how the single cell formed at fertilization forms an embryo and then a full adult organism.
- CO 4:** Integrate genetics, molecular biology, biochemistry, cell biology, anatomy and physiology during embryonic development.
- CO 5:** Understand a variety of interacting processes, which generate an organism's heterogeneous shapes, size, and structural features.

Units	DSCC-13: Course Title: Evolutionary and Developmental Biology-Theory (Code:036ZOO 011)	56.hrs/sem
Unit- I	Origin of Life and theories; Historical review of evolutionary concept. Theories of Evolution: Lamarckism, Darwinism (Natural, Sexual and Artificial selection), Mutation Theory of Evolution (Hugo de Vries) and Neo- Darwinism (Synthetic theory of evolution, gene mutation, gene flow, genetic drift, Hardy-Weinberg equilibrium). Adaptive radiations: Patterns of evolution (Divergence, Convergence, Parallel, Co-evolution).	14

Unit- II	<p>Evidences of Evolution: Relationship among organisms, Morphological and Anatomical evidences, Embryological evidences, Paleontological evidences, Bio-geographical evidences, Biochemical/Physiological evidences, Cytological evidences, Taxonomical evidences and Current evidences.</p> <p>Geological Time Scale/ Stratigraphic Scale.</p> <p>Species Concept and Extinction: Concept of species; Modes of speciation: Allopatric and Sympatric species; Mass extinction (Causes, Names of five major extinctions)</p> <p>Origin and evolution of Human and Horse.</p>	14
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Unit- III	Introduction to Developmental Biology: Scope and theories of development biology Early Embryonic Development: Gametogenesis: Spermatogenesis and oogenesis in mammals. Fertilization: external (amphibians), internal (mammals), monospermy and polyspermy; Early development of frog and humans (structure of mature egg and its membranes, patterns of cleavage, fate map, up to formation of gastrula); types of morphogenetic movements; Fate of germ layers; Neurulation in frog embryo.	14
Unit- IV	Embryonic membranes and early development of Chick: Development, structure and functions of yolk sac, amnion, chorion and allantois, structure of hen's egg, cleavage, blastula, gastrulation, origin and structure of primitive streak, structure of 18, 24, 36 and 48 hrs chick embryos. Placenta: Classification of placenta (morphological and histological) with examples, and functions of placenta. Modern trends in human reproduction: In-vitro fertilization, sperm and egg banks, sexually transmitted diseases (AIDS, syphilis and gonorrhea).	14

References:

1. Ridley, M (2004) Evolution (3rd edition) Blackwell Publishing
2. Hall, B.K. and Hallgrimson, B(2008)Evolution(4th edition) Jones and Barlett Publishers
3. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press.
4. Campbell, N. A. and Reece J. B. (2011). Biology. IX Edition, Pearson, Benjamin, Cummings.
5. Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
6. Developmental Biology: T. Subramaniam, (Reprint), Narosa Publishing House Pvt. Ltd., New Delhi
7. Developmental biology: Werner A. Müller, Springer Science & Business Media. (2012).
8. Human Embryology and Developmental Biology E-Book: Bruce M. Carlson, Elsevier Health Sciences.
9. Developmental Biology: Michael J. F. Barresi, Scott F. Gilbert, Oxford University Press. (2019)

Formative Assessment for Theory	
Assessment Occasion/ type	Marks
Internal Assessment Test 1	10
Internal Assessment Test 2	10
Quiz/ Assignment/ Small Project	10
Seminar	10
Total	40 Marks
<i>Formative Assessment as per guidelines.</i>	

B.Sc. Semester – VI
Discipline Specific Course (DSCC)-14
Course Title: Evolutionary and Developmental Biology (Practical)
CourseCode: 21BSC6C7ZOO7P

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-14	Practical	02	04	56 hrs	3hrs	25	25	50

Course Outcomes (COs): At the end of the course, students will be able to:

- CO 1: Explain core features of evolutionary theory and their applications to biological systems.
- CO 2: Explain how evolutionary patterns and processes can be inferred using sequence data, the biology of extant organisms, and fossils.
- CO 3: Study the process by which organisms grow and develop.
- CO 4: Understand the development of multicellular organisms from a single cell zygote.
- CO 5: Learn interesting and unique post-embryonic development in other animals.
- CO 6: Understand the concept of aging and the relevance of this knowledge in several medical applications.

Expt. No.	DSCC-14: Course Title: Evolutionary and Developmental Biology-Practical (Code:036 ZOO 012)	56.hrs/sem
1	Study and verification of Hardy-Weinberg Law by chi-square analysis.	3
2	Graphical representation and interpretation of data of height/weight of a sample of 100 humans in relation to their age and sex	3
3	Study of connecting links and fossils (models/pictures); Connecting links/ Living fossils: Neopilina, Peripatus, Limulus, Latimeria, Sphenodon, Archeopteryx and Duck Billed Platypus	3
4	Study of homology and analogy from suitable examples.	3
5	Study of aquatic, arboreal and volant adaptations with suitable examples: Shark, Turtle, Chameleon, Loris, Exocoetus, Bat, Pigeon and Draco	4
6	Vestigial organs: Vermiform appendix, Wisdom teeth, Coccyx (tail bone), Tonsils, Body hairs, Nipples on males, Nictitating membranes of eye (Any three)	4
7	Types of eggs based on quantity and distribution of yolk: Sea urchin, Insect, Frog, Chick.	5
8	Study of development of chick embryo through incubated chick eggs upto 96hrs	6
9	Study of stages of development of Frog: Cleavage stages, Blastula, Gastrula, Neurula stages (whole mount) and various stages of tadpole	6
10	Study of permanent slides of Chick embryo -18 hrs, 24 hrs, 36 hrs, 48 hrs (whole mount and T.S of 18 hrs and 24 hrs chick embryo)	6
11	Evolution of Man and Horse (Charts and models)	6
12	Study of Mesozoic Reptiles (Charts or models);	7

	Study of adaptive radiations in feet of birds and mouth parts in insects with example	
13	Any other practical related to this paper may be added based on the feasibility	

Scheme of Practical Examination (distribution of marks): 25 Marks for Semester end Examination

1. Perform all the experiments as per the instructions in each question

Semester end Examination for Practical	
Assessment	Distribution of Marks
1. Major Experiments	08
2. Minor Experiments	05
3. Identifications (A-D)	08
4. Viva	02
5. Journal	02
Total	25 Marks

Note: Same Scheme may be used for IA (Formative Assessment) examination for 25 marks

B.Sc. Semester – VI
Discipline Specific Course (DSCC)-15
Course Title: Environmental Biology, Wildlife Management and Conservation (Theory)
CourseCode: 21BSC6C8ZOO8L

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-15	Theory	04	04	56 hrs	2hrs	40	60	100

Course Outcomes (COs): At the end of the course, students will be able to:

- CO 1:** Develop an understanding of how animals interact with each other and their natural environment.
- CO 2:** Get knowledge about all types of ecosystems, food chains, webs and energy models.
- CO 3:** Study various types of environmental pollutions
- CO 4:** Develop the ability to use the fundamental principles of wildlife ecology to solve local, regional and national conservation and management issues.
- CO 5:** Gain an appreciation for the modern scope of scientific inquiry in the field of wildlife conservation management.
- CO 6:** Develop an ability to analyze, present and interpret wildlife conservation management information.

Units	DSCC-15: Course Title: Environmental Biology, Wildlife Management and Conservation-Theory (Code:036 ZOO 013)	56.hrs/sem
Unit I	Ecology: Introduction to ecology, Definition, Ecosystem, Types of ecosystem, Food chain and Food web, Trophic levels. Environment: Definition, Types of environment, Terrestrial, Aquatic, Desert, Grassland and Aerial environment. Marine habitat: Zonation of the sea and ecological classification of marine biota, coastal ecology, estuarine ecology and mangroves. Freshwater habitat: Lentic and Lotic systems. Ecological classification of fresh water animals Terrestrial habitat: A brief account of biomes Ecological adaptations to marine, freshwater and terrestrial habitats.	14
Unit II	Environmental Pollution: Definition, types of pollutants, air, soil, water and thermal pollution, ozone layer depletion, biomagnifications, bioaccumulation and bioremediation. Effects of pollution on plants and animals. Toxicants – Natural and synthetic toxicants and toxicity measurements. Global warming, Acid rain, Bio-accumulation, Bio-magnification, Eutrophication-Types and its impact.	14

Unit III	Distribution of Wildlife in India: The Himalayan ranges, The peninsular India sub-region, Deccan plateau, Western ghats, Eastern hill chain, Aravali ranges, Indian desert, Tropical rain forests, Wildlife in Andaman and Nicobar Islands. Wild life problems: Hunting, overharvesting, habitat destruction & degradation, over population, and possibilities of climatic changes.	14
Unit IV	Wildlife Management and Conservation: In-situ and ex-situ conservation methods; Wildlife sanctuaries, National parks, Biosphere reserves, Project Tiger, Project Elephant, Project Lion, Zoological Gardens, Habitat preservation and Captive breeding. Wildlife Protection Act, 1972, Causes and depletion of Wildlife, General strategies and issues, Concept of home range and territory, Animal census, Tracing movement and Remote sensing and GIS.	14

References:

1. Colinvau, P.A. (1993) Ecology (2nd edition) Wiley, John and Sons, Inc.
2. Krebs, C.J. (2001) Ecology (6th edition) Benjamin Cummings.
3. Odum, E.P. (2008) Fundamentals of Ecology. Indian Edition. Brooks/Cole. (3rd Edition) Blackwell Sci.
4. Kendeigh, F.C. (1984) Ecology with Special Reference to Animal and Man. Prentice Hall Inc.
5. Caughley, G., and Sinclair, A.R.E. (1994) Wildlife Ecology and Management. Blackwell Science.
6. Woodroffe, R., Thirgood, S. and Rabinowitz, A. (2005) People and Wildlife, Conflict or Co-existence? Cambridge University.
7. Bookhout, T.A. (1996) Research and Management Techniques for Wildlife and habitats (5th edition) The Wildlife Society, Allen Press.
8. Sutherland, W.J. (2000) The Conservation Handbook: Research, Management and Policy. Blackwell Sciences
9. Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008) Problem solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing

Formative Assessment for Theory	
Assessment Occasion/ type	Marks
Internal Assessment Test 1	10
Internal Assessment Test 2	10
Quiz/ Assignment/ Small Project	10
Seminar	10
Total	40 Marks
<i>Formative Assessment as per guidelines.</i>	

B.Sc. Semester – VI
Discipline Specific Course (DSCC)-16
Course Title: Environmental Biology, Wildlife Management and Conservation (Practical)
CourseCode: 21BSC6C8ZOO8P

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-16	Practical	02	04	56 hrs	3hrs	25	25	50

Course Outcomes (COs): At the end of the course, students will be able to:

CO 1: Understand the basic concepts of environmental sciences, ecosystems, natural resources, population, environment and society

CO 2: Understand the basic concepts of toxicology, their impact on human health and remedial measures

CO 3: Provide understanding and knowledge on modern concepts in wildlife management and relevant conservation policies and legislation and their enforcement mechanism at Global and Local Level,

CO 4: Understand the scientific approach to wildlife management and planning.

CO 5: Develop scientific skills for resolving human wildlife conflict including capture, handling, care and management of wild animals.

Expt. No.	DSCC-16: Course Title: Environmental Biology, Wildlife Management and Conservation-Practical (Code: 036 ZOO 014)	56.hrs/ sem
1	Collection of water sample and analysis of physical parameters of water: Temperature, pH, Electrical Conductivity.	4
2	Estimation of chemical parameters of water: Dissolved Oxygen (O ₂), Carbon Dioxide (CO ₂), Hardness, Chloride, Alkalinity, Total dissolved solids (TDS).	6
3	Analysis of physical parameters of soil: pH, EC, Soil moisture, Soil temperature	2
4	Determination of organic matter in the soil sample	4
5	Study of tropical pond as an ecosystem: Study of flora and fauna and interaction between the various constituents using charts.	4
6	Analysis of air pollution: Air monitoring for particulate matter	4
7	Collection, preservation and estimation of zooplanktons	4
8	Study of threatened animals of India (charts/models/pictures): Tiger, Lion, one horned Rhinoceros, Golden langur, Lion tailed monkey, Musk deer, Kashmir stag, Great Indian horn bill and Indian rock python.	4
9	Location of Tiger reserves, National parks, Biosphere reserves, Wildlife sanctuaries of India on Map.	4

10	Demonstration of field equipments used in Wildlife census: Compass, Binoculars, Spotting scope, Range finders, Global Positioning System, Various types of cameras and lenses.	4
11	Identification wild animals: Wild animal's pugmarks, hoof marks scats, pellet groups, nest, antlers. Demonstration of field techniques for wild flora and fauna.	4
12	Visit to Zoo/ Sanctuaries/ National parks/ Biosphere reserves	12
13	Any other practical's related to this paper may be added based on the feasibility	

Scheme of Practical Examination (distribution of marks): 25 Marks for Semester end Examination

1. Perform all the experiments as per the instructions in each question

Semester end Examination for Practical	
Assessment	Distribution of Marks
1. Major Experiments	08
2. Minor Experiments	05
3. Identifications (A-D)	08
4. Viva	02
5. Journal	02
Total	25 Marks

Note: Same Scheme may be used for IA (Formative Assessment) examination for 25 marks

**B.Sc. Semester – VI
INTERNSHIP**

Course Title: Internship (Practical) Course Code:

Type of Course	Theory / Practical	Credits	Instruction hour/ week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
Internship	Practical	02	04	56 hrs.	-	50	0	50

Course Outcomes (COs): At the end of the course students will be able to:

- CO 1:** Explore career alternatives prior to graduation and Integrate theory and practice
- CO 2:** Assess interests and abilities in their field of study/ research.
- CO 3:** Develop work habits and attitudes necessary for job success
- CO 4:** Build a record of work experience
- CO 5:** Identify, write down, and carry out performance objectives related to the job assignment

Expt. No.	Internship: Course Title: Internship-Practical (Code: 036 ZOO 091)	56.hrs/sem
1	Small Laboratory Research Projects related to Zoology OR	56
2	Field Study Report: Survey of animal biodiversity nearby villages/ ecosystem OR	
3	Survey of insect vectors/ animal diseases/human diseases/blood groups etc. OR	
4	Any other work related to this paper may be added based on the feasibility	

Formative Assessment for Practical	
Assessment	Distribution of Marks
Project / Survey work / Field Study Report submission	25
Internal marks based on the performance of work by mentor	10
Presentation of work	15
Total	50 Marks
<i>Formative Assessment as per guidelines.</i>	

Internship:

A course requiring students to participate in a professional activity or work experience, or cooperative education activity with an entity external to the education institution, normally under the supervision of an expert of the given external entity. A key aspect of the internship is induction into actual work situations for 2 credits. Internships involve working with local industry, local governments (such as panchayats, municipalities) or private organizations, business organizations, artists, crafts persons, and similar entities to provide opportunities for students to actively engage in on-site experiential learning.

Note:

1. 1 credit internship is equal to 30hrs on field experience.
2. Internship shall be Discipline Specific of 45-60 hours (2 credits) with duration 1-2 weeks.
3. Internship may be full-time/part-time (full-time during last 1-2 weeks before closure of the semester or weekly 4 hrs in the academic session for 13-14 weeks).
4. College shall decide the suitable method for programme wise but not subject wise.
5. Internship mentor/supervisor shall avail work allotment during 6th semester for a maximum of 20 hours.
6. The student should submit the final internship report (45-60 hours of Internship) to the mentor for completion of the internship.
7. Method of evaluation: Presentations/Report submission/Activity etc.

UG programme: 2023-24

GENERAL PATTERN OF THEORY QUESTION COURSE FOR DSCC/ OEC

(60 Marks for Semester End Examination with 2 Hrs duration)

- a. Answer any six Questions from Question I
- b. Answer any Three questions from II, III, IV and V

Q.No.I	Answer any six Questions (Two question from Each Unit) 1. 2. 3. 4. 5. 6. 7. 8.	2X6=12
Q.No.II	(Should cover Entire Unit-I) 9. 10. 11. 12.	4X3=12
Q.No.III	(Should cover Entire Unit-II) 13. 14. 15. 16.	4X3=12
Q.No.IV	(Should cover Entire Unit-III) 17. 18. 19. 20.	4X3=12
Q.No.V	(Should cover Entire Unit-IV) 21. 22. 23. 24.	4X3=12