HAVERI UNIVERSITY, HAVERI

B.Sc. in Zoology

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SYLLABUS

DISCIPLINE SPECIFIC CORE COURSE (DSCC) FOR SEM V & VI,

SKILL ENHANCEMENT COURSE (SEC) FOR SEM V
INTERNSHIP COURSE FOR SEM VI

With Effect from 2025-26

AS PER N E P - 2020

Haveri University, Haveri

B.Sc. in Zoology

Effective from 2025-26

Sem.	Type of Course	Theory/ Practical	Course Code	CourseTitle	Instruction hour/ week	Total hours / sem	Duration of Exam	Marks			Credits
								Formative	Summative	Total	
V	DSCC-9	Theory		Non-Chordates and Economic Zoology	04hrs	56	02 hrs	40	60	100	04
	DSCC-10	Practical		Non-Chordates and Economic Zoology	04 hrs	56	03 hrs	25	25	50	02
	DSCC-11	Theory		Chordates and Comparative Anatomy	04hrs	56	02 hrs	40	60	100	04
	DSCC-12	Practical		Chordates and Comparative Anatomy	04 hrs	56	03 hrs	25	25	50	02
	Other subject										04
	Other subject										04
	Other subject										04
	SEC-3	Practical		The Bee Keeping	04hrs	56	03 hrs	25	25	50	02
	Total										**26**
VI	DSCC-13	Theory		Evolutionary and Developmental Biology	04hrs	56	02 hrs	40	60	100	04
	DSCC-4	Practical		Evolutionary and Developmental Biology	04 hrs	56	03 hrs	25	25	50	02
	DSCC-15	Theory		Environmental Biology, Wildlife Management and Conservation	04hrs	56	02 hrs	40	60	100	04
	DSCC-16	Practical		Environmental Biology, Wildlife Management and Conservation	04 hrs	56	03 hrs	25	25	50	02
	Other subject										04
	Other subject										04
	Other subject										04
	Internship-1	Practical		Internship				50	0	50	02
	Total										**26**

B.Sc. Semester – V

Discipline Specific Course (DSCC)-9

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

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Durationof 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)	56 hrs
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 Ascarisasis. 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 formation. Type study: Pila (morphology, shell, respiration, nervous system and Reproduction) **Phylum Echinodermata**	14

	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

Publishing Home.

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**
Formative Assessment as per guidelines	

B.Sc. Semester – V

Discipline Specific Course (DSCC)-10

Course Title: Non-Chordates and Economic Zoology (Practical)
Course Code:

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)**	**56 hrs**
1	Preparation and observation of protozoan culture. **Protozoa**: Systematics of *Amoeba, Euglena, Noctiluca, Paramecium* and *Vorticella* (Permanent slides/ Charts).	4
2	**Porifera:** Systematics of *Sycon, Euplectella, Hyalonema, Spongilla* and *Euspongia* T.S of *Sycon*, Spicules and Gemmules (Specimens/ Permanent slides/ Charts)	4
3	**Cnidaria:** Systematics of *Aurelia* and *Metridium* (Specimens). Slides/Charts of *Hydra*, *Obelia* - polyp and medusa, and *Ephyra* larva, T.S. of *Metridium* passing through mesenteries. **Study of Corals**- *Astraea, Fungia, Meandrina, Corallium, Gorgonia, Millepora* and *Pennatula.*	4
4	**Helminthes:** Systematics of *Planaria, Fasciola hepatica* and *Taenia solium*, Ascaris- Male and female (Specimens/Charts). Slides/Charts of T.S. of *Planaria*, T.S. of male and female Ascaris.	4
5	**Annelida:** Systematics of *Nereis, Heteronereis, Sabella, Aphrodite* (Specimens/Charts). Slide/Chart of T.S. of earthworm through typhlosole.	4
6	**Arthropoda**: Systematics of *Panaeus, Palaemon, Astracus,* Scorpion, Spider, *Limulus, Peripatus, Millipede, Centipede,* Praying mantis, Termite Queen, Moth, Butterfly, Dung beetle /Rhinocerous beetle (Any six specimens). Slide/Chart of Larvae- Nauplius, Zoea, Mysis.	6
7	**Mollusca:** Systematics of *Chiton, Mytilus, Aplysia, Pila, Octopus, Sepia* (Specimens) and Glochidium larva (Slide/Chart). **Shell Pattern**- *Unio, Ostrea, Cypria, Murex, Nautilus, Patella, Dentalium,* Cuttle bone	4
8	**Echinodermata**: Systematics of Sea star, Brittle star, Sea Urchin, Sea Cucumber, Sea lilly (Specimens/Charts). Slides/Charts of Bipinnaria larva, Echinopluteusl arva	4

	and Pedicellaria.	
9	**Harmful Non-chordates:** Soil Nematodes, Agricultural, Veterinary and Human pests (Ticks, Mites and Bugs).	4
10	**Beneficial Non-chordates:** **Sericulture:** Life cycle of *Bombyx mori*, 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:

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)**	**56 hrs**
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: Balanoglossus- Habit and Habitat, Morphology, Coelom. Tornaria larva and its affinities. **Urochordata:** Type Study: *Herdmania*- Habit and Habitat, Morphology, Ascidian tadpole-structure and its retrogressive metamorphosis. **Cephalochordata:** Type Study: *Branchiostoma* (*Amphioxus*)-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	**Pisces:** Osmoregulation, migration and swim bladder in fishes. Types of caudal fins, scales in fishes. **Amphibia:** Origin of Amphibia, Parental care and Neoteny in Amphibia, **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. **Aves:** Flightless birds and their distribution, Major types of beaks. Kinds of migration in birds. Flight adaptations in birds. **Mammals:** Distribution of Prototheria and Metatheria with examples. Dentition in mammals and evolution of molar tooth. Adaptive radiation in mammals.	14

Unit-IV	**Comparative Anatomy of Vertebrates:** **Integumentary System:** Structure of skin and its derivatives. **Skeletal System:** Comparative account of Axial (Skull) and Appendicular (girdles) Skeletal system in Amphibians (Frog), Reptiles (Calotes), Aves (Pigeon) and Mammals (Rabbit). 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). **Excretory System:** Succession of vertebrate kidney and Evolution of urino-genital ducts in vertebrates	14

References:

1. Colbert*et al*: Colbert's Evolution of the Vertebrates: A history of the back boned animals through time. (5thed2002, Wiley–Liss).
2. Hildebrand:Analysis of Vertebrate Structure (4thed1995,JohnWiley)
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 (6thed1986, CBS Publishing, Japan)
7.Young:The Life of Vertebrates (3rded 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**
Formative Assessment as per guidelines	

B.Sc. Semester – V

Discipline Specific Course (DSCC)-12

Course Title: Chordates and Comparative Anatomy (Practical)
Course Code:

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)	56 hrs
1	**Protochordata**: Balanoglossus and T. S through proboscis Ascidian/*Herdmania* and *Amphioxus,* T.S. of *Amphioxus* through pharynx and intestine. **Cyclostomata:** *Petromyzon*, *Myxine.* Ammocoete larva	04
2	**Pisces**: Cartilaginous fishes – *Narcine, Trygon, Pristis, Myolobaties, Scolidion.*(Any four) Bony fishes– Zebrafish, Hippocampus, Muraena, Ostracion, Tetradon, Pleuronectus, 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**– *Saccobranchus, Clarias* and *Anabas.*	04
4	**Amphibia**: *Rana, Bufo, Ambystoma, Axolotl larva, Necturus and Ichthyophis.*	04
5	**Reptilia**: Turtle, Tortoise, *Mabuya, Calotes,* Chameleon, *Varanus*. **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, Calotes, Pigeon and Rabbit	05
10	**Comparative account** of skin in Shark, Frog, Calotes, 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)**	**56 hrs**
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)
Course Code:

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)**	**56 hrs**
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	**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. **Geological Time Scale**/ Stratigraphic Scale. **Species Concept and Extinction**: Concept of species; Modes of speciation: Allopatric and Sympatric species; Mass extinction (Causes, Names of five major extinctions) **Origin and evolution** of Human and Horse.	14
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,	14

	patterns of cleavage, fate map, up to formation of gastrula); types of morphogenetic movements; Fate of germ layers; Neurulation in frog embryo.	
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 (3rdedition) Blackwell Publishing

2. Hall, B.K. and Hallgrimson, B(2008)Evolution(4thedition) 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. T. Subramaniam – 2012 Developmental Biology), Narosa Publishing House Pvt. Ltd., New Delhi

7.Werner A. Müller, Developmental Biology (2012) Springer Science & Business Media.

8.Bruce M. Carlson, Human Embryology and Developmental Biology E-Book Elsevier Health Sciences.

9. Michael J. F. Barresi, Scott F. Gilbert, Developmental Biology (2019) Oxford University 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**
Formative Assessment as per guidelines	

B.Sc. Semester – VI

Discipline Specific Course (DSCC)-14

Course Title: Evolutionary and Developmental Biology (Practical)

Course Code:

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)	56 hrs
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, Sphenedon, 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); Study of adaptive radiations in feet of birds and mouth parts in insects with example	7
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)
Course Code:

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)**	**56 hrs**
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: Z**onation of the sea and ecological classification of marine biota, coastalecology, 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. Colinvaux,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, FC.(1984) - Ecology with Special Reference to Animal and Man. Prentice HallInc.
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**
Formative Assessment as per guidelines	

B.Sc. Semester – VI

Discipline Specific Course (DSCC)-16

Course Title: Environmental Biology, Wildlife Management and Conservation (Practical)
Course Code:

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)**	**56 hrs**
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)**	**56 hrs**
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**
Formative Assessment as per guidelines	

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: 2025-26

GENERAL PATTERN OF THEORY QUESTION COURSE FOR DSCC/ OEC

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

X Part-A

1. Question number 01- 06 carries 2 Marks each. Answer any 05 questions : 10 Marks

Part-B

2. Question number 07 - 11 carries 05 Marks each. Answer any 04 questions : 20 Marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions : 30 Marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

(Note: Proportionate weightage shall be given to each unit based on number of hours prescribed)

HAVERI UNIVERSITY, HAVERI

Four - Year B.Sc. (Hons.) Program

SYLLABUS FOR III & IV SEMESTER

Course: ZOOLOGY

DISCIPLINE SPECIFIC CORE COURSE (DSCC) FOR III & IV SEMESTER

AND

OPEN ELECTIVE COURSE (OEC) FOR III & IV SEMESTER

With Effect from 2024-25

AS PER N E P - 2020

Haveri University, Haveri
Subject: Zoology
With Effect from 2024-25

Semester	Type of Course	Course Code	Instructionhour / week (hrs)	Total hours of Syllabus / Semester	Duration of Exam (hrs)	Formative Assessment Marks	Summative Assessment Marks	Total Marks	Credits
III	DSCC-5: Molecular Biology, Bioinstrumentation and Techniques in Biology (Theory) - V		04	56	02	40	60	100	04
	DSCC-6: Molecular Biology, Bioinstrumentation and Techniques in Biology (Practical) -VI		04	52	03	25	25	50	02
	OEC- 3 Endocrinology		03	42	02	40	60	100	03
IV	DSCC -7: Gene Technology, Immunology and Computational Biology (Theory) - VII		04	56	02	40	60	100	04
	DSCC -8: Gene Technology, Immunology and Computational Biology (Practical) - VIII		04	52	03	25	25	50	02
	OEC- 4: Animal Behaviour		03	42	02	40	60	100	03
Details of the other semesters will be given later									

Programme Outcome (PO)

After the completion of 03/ 04 years Degree in Zoology, students will be able to:

PO 1: Students gain knowledge and skill in the fundamentals of animal sciences, understands the complex interactions among various living organisms
PO 2: Analyze complex interactions among the various animals of different phyla, their distribution and their relationship with the environment
PO 3: Apply the knowledge of internal structure of cell, its functions in control of various metabolic functions of organisms
PO 4: Understands the complex evolutionary processes and behaviour of animals
PO 5: Correlates the physiological processes of animals and relationship of organ systems
PO 6: Understanding of environmental conservation processes and its importance, pollution control and biodiversity and protection of endangered species
PO 7: Gain knowledge of agro based small scale industries like sericulture, fish farming, butterfly farming and vermicompost production
PO 8: Understands about various concepts of genetics and its importance in human health
PO 9: Apply the knowledge and understanding of Zoology to one's own life and work
PO 10: Develops empathy and love towards the animals
PO 11: Candidates find opportunities in government departments, environmental agencies, universities, colleges, biotechnological, pharmaceutical, environmental/ecological fields
PO 12: There are numerous career opportunities for candidates completing their B.Sc, M.Sc and Ph.D. in Zoology in public and private sectors

Programme Specific Outcomes (PSO)

PSO III:

PSO 1: Understanding of the processes of central dogma viz. transcription, translation etc. underlying survival and propagation of life at molecular level

PSO 2: Understanding how genes are ultimately expressed as proteins, which are responsible for the structure and function of all the organisms

PSO 3: Learn how four sequences (3 letter codons) generate the transcripts of life and determine the phenotypes of organisms

PSO 4: Understand the basics of various instruments like microscopes and bioinstruments used in biological studies and their applications

PSO 5: They are able to understand the use of biological instrumentation and proper laboratory techniques

PSO 6: The students will be acquiring basic experimental skills in various techniques in the fields of molecular biology

PSO7: To learn various techniques used in biology like histochemistry and immunotechniques

PSO IV:

PSO 1: To understand the principles of genetic engineering and its applications

PSO 2: To understand the basics of immunology and various mechanisms involved in immunity and their response

PSO 3: Acquired skills in diagnostic testing, haematology, staining procedures used in clinical and research laboratories, will provide them opportunity to work in diagnostic or research laboratory.

PSO 4: Acquired practical skills in biostatistics, bioinformatics can be used to pursue career as a scientist in drug development industry in India or abroad.

PSO 5: To know various type of biostatistical and bioinformatics techniques

PSO 6: Students gain skills in basics of computers, operating systems, overview of programming languages, internet services, sequencing techniques

PSO 7: Attained knowledge of data collection, tabulation and presentation of data and measures of central tendency, probability and Chi-square test.

PSO 8: Know the applications of internet and statistical bioinformatics in research

B.Sc. Semester – III

DSCC-5: Molecular Biology, Bioinstrumentation and Techniques in Biology (Theory)

Course Outcome (CO):

After completion of this course students will be able to:

CO1: Acquire better understanding and comprehensive knowledge regarding most of the essential aspects of molecular biology subject, which in turn will provide a fantastic opportunity to develop professional skill related to the field of molecular biology.
CO2: The course will mainly focus on the study of principal molecular events of cell incorporating DNA Replication, Transcription and Translation in prokaryotic as well as eukaryotic organisms.
CO3: Acquiring knowledge on instrumentation and techniques in biology.

Syllabus **DSCC-5: Molecular Biology, Bioinstrumentation and Techniques in Biology (Theory)**	**Total Hrs: 56**
Unit I:	**14 hrs**
Chapter 1: Process of Transcription • Fine structure of gene (Cistron, Recon, Muton) • RNA polymerases - types and functions • Transcription in prokaryotes and eukaryotes	**08**
Chapter 2: Process of Translation • Genetic code and its salient features • Translation in prokaryotes and eukaryotes	**06**
Unit-II :	**14 hrs**
Chapter 3: Regulation of gene expression-I • Regulation of gene expression in prokaryotes- lac operon (inducible) and trp operon(repressible) in *E. coli* • Regulation of gene expression in eukaryotes - Role of chromatin (euchromatin and heterochromatin) in gene expression • Post-transcriptional modifications: capping, splicing, polyadenylation • Concept of RNA editing (mRNA), gene silencing, and, RNAi.	**09**
Chapter 4: Regulation of gene expression-II • Post-translational modifications: purpose, advantages, and significance; glycosylation,methylation, phosphorylation, and acetylation. • Intracellular protein degradation (lysosomal autophagy and ubiquitin proteosome pathway).	**05**

Unit-III:	**14 hrs**
Chapter 5: Microscopy • Principles and applications of Light microscopy, Dark field microscopy, Phase contrastmicroscopy, Fluorescence microscopy, Confocal microscopy and Electron microscopy (SEM and TEM). • **Micrometry:** Principle and applications of micrometry	**09**
Chapter 6: Centrifugation and Chromatography • Centrifugation: Principles, types, and applications(High speed and Ultracentrifugation) • Chromatography : Principle and applications of: TLC, HPLC and GC	**05**
Unit IV:	**14 hrs**
Chapter 7: Biochemical Instrumentation • Colorimetry and Spectrophotometry: Beer-Lambert's law, Absorption spectrum, UV-VLSpectrophotometer. • pH meter, measurement of pH • Principle, applications and safety measures of Radio-tracer techniques - Autoradiography.	**06**
Chapter 8: Molecular Techniques • Principle and applications of Agarose Gel- Electrophoresis, SDS-PAGE, DNA Sequencing (Sanger's Dideoxy method),PCR, DNA Fingerprinting, ELISA, Southern Blotting and Western Blotting.	**08**

Recommended Books/References:

1. Principles & Techniques of Biochemistry And Molecular Biology Keith Wilson and John Walker 7th Edition Cambridge University Press (2010)
2. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).
3. Alberts et al: Molecular Biology of the Cell: Garland (2002).
4. Cooper: The Cell: A Molecular Approach: ASM Press (2000).
5. Karp: Cell and Molecular Biology: Wiley (2002).
6. Watson et al. Molecular Biology of the Gene. Pearson (2004).
7. Lewin. Genes VIII. Pearson (2004).
8. Pierce B. Genetics. Freeman (2004).
9. Sambrooket *al.* Molecular Cloning Vols I, II, III. CSHL (2001).
10. Primrose. Molecular Biotechnology. Panima (2001).
11. Clark andSwitzer. Experimental Biochemistry. Freeman (2000)
12. Principles of Genetics Robert H. Tamarin WC B/McGraw-Hill (1999)
13. Animal Microtechniques by Humason(1962)
14. De- Robertis- Cell and Molecular Biology.
15. Verma, P.S. and Agrawal, V.K. Molecular Biology
16. Bioinstrumentation by L. Veerakumari

B.Sc. Semester – III

DSCC-6: Molecular Biology, Bioinstrumentation and Techniques in Biology (Practical)

Course Outcomes (CO):

After completion of this Course students will be able to:

CO 1: To understand the principle of qualitative and quantitative analysis of nucleic acids (DNA and RNA)
CO 2: Understand the basic principles and applications of bioinstruments and biotechniques
CO 3: Understand the basic principles of microscopy, working of different types of microscopes
CO 4: Understand the principle of measuring the concentrations of macromolecules in solutions by colorimeter and spectrophotometer
CO 5: Learn about some of the commonly used separation techniques like centrifugation, chromatography
CO 6: To know about measurement of cells types through micrometry and also to get knowledge about virtual labs

Syllabus

DSCC-6: Molecular Biology, Bioinstrumentation and Techniques in Biology (Practical)

List of the experiments for 52 hrs

1. To study the working principle of Simple, Compound, and Binocular microscopes
2. To study the working principle of various laboratory equipments: pH Meter, Electronic balance, Laminar air flow, Incubator, Centrifuge, Micropipettes, Chromatography apparatus, Colorimeter , Spectrophotometer, PCR, Electrophoresis.
3. To prepare fixatives, stains and buffers (Phosphate, Citrate, Tris-HCL buffer).
4. To learn the working of measurement of the absorbance of any sample by using Colorimeter and/ or Spectrophotometer
5. To study Blotting techniques (working principle, procedure and applications)
6. Estimation of RNA by Orcinol method.
7. Estimate of DNA by Diphenyl Amine (DPA) method
8. To identify different unknown amino acids using ascending paper chromatography.
9. Isolation of DNA extraction from blood or any tissue samples.
10. Micrometry study of different cell types
11. Demonstration of differential centrifugation to fractionate components in a given mixture.
12. To estimate amount of protein by Lowry's method
13. Visit to nearby University/Research Institutions for demonstration of molecular biology techniques, bioinstruments/ biotechniques for students (not mandatory)
14. Any other practical's related to this paper may be added based on the feasibility

Recommended Books/References:

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. Molecular Biology of the Cell, 4th edition. New York: Garland Science (2002).
2. Daniel L. Hartl and Maryellen Ruvolo. Genetics: Analysis of Genes and Genomes, 8th Edition. Burlington,Mass.: Jones & Bartlett Learning (2012).
3. Gerald Karp. Cell and Molecular Biology: Concepts and Experiments, 5th Edition. Wiley Publication (2008).
4. Harvey Lodish, Arnold Berk, Paul Matsudaira, Chris A. Kaiser, Monty Krieger, Freeman. Molecular CellBiology, 5th edition. W. H. & Company (2003).
5. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, RichardLosick.Molecular Biology of the Gene, 5th edition. Cold Spring Harbor Laboratory Press (2003).
6. Stryer, Lubert. Biochemistry, 2nd Edition. W. H. Freeman and Company, New York (1981).

General instructions:

Perform all the experiments as per the instructions in each question

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

1. Major Experiments	**08 Marks**
2. Minor Experiments	**05 Marks**
3. Identifications (A-D)	**08 Marks**
4. Viva	**02 Marks**
5. Journal	**02 Marks**

Total 25 Marks

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

B.Sc. Semester – III

OEC- 3: Endocrinology

Course Outcome (CO):

After completion of this course students will be able to:

CO 1: Differentiate among endocrine, paracrine and autocrine systems.
CO 2: Describe the different classes and chemical structures of hormones.
CO 3: Identify the glands, organs, tissues and cells that synthesize and secrete hormones, hormone precursors and associated compounds.
CO 4: Identify and discuss the integration of the endocrine system in general with focus on specific interactions.
CO 5: Explain the consequences of under- and overproduction of hormones.

Syllabus **OEC-3: Title- Endocrinology**	**Total Hrs: 42**
Unit-I:	**14 hrs**
Chapter 1: About Endocrine glands • Endocrine glands and classifications of hormones. • Characteristics and Transport of Hormones. **Chapter 2: Hypothalamus-Hyphophysis** • Hypothalamus as a neuroendocrine organ • Pituitary – Structure and functions • Chemical nature, mode of action, and functions. • Pituitary disorders **Chapter 3: Pineal gland** • Structure and functions of Pineal gland. • Hypo- and hyperactive states of the gland.	
Unit-II:	**14 hrs**
Chapter 4: Thyroid and parathyroid • Histological structure of the glands. • Chemical nature, mode of action, and functions of the hormones. • Hypo-and hyperactive states of the glands. **Chapter 5: Adrenal cortex and medulla** • Histological structure of the gland. Chemical nature, and functions • Hypo- and hyperactive states of the gland. **Chapter 6.** Prostaglandins	
Unit-III:	**14 hrs**
Chapter 7: Pancreas • Pancreatic islets - histological structure. Chemical nature, and function. Hormonalcontrol of blood sugar. • Hyperinsulinism and diabetes mellitus. **Chapter 8: Gastro-intestinal hormones** • Functions and regulation of secretion of the hormones. **Chapter 9: Different types of Rhythms**	

• Ultradian, circadian, infradian. Different zeitgebers and their relation with circadianclock • Neural basis of biological clock and role of suprachiasmatic nuclei. Sleep-wakefulness cycle. Time keeping genes. Jet-lag and shift work.	

Recommended Books/References:

1. William's Text Book of Endocrinology Larsen et al.: An Imprint of Elsevier.
2. Endocrinology, Mac E. Hadley, Pearson Education.
3. The Kidney-An outline of Normal and Abnormal Functions, by H.E. Dewardener, ELBS.
4. Vander's Human Physiology, E.P. Widmaier et al., McGraw-Hill, Higher Education.
5. Concise Medical Physiology by S.K. Chaudhuri, New Central Book Agency.
6. Endocrinology. Vols.I, II and III by L.O. DeGroot. W.B. Saunders Co.
7. The Physiology of Reproduction, Vols.I & II, by E. Knobil and J.D. Neil. Raven Press.
8. Guyton and Hall. Text book of Medical Physiology. 13th Edition.
9. Histology: A Text and Atlas. Sixth Edition. Ross & Pawlina. Lippincott Williams & Wilkins.
10. Vertebrate Endocrinology by David O. Norris.

Details of Formative Assessment (IA) for DSCC/OEC (Theory):40% weightage for total marks

Type of Assessment	Weightage	Duration	Commencement
Written test-1	10%	1 hr	8th Week
Written test-2	10%	1 hr	12th Week
Seminar	10%	10 minutes	--
Case study / Assignment /Field work / Project work/ Activity	10%	------	--
Total	40% of the maximum marks allotted for thepaper		

GENERAL PATTERN OF THEORY QUESTION PAPER FOR DSCC/ OEC
(60 marks for Semester end Examination with 2 Hrs duration)

Part-A

1. Question number 1-06 carries 2 Marks each. Answer any 05 questions : 10 marks

Part-B

2. Question number 07- 11 carries 05 Marks each. Answer any 04 questions : 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub- questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

B.Sc. Semester – IV

DSCC- 7: Gene Technology, Immunology and Computational Biology (Theory)

Course Outcome (CO):

After completion of this course students will be able to:

CO1: Acquaint knowledge on versatile tools and techniques employed in genetic engineering andrecombinant DNA technology.
CO2: An understanding on application of genetic engineering techniques in basic and applied experimental biology.
CO3: To acquire a fundamental working knowledge of the basic principles of immunology.
CO4: To understand how these principles, apply to the process of immune function.
CO5: Use, and interpret results of, the principal methods of statistical inference and design; helpsto communicate the results of statistical analyses accurately and effectively; helps in usage of appropriate tool of statistical software.

Syllabus **DSCC- 7: Gene Technology, Immunology and Computational Biology (Theory)**	**Total Hrs: 56**
Unit-I:	**14 hrs**
Chapter 1: Principles of Gene Manipulation ● Recombinant DNA Technology: Introduction, steps involved. ● Restriction enzymes and Ligases and Nucleic acid modifying enzyme. ● Gene cloning vector: Concept of Plasmids-pBR322, Lamda phage vectors,Cosmids ● Gene transfer techniques (Direct and indirect). ● Screening and selection of recombinant colonies/cells	**07**
Chapter 2: Applications of Genetic Engineering • Transgenic animals (Transgenic Cow, Transgenic Fish); Transgenic plants(cry protein); Gene silencing (Knock out and Knock in mouse). ● Production of Human Recombinant insulin and ● Hybridoma technology: Synthesis and applications of Monoclonal antibodies ● Gene Therapy (SCID) ● Biosensors and its applications	**07**
Unit-II:	**14 hrs**
Chapter 3: Introduction to the Immune System • Defence against diseases: Introduction, First and second line of defence, Types of immunity: Innate and acquired immunity; Antigen presenting cells (APC's), Role of Band T-lymphocytes (Humoral immunity and Cell mediated immunity), primary and secondary immune response. • Functional aspects of organs of the Immune system - Thymus and bone marrow spleen, Lymph Node, Small intestine and Liver (Peyer's patchesand Von Kupffer cells).	**07**

Chapter 4: Antigens and Antibodies • Antigens and haptens: Properties (foreignness, molecular size, heterogeneity). • B and T cell epitopes. • Structure of IgG and functions of different classes of immunoglobulins. • Major histocompatibility complex - Structure of MHC I & II.	**07**
Unit-III:	**14 hrs**
Chapter 5: Clinical Immunology • Immunity against diseases of viral, bacterial and protozoan infections. • Vaccines: Types and Uses - Immunization schedule for children. • Transplantation immunology: Transplantation of organ- Types, graft rejection and Immuno-suppressors. **Chapter 6: Bioinformatics** • Databases: Sequence and structural • Sequence analysis (Homology): Pairwise and Multiple Sequence alignment- BLAST, CLUSTALW, Sequence alignment- FASTA. • Scope and applications of Bioinformatics.	**07** **07**
Unit-IV:	**14 hrs**
Chapter 7: Biostatistics I • Measures of central tendency: Mean, Median, Mode. • Data summarizing: Frequency distribution, Graphical presentation - Bardiagram, Pie diagram, Histogram. **Chapter 8: Biostatistics II** • Measures of dispersion: Range, Standard Deviation, Variance. • Correlation and Regression. • Tests of significance: F-test, ANOVA, t-test and Chi square test.	**07** **07**

Recommended Books/References:

1. Primrose &Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003).
2. Hartl& Jones. Genetics: Principles &Analsysis of Genes & Genomes. Jones & Bartlett (1998).
3. Sambrook *et al* .Molecular Cloning Vols I, II, III. CSHL (2001).
4. Primrose. Molecular Biotechnology. Panima (2001).
5. An Introduction to Genetic Engineering by Desmond S. T. Nicholl
6. Principles of Genetics by D. Peter Snustad and Michael J. Simmons
7. Fundamental Immunology by William E. Paul
8. A Textbook of Immunology by Dr. P Madhavee Latha

9. Basic Bioinformatics by S. Ignacimuthu
10. Kuby Immunology by Punt, W. H. Freeman
11. Introduction to Bioinformatics (2003) by T.K. Attwood & D.J. Parry
12. Statistical Methods by G. W. Snecdeor and W. G. Cochran, Willey Blackwell.
13. Introductory Biological Statistics by John E. Havel, Raymond E. Hampton and Scott J. Meiners.
14. Sambrooket *al.* Molecular Cloning Vols I, II, III. CSHL (2001).
15. Clark and Switzer. Experimental Biochemistry. Freeman (2000)
16. Animal Microtechniques by Humason(1962)
17. De- Robertis- Cell and Molecular Biology.
18. Verma, P.S. and Agrawal, V.K. Molecular Biology
19. Bioinstrumentation by L. Veerakumari

B.Sc. Semester – IV

DSCC-8: Gene Technology, Immunology and Computational Biology (Practical)

Course Outcomes (CO):

After completion of this course students will be able to:

CO 1: Understand the principles of genetic engineering with hands on experiments in detection of diseases

CO 2: Get introduced to DNA testing and utility of genetic engineering in forensic sciences.

CO 3: Understand the basics of immunology and its applications in clinical research.

CO 4: Study on immune system and its components

CO 5: Apply knowledge and awareness of the basic principles and concepts of biology, computers science and mathematics existing software's effectively to extract information from large data bases to use this in computer modeling

CO 6: Use bioinformatics tools to find out evolutionary/ phylogenetic relationship of organisms using gene /protein sequences

CO 7: Understand and can apply biostatistics and bioinformatics tools in research.

Syllabus

DSCC-8: Gene Technology, Immunology and Computational Biology (Practical)

List of the Experiments for 52 hrs

1. Calculate the mean, median, mode and standard deviation (Measurement of pre and post clitellar lengths (with suitable examples).
2. Measure the height and weight of all students in the class and apply statisticalmeasures.
3. Determination of ABO Blood group and Rh factor.
4. To study of lymphoid organs: Thymus, Bone marrow, Spleen, Tonsil, Lymph node (Slides /Charts/ Video)
5. Preparation of blood smears to study various blood cells like RBC, WBC, Platelets, Lymphocytes & Monocytes
6. Separation of different blood cells like RBC, WBC, Platelets, Lymphocytes & Monocytes
7. To study Restriction enzyme digestion using teaching kits (Demonstration only).
8. To detect genetic mutations by Polymerase Chain Reaction (PCR) usingteaching kits (Demonstration only).
9. Demonstration of agarose gel electrophoresis for detection of DNA.
10. Demonstration of Polyacrylamide Gel Electrophoresis (PAGE) for detectionof proteins.
11. To calculate molecular weight of unknown DNA and protein fragments fromgel pictures. (https://youtube/mCiCiO0cfbg)
12. To learn nucleotide sequence database.
13. To learn sequence alignment: Pairwise alignment (Protein/ DNA).
14. To learn about basics of computer applications in biology
15. Visit to nearby University/Research Institutions for demonstration of genetic engineering /

Immunology/Bioinformatic techniques for students

16. Any other practical's related to this paper may be added based on the feasibility

Recommended Books/References:

1. Primrose &Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003).
2. Hartl& Jones. Genetics: Principles &Analsysis of Genes & Genomes. Jones & Bartlett (1998).
3. Sambrook *et al* .Molecular Cloning Vols I, II, III. CSHL (2001).
4. Primrose. Molecular Biotechnology. Panima (2001).
5. An Introduction to Genetic Engineering by Desmond S. T. Nicholl
6. Principles of Genetics by D. Peter Snustad and Michael J. Simmons
7. Fundamental Immunology by William E. Paul
8. A Textbook of Immunology by Dr. P Madhavee Latha
9. Basic Bioinformatics by S. Ignacimuthu
10. Kuby Immunology by Punt, W. H. Freeman
11. Introduction to Bioinformatics (2003) by T.K. Attwood & D.J. Parry
12. Statistical Methods by G. W. Snecdeor and W. G. Cochran, Willey Blackwell.
13. Introductory Biological Statistics by John E. Havel, Raymond E. Hampton and Scott J. Meiners.

General instructions:

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

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

1. Major Experiments	**08 Marks**
2. Minor Experiments	**05 Marks**
3. Identifications (A-D)	**08 Marks**
4. Viva	**02 Marks**
5. Journal	**02 Marks**

Total 25 marks

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

B.Sc. Semester – IV

OEC – 4: Animal Behaviour

Course Outcomes (CO):

After completion of this course students will be able to:

CO 1: Understand types of animal behaviour and their importance to the organisms
CO 2: Explain about behaviour, migration and communication in animals
CO 3: Understand about ecological aspects of behaviour and social behaviour
CO 4: Understand animal behaviour and response of animals to different instincts
CO 5: Understand the proximate controls of behavior including the role of pheromones
CO 6: Learn about reproductive behaviour and parental care in animals

Syllabus **OEC-4: Animal Behaviour**	**Total Hrs: 42**
Unit-I:	**14 hrs**
Chapter 1: Introduction to Animal Behaviour • Brief contributions of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, NikoTinbergen. • Proximate and ultimate causes of behaviour. **Chapter 2: Patterns of Behaviour** • Stereotyped Behaviors - Orientation and Reflex. • Individual Behavioural patterns: Instinct and Learned Behaviour • Associative learning, classical and operant conditioning, Habituation, Imprinting.	
Unit-II:	**14 hrs**
Chapter 3: Social Behaviour: • Social organization in termites and honey bees. • Social behaviour: Altruism. • Conflict behaviour. **Chapter 4: Sexual Behaviour** • Sexual dimorphism, Mate choice in peacock. • Intra-sexual selection (male rivalry in red deer). • Kinship theory: Relatedness & inclusive fitness. • Parental care in fishes (Nest Building & cost benefit)	
Unit-III:	**14 hrs**
Chapter 5: Chronobiology • Brief historical developments in chronobiology. • Adaptive significance of biological clocks. • Biological Rhythms **Chapter 6: Communications in animals** • Bioluminescence in deep sea fishes and insects • Territoriality in Monkeys and Dogs • Role of pheromones in animal communication- Insects and Vertebrates, • Communication in Honey bees (Waggle Dance)	

Recommended Books/References:

1. Drickameré Vessey: Animal Behaviour, Concepts, Processes and Methods (Wadsworth)
2. Grier: Bilogy of Animal Behaviour (Mosby College)
3. Immelmann: Introduction to Ethology (Plenum Press)
4. Lorenz: The Foundation of Ethology (Springer-Verlag)
5. Manning: An Introduction to Animal Behaviour (Addison - Wesley)
6. McFarland: Animal Behaviour, Psychology, Ethology and Evolution (Pitman)
7. Price & Stoker: Animal behaviour in laboratory and field (Freeman)
8. Wood-Gush: Elements of Ethology (Chapman and Hall)
9. Animal Behaviour by Alock (2013)
11. Introduction to Animal Behaviour by Manning A. & M.S.Dawkins (2012)
12. Ecology by Charles J. Krebs (2009)
13. Elements of Ecology by Clarke (2015).

Details of Formative Assessment (IA) for DSCC /OEC (Theory):40% weightage for total marks

Type of Assessment	Weightage	Duration	Commencement
Written test-1	10%	1 hr	8th Week
Written test-2	10%	1 hr	12th Week
Seminar	10%	10 minutes	--
Case study / Assignment / Field work / Project work/ Activity	10%	------	--
Total	40% of the maximum marks allotted for the paper		

GENERAL PATTERN OF THEORY QUESTION PAPER FOR DSCC/ OEC
(60 marks for Semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 Marks each. Answer any 05 questions : 10 marks

Part-B

2. Question number 07- 11 carries 05 Marks each. Answer any 04 questions : 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.