

COURSE PATTERN AND SCHEME OF EXAMINATION OF B.Sc. ZOOLOGY

Semester I								
Sl. No	Course Code	Title of the Course	Category of Courses	Teaching Hours per Week	SEE	IA	Total Marks	Credits
1		Animal Diversity-I (Non- Chordata)	Theory	4	80	20	100	3
2		Animal Diversity-I (Non- Chordata)	Practical	4	40	10	50	2
Semester II								
3		Animal Diversity- II (Chordata)	Theory	4	80	20	100	3
4		Animal Diversity- II (Chordata)	Practical	4	40	10	50	2
Semester III								
5		Physiology, Biochemistry and Immunology	Theory	4	80	20	100	3
6		Physiology, Biochemistry and Immunology	Practical	4	40	10	50	2
7		Parasitological and Vector Biology	Elective/ Optional	2	40	10	50	2
Semester IV								
8		Histology, Animal Behavior, Applied Zoology	Theory	4	80	20	100	3
9		Histology, Animal Behavior, Applied Zoology	Practical	4	40	10	50	2
10		Aquarium Fish Keeping	Elective/ Optional	2	40	10	50	2
Semester V								
11		Cell Biology and Biotechnology	Theory	4	80	20	100	3
12		Genetics, Biostatistics, Evolution and Paleontology	Theory	4	80	20	100	3
13		Cell Biology, Biotechnology, Genetics,	Practical	4	40	10	50	2

		Biostatistics, Evolution and Paleontology						
Semester VI								
14		Reproductive Biology and Developmental Biology	Theory	4	80	20	100	3
15		Environmental Biology, Toxicology and Wildlife Biology	Theory	4	80	20	100	3
16		Reproductive Biology, Developmental Biology, Environmental Biology, Toxicology and Wildlife Biology	Practical	4	40	10	50	2
17		Project work / Field training	Skill enhancemen t programme	3-4	40	10	50	2

MANGALORE UNIVERSITY
STATE EDUCATION POLICY (SEP-2024)
B.Sc. DEGREE - ZOOLOGY

Program Name	B.Sc.	SEMESTER	I
Course Title	ANIMAL DIVERSITY-I (NON-CHORDATA) (THEORY)		
Course Code:	BSCZOC	No. of Credits	3
Contact hours	40 Hrs (4 hours/week)	Duration of SEA/Exam	3 Hrs.
Formative assessment marks	20	Summative assessment marks	80

Unit - I: Introduction, Biodiversity, Protozoa

- 1.1 Introduction** 2 Hrs
Principles of animal classification - Binomial nomenclature, Linnaean hierarchy; Criteria for animal classification - body layers, coelom, body symmetry, metamerism, cephalisation; Definition of species; Phylogeny; Classification of Animal Kingdom up to phylum.
- 1.2 Biodiversity** 3 Hrs
Levels of biodiversity - species, genetic and ecosystem level diversity; Concept of Biodiversity hotspots; Biodiversity hotspots of India with emphasis on Western Ghats & Himalaya hotspots.
- 1.3 Phylum: Protozoa** 5 Hrs
General characters of the phylum and classification up to classes with suitable examples; Structure and life history of malarial parasite (*Plasmodium vivax*) and human parasitic protozoan (*Entamoeba histolytica*).

Unit - II: Porifera, Coelenterata, Ctenophora

- 2.1 Phylum: Porifera** 5 Hrs
General characters of the phylum and classification up to classes with suitable examples; Sycon-morphology; canal system in sponges.
- 2.2 Phylum: Cnidaria and Ctenophora** 5 Hrs
General characters of the phylum and classification up to classes with suitable examples; Polymorphism in *Physalia* and *Halistemma*; Coral reefs – Fringing, Barrier, Atoll; Structure of Corallite; Metagenesis in *Obelia*.
- 2.2.1** Distinctive characters of Ctenophora, External of *Pleurobrachia*.

Unit - III: Platyhelminthes, Nematelminthes and Annelida

- 3.1 Phylum: Platyhelminthes** 3 Hrs
General characters of the phylum and classification up to classes with suitable examples; Structure and life history of liver fluke and tapeworm.
- 3.2 Phylum: Nematelminthes** 3 Hrs
General characters of the phylum with suitable examples; External characters, life cycle and pathogenicity and preventive measures of *Ascaris*.
- 3.3 Phylum: Annelida** 4 Hrs

General characters of the phylum and classification up to classes with suitable examples; Tubicolous adaptations in *Sabella* and *Chaetopterus*; External features and life history of earthworm.

Unit - IV: Arthropoda, Onychophora, Mollusca and Echinodermata

- 4.1 Phylum: Arthropoda and Onychophora** 4Hrs
General characters of the phylum and classification up to classes with suitable examples; Externals of marine prawn (*Penaeus*) with detailed account of appendages; Metamorphosis in insects – Definition, types with examples – ametabola, hemimetabola and holometabola; Externals of *Peripatus*.
- 4.2 Phylum: Mollusca** 3Hrs
General characters of the phylum and classification up to classes with suitable examples; External features of *Unio* and *Pila*.
- 4.3 Phylum: Echinodermata** 3Hrs
General characters of the phylum and classification up to classes with suitable examples; External features and water-vascular system of *Asterias*; Larval forms of Echinodermata – Bipinnaria, Echinopluteus.
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Note:

1. Local examples with common and scientific names are to be given more emphasis for all the groups.
2. While selecting the examples, only such of the salient features of the examples have to be mentioned which are necessary to explain the general characters of the phylum/class.

REFERENCES:

1. Adam, S. 1990. A Students Text Book of Zoology, Vol. I, II & Vol. III. Low Price Publications, New Delhi.
2. Agarwal, V.K. 2017. Zoology for Degree Students: Non-Chordata, S. Chand & Company, New Delhi.
3. Ayyar, E. 1982. A Manual of Zoology Vol. I, Part I & II, S. Vishwanathan Pvt. Ltd.
4. Barnes, R.S.K., Calow. P., Olive, P.J.W., Golding, D.W., Spicer, J.I. 2002. The Invertebrates: Synthesis, Blackwell Publishing.
5. Dhama, P.S. & Dhama, J.K. 2021. Invertebrate Zoology, 5th Edition, R. Chand & Co. New Delhi.
6. Hickman, C., Roberts, L.S., Keen, S.L., Larson, A. and Eisenhour, D. 2018. Animal Diversity, McGraw-Hill.
7. Holland, P. 2011. The Animal Kingdom: A Very Short Introduction, Oxford University Press.
8. Hussain, S. A. & Achar, K.P. 1999. Biodiversity of the Western Ghats Complex of Karnataka. Resource Potential and Sustainable Utilization. Mangalore: Biodiversity Initiative Trust.
9. Jordan, E.L. & Verma, P.S. 2022. Invertebrate Zoology, S. Chand & Company, New Delhi.
10. Kotpal, R.L. 2017. Modern Text Book of Invertebrates, Rastogi Publications, Meerut.
11. Kotpal, R.L. 2017. Protozoa to Echinodermata (Phylum Series), Rastogi Publications, Meerut.
12. Lal, S.S. 2016. A Text book of Practical Zoology – Invertebrates, Rastogi Publications.
13. Verma, P.S. 2013. A Manual of Practical Zoology – Invertebrates, S. Chand & Co. New Delhi.

Program Name	B.Sc.	SEMESTER	I
Course Title	ANIMAL DIVERSITY-I (NON-CHORDATA) (PRACTICAL)		
Course Code:	BSCZOP	No. of Credits	2
Contact hours	4 Hrs/week	Duration of SEA/Exam	3 Hrs
Formative assessment marks	10	Summative assessment marks	40

A. Museum specimens and slides.

Commonly available specimens cited in the list of examples are to be selected for practicals.

B. Dissections (Demonstration only)

1. Prawn: Nervous system
2. Earthworm: Nervous system
3. Leech: a) Digestive system
b) Reproductive system
4. Cockroach: a) Digestive system
b) Nervous system
c) Male and female reproductive systems
5. Observations of hay infusion culture to study living protozoans like *Euglena*, *Paramecium*, *Vorticella*, *Amoeba* etc.

C. Mounting and Whole mount preparations

- i) Demonstration of mounting of the following:
 - a. Prawn: Appendages
 - b. Leech: i) Salivary gland cells
ii) Jaw
 - c. Cockroach: Salivary glands, Mouth parts
 - d. Earthworm: Ovary, Body setae
- ii) Whole mount preparation: Cnidarian colonies - *Obelia*, *Sertularia*, *Pennaria*, *Tubularia* (any two); Crustacean larvae – Nauplius, Zoea, Mysis (any two) - Processing and mounting.

LIST OF MUSEUM SPECIMENS AND SLIDES

1. Slides of *Elphidium*, *Euglena*, *Plasmodium*, *Paramecium*, and *Vorticella*.
 2. Specimens of *Euplectella*, *Sycon*, slides of sponge spicules.
 3. *Obelia*, *Physalia*, *Aurelia*, *Sea anemone*, *Fungia*.
 4. Planaria, Liver fluke, Tapeworm, *Ascaris* (Male and Female).
 5. *Nereis*, *Chaetopterus*, *Pheretima*, *Leech*.
 6. *Carcinus* (male or female crab), *Peripatus*, *Lepas*, *Scolopendra*, *Limulus* and *Palamnaeus* (Scorpion).
 7. *Chiton*, *Dentalium*, *Xancus*, *Pila*, *Unio*, *Nautilus*, *Octopus*.
 8. *Asterias* (Star fish), *Ophiothrix* (Brittle star), *Echinus* (Sea-urchin), *Cucumaria* (Sea-cucumber), *Antedon* (Sea-lily), *Bipinnaria* larva, *Pluteus* larva.
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SCHEME OF PRACTICAL EXAMINATION
B.Sc. ZOOLOGY: I SEMESTER
Course Title: ANIMAL DIVERSITY- I (NON-CHORDATA)

Code: BSCZOP

Duration: 3 hours

Max. Marks: 40

I. Dissection - Identify, draw labeled diagram and comment on the systems A and B . (Identification of the system - 1 Mark; Labelled diagram of the entire system - 2 Marks; Description - 1 Mark) (A & B in different animals)	2 x 4 = 08
I. Mounting – Identify and comment on C . [Any one item from C (i)] (Identification -1 Mark; Diagram -1 Mark; Minimum two unique characters -1 Mark)	03
II. Mounting – Make a stained, temporary mounting of the given material D . [Any one item from C (ii)] (Stained preparation-2 Marks; Procedure-1 Mark)	03
III. Identify, classify, draw labeled diagram and comment on E , F , G , and H . (1 slide, 3 specimens). (Identification - ½ Mark; Classification -½ Mark; Labelled diagram -1 Mark; Four Comments - 2 Marks)	4x4=16
IV. Class records	10
	TOTAL = 40

Note:

1. Questions must be framed as per the scheme provided.
2. Internal assessment marks to be allotted after conducting one practical test at the end of the semester.

Program Name	B.Sc.	SEMESTER	II
Course Title	ANIMAL DIVERSITY-II (CHORDATA) (THEORY)		
Course Code:	BSCZOC	No. of Credits	3
Contact hours	40 Hrs (4 hours/week)	Duration of SEA/Exam	3 Hrs
Formative assessment marks	20	Summative assessment marks	80

Unit - I: Hemichordata, Chordata, and Cyclostomata

- 1.1 Hemichordata** 2 Hrs
General characters of the phylum and external features of *Balanoglossus*; Tornaria larva.
- 1.2 Chordata** 1 Hrs
General characters of Chordata and outline classification up to subphyla.
- 1.2.1 Protochordata** 2 Hrs
Characters of Urochordata and Cephalochordata with examples; External features of *Herdmania* and *Branchiostoma*.
- 1.3. Vertebrata** 1 Hrs
General characters of Vertebrata; Outline classification up to classes.
- 1.4 Cyclostomata** 4 Hrs
General characters; External features and differences between Lamprey (*Petromyzon*) and Hag fish (*Myxine*), Structure of Ammocoetes larva and its metamorphosis.

Unit - II: Pisces and Amphibia

- 2.1. Pisces** - General characteristics and aquatic adaptations of fishes. 2 Hrs
- 2.2 Chondrichthyes and Osteichthyes** 2 Hrs
General characters of Chondrichthyes with examples; General characters of Osteichthyes with examples.
- 2.3 Amphibia** 2 Hrs
General characters and classification up to orders; Distinguishing features of Anura, Apoda and Urodela with suitable examples.
- 2.3.1 Endoskeleton of Frog** 4 Hrs
Skull, lower jaw, hyoid apparatus, vertebral column, pectoral and pelvic girdles, limb skeleton.

Unit - III: Reptilia and Aves

- 3.1 Reptilia** 5 Hrs
General characters and classification up to orders (living orders only) with suitable examples; Temporal fossae and arcades in reptiles; Indian snakes – Examples of poisonous and Non- poisonous snakes; Distinguishing poisonous from non-poisonous snakes; Poison apparatus and its working mechanism; Snake venom and anti-venom.
- 3.2 Aves** 5 Hrs
General characters and classification; Distinctive features of Archaeornithes and Neornithes with reference to Palaeognathae, Impennae and Neognathae giving suitable examples; Flight adaptations in birds.

Unit - IV: Mammalia

4.1 Classification and distinctive features	4Hrs
General characters and classification up to subclasses; Distinctive features of Prototheria, Metatheria and Eutheria with important examples.	
4.2. Important characters of following Eutherian orders with examples.	4Hrs
Primates, Chiroptera, Cetacea, Perissodactyla, Artiodactyla, Carnivora, Rodentia and Proboscidea.	
4.3. Organ systems	1 Hrs
Study of digestive system and reproductive system of rat.	
4.4 Exoskeletal structures	1Hrs
Structure of horns, antlers, hooves & hairs.	

Note:

1. Local examples with common and scientific names are to be given more emphasis for all the groups.
2. While selecting the examples, only such of the salient features of the examples have to be mentioned which are necessary to explain the general characters of the phylum/class.

REFERENCES:

1. Adam, S. 1990. A Students Text Book of Zoology, Low Price Publications, Delhi, Vol. I, II & Vol.III.
2. Ayyar, E. 1982. A Manual of Zoology Vol. II, S. Vishwanathan Pvt. Ltd.
3. Colbert, E.H. 2011. Evolution of the Vertebrates, Wiley Student Edition.
4. Dhama & Dhama. 2014. Chordate Zoology, R. Chand & Co. New Delhi.
5. Jordan, E.L. & Verma, P.S. 2013. Chordate Zoology, S. Chand & Company, New Delhi.
6. Kotpal, R.L. 2016. Modern Text Book of Zoology – Vertebrates, Rastogi Publications, Meerut.
7. Lal, S.S. 2009. Practical Zoology Vertebrate 12th Ed, Rastogi Publications, Meerut.
8. Parker, T. J. & William, A. H. 1990. A Text Book of Zoology, Low Price Publications, Delhi, Vol. I & II.
9. Prasad, S.N. and Kashyap, V. 2015. A text book of Vertebrate Zoology, New Age International Ltd, New Delhi.
10. Prabhakar Achar, K. & Geetha Nayak, K. 2000. Birds of Dakshina Kannada, Bhuvanendra Nature Club - India.
11. Prakash, M. & Arora, C. K. 1998. Laboratory Animals, Anmol Publicating, Ansari Road, NewDelhi.
12. Verma, P.S. 2013. A Manual of Practical Zoology (Vertebrates), S. Chand & Company, New Delhi.

Program Name	B.Sc.	SEMESTER	II
Course Title	ANIMAL DIVERSITY-II (CHORDATA) (PRACTICAL)		
Course Code:	BSCZOP	No. of Credits	2
Contact hours	4 Hrs/week	Duration of SEA/Exam	3 Hrs
Formative assessment marks	10	Summative assessment marks	40

A. Museum specimens and slides

Commonly available specimens cited in the list of examples are to be selected for practicals.

B. Dissections (Demonstration only)

1. Mouse
 - a) Digestive system
 - b) Male and Female Urinogenital systems
2. Fish- Afferent branchial system, Cranial nerves V, VII, X.

C. Mounting

Fish scales (Placoid, Cycloid and Ctenoid)

D. Study of Exoskeletal structures: Bird feathers (Down feather, Contour feather); Horns (Cattle, Sheep); Hooves (Cattle, Horse/ Donkey)

E. Study of Endoskeletal structures: Skull (Amphibian, Reptilian, Avian, Mammalian); Vertebrae, Girdles and limb skeleton of Frog.

LIST OF MUSEUM SPECIMENS AND SLIDES

1. *Balanoglossus*, *Herdmania*, *Amphioxus*, Tornaria larva (all).
2. *Petromyzon*, *Myxine*, *Ammocoetes* larva (all).
3. *Narcine* (Electric ray), *Pristis* (Saw fish), *Trygon* (Sting ray), *Scoliodon* (Shark) (Any two).
4. *Anguilla*, *Hippocampus*, *Anabas testudineus*, *Catla catla*, *Clarius batrachus*, *Gambusia affinis* (Any two).
5. *Ichthyophis* (Caecilian), *Bufo melanosticus* (Common Toad), *Rana hexadactyla* (Indian Pond Frog), *Rana cyanophlyctis* (Skipper Frog), *Hoplobatrachus tigerinus* (Indian Bull Frog), *Rhacophorus malabaricus* (Malabar Gliding Frog), *Ambystoma*, Salamander, Axolotl larva (1 limbless; 1 tailed; others -2).
6. *Hemidactylus frenatus* (Southern House Gecko), *Calotes versicolor* (Common garden Lizard), *Varanus benghalensis* (Common Indian Monitor), *Draco dussumieri* (Draco), *Calotes rouxi* (Forest Calotes), *Chameleon zeylancius* (Indian Chaemeleon), *Crocodylus porosus* (Mugger) - (any three).
7. *Ptyas mucosus* (Common rat snake), *Bungarus fasciatus* (Banded Krait), *Bungarus caeruleus* (Common Indian Krait), *Naja naja* (Indian Cobra), *Python molurus* (Indian Python), *Trimeresurus malabaricus* (Pit Viper), *Eryx conicus* (Russell's Earth Boa), *Daboia russelii* (Russell's Viper) - (any four).

8. *Geochelone elegans* (Starred Tortoise), *Geochelone travancorica* (Travancore Tortoise), *Chelone mydas* (any two).
9. *Pycnonotus jocosus* (Red whiskered Bulbul), *Dicrurus adsimilis* (Black Drongo or King crow), *Oriolus xanthornus* (Black-hooded Oriole), *Sturnus pagodarum* (Black headed or Brahminy Myna), *Psittacula cyanocephala* (Blossom headed Parakeet), *Haliastur indus* (Brahminy Kite), *Centropus sinensis* (Crow Pheasant), *Ardea cinerea* (Grey Heron), *Corvus splendens* (House Crow), *Passer domesticus* (House Sparrow), *Tyto alba* (Indian Barn Owl), *Ploceus philippinus* (Indian Baya), *Oriolus oriolus* (Indian Golden Oriole), *Pavo cristatus* (Indian Peafowl), *Acridotheres tristis* (Common Myna), *Ardeola grayii* (Indian Pond Heron or Paddy bird), *Nectarinia asiatica* (Indian Purple Sunbird), *Copsychus saularis* (Magpie Robin), *Amaurionis phoenicurus* (Indian Whitebreasted Waterhen), *Dinopium benghalense* (Lesser Golden backed Woodpecker), *Egretta garzetta* (Little Egret) - (any four).
10. *Echidna*, *Bandicota indica* (Bandicoot Rat), *Lepus nigricollis* (Black naped hare), *Macaca radiata* (Bonnet Macaque), *Presbytis entellus* (Common Langur), *Herpestus edwardsi* (Common Mongoose), *Paradoxurus hermaphrodites* (Common Palm Civet), *Petaurista philippensis* (Common giant flying squirrel), *Funambulus palmarum* (Three striped palm squirrel), *Rousettus leshenulti* (Fulvous fruit bat), *Mus musculus* (House Mouse), *Rattus rattus* (House Rat), *Pteropus giganteus* (Indian Flying Fox) - (any three).

Note: 1. Local examples with common and scientific names are to be given more emphasis for all the groups.

2. Only such of the salient features of the examples have to be mentioned which are necessary to explain the general characters of the phylum/class.

3. In the event of non-availability of specimens, related internet downloaded photos/movies can be shown.

SCHEME OF PRACTICAL EXAMINATION
B.Sc. ZOOLOGY: II SEMESTER
Course Title: ANIMAL DIVERSITY- II (CHORDATA)

Code: BSCZOP

Duration: 3 hours

Max. Marks: 40

I. Dissection - Identify, draw labeled diagram and comment on the systems A and B . (Identification of the system - 1 Mark; Labelled diagram of the entire system - 2 Marks; Description - 1 Mark) (A & B in different animals)	2x4 = 08
II. Mounting – Make a stained, temporary mounting of the given material C (Fish Scale) (Stained preparation-2 Marks)	02
III. Identify, classify, draw labeled diagram and comment on D , E , and F . (Identification-½ Mark; Classification-½ Mark; Labelled diagram-1 Mark; Four Comments-2 Marks)	3x4=12
IV. Exoskeleton – Identify and comment on G . (Identification-1 Mark; Minimum two unique features-1 Mark)	02
V. Endoskeleton – Identify and comment on the material H and I (One Skull/Girdle/limb Skeleton; One vertebra). (Skull/Girdle/Limb Skeleton: Identification-1 Mark; Minimum six unique features-3 Marks) (Vertebra: Identification - ½ Mark; Minimum 3 unique features - 1½ Marks)	4+2=06
VI. Class records	10
	TOTAL = 40

Note:

3. Questions must be framed as per the scheme provided.
4. Internal assessment marks to be allotted after conducting one practical test at the end of the semester.

Program Name	B.Sc.	SEMESTER	III
Course Title	PHYSIOLOGY, BIOCHEMISTRY AND IMMUNOLOGY (THEORY)		
Course Code:	BSCZOC	No. of Credits	3
Contact hours	40 Hrs (4 hours/week)	Duration of SEA/Exam	3 Hrs
Formative assessment marks	20	Summative assessment marks	80

Unit - I: Physiology

- 1.1 Introduction** 1 Hr
Definition; Branches and scope of physiology.
- 1.2 Osmoregulation** 2 Hrs
Definition; Types of solutions-hypotonic, isotonic and hypertonic; Osmoconformers and Osmoregulators; Osmoregulation in shark, marine and freshwater teleosts, terrestrial mammals (Kangaroo rat and camel).
- 1.3 Thermoregulation** 2 Hrs
Ectotherms, Endotherms, and Heterotherms; Temperature regulation in Poikilotherms and Homeotherms; Aestivation and hibernation.
- 1.4 Digestion** 2 Hrs
Mechanical and chemical digestion; Digestion and absorption of carbohydrates, proteins and lipids.
- 1.5 Respiration** 3 Hrs
External and internal respiration; Respiratory pigments - Haemoglobin, haemocyanin and haemoerythrin; Physiology of respiration – breathing, exchange of gases - transport of oxygen - oxygen dissociation curves - Bohr effect - transport of carbon dioxide - chloride shift; Respiratory quotient.

Unit - II: Physiology (Contd...)

- 2.1. Circulation** 3 Hrs
Types of circulation; Structure and functions of human heart; Origin and conduction of heart beat; Cardiac cycle; Blood pressure - hypertension and hypotension; Composition of human blood – Plasma, Erythrocytes, leucocytes and platelets.
- 2.2 Nirtrogen Excretion** 3 Hrs
Nitrogen excretion in aquatic and terrestrial animals – Ammonotelism, Ureotelism and Uricotelism with examples; Ornithine cycle in humans; Physiology of urine formation in humans – ultrafiltration, tubular reabsorption and tubular secretion.
- 2.3 Muscle Contraction** 4 Hrs
Principal types of muscles; Ultrastructure of striated muscles; Contractile proteins - myosin, actin, tropomyosin, troponin and actinin; Mechanism of muscle contraction and relaxation - the sliding filament theory; Structure of neuromuscular junction; Properties of muscle - Muscle fatigue, muscle twitch, muscle tetanus, rigor mortis.
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Unit - III: Physiology (Contd...)

- 3.1 Nerve Coordination** 3 Hrs
Types of nervous systems; Structure and types of neurons; Nature and conduction of nerve impulse; Types of synapses and synaptic transmission.
- 3.2 Sense Organs** 3 Hrs
Classification of sense organs – Photo-, chemo- and thermoreceptors; Structure of mammalian ear and mechanism of hearing; Structure of mammalian eye and mechanism of image formation.
- 3.3 Endocrine System** 4 Hrs
Human endocrine glands – Functions of Pituitary, thyroid, parathyroid, pancreas, adrenals, and pineal glands; Hormonal disorders in humans - Pituitary dwarfism, Cretinism, Cushing's disease, Diabetes mellitus; Hypothalamus - stimulating and inhibitory effects.
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Unit - IV: Biochemistry and Immunology

- 4.1 Biochemistry**
- 4.1.1 a. Carbohydrates** – Definition, classification, examples; Biological importance.
- b. Lipids** - Definition, classification, examples; Biological importance. 1 Hrs
- 4.1.2 Proteins** – Definition; A brief account of amino acids; Classification of proteins, examples and biological importance of proteins. 1 Hrs
- 4.1.3 Enzymes** – Definition, types; Classification of enzymes (IUB system); Mechanism of enzyme action – Lock and key model; Factors affecting enzyme action; Mechanism of enzyme inhibition. 2 Hrs
- 4.1.4 Vitamins** - Functions of Fat soluble vitamins (A, D, E and K), water soluble vitamins (B-complex and vitamin C); Deficiency symptoms: Night blindness, Scurvy, Beri-beri, Rickets. 1 Hrs
- 4.2 Immunology** 5 Hrs
Immune System - innate and acquired; Cells of immune system; Organs of immune system - Primary lymphoid organs (Bone Marrow, Bursa of Fabricius, Thymus), Secondary lymphoid organs (Lymphoid follicles, lymph nodes, Peyer's patches); Antigens and Antigenicity; Immunoglobulins - structure and functions of IgG; Primary and secondary immune responses; Immunization; Autoimmune diseases – Definition, examples – Type I Diabetes and Rheumatoid Arthritis.
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REFERENCES:

1. Abul, K. A. and Andrew, H. L. 2003. Cellular and Molecular Immunology, Saunders Publications.
2. Chatterjee, C. C. 2013. Human Physiology, Vol. I., CBS Publishing.
3. Conn, E.E., & Stumpf, P.F. 1995. Outlines of Biochemistry, John Wiley and Sons.
4. David, M., Jonathan, B., David, R.B., and Ivan, R. 2006. Immunology, Mosby, Elsevier Publication.
5. Deb, A.C. 2012. Fundamentals of Biochemistry, New Central Book Agency.
6. Giese, A. C. 1969. Cell Physiology, Saunders Co. Ltd.
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8. Hoar, W.S. 1983. Comparative Animal Physiology, Prentice Hall.
9. Ivan, M. R. 1988. Essential Immunology, Low Price Edn. VI, ELBS Publisher.
10. Joshi, K.R., Osama, N.O. 1998. Immunology, 4th Edition, Agro Botanica, Bikaner.

11. Kindt, T.J., Goldsby R.A., Osborne, B.A., and Kuby, J. 2006. Immunology, VI Edition, W.H. Freeman Company.
12. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell. 1988. Harper's Biochemistry XXI edn. Prentice Hall International Inc. Connecticut.
13. Nandini Shetty. 1993. Immunology-Introductory Text Book, Wiley Eastern Ltd., New Delhi.
14. Nelson, D.L. & Cox, M.M. 2005. Lehninger's Principle of Biochemistry, W.H. Freeman & Company, New York.
15. Prosser and Brown. 1973. Comparative Animal Physiology, Satish Book Enterprises, Agra.

Program Name	B.Sc.	SEMESTER	III
Course Title	PHYSIOLOGY, BIOCHEMISTRY AND IMMUNOLOGY (PRACTICAL)		
Course Code:	BSCZOP	No. of Credits	2
Contact hours	4 Hrs/week	Duration of SEA/Exam	3 Hrs
Formative assessment marks	10	Summative assessment marks	40

MAJOR EXPERIMENTS:

A. Physiology:

1. Total erythrocyte counts in human blood sample.
2. Total leucocyte counts in human blood sample.
3. Salivary amylase activity test of human saliva.
4. Osmotic haemolysis in animal cells.

B. Biochemistry:

1. Qualitative tests:
 - a. Carbohydrates: Molisch's Test, Benedict's test for glucose, Iodine test for starch.
 - b. Proteins: Biuret test, Xanthophoretic test, Ninhydrin test.
 - c. Nitrogenous excretory wastes:
 - i. Ammonia - Nessler's reagent test.
 - ii. Urea – Sodium hypobromite test.
 - iii. Uric acid - Folin's uric acid reagent test.
 - d. Abnormal constituents of Human urine:
 - i. Sugar (glucose) – Benedict's test.
 - ii. Albumen – Heller's Nitric acid ring test.
 - iii. Ketone – Rothera's test.

C. Immunology:

1. Preparation of stained blood smear and identification of different types of blood cells – RBCs, Neutrophils, Lymphocytes, Eosinophils, Monocytes, and Basophils.
2. Identification of organs of immune system – Bone marrow, Thymus, Lymph nodes, Spleen, Peyer's patches, Tonsils – Specimens/slides/charts/models.

***Note:** (Students have to identify the presence of the organic compound in the sample provided, giving the principle of reaction).

MINOR EXPERIMENTS:

1. Preparation of haematin crystals from human blood.
2. Determination of bleeding time of human blood.
3. Determination of clotting time of human blood.
4. Estimation of hemoglobin in human blood (Sahli's method).
5. Detection of lipids – Solubility test, Greasy spot test.

SCHEME OF PRACTICAL EXAMINATION
B.Sc. ZOOLOGY: III SEMESTER

Course Title: PHYSIOLOGY, BIOCHEMISTRY AND IMMUNOLOGY

Code: BSCZOP

Duration: 3 hours

Max. Marks: 40

-
- | | |
|---|----|
| I. Physiology experiment (by lots).
(Conducting the test - 4 Marks; Principle/Procedure/observation/calculation/Inference - 4 Marks;
Result - 2 Marks) | 10 |
| II. Biochemistry experiment (by lots).
Conduct suitable qualitative tests for the detection of Organic compounds/
Nitrogenous wastes/abnormal constituents of urine in the sample provided and report
(Name of the test - 1 Mark; Principle - 2 Marks; Conducting the test - 3 Marks;
Procedure/observation/inference (in tabular form) -3 Marks; Result -1 Mark) | 10 |
| III. Immunology: Identify and comment on the Cell A and Organ B (Common for all).
(Cell A: Identification - ½ Mark, Diagram – 1 Mark, Comments – 1 Mark.
Organ B: Identification - ½ Mark, Comments – 2 Marks) | 05 |
| IV. Minor experiment (any one) - Common for all.
(Experiment - 4 Marks; Report-1 Mark) | 05 |
| V. Class record | 10 |

TOTAL = 40

Note:

1. Questions must be framed as per the scheme provided.
2. Internal assessment marks to be allotted after conducting one practical test at the end of the semester.

Program Name	B.Sc.	SEMESTER	IV
Course Title	HISTOLOGY, ANIMAL BEHAVIOUR, APPLIED ZOOLOGY (THEORY)		
Course Code:	BSCZOC	No. of Credits	3
Contact hours	40 Hrs (4 hours/week)	Duration of SEA/Exam	3 Hrs
Formative assessment marks	20	Summative assessment marks	80

Unit - I: Histology

10 Hrs

Study of histological structure of following mammalian organs.

- (a) Stomach (b) Intestine (c) Ovary (d) Testis
(e) Liver (f) Pancreas (g) Thyroid (h) Kidney (i) Adrenal (l) Pituitary

Unit - II: Animal Behaviour

2.1 Introduction, Types of Animal Behaviour

2 Hrs

Innate behaviour - taxes, reflexes, instincts and motivation;
Learnt behaviour - habituation, imprinting, conditioned reflexes and insight learning;
Biological clock - circadian rhythms.

2.2 Social organisation in animals

2 Hrs

Social behaviour – Definition; Social behaviour in Honey bees, termites, monkeys.

2.3 Animal migration

2 Hrs

Introduction; Advantages of migration; Migration in fishes - anadromous, catadromous;
Migration in birds - types of migration, orientation and navigation, preparation for migration.

2.4 Courtship and Nesting Behaviour

2 Hrs

Introduction; Courtship behaviour in Peacock, River Tern, and Sarus Crane; Types of nests in birds; Nesting behaviour in Baya Weaver Bird and Hornbill.

2.5 Parental Care

2 Hrs

Parental care in fishes (*Hippocampus*, *Tilapia* species, *Arius* species) and amphibians (*Rhacophorus*, salamander, *Hyla* and *Ichthyophis*).

Unit - III: Applied Zoology

3.1 Dairy

3 Hrs

Introduction; Breeds of dairy animals; Cattle: Milch breeds - Red Sindhi, Gir; Draught breeds - Amrithmahal, Hallikar; Dual purpose breeds - Krishna valley, Ongole; Exotic breeds – HF, Jersey; Buffalo breeds - Nagpuri, Surti; Goat breeds - Jamunapuri, Malabari; Milk - composition and uses; Milk products - Butter, Ghee, Cheese and Paneer - uses; Utility of cattle in agriculture and transport, biogas, fertilizer and gelatin production.

3.2 Poultry

3 Hrs

Introduction; Poultry breeds - layers, broilers and dual purpose breeds with any two example each; Desi breeds of poultry - Aseel, Chittagong, Kadaknath, Giriraja; Housing management of poultry – intensive and semi-intensive methods; Poultry diseases – Ranikhet,

Fowl pox, Tick fever (Spirochaetosis), Fowl cholera; Prevention and control of poultry diseases.

- 3.3 Vermitechnology** 4 Hrs
Ecological classification of earthworms (Epigeic, anesic, endogeic); Introduction to vermiculture; Methods of vermiculture – bin and pit methods; Preparation of vermicompost from any organic waste material (weeds, waste, domestic wastes, paper wastes etc.); Uses of vermicompost and vermiwash.
-

Unit - IV: Applied Zoology (Contd...)

- 4.1 Aquaculture** 3 Hrs
Definition; Techniques of culturing freshwater fishes; Induced breeding and seed fish production; Fish diseases and their control – White spot disease, Gyrodactylosis, Bacterial gill rot; Shrimp culture.
- 4.2 Apiculture** 3 Hrs
Introduction; Bee species used for apiculture; Methods of bee keeping – Traditional method, Modern method – Langstroth model; Predators of honey bees; Extraction of honey; Nutritive value and uses of honey; Bee wax and its uses; Diseases of honey bees and control - Nosemosis, American Foulbrood, Thai Sac Brood.
- 4.3 Pearl Culture** 2 Hrs
Species of Pearl Oysters and their occurrence; Formation of natural pearl; Pearl producing sites in India; Steps involved in pearl culture – Oyster collection, Rearing, Insertion of nucleus, Post-operational care, harvesting.
- 4.4 Lac Culture** 2 Hrs
Lac insect – *Kerria lacca* – Structure and life history; Host plants; Cultivation of Lac; Economic importance of Lac.
-

REFERENCES:

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2. Berry, A.K. 2013. Text Book of Animal Histology, Emkay Publications.
3. Freeman, W.H. & Brain, B. 1968. An Atlas of Histology, 2nd Edition, Heinemann Edwal Books Ltd., London.
4. Gillespie & Flanders. 2010. Modern Live Stock & Poultry Production, Delmar, Cengage Learning.
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7. Jaya surya and Armugam, N. 2013. Economic Zoology, Saras Publishers.
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15. Uday, S. B. 1995. Vermiculture Ecotechnology, Bhawalkar Earthworm Research Institute, Pune.

Program Name	B.Sc.	SEMESTER	IV
Course Title	HISTOLOGY, ANIMAL BEHAVIOUR, APPLIED ZOOLOGY (PRACTICAL)		
Course Code:	BSCZOP	No. of Credits	2
Contact hours	4 Hrs/week	Duration of SEA/Exam	3 Hrs
Formative assessment marks	10	Summative assessment marks	40

-
1. Observation of mammalian histology slides of the following organs: Stomach, Small intestine, Liver, Pancreas, Kidney, Ovary, testis, Thyroid and Adrenal.
 2. Preparation of permanent slides of mammalian Stomach, Liver, Pancreas, Small intestine, Kidney, Testis, Ovary, Thyroid and Adrenal of Rat. (Any two slides prepared by the students have to be submitted at the time of examination).
 3. Animal behaviour:
 - a. Social behaviour in honey bees – Castes – Queen, Drone, Worker.
 - b. Study of bird's nests – Any four different types of nests.
 - c. Study of Parental care – *Hippocampus*, *Ichthyophis*.
 4. a. Milk products – Curd, Butter, Ghee, Cheese, Paneer.
b. Fish products – Fish oil, Fish meal, Fish manure.
c. Honey and Beewax.
d. Poultry – Egg, Meat.
e. Pearl and Lac.
 5. Field oriented practicals:
 - i. Study of nesting and roosting places in birds, study of various types of bird nests (as per the availability).
 - ii. Field visit to study animal behaviour in natural habitat –
Identification of castes/ Study of bee colonies, bee hives/ant colonies, ant nests/ termites and their mounds/ nesting behavior in solitary and social wasps/monkey troops etc.
 - iii. Preparation of vermicompost using different raw materials (such as weeds, paper waste, domestic waste, sugar cane etc.)
 - iv. Visit to honey bee rearing centers.
 - v. Visit to fish/shrimp breeding centers.
 - vi. Visit to dairy.
 - vii. Visit to poultry farm.

Note: The field studies should be based on the above mentioned topics which shall be allotted at the beginning of semester. Each student shall prepare separate field report which is to be certified by staff in-charge and HOD. It should be submitted during practical examination which shall be evaluated by both internal and external examiners. Field work must be supported by proper documents and photographs of the field visit by individual students.

SCHEME OF PRACTICAL EXAMINATION
B.Sc. ZOOLOGY: IV SEMESTER
Course Title: HISTOLOGY, ANIMAL BEHAVIOUR, APPLIED ZOOLOGY
(PRACTICAL)

Code: BSCZOP

Duration: 3 hours

Max. Marks: 40

I. Histology - Stain, mount, and identify the paraffin section provided. (Slide preparation - 5 Marks; Identification -1 Mark)	06
II. Histology – Identify, draw labelled diagram and comment on permanent slides A and B . (Identification -1 Mark; Labelled diagram -1 Mark; Comments - 2 Marks)	2x4 = 08
III. Animal behaviour: Identify and comment on C and D . (Identification - ½ Mark; Comments - 1½ Marks)	2x2 = 04
IV. Applied Zoology: Identify and comment on E , F and G . (Identification - ½ Mark; Comments - 1½ Marks)	2x3 = 06
V. Field Report* (Introduction -1 Mark; Details of field visited - 1 Mark; Observations including photographs - 3 Marks; References -1 Mark)	06
VI. Class Record + Slides	8+2 = 10
	TOTAL = 40

*The Hand written field report (not exceeding 10 A4 size sheets) should include introduction, details of fields visited, detailed account of observations made, original photographs and references.

Note:

1. Questions must be framed as per the scheme provided.
2. Internal assessment marks to be allotted after conducting one practical test at the end of the semester.

Program Name	B.Sc.	SEMESTER	V
Course Title	CELL BIOLOGY AND BIOTECHNOLOGY (THEORY)		
Course Code:	BSCZOC	No. of Credits	3
Contact hours	40 Hrs (3 hours/week)	Duration of SEA/Exam	3 Hrs
Formative assessment marks	20	Summative assessment marks	80

Unit - I: Cell Biology

- 1.1 Introduction** 1 Hrs
Definition; Subdivisions of cell biology; Scope of cell biology.
- 1.2 Chromosomes** 4 Hrs
Morphology of chromosomes - centromere, telomere; Heterochromatin and Euchromatin; Types of chromosomes, chromosome number; Ultrastructure of chromosomes - Nucleosome model, Giant chromosome - Polytene and Lampbrush chromosomes.
- 1.3 Nucleic Acids** 5 Hrs
Introduction - Identification of genetic material - Griffith's experiment, experiments of Avery, MacLeod and McCarty, Hershey-Chase experiment; Chemistry of nucleic acids - structure of DNA - Watson and Crick DNA model; Mechanism of DNA replication - Meselson and Stahl's experiment. DNA repair - Excision repair, photoreactivation and recombinational repairs; Types of RNA; Transcription and RNA processing (Intron splicing and post transcriptional modifications).

Unit - II: Cell Biology (Contd...)

- 2.1 Plasma membrane and cell junctions** 3 Hrs
Fluid mosaic model of plasma membrane; Functions of plasma membrane; Types of cell junctions; Extracellular matrix.
- 2.2 Cytoskeleton elements** 2 Hrs
Microtubules; Microfilaments; Intermediate filaments - organization and functions.
- 2.3. Cell differentiation** 1 Hrs
Definition; Nucleo-cytoplasmic interactions (Experiments with *Acetabularia*).
- 2.3 Cancer and Carcinogenic Agents** 4 Hrs
Concept of cancer; Types of cancer; Characteristics of cancerous cells; Oncogenes; Immune system in cancer; Carcinogenic agents - physical, chemical and biological; Strategies of cancer therapy - Immunotherapy, Radiotherapy, Chemotherapy; Role of telomere in cell ageing and cancer; A brief account on apoptosis.

Unit - III: Cell Biology (Contd...)

- 3.1 Genetic Code and Protein Biosynthesis** 3 Hrs
Genetic code: Definition and Properties, Wobble hypothesis; Protein Biosynthesis - Components of protein biosynthesis; Mechanism of protein biosynthesis.
- 3.2. Mitosis** 3 Hrs
Cell cycle - Phases of cell cycle - interphase - prophase - centriole cycle - mitotic apparatus - metaphase, anaphase and telophase; Cytokinesis; Differences between mitosis in animal and plant cells; significance of mitosis; Mitotic inhibitors - examples and applications.
- 3.3. Meiosis** 4 Hrs

Phases of meiotic cycle - I meiotic division - Synaptonemal complex and recombination; Mechanism of crossing over; cytological basis of crossing over (Stern's experiment); Significance of crossing over; Interkinesis; Second meiotic division; Significance of meiosis; Differences between mitosis and meiosis.

Unit - IV: Biotechnology

4.1 Introduction to Genetic Engineering 4Hrs

Introduction; Restriction endonucleases (I, II and III); Cloning vehicles - plasmids, episomes, transposons, animal viruses, shuttle vectors; Gene libraries -genomic library - cDNA library; Introducing Cloned Genes into the Host Cells - Transformation, Transduction, Particle Gun, Electroporation.

4.2 Techniques in Biotechnology 3 Hrs

PCR technique, Southern, Northern and Western blotting technique; DNA finger printing - principle, method and applications; DNA sequencing – Sanger and Cohlson's Method; Proteomics and genomics; Protein engineering; FISH, RAPD, RFLP - Definition and applications.

4.3 Applications of Biotechnology 3 Hrs

Introduction; Microbes in pollution control; Biotechnology in bioremediation; Biotechnology in disease prevention and diagnosis, Pharmaceuticals, Vaccines; Transgenic animals; Stem cells in transgenesis; Gene therapy.

REFERENCES:

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8. Kumar, H. D. 1993. Molecular Biology & Biotechnology, Second Revised Edition, VikasPublishing House Pvt. Ltd.
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Program Name	B.Sc.	SEMESTER	V
Course Title	GENETICS, BIOSTATISTICS, EVOLUTION AND PALAEOLOGY (THEORY)		
Course Code:	BSCZOC	No. of Credits	3
Contact hours	40 Hrs (3 hours/week)	Duration of SEA/Exam	3 Hrs
Formative assessment marks	20	Summative assessment marks	80

Unit - I: Genetics

- 1.1. Introduction and Laws of Inheritance** 4Hrs
Introduction and branches of genetics; Heredity and variation; Mendel's experiments - Mono and Dihybrid crosses, Test cross and Back cross; Mendel's laws of inheritance; Use of *Drosophila* in genetic studies; Dihybrid crosses in *Drosophila*.
- 1.2 Interaction of Genes (Modified genetic ratios)** 3Hrs
Incomplete dominance - 1:2:1 - Plumage pigmentation in fowl.
Supplementary factors - 9:3:3:1 - Comb pattern in fowls.
Dominant Epistasis - 12:3:1 - Plumage colour in Leghorn and Wyandotte.
Recessive Epistasis - 9:3:4 - Coat colour in Guinea pigs.
Complementary factors - 9:7 - Flower colour in sweet peas.
Lethal genes - Coat colour in mice.
- 1.3 Multiple Alleles, Polygenic inheritance and Pleiotropism** 3 Hrs
ABO blood groups in humans; Rh factor - Erythroblastosis fetalis; Blood typing and blood transfusion; Inheritance of coat color in rabbit; Polygenic inheritance in man - skin color; Pleiotropism (Cystic fibrosis in humans and vestigial wing in *Drosophila*).

Unit - II: Genetics (Contd....)

- 2.1 Nature and Nurture** 1 Hrs
Definition; Norm of reaction, Experiments on Himalayan Albino rabbit and Human twins; Phenocopy; Penetrance and expressivity with examples.
- 2.2 Linkage and gene mapping** 3 Hrs
Linkage – Definition; Complete and partial linkage in *Drosophila*; Significance of linkage; Linkage maps - Construction of chromosome maps; Two-point test cross, three point test cross.
- 2.3 Sex-determination and Sex linked inheritance** 3Hrs
Types of Sex chromosomes; Chromosomal mechanism of sex determination (XX-XY, XX-XO, ZZ-ZW and ZZ-ZO types with specific examples); Sex linked inheritance in *Drosophila* (White eye); Haemophilia and colour blindness in man; Sex linkage in birds (barred plumage pattern in poultry); Sex limited (plumage pattern in Leghorn fowls) and sex influenced traits (baldness in humans).
- 2.4 Gene, gene regulation and Gene Mutation** 3Hrs
Fine structure of gene - cistron, muton, recon, introns; Regulation of gene expression in prokaryotes - Lac Operon; Mutation – point mutation, frame-shift mutation, insertions. CIB technique.
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Unit - III: Human Genetics and Biostatistics

3.1 Human Genetics

4 Hrs

Human karyotype; Idiogram; Pedigree analysis; Common human chromosomal syndromes - Klinefelter's and Turner's Syndromes, Down's syndrome; Inborn errors of metabolism – Albinism, Phenylketonuria, Alkaptonuria, Sickle cell anemia, Thalassemia, Huntington's chorea; Prenatal diagnosis - Amniocentesis, chorionic villus sampling; Genetic counseling.

3.2 Biostatistics

6 Hrs

Introduction to biostatistics - Basic concepts; Presentation of data - Tabulation, frequency distribution, graphical and diagrammatic representation; Analysis of data - mean, median and mode; Standard deviation; Tests of significance - Student t - test, chi-square test. (Wherever necessary, appropriate problems should be worked out).

Unit - IV: Evolution and Palaeontology

4.1 Theories of Organic Evolution and Speciation

4 Hrs

Lamarckism; Darwin-Wallace theory of Natural Selection; Synthetic theory of evolution -Neo-Darwinism; Hardy-Weinberg law of equilibrium; Factors influencing change in gene frequencies of a population - gene mutation, gene flow, genetic drift; Natural Selection –types - Stabilizing selection, Directional selection and Disruptive selection; Artificial selection with examples (insecticidal resistance in insects or industrial melanism); Isolation and Isolating mechanisms – i. Geographical isolation. ii. Reproductive isolation -Prezygotic/Premating isolation – Ecological, Seasonal, Ethological, Mechanical, Physiological and Gametic mortality; Post zygotic/Post mating isolation – Cytological, Zygotic mortality, Hybrid inviability, Hybrid sterility; Speciation - sympatric and allopatric speciation.

4.2 Evidences of Organic Evolution

2 Hrs

Evidences from comparative morphology and anatomy, comparative physiology and biochemistry, comparative embryology and palaeontology.

4.3 Palaeontology

2 Hrs

Brief account of geological time scale; Fossils and fossilization; Dinosaurs; Study of connecting links: *Peripatus* and *Archaeopteryx*.

4.4. Evolution of Horse and Man

2 Hrs

Origin and evolution of horse (*Eohippus*, *Mesohippus*, *Merichyppus* and *Equus*) and man (*Australopithecus*, Java ape man, Neanderthal man and Cro-Magnon Man).

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1. Dobzhansky, Ayala, Stebbins & Valentine. 1977. Evolution, W.H. Freeman & Company.
2. Gardner. 1991. Principles of Genetics, John Wiley & Sons Inc., New York.
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15. Verma, P.S. and Agarwal. 2004. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Company, New Delhi.

Program Name	B.Sc.	SEMESTER	V
Course Title	CELL BIOLOGY, BIOTECHNOLOGY, GENETICS, BIostatISTICS, EVOLUTION AND PALAEONTOLOGY (PRACTICAL)		
Course Code:	BSCZOP	No. of Credits	2
Contact hours	4 Hrs/week	Duration of SEA/Exam	4 Hrs
Formative assessment marks	20	Summative assessment marks	80

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1. Observation of permanent slides of onion root tip to study all stages of mitosis.
 2. Observation of permanent slides of grasshopper testis to study various stages of meiosis.
 3. Squash preparation of onion root tip to demonstrate stages of mitosis.
 4. Squash preparation of grasshopper testis to demonstrate stages of meiosis.
 5. Squash preparation of salivary gland chromosomes of *Drosophila/ Chironomous* larva.
 6. Isolation of DNA from coconut endosperm/chicken liver.
 7. Experiments with *Drosophila*.
 - Phenotypic characters and sexual dimorphism in *Drosophila*.
 - Mutants of *Drosophila* (white eye, bar eye, sepia eye, vestigial wing, curly wing, ebony body and yellow body – any four).
 - Mounting of sex comb.
 8. Blood typing for the detection of ABO blood group and Rh factor.
 9. Genetics problems
 - Genetic problems: Monohybrid inheritance (1)
 - Genetic problems: Dihybrid inheritance (1)
 - Genetic problems: Multiple alleles - ABO blood group in humans (1)
 - Sex-linked inheritance in *Drosophila* (1)
 - Sex linked inheritance in humans (1)
 10. Biostatistics problems
 - Graphical/diagramatic representation (2)
 - Mean, median, mode (2)
 - Chi-square test (1)
 - Student t- test (1)
 11. Evolution
 - Study of homologous organs - forelimbs of frog and bird; mouth parts of cockroach, mosquito and butterfly.
 - Study of analogous organs - wings of insect and bird.
 - Study of vestigial organs - appendix and third molar tooth in man.
 12. Palaeontology
 - Connecting links: *Peripatus* and *Archaeopteryx*.
 - Living fossil: *Nautilus*.
 - Models of Dinosaurs: (Tyrannosaurus, Brontosaurus, Stegosaurus and Triceratops).
 - Study of models of fossil man. (Any two available models).
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SCHEME OF PRACTICAL EXAMINATION
B.Sc. Zoology: V Semester
Course Title: CELL BIOLOGY, BIOTECHNOLOGY,
GENETICS, BIOSTATISTICS, EVOLUTION AND PALEONTOLOGY
Code: BSCZOP

Duration: 4 hours

Max. Marks: 80

-
- I. Squash - Make a stained squash preparation of onion root tip or grass hopper testis. 10
(Stained slide preparation with at least one dividing stage - 6 Marks; Report - 1 Mark; labelled diagram - 1 Mark; comment – 2 Mark)
- II. Squash - Make a stained squash preparation of salivary gland chromosomes. 10
(Dissecting the gland - 3 Marks; Salivary gland chromosomes slide preparation - 4 Marks; comment - 3 Marks)
- III. Identify and comment on the permanent slides **A & B** with labeled diagrams. 2x5 = 10
(1- mitosis and 1- meiosis) (Identification - 1 Mark; Labeled diagram – 2 Marks; Comments -2 Marks)
- IV. Solve the genetics problem **A** and biostatistics problem **B**. 2x5 = 10
(Working out the problem - 4 Marks; Result – 1 Mark)
- V. Mounting:
- a. Make a temporary mounting of the sex comb. 05
(Mounting of entire tarsus with sex comb on a glass slide with cover slip and focused under low power)
- b. Identify the ABO and Rh blood group of the given blood sample and comment on the significance of blood grouping. 05
(Identification of ABO and Rh group $\frac{1}{2} + \frac{1}{2} = 1$ Mark; Reasons 2+1 = 3 Marks (student should write the antigen antibody reaction of the identified blood group; Significance - 1 Mark)
- VI. Identify the *Drosophila* mutants **C** and **D** with reasons. 2x3 = 06
(Identification - $\frac{1}{2}$ Mark; Chromosome number and site - $\frac{1}{2}$ Mark; Characters -2 Marks)
- VII. Identify and comment on **E** (specimen or model from Evolution or Paleontology). 04
(Identification 1 Mark; Labeled diagram - 1 Mark; Comments - 2 Marks).
- VIII. Class Record (15)+Viva (05) 20
- Total = 80
-

- Note:** 1. Questions must be framed as per the scheme provided.
2. Internal assessment marks to be allotted after conducting one practical test at the end of the semester.

Program Name	B.Sc.	SEMESTER	VI
Course Title	REPRODUCTIVE BIOLOGY AND DEVELOPMENTAL BIOLOGY (THEORY)		
Course Code:	BSCZOC	No. of Credits	3
Contact hours	40 Hrs (3 hours/week)	Duration of SEA/Exam	3 Hrs
Formative assessment marks	20	Summative assessment marks	80

Unit - I: Reproductive Biology

- 1.1 Reproductive system** 2 Hrs
 Male reproductive system: primary sex organs - male accessory ducts - copulatory organ - accessory glands; Female reproductive system - primary sex organs - female accessory organs - accessory glands - external genitalia; Secondary sexual characters in humans.
- 1.2 Gametogenesis** 3 Hrs
 Spermatogenesis - Formation of spermatids - Spermiogenesis - Structure of mature Spermatozoan; Oogenesis - Previtellogenesis and Vitellogenesis - Estrous cycle in non-primate mammals and menstrual cycle in humans; Comparison between spermatogenesis and Oogenesis.
- 1.3 Parthenogenesis** 2 Hrs
 Kinds of parthenogenesis - Natural – Arrhenotoky, Thelytoky - automixis and apomixes; Cyclical parthenogenesis in gall wasps and aphids; Larval parthenogenesis in liver flukes; Artificial parthenogenesis; Significance of parthenogenesis.
- 1.4. Modern trends in Reproduction** 3 Hrs
 Manipulation of reproduction - Gene bank, Sperm bank, Superovulation, Cryopreservation; *In-vitro* fertilization (IVF) and embryo transfer (ET); Zygote intra fallopian transfer (ZIFT); Intra uterine transfer (IUT); Gamete intra fallopian transfer (GIFT); Intra cytoplasmic sperm injection (ICSI); Intra-uterine insemination (IUI); Artificial insemination (AI); Surrogate mother; Animal cloning; Cloning of Dolly.

Unit - II: Developmental Biology

- 2.1 Introduction** 3 Hrs
 Definition and scope; Theories of development - Preformation theory, Epigenetic theory, Baer's Law and Biogenetic law; Branches of embryology; Phases of ontogenetic development – Development and differentiation; Patterns of development - Oviparity, ovo-viviparity and viviparity with examples.
- 2.2 Type of Eggs and Sperms** 1 Hr
 Types of eggs based on amount and distribution of yolk with examples; Mosaic and regulative eggs; Cleidoic egg and its significance; Types of sperms with examples.
- 2.3 Fertilization** 3 Hrs
 Kinds of fertilization - external, internal, self and cross fertilization with examples; Mechanism of fertilization - approximation of gametes – chemotaxis - fertilizin and antifertilizin – capacitation - acrosome reaction and sperm penetration - activation of ovum - cortical reaction and fertilization membrane formation – Amphimixis; Monospermic & polyspermic fertilization; Significance of fertilization.

- 2.4 Cleavage** 3 Hrs
Definition; Types of cleavage - holoblastic and meroblastic; Patterns of cleavage – radial, biradial, spiral and bilateral cleavage with examples; Effects of yolk on cleavage; Types of blastula with examples.
-

Unit - III: Developmental Biology (Contd...)

- 3.1 Organizer Phenomenon** 3 Hrs
Definition - The amphibian organizer; The organizer's role in development; Potencies of the dorsal lip of the blastopore of amphibian gastrula; Brachet's experiment; Experiment of Spemann and Mangold; Induction of Organizer; Chemical nature of organizer; Parts of organizer; Theories of organizer phenomenon.
- 3.2 Early Development of Frog** 4 Hrs
Cleavage - Blastula - Fate maps of Blastula - Gastrulation - Mesogenesis - Notogenesis and Neurulation.
- 3.3 Early Development of Chick** 3 Hrs
Structure of hen's egg - cleavage - blastula - gastrulation - origin and structure of primitive streak - structure of 18, 24 and 48 hours chick embryos.
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Unit - IV: Developmental Biology (Contd...)

- 4.1 Extraembryonic Membranes of Chick** 2 Hrs
Development, Structure and functions of Yolk-sac, Amnion, Chorion and Allantois.
- 4.2 Placenta** 3 Hrs
Definition; Types of placenta- Yolk sac placenta (marsupials), Allantoic placenta - Structure and functions; Morphological and histological classification of placenta with examples.
- 4.3 Early Development of Human Foetus** 3 Hrs
Structure of Graafian follicle; Ovulation; Fertilization; Morula -blastocyst - implantation – gastrulation; Placenta - structure and functions; Twins and multiple births.
- 4.4 Role of Hormones in Development** 2 Hrs
Gonadotropins and their functions; Hormones secreted by testis and ovaries and their functions; Hormones of placenta and their functions.
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2. Armugam, N. 2005. A Text Book of Embryology, Saras Publication, Nagercoil.
3. Balinsky, B.I. 2012. An Introduction to Embryology, Cengage Learning.
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10. Nair and Achar. 1985. A Text Book of Embryology, Himalaya Publishing House.
11. Nelsen. 1953. Comparative Embryology of the Vertebrates, Mc Graw Hill.
12. Shastry & Shukla. 2012. Developmental Biology, Rastogi Publications.

13. Subramanian. 2013. Developmental Biology, MJP Publishers.
14. Verma & Agarwal. 2000. Chordate Embryology, S. Chand & Co., New Delhi.
15. Wright, S.J. 2005. A Photographic Atlas of Developmental Biology, Morton Publishing Company.

Program Name	B.Sc.	SEMESTER	VI
Course Title	ENVIRONMENTAL BIOLOGY, TOXICOLOGY AND WILDLIFE BIOLOGY (THEORY)		
Course Code:	BSCZOC	No. of Credits	3
Contact hours	40 Hrs (3 hours/week)	Duration of SEA/Exam	3 Hrs
Formative assessment marks	20	Summative assessment marks	80

Unit - I: Environmental Biology

- 1.1 Introduction** 2 Hrs
Definition and subdivisions of ecology; Concept of habitat - Micro-habitat and Macro-habitat; Ecological Niche - Spatial, Trophic and Multidimensional.
- 1.2 Abiotic Factors** 2 Hrs
Major abiotic factors – Light and Temperature; Adaptation to extreme environment - Effect of light and temperature on animals – Cyclomorphosis. Soil types and profile.
- 1.3 Biotic Factors** 3 Hrs
Mutualism with examples; Proto co-operation and commensalism with examples; Parasitism - types with examples; Ammensalism and predation - examples and their importance; Competition - intraspecific and interspecific - Gause's principle.
- 1.4 Habitats** 3 Hrs
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 freshwater animals; Terrestrial habitats - A brief account of biomes.

Unit - II: Environmental Biology (Contd...)

- 2.1 Population Ecology** 2 Hrs
Population attributes - population density - natality and mortality; Age distribution, age pyramids; Population growth rate - population growth curves - logistic and exponential; Biotic Potential - Allee's principle.
- 2.2 Community Ecology** 3 Hrs
Community structure; Ecological determinants; Ecotone and edge effect; Ecological stratification; Alpha, beta, and gamma diversity; Shannon Index and Simpson's Index; Significance of biodiversity indices.
- 2.3 Ecosystem** 5 Hrs
Types of ecosystems with examples; Natural ecosystems; Man engineered ecosystems; Microecosystem; Biosphere and ecotone; Ecosystem - Structural components; Functions of ecosystem – productivity - primary and secondary, decomposition, energy flow – I and II laws of thermodynamics; Food chains - types with examples; Food webs with examples; Ecological pyramids - Types with examples; Nutrient cycling - nitrogen, carbon and phosphorus.
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Unit - III: Environmental Pollution and Toxicology

3.1 Environmental Pollution with Reference to India

4 Hrs

Air pollution – Major air pollutants (Carbon dioxide, oxides of sulphur and nitrogen); Control of gaseous pollutants – combustion – absorption – adsorption; Control of particulate pollutants - filters, electrostatic precipitators, cyclone separators, scrubbers and catalytic converters; Air (Prevention and Control of Pollution) Act; Auto fuel policies in India - Bharath stage; A brief account of Acid rain, photochemical smog and ozone hole; Montreal protocol; Control of water pollution - Sewage/ effluent treatment – primary and secondary treatments; Water Act – River action plan; A brief account on BOD and Eutrophication; Solid waste management; Bioindicators and geindicators - definition and examples; Environmental Protection Act 1986.

3.2 Global Impacts

2 Hrs

Climate change- Global warming- Sources, effect and control measures-Kyoto protocol.

3.3 Toxicology

4 Hrs

Definition; Major subdivisions of toxicology and dose response curve; Toxicological parameters - acute and chronic toxicity; LD50, LC50; Factors influencing toxicity - route of administration, host factors-species, age, sex; Bioactivation and detoxification of xenobiotics - types of xenobiotics; Mechanism of biotransformation - phase I and II reactions; Pesticide toxicity - toxicity of organophosphate, organochloride, carbamate and pyrethroid pesticides citing two examples for each; Biomagnification - Biomagnification of DDT and Mercury; Antidotal therapy - Definition and types of antidotes with examples.

Unit - IV: Wildlife Biology

4.1. Zoogeography and Distribution of Wildlife

3 Hrs

Zoogeographical realms of world with climatic conditions and examples of characteristic fauna; A brief account of Wallace's line; Continuous and discontinuous distributions with examples; Barriers of dispersal - topographic and vegetation barriers - large bodies of water as barriers – climatic barriers.

4.2 Threats to Wildlife

1 Hrs

Anthropogenic factors - Hunting, over harvesting, habitat destruction, degradation, habitat shrinkage, climate change; Human animal conflict.

4.3 Wildlife Conservation

6 Hrs

Agencies engaged in wildlife conservation - Government organisations and non-government organizations (NGOs); Wildlife (protection) Act 1972; CITES (Convention on International Trade in Endangered Species of Wildlife Flora and Fauna); Endangered fauna of India; IUCN categories of endangered animals; Unique Indian animals; Endemic species with examples; Red Data Book; Ramsar convention; CBD; Biosphere reserves - Important National Parks and Wildlife sanctuaries of India (with special emphasis on Karnataka); Special Projects - Project Tiger; Project Elephant; Project Rhino; Biodiversity Protection Act.

REFERENCES:

1. Agarwal, K.C. 2008. Environmental Biology, II edition, Nidhi Publishers.
2. Arora, M.P. 2001. Ecology, Himalaya Publishing House, New Delhi.
3. Darlington, P.J. 1996. Zoogeography- The Geographic distribution of animals, John Wiley & Sons, New York.
4. Ehrlich, P.R. & Rough, G. S. 1987. The Science of Ecology, Macmillan Publishing Company, New York.

5. Fan, A., Mand Chang, L.W. (Ed). 1996. Toxicology and Risk Assessment: Principles and Methods and Applications. Marcell Dekker Publishers, New York.
6. Habermehl, G.G. 1981. Venomous Animals and Their Toxins, Springer-Verlag, Berlin.
7. Hosetti & Venkateshwarulu. 2018. Trends in Wildlife Biodiversity Conservation, DayaPublishing House, New Delhi.
8. Jonathan, G. & David, C. P. 1992. The Wildlife of India, The Guide Book Company Limited, Hong Kong.
9. Nair, S.M. 1992. Endangered Animals of India, National Book Trust, India.
10. Odum, E.P. 2004. Fundamentals of Ecology, Cengage Learning.
11. Prater, S.H.1971. The Book of Indian Animals, BNHS, Oxford University Press.
12. Saharia, V.B. 1982. Wildlife in India, Natraj publications, Dehradun.
13. Sharma, P. D. 1999. Toxicology. Rastogi Publishers, Meerut.
14. Sinha, K. (Ed.). 1996. Biodiversity-Global Concerns, Commonwealth Publishers, New Delhi.
15. Verma and Agarwal. 2000. Principles of Ecology, S. Chand & Co, New Delhi.

Program Name	B.Sc.	SEMESTER	VI
Course Title	REPRODUCTIVE BIOLOGY, DEVELOPMENTAL BIOLOGY ENVIRONMENTAL BIOLOGY, TOXICOLOGY AND WILDLIFE BIOLOGY (PRACTICAL)		
Course Code:	BSCZOP	No. of Credits	3
Contact hours	4 Hrs/week	Duration of SEA/Exam	4 Hrs
Formative assessment marks	20	Summative assessment marks	80

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- Study of different types of eggs and sperms:
Type of eggs: Insect, amphioxus, frog, chick and human (any 4)
Type of sperms: Frog, domestic fowl, rat, mouse and human (any 4)
 - Stages of development of frog: Study of cleavage stages, blastula, gastrula and neurula (sections) and various stages of tadpole.
 - Study of permanent slides of chick embryo: 18 hrs, 24 hrs, 36 hrs and 48 hrs (WM); T.S. of 18 hrs and 24 hrs chick embryo.
 - Study of permanent slides/charts of histological types of placenta (All five)
 - Study of charts or models of morphological types of placenta: Diffuse, cotyledonary, intermediate, zonary and discoidal placenta.
 - Whole mount preparation (Permanent)
 - Mosquito larvae.
 - Zoea, Nauplius, Mysis.
 - Study of aquarium as an ecosystem: Study of fauna and flora and interaction between the various constituents.
 - Water quality parameters assessment:
 - Estimation of Dissolved Oxygen (O₂)
 - Estimation of Carbon dioxide (CO₂)
 - Estimation of hardness and salinity of water.
 - Study of ecological adaptations and morphological peculiarities: Hermit crab, Stick insect, Glow worm, Stink bug, Puffer fish, Angler fish, Exocoetus, Phrynosoma, Draco, Chaameleon and Bat.
 - Study of biotic relationship: Leguminous plants, Termites, Liver fluke, Tape worm, Sucker fish, Insectivores plant.
 - Identification of wild animals: Pugmarks (tigers) and hoof marks (gaur); Scates (elephants) and pellet counts (deer); Antlers (sambhar).
 - Study of threatened animals of India (by models/pictures/charts): Sarus crane, Common leopard, Great Indian bustard, Himalayan quail, House sparrow, Nilgiri tahr, Gharial, Asiatic lion, Ganges river dolphin, Black-necked crane, Smooth-coated otter, Golden mahseer, Indian pangolin, Brow-antlered deer- **Any five**.
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SCHEME OF PRACTICAL EXAMINATION

B.Sc. ZOOLOGY: VI SEMESTER

**Course Title: REPRODUCTIVE BIOLOGY, DEVELOPMENTAL BIOLOGY,
ENVIRONMENTAL BIOLOGY, TOXICOLOGY AND WILDLIFE BIOLOGY**

Code: BSCZOP

Duration: 4 hours

Max. Marks: 80

I. Identify, draw labeled diagram and comment on permanent slides of developmental stages A and B. (1 from frog + 1 from chick) (Identification -1 Mark, Labeled diagram -2 Marks, Comments - 1 x 3 = 3 Marks)	2 x 6 =12
II. a. Identify, draw labeled diagram and comment on C (C- Egg or sperm) (Identification - 1 Mark, Labeled diagram -1 Mark, Comments - 2 Marks)	04
b. Submission of one permanent slide (Whole mount)	02
III. Identify, draw labelled diagram and comment on the given placental charts/slides/models/specimens D and E. (D-histological placenta & E-morphological placenta) (Identification -1 Mark, Example -1 Mark, Labeled diagram -1 Mark, Comments – 3 Marks)	2 x 6 12
IV. Estimation of dissolved O ₂ /CO ₂ /Salinity/Hardness of water. (Principle-1 Mark, Procedure-4 Marks, Readings & calculation-2 Marks, Results-1 Mark)	08
V. Comment on aquarium ecosystem. (Diagram-2 Marks, Comments-4 Marks)	06
VI. Identify and comment on the ecological adaptations and morphological peculiarities of F & G. (Identification- 1 Mark, Diagram-1 Mark, Comments-2 Marks)	2x4=08
VII. Comment on the biotic relationships of H. (Identification- 1 Mark, Diagram-1 Mark, Comments-2 Marks)	04
VIII. Identify and comment on I. (Question from Expt.-11/12) (Identification- 1 Mark, Comments-3 Marks))	04
IX. Class Record (15) + Viva (5)	20
	Total = 80

Note:

1. Questions must be framed as per the scheme provided.
2. Internal assessment marks to be allotted after conducting one practical test at the end of the semester.

Program Name	B.Sc.	SEMESTER	IV/V/VI
Compulsory Course	SKILL ENHANCEMENT PROGRAMME- PROJECT WORK / FIELD TRAINING		
Course Code:	BSCZOC	No. of Credits	2
Contact hours	3-4 Hrs/week	Duration of SEA/Exam	3 Hrs
Formative assessment marks	10	Summative assessment marks	40

Proposed topics for project work/field training:

1. Study of animal diversity in various habitats - Gardens/croplands/grasslands/forests/ponds/rivers/streams/sea shores.
2. Bird watching and preparation of checklist of birds from different habitats.
3. Identification and study of local edible fishes.
4. Listing and identifying local butterflies and preparation of checklist of butterflies.
5. Listing and identifying common spiders and ants.
6. Listing and identifying terrestrial and freshwater molluscs.
7. Identification of molluscan shells from nearby coasts.
8. Diversity of ornamental fishes.
9. Diversity of insects.
10. Insect pests of vegetables, fruit crops, horticultural plants, paddy etc.
11. Store pests.
12. Study of biodiversity in sacred groves.
13. Study of community: By quadrat method to determine frequency, density and abundance of different species present in the community.
14. Diversity of mosquito species.
15. Diversity of wild varieties of *Drosophila*.
16. Listing and studying the use of fertilizers and pesticides in agricultural fields.
17. Identification and behavioural study of wasps.
18. Identification and study of local edible shell fishes.
19. Study of simple Mendelian traits in human populations.
20. Studying organic farming.
21. Study of soil fauna.
22. Evaluation of larvicidal / adulticidal properties of chemicals or plant extracts on mosquito or other pests.

Note: In addition to the above mentioned exercises any faunal diversity of local interest and their characteristic features/Environmental pollution problems/Toxicological problems/Human population studies/Ecosystem studies/Utilization of energy resources/Wildlife depletion and conservation topics may be chosen for project work.

Note: During field studies care should be taken not to disturb/remove the specimens/nests etc.

Guidelines for project work

1. Project allotment should be done at the beginning of semester and topic should be finalized in consultation with the guide by the student.
2. Each project work will be carried out as individual (preferably) or in a batch of 2/3/4 students. There shall not be more than 4 students in each group.
3. Dissertation work has to be submitted in the format prescribed.

4. Title page, Page I - Certificate, Page II - Declaration, Page III - Acknowledgements, Page IV – contents followed by the body of the dissertation.
5. Contents should include the following subheadings:
 1. Introduction with Review of Literature
 2. Materials and Methods
 3. Result and Discussion.
 4. Summary
 5. References
 6. Plates containing original photographs (Minimum 6 photos/page)
 7. Annexure (not compulsory)
6. Dissertation should contain a minimum of 20 pages excluding photographs (A4 sheets with 1 inch margin on all sides, Times New Roman font, font size -12 and line spacing - 1.5).
7. A student who is going to other institutions/industry/laboratory/fields for any assistance has to take permission letter by the HOD/Principal of the college.
8. Dissertation has to be submitted individually even if the work is done in group, i.e. one student has to submit his/her dissertation exclusively. No joint author submission. The dissertation to be certified by project guide and HOD. Certified dissertation shall be submitted during practical examination which shall be evaluated by both internal and external examiners.

SCHEME OF EXAMINATION
B.Sc. ZOOLOGY: VI SEMESTER
COMPULSORY PAPER - SKILL ENHANCEMENT (PROJECT WORK/FIELD TRAINING)

Code: BSCZOC

Duration: 3 hours

Max. Marks: 40

<p>I. Field work and preparation of dissertation (To be evaluated by project guide* + internal examiner** + external examiner** each for 20 marks and average shall be taken). * Project guide shall assess the candidate based on his/her involvement in the field work and preparation of dissertation. Marks allotment for the same shall be handed over to HOD in a sealed cover which will be transmitted to examiners. ** Distribution of marks: Introduction with review of literature - 3 Marks, Materials and methods - 3 Marks, Result and discussion - 8 Marks, Summary – 1 Mark, References – 1 Mark, Plates containing original photographs - 4 Marks)</p>	<p>20 Marks</p>
<p>II. Presentation by the candidate* (PPT slides preferably or charts) (Preparation of PPT slides or charts – 4 Marks, presentation – 6 Marks) *Presentation to be done individually even if the project is carried out in team.</p>	<p>10 Marks</p>
<p>III. Viva-voce (Based on the contents of dissertations)</p>	<p>10 Marks</p>
<p>Total = 40 Marks</p>	

Note: Internal assessment marks to be allotted based on the preparation and presentation of the dissertation topic.

SCHEME OF EXAMINATION: B.Sc. - I to VI SEMESTERS (THEORY)**CORE SUBJECT: ZOOLOGY**

Question No.	PART - A	Marks
I	Answer any TEN Questions out of TWELVE Questions (Give 3 questions from each unit)	10 x 2 = 20
	PART - B	
	Unit - I	
II	4 Marks Questions (Answer any TWO out of THREE)	4 x 2 = 8
III	7 Marks Questions (Answer any ONE out of TWO)	7 x 1 = 7
	Unit - II	
IV	4 Marks Questions (Answer any TWO out of THREE)	4 x 2 = 8
V	7 Marks Questions (Answer any ONE out of TWO)	7 x 1 = 7
	Unit - III	
VI	4 Marks Questions (Answer any TWO out of THREE)	4 x 2 = 8
VII	7 Marks Questions (Answer any ONE out of TWO)	7 x 1 = 7
	Unit - IV	
VIII	4 Marks Questions (Answer any TWO out of THREE)	4 x 2 = 8
IX	7 Marks Questions (Answer any ONE out of TWO)	7 x 1 = 7

GROUP II: OPEN ELECTIVE (SUPPORTIVE TO THE DISCIPLINE OF STUDY)

BSCZOCE : PARASITOLOGY AND VECTOR BIOLOGY

(To be studied in the III Semester B.Sc.)

(Hours of instruction: 2 hours per week. Total: 24 Hours)

Syllabus

Unit - I: Parasitology

Brief account of the disease caused, mode of infection, transmission, pathogenecity and control measures of following parasites:

- | | |
|---|-------|
| 1. Protozoan: <i>Giardia</i> and <i>Trichomonas</i> . | 3 Hrs |
| 2. Helminthes: <i>Taenia</i> and <i>Ancylostoma</i> . | 3 Hrs |
| 3. Bacterial: Typhoid and Cholera. | 3 Hrs |
| 4. Viral: Hepatitis and H1N1. | 3 Hrs |

Unit - II: Vector Biology and Integrated Vector Management

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|--|-------|
| 1. Vectors: Introduction, types of vectors with examples; Tools for vector control, Sources –biological, chemical, adulticides and larvicides. | 4 Hrs |
| 2. Causative organism, transmission and control measures of following vector borne diseases: Filariasis, Japanese Encephalitis, Dengue and Chikungunia. | 4 Hrs |
| 3. Arthropods vectors: Diseases transmitted and control Mosquitoes with reference to Mosquitoes (<i>Anopheles</i> , <i>Culex</i> , <i>Aedes</i> and <i>Mansonia</i>), Sand fly, Fleas, Stable or Dog Fly, Tsetse Fly, Bed Bugs, Cockroach, House Fly, Human Louse, Bed Bug, Ticks and Mites. | 2 Hrs |
| 4. Avian and mammalian vectors: diseases transmitted and control measures with reference to Domestic Fowl, Rat, Bat, Dog, Cattle, Monkey. | 2 Hrs |

REFERENCES:

1. Apurba, S. S and Sandhya, B. 2014. Essentials of Medical Parasitology, Jaypee Brothers Medical Publishers.
2. Arora, D.R. and Arora, B. 2001. Medical Parasitology, CBS Publications.
3. Chandler, A.C. & Read, C.P. 1961. Introduction to Parasitology, John Wiley & Sons Inc.
4. Chatterjee, K.D. 2009. Parasitology: Protozoology and Helminthology, CBS Publishers & Distributors.
5. David, D.V. and Kumara Swami. 1988. Elements of Economic Entomology, Popular Book Depot, Madras.
6. Mathews, G. 2011. Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases, Wiley-Blackwell.
7. Pedigo, L.P. 2002. Entomology and Pest Management, Prentice Hall Publication.
8. Smyth, J.D. 1994. Introduction to Animal Parasitology, Cambridge University Press.
9. William, H. M., Richard, S. D., Robert, B. G. 1999. Parasitology & Vector Biology, Academic Press.

GROUP II: OPEN ELECTIVE (NURTURING STUDENT'S PROFICIENCY/SKILL)
BSCZOCE : AQUARIUM FISH KEEPING
(To be studied in the IV Semester B.Sc.)
(Hours of instruction: 2 hours per week. Total: 24 hours)
Syllabus

Unit - I: Introduction to Aquarium Fish Keeping

1. **Biology of Aquarium Fishes** 6 Hrs
Importance and scope of aquarium fish keeping; Exotic and endemic species of aquarium fishes; Common characters and sexual dimorphism in aquarium fishes: Guppy, Molly, Sword tail, Gold fish, Angel fish, Koi, Gourami, Zebra fish, Fighter fish.
 2. **Aquarium Setup** 6 Hrs
Construction and preparation – size, shape, substrate, ornamental aquatic plants, bio-filters, aerators; Accessories for fish tank - hood and light, nets, suction tube, feeding cups and breeding traps; Water quality management - pH, hardness, salinity, oxygen, carbon dioxide, chlorine, ammonia and temperature.
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Unit - II: Aquarium Management

1. **Food, Feeding and Reproduction** 6 Hrs
Nutritional requirement of fishes, fish feed, composition of fish feed; Feeding methods- live feed, artificial feed; Reproductive Biology of Gold fish, Fish seed collection.
 2. **Transportation and Disease Management** 6 Hrs
Live fish transport - fish handling, packing and forwarding techniques; Aquarium fish diseases - Bacterial, Viral, Fungal and Protozoan infections, treatment and control.
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REFERENCES:

1. Ahilan, B., Felix, N., Santhnam R. 2008. Textbook of Aquaculture, Daya Publishing House.
2. Alappat, H. J. & Biju, K. 2011. Aquarium Fishes: A Colourful Profile, B.R. Publishing Corporation.
3. Amita, S. 2003. Aquarium Management, Daya Publishing House.
4. Biju, K. & Alappat, M. 1995. A Complete Guide to Aquarium Keeping, Low Price Publications.
5. David, A. 2011. Encyclopedia of Aquarium & Pond Fish, Penguin, UK.
6. Rolf, G. 1963. Aquarium Fish Diseases, TFH Publications.
7. Tharadevi, C.S., Jayashree, K.V., Arumugam, N. 2015. Home Aquarium and Ornamental Fish Culture, Saras Publication.
8. Ulrich, S. 2005. Tropical Freshwater Aquarium Fish from A to Z, Barron's Educational Series Inc., U.S.
9. Uma., Felix & Gopalakannan. 2018. Fish Diseases & Management, Tamil Nadu Dr. Jayalalitha University.

SCHEME OF EXAMINATION

OPEN ELECTIVE PAPERS (**BSCZOCE** and **BSCZOCE**)

Question No.	PART - A	Marks
I	Answer any FIVE Questions out of SIX Questions (Give 3 questions from each unit)	5 x 2 = 10
	PART - B	
	Unit - I	
II	4 Marks Questions (Answer any TWO out of THREE)	4 x 2 = 8
III	7 Marks Questions (Answer any ONE out of TWO)	7 x 1 = 7
	Unit - II	
IV	4 Marks Questions (Answer any TWO out of THREE)	4 x 2 = 8
V	7 Marks Questions (Answer any ONE out of TWO)	7 x 1 = 7



