

Department of Zoology

School of Biological Sciences



Curriculum Framework

B.Sc. Zoology

Based on National Education Policy- 2020

Doctor Harisingh Gour Vishwavidyalaya

(A Central University)

Sagar-Madhya Pradesh-470003

Level: Semester I			
Nature of Course	Course Code	Course Title	Credits
Discipline Specific Major	ZOO-DSM-111	Animal Diversity - Theory	4
	ZOO-DSM-112	Animal Diversity - Practical	2
Ability Enhancement Course	ZOO-AEC-113	Environmental Science	2
Skill Enhancement	ZOO-SEC-114	Poultry Farming	2
Multi-Disciplinary Major	ZOO-MDM-115 (MOOC)	Applied Entomology - Theory	4
Multi-Disciplinary Major	ZOO-MDM-116	Applied Entomology- Practical	2
Semester II			
Nature of Course	Course Code	Course Title	Credits
Discipline Specific Major	ZOO-DSM-211	Comparative Anatomy and Developmental Biology of Vertebrates-Theory	4
	ZOO-DSM-212	Comparative Anatomy and Developmental Biology of Vertebrates-Practical	2

Ability Enhancement	ZOO-AEC-213	Aquarium Fish Keeping	2
Skill Enhancement Course	ZOO-SEC-214	Introduction to Sericulture	2
Multi-Disciplinary	ZOO-MDM-215	Molecular Biology & Bioinformatics-Theory	4
Multi-Disciplinary	ZOO-MDM-216	Molecular Biology & Bioinformatics-Practical	2
Semester III			
Nature of Course	Course Code	Course Title	Credits
Discipline Specific Major	ZOO-DSM-311	Physiology and Biochemistry	4
	ZOO-DSM-312	Physiology and Biochemistry	2
Ability Enhancement	ZOO-AEC-313	Science Communication and Popularization	2
Skill Enhancement	ZOO-SEC-314	Introduction to Apiculture	2
Multi-Disciplinary	ZOO-MDM-315 (MOOC)	Silkworm Rearing and Reeling Technology-Theory	4
Multi-Disciplinary	ZOO-MDM-316	Silkworm Rearing and Reeling Technology-Practical	2
Semester IV			
Nature of Course	Course Code	Course Title	Credits

Discipline Specific Major	ZOO-DSM-411	Genetics and Evolutionary Biology-Theory	4
	ZOO-DSM-412	Genetics and Evolutionary Biology-Practical	2
Ability Enhancement Course	ZOO-AEC-413	Human Nutrition	2
Skill Enhancement	ZOO-SEC-414	Toxicology	2
Multi-Disciplinary	ZOO-MDM-415	Animal Biotechnology- Theory	4
Multi-Disciplinary	ZOO-MDM-416	Animal Biotechnology-Practical	2
Semester V			
Nature of Course	Course Code	Course Title	Credits
Discipline Specific Major	ZOO-DSM-511	Immunology	4
Discipline Specific Major	ZOO-DSM-512	Immunology	2
Ability Enhancement Course	ZOO-AEC-513	History of Indian Science	2
Skill Enhancement Course	ZOO-SEC-514	Public Health and Hygiene	2
Multi-Disciplinary Major	ZOO-MDM-515 (MOOC)	Fish and Fisheries – Theory	4

Multi-Disciplinary Major	ZOO-MDM-516	Fish and Fisheries – Practical	2
Multi-Disciplinary Major	ZOO-ITEP-517 (MOOC)	Vocational: Bee Keeping	10
Semester VI			
Nature of Course	Course Code	Course Title	Credits
Discipline Specific	ZOO-DSM-611	Ap/pIied Zoology-Theory	4
	ZOO-DSM-612	Applied Zoology-Practical	2
Ability Enhancement Course	ZOO-AEC-613	Good Laboratory Practices	2
Skill Enhancement Course	ZOO-SEC-614	Computer Application	2
Multi-Disciplinary Major	ZOO-MDM-615	Biostatistics & Computer Application- Theory	4
Multi-Disciplinary Major	ZOO-MDM-616	Biostatistics & Computer Application - Practical	2

Level: Semester VII			
Nature of Course	Course Code	Course Title	Credits
Discipline Specific Major	ZOO-DSM-711	Molecular Taxonomy-Theory	4
Discipline Specific Major	ZOO-DSM-712	Molecular Taxonomy- Practical	2
Discipline Specific Major	ZOO-DSM-713	Fundamental of Neuroscience-Theory	4
Discipline Specific Major	ZOO-DSM-714	Fundamental of Neuroscience-Practical	2
Multi-Disciplinary Major	ZOO-MDM-715	Research Methodology - Theory	4
Multi-Disciplinary Major	ZOO-MDM-716	Research Methodology - Practical	2
Skill Enhancement Course	ZOO-SEC-717	Internship/experiential learning/ Field work/minor project- Practical	2

Level: Semester VIII			
Nature of Course	Course Code	Course Title	Credits
Discipline Specific Major	ZOO-DSM-811	Aquatic Ecosystem Management-Theory	4
Discipline Specific Major	ZOO-DSM-812	Aquatic Ecosystem Management--Practical	2
Discipline Specific Major	ZOO-DSM-813	Clinical Biology-Theory	4
Discipline Specific Major	ZOO-DSM-814	Clinical Biology-Practical	2
Discipline Specific Dissertation	ZOO-DSM-815	Discipline Specific Dissertation	12
Total			24

Level: Semester I			
Nature of Course	Course Code	Course Title	Credits
Discipline Specific Major	ZOO-DSM-111	Animal Diversity - Theory	4
	ZOO-DSM-112	Animal Diversity - Practical	2
Ability Enhancement Course	ZOO-AEC-113	Environmental Science	2
Skill Enhancement Course	ZOO-SEC-114	Poultry Farming	2
Multi-Disciplinary Major	ZOO-MDM-115 (MOOC)	Applied Entomology - Theory	4
Multi-Disciplinary Major	ZOO-MDM-116	Applied Entomology- Practical	2

**B.SC. I SEMESTER
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: ANIMAL DIVERSITY
COURSE CODE: ZOO-DSM-111
THEORY**

L	T	P	C
4	0	0	4

Objective: To gain an understanding of the structural and functional diversity of Invertebrate and Vertebrate animals.

Unit I: Lower Invertebrates

a. Protista

General Characters and Classification up to classes.

Locomotory Organs and locomotion in Protozoa.

b. Porifera

General Characters and Classification up to classes.

Canal System in *Sycon*

c. Cnidaria

General Characters and classification up to classes.

Polymorphism in Hydrozoa.

d. Nematelminthes

General Characters and classification up to classes.

Life history of *Ascaris lumbricoides* and its parasitic adaptations.

Unit II: Higher Invertebrates-I

a. Platyhelminthes

General characters and classification up to classes.

Life history of *Taenia solium*.

b. Annelida

General characters and classification up to classes.

Metamerism and Coelom formation in Annelida.

c. Arthropoda

General characters and classification up to classes.

Vision in Arthropoda.

Metamorphosis in Insects.

Unit III: Higher Invertebrates-II

a. Mollusca

General characters and classification up to classes.

Torsion in Gastropods

b. Echinodermata

General characters and classification up to classes.

Water Vascular system in Asteroidea.

c. Hemichordata

General features and affinities of *Balanoglossus*.

Unit IV: Lower Chordates

a. Protochordata

General features and affinities of Urochordata and Cephalochordates

Metamorphosis in *Herdmania*

b. Agnatha

General features and affinities of Cyclostomes.

c. Pisces

General features and Classification up to order

Osmoregulation

d. Amphibia

General features and Classification up to order.

Parental care in Amphibia.

Unit V: Higher Chordates

a. Reptiles

General features and Classification up to order.

Poisonous and Non-poisonous Snakes

Biting Mechanism

b. Aves

General features and Classification up to order.

Migration in Birds

c. Mammals

General features and Classification up to order.

Origin of mammals.

Suggested Readings: (Latest Edition)

1. Barnes R.S.K., Calow P., Olive P.J.W., Golding, D.W. and Spicer, J.I. The Invertebrates: A New Synthesis, III Edition, Blackwell Science.
2. Kotpal R.L. Modern text book of Zoology: Invertebrates. Rastogi Publication, New Delhi. Barrington.
3. Kotpal R.L. Modern text book of Zoology: Vertebrates. Rastogi Publication, New Delhi. Barrington.

Learning Outcomes:

After successfully completing this course, the students will be able to:

- learn structural and functional diversity in different groups of animals.
- gain knowledge and skill in the fundamentals of animal sciences

**B.SC. I SEMESTER
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: ANIMAL DIVERSITY
COURSE CODE: ZOO-DSM-112
PRACTICAL**

L	T	P	C
0	0	2	2

Students will study the external features of the following animals-

- 1. Protozoa:** *Amoeba, Euglena, Paramecium.*
- 2. Porifera:** T. S. and L.S. of *Sycon, Euspongia.*
- 3. Cnidaria:** *Obelia, Physalia, Aurelia, Tubipora, Metridium, Coreallia, Pennatula, Madrepora, Zoanthus, Alcyonium, Porpita, Physalia, Gorgonia.*
- 4. Platyhelminthes:** *Taenia solium* and Study of its life cycle stages, *Dugesia.*
- 5. Nematelminthes:** Male and female *Ascaris lumbricoides.*
- 6. Annelida:** *Aphrodite, Nereis, Heteronereis, Pheretima, Hirudinaria, Polygordius, Chaetopterus.*
- 7. Arthropoda:** *Palaemon, Cancer, Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis, Bombax mori, Dragon fly, Lepus, Musca, Paripatus, Mentis.*
- 8. Mollusca:** *Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus, Solen, Limax, Dentalium.*
- 9. Echinodermata:** *Pentaceros, Ophiura, Echinus, Cucumaria, Antedon, Star fish, Ophiothorix, Echinus, Holothuria, Thyone.*
- 10. Hemichordata:** *Balanoglossus.*
- 11. Protochordata:** *Herdmania, Branchiostoma.*
- 12. Agnatha:** *Petromyzon, Myxine.*
- 13. Pisces:** *Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla.*
- 14. Amphibia:** *Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla.*
- 15. Reptilia:** *Chelone, Hemidactylus, Chamaeleon, Draco, Viper, Naja, Crocodylus, Gavialis.*
- 16. Key for Identification of poisonous and non-poisonous snakes.**

17. **Aves:** Study of six common birds from different orders.
18. **Mammalia:** Bat, *Funambulus*, *Loris*.
19. An “**animal album**” containing photographs, cut outs, with appropriate write up about the above-mentioned taxa. Different taxa/topics may be given to different sets of students for this purpose.

**B.SC. I SEMESTER
ABILITY ENHANCEMENT COURSE
COURSE TITLE: ENVIRONMENTAL SCIENCES
COURSE CODE: ZOO-AEC-113
THEORY**

L	T	P	C
2	0	0	2

Objective: The purpose of this course is to understand the significance of the environment and the necessity of conserving natural resources for the betterment of human well-being.

Unit I: Introduction to Ecosystem

- a. Structure and function of different ecosystems
- b. Food chains, food webs and ecological succession.

Unit II: Natural Resources

- a. Land resources and land use change, Land degradation, soil erosion and desertification.
- b. Deforestation
- c. Water: Use and over-exploitation of surface and ground water, floods, droughts.
- d. Renewable and non-renewable energy sources.

Unit III: Biodiversity and Conservation

- a. Levels of biological diversity: genetic, species and ecosystem diversity.
- b. India as mega-biodiversity nation: Endangered and endemic species of India.
- c. Threats of biodiversity
- d. Conservation of biodiversity

Unit IV: Environmental Pollution

- a. Environmental pollution: types, causes and control.
- b. Nuclear hazards and human health risks.
- c. Solid waste management.
- d. Climate change, global warming, ozone layer depletion, acid rains.
- e. Pollution case studies.

Unit V: Human Communities, Policies & Practices

- a. Human population growth.
- b. Disaster management.
- c. Environmental movements: Chipko, Silent valley, Bishnoi of Rajasthan.
- d. Environmental Protection Act; Wildlife Protection Act; forest Conservation Act.
- e. International agreements: Montreal and Kyoto protocols and convention on Biological Diversity.
- f. Environmental ethics: Role of Indian and other religions and cultures in environment Conservation.

Suggested Readings: (Latest Edition)

1. Erach Bharucha. Text book of Environmental Studies for undergraduate courses, University Grants Commission, New Delhi.
2. Odum E.P. Basic Ecology, Sanders, Philadelphia.
3. Cunningham W.P., Cooper, T.H., Gorhani, E and Hepworth, M.T. Environmental Encyclopedia, Jaico Publ. House, Mumbai.

Learning outcomes:

After successful completion of this course, the students will be able to:

- understand interactions between organisms and their environment, drive the dynamics of individuals, populations, communities, and ecosystems.
- recognize the ecological basis for regional and global environmental issues.

**B.SC. I SEMESTER
SKILL ENHANCEMENT COURSE
COURSE TITLE: POULTRY FARMING
COURSE CODE: ZOO-SEC-114
THEORY**

L	T	P	C
2	0	0	2

Objective: To acquire knowledge and skills in poultry farming as a means of providing employment opportunities.

Unit I: Overview of Poultry Farming

- a. Types of Breed, Rearing methods, Laying cages
- b. Nutritive value of egg and Meat.
- c. General features of Plymouth Rock, Light Sussex, Minorca, Rhode Island, Red and White Leghorn.

Unit II: Classification of Fowls

- a. Based on their use as Egg and Meat.
- b. Commercial layers.
- c. Dual purpose varieties.
- d. Varieties of fowl for Game and Ornamental purposes.

Unit III: Poultry Feeding

- a. Management of Egg Layers.
- b. Management of Broilers in large scale farms.
- c. Housing and Equipment.

Unit IV: Poultry diseases

- a. Viral, Bacterial, Fungal, Protozoan and Parasitic Lice etc.
- b. Prevention and precautions during vaccination.

Unit V: Management of modern Poultry Farms

- a. Methods of Brood rearing.
- b. Progressive plans to promote Poultry as a Self- Employment venture.

Suggested Readings: (Latest Edition)

1. Sainsbury D. Poultry Health and Management: Chickens, Ducks, Turkeys, Geese, Quail, Blackwell Science.
2. McMullin. Pocket Guide to Poultry Health and Disease, Nottingham University Press.
3. Rose S. Principles of Poultry Science, CABI Publishing.

Learning Outcomes:

After successfully completing this course, the students will be able to:

- Identify fowl species use poultry species, their various developmental stages, poultry diseases and their prevention in order to generate employment opportunities.

**B.SC. I SEMESTER
MULTI-DISCIPLINARY-MAJOR
COURSE TITLE: APPLIED ENTOMOLOGY
COURSE CODE: ZOO-MDM-115
THEORY**

L	T	P	C
2	0	0	2

MOOC: https://onlinecourses.swayam2.ac.in/cec25_bt07/preview

Objective: To Provide students with a comprehensive understanding of Applied Entomology.

Course layout

Week – I - 1. Characteristic features of insects 2. Metamorphosis in insects 3. Salient features of insect orders

Week – II - 4. Lepidoptera 5. Diptera 6. Hymenoptera

Week – III - 7. Coleoptera 8. Hemiptera 9. Neuroptera

Week - IV - 10. Insect behavior 11. Identification of a few insects using keys 12. Beneficial insects

Week – V - 13. Silkworms 14. Honeybee 15. Lac insect

Week – VI - 16. Parasitoids 17. Predators and Pollinators 18. Insects as human food 19. Insects as important laboratory tools

Week – VII - 20. Categories and types of pests 21. Harmful insects 22. Agricultural pests 23. Veterinary insects and other pests

Week - VIII - 24. Rat flea 25. Pests of public health importance 26. Mosquito

Week – IX - 27. House fly 28. Louse 29. Bed bugs

Week - X - 30. Insect vectors 31. Insect pest control 32. Pesticides 33. Integrated pest management

Week - XI - 34. Social insects 35. Termites 36. Wasps and ants

Books and references:

1. Applied Entomology. New Age International (P) Ltd. Publishers, New Delhi. Fenemore, P.G. and Alka Prakash (1992)
2. Entomology at a Glance. Agrotech Publishing House, Udaipur Saxena, R.C. and Srivastava, R.C. (2003)
3. Text Book of Applied Entomology. Vol. I. Kalyani Publishers, New Delhi Srivastava, K.P. (2005)
4. Text Book of Applied Entomology. Vol. II. Kalyani Publishers, New Delhi Srivastava, K.P. (2004)
5. Study Material for Insect Ecology and Integrated Pest Management: Department of Agricultural Entomology, Acharya N.G. Ranga Agricultural University, Hyderabad. Raghavaiah, G. and Ramesh Babu, T. (2012)

Learning outcomes:

By the end of this course, learners will be able to:

- Explain and analyze the structural and functional characteristics of insects, including external morphology and adaptations
- Differentiate and describe the stages of metamorphosis and relate these to insect growth and development

**B.SC. I SEMESTER
MULTI-DISCIPLINARY-MAJOR
COURSE TITLE: APPLIED ENTOMOLOGY
COURSE CODE: ZOO-MDM-116
PRACTICAL**

L	T	P	C
0	1	1	2

1. Study the main body parts of insects (head, thorax, abdomen, wings, legs, antennae)
2. Observe life cycle stages of insects such as butterfly or housefly to understand metamorphosis.
3. Identify locally available insects using keys
4. Observe useful insects like silkworm (cocoon), honeybee (honey), and lac insect (lac stick) and note their importance.
5. Collect mosquito larvae from stagnant water and observe their shape and movement.
6. Visit a garden or crop field to see insect damage on leaves or stems and identify the pest and observe pest management strategies

Semester II			
Nature of Course	Course Code	Course Title	Credits
Discipline Specific Major	ZOO-DSM-211	Comparative Anatomy and Developmental Biology of Vertebrates-Theory	4
	ZOO-DSM-212	Comparative Anatomy and Developmental Biology of Vertebrates-Practical	2
Ability Enhancement Course	ZOO-AEC-213	Aquarium Fish Keeping	2
Skill Enhancement Course	ZOO-SEC-214	Introduction to Sericulture	2
Multi-Disciplinary Major	ZOO-MDM-215	Molecular Biology & Bioinformatics- Theory	4
Multi-Disciplinary Major	ZOO-MDM-216	Molecular Biology & Bioinformatics- Practical	2
			Total Credits 16

B.SC. II SEMESTER
DISCIPLINE SPECIFIC MAJOR (DSM)
COURSE TITLE: COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF
VERTEBRATES
COURSE CODE: ZOO-DSM-211
THEORY

L	T	P	C
4	0	0	4

Objective: To acquire knowledge on comparative anatomy and embryonic development in animals.

Unit I: Comparative Anatomy -I

- a. **Integumentary System:** Derivatives of integument with reference to glands and digital tips.
- b. **Skeletal System:** Axial and Appendicular Skeleton.
- c. **Digestive System:** Brief account of alimentary canal and digestive glands.

Unit II: Comparative Anatomy -II

- a. **Respiratory System:** Gills, lungs, air sacs and swim bladder.
- b. **Circulatory System:** Evolution of heart and aortic arches.

Unit III: Comparative Anatomy -III

- a. **Urinogenital System:** Succession of kidney, Evolution of urogenital ducts.
- b. **Nervous System:** Comparative account of brain.
- c. **Sense Organs:** Type of receptors: Vision, Hearing, Taste, Smell and Touch.

Unit IV: Early Embryonic Development

- a. Gametogenesis: Spermatogenesis and Oogenesis.
- b. Structure and types of eggs
- c. Mechanism of Fertilization
- d. Planes and patterns of cleavage.
- e. Type of Blastula; Fate maps.
- f. Early development of frog and chick up to the formation of three germinal layers.

Unit V: Late and Post Embryonic Development

- a. Fate of three germinal layers
- b. Extra-embryonic membranes in Chick
- c. Structure, types and function of Placenta in mammals
- d. Metamorphosis: Changes, hormonal regulations in amphibians
- e. Regeneration: Mode of regeneration, epimorphosis, morphallaxis and compensatory regeneration.
- f. Ageing: Concepts and theories.

Suggested Readings: (Latest Edition)

1. Kardong K. V. Vertebrates Comparative Anatomy. Function and Evolution. Tata McGraw Hill Publishing Company. New Delhi.
2. Raven P. H. and Johnson, G. B. Biology, Tata McGraw Hill Publications. New Delhi.
3. Carlson Bruce M. Patten's Foundations of Embryology, McGraw Hill, Inc.
4. Gilbert S. F. Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
5. Kalthoff. Analysis of Biological Development, McGraw-Hill Publishers Lewis
6. Wolpert. Principles of Development. Oxford University Press

Learning Outcomes:

After successfully completing this course, the students will be able to:

- Understand comparative anatomy of different systems in vertebrates
- Learn the mechanism of embryonic development and implantation of foetus.

**B.SC. II SEMESTER
DISCIPLINE SPECIFIC MAJOR (DSM)
COURSE TITLE: COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF
VERTEBRATES
COURSE CODE: ZOO-DSM-212
PRACTICAL**

L	T	P	C
0	0	2	2

Study of the characteristic features of:

1. Disarticulated skeleton of Fowl

- a. Vertebrae (atlas, fused thoracic, synsacrum, pygostyle)
- b. Limb bones (humerus, radio-ulna, femur, tarso-metatarsus)
- c. Girdles (pectoral, Fercula and pelvic)

2. Disarticulated skeleton of Rabbit

- a. Vertebrae (atlas, axis, lumbar, sacral, caudal)
- b. Limb bones (humerus, radio-ulna, femur, tibio-fibula)
- c. Girdles (pectoral and pelvic)

3. Skull

- a. One herbivorous (Rabbit)
- b. One carnivorous (Dog)

4. Study of integumentary derivatives: Observe and sketch scales, feathers, hair, claws, nails, and glands from preserved specimens or slides

5. Study of developmental stages in frog: whole mounts and sections through permanent slides.

6. Examination of gametes – frog/rat- sperm and ova through permanent slides or photomicrographs.

7. Study of placenta using microphotographs.

**B.SC. II SEMESTER
ABILITY ENHANCEMENT COURSE (AEC)
COURSE TITLE: AQUARIUM FISH KEEPING
COURSE CODE: ZOO-AEC-211
THEORY**

L	T	P	C
1	1	0	2

Objective: In order to obtain the requisite information for the purpose of maintaining an aquarium, with considerations for both decorative and commercial purposes.

Unit I: Introduction to Aquarium Fish Keeping

- a. History and importance of aquarium fish keeping.
- b. The potential scope of aquarium as a Cottage Industry.
- c. Exotic and endemic species of aquarium Fishes

Unit II: Biology of Aquarium Fishes

- a. Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes.
- b. General features of Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish.

Unit III: Food and feeding of Aquarium fishes

- a. Use of live fish feed organisms.
- b. Preparation and composition of formulated fish feeds

Unit IV: Fish Transportation

- a. Live fish transport handling,
- b. Packing and forwarding techniques.

Unit V: Maintenance of Aquarium

- a. General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry.

Suggested Readings: (Latest Edition)

1. Arumugam N. Home Aquarium and Ornamental Fish Culture. Saras Publication, New Delhi.
2. Vincent Hargreaves. Complete book on Fresh water Aquarium. Thunder Bay, Oxford.
3. e-contents Aquarium Fish and their maintenance.

Learning Outcome:

After successfully completing this course, the students will be able to-

- Setting up of fresh water aquarium.
- Learning the maintenance of an aquarium.

**B.SC. II SEMESTER
SKILL ENHANCEMENT COURSE
COURSE TITLE: INTRODUCTION TO SERICULTURE
COURSE CODE: ZOO-SEC-214
THEORY**

L	T	P	C
1	1	0	2

Objective: To acquire the necessary information for sericulture and to create employment opportunities.

Unit I: Mulberry Cultivation

- a. Classification of commercially important mulberry varieties for sericulture
- b. Site selection and land preparation for mulberry plantations
- c. Planting methods, spacing, and mulching techniques
- d. Irrigation, fertilization, pruning, and weed management practices
- e. Leaf harvesting, grading, and preservation methods

Unit II: Silkworm Diseases and Nutritional Disorders

- a. Fungal diseases (pebrine, white muscardine): etiology, symptoms, prevention, and control
- b. Bacterial diseases (flacherie, septicemia): causative agents and remedial measures
- c. Viral diseases (grasserie, denisonucleosis) and management strategies
- d. Nematode infestations and their control
- e. Nutritional deficiency disorders: identification and corrective feeding protocols

Unit III: Silkworm Rearing Techniques

- a. Rearing house design, hygiene, and biosecurity measures
- b. Chawki (early instar) rearing: environmental requirements and feeding schedules
- c. Late-age (fifth instar) rearing: mounting practices, spacing norms, and deflossing techniques
- d. Integrated Silkworm Rearing Management (ISRM) for yield optimization

Unit IV: Cocoon Harvesting and Processing

Physical and commercial grading of cocoons

- Cocoon harvesting, sorting, and storage protocols
- Reeling operations: raw silk recovery, types of reeling (hot-, cold-, and semi-hot bath), and waste management
- By-products of sericulture (pupae, castor, chrysalides): processing and value-addition

Unit V: Sericulture Industry and Entrepreneurship

- Economic importance and role of sericulture in rural development
- Structure, current status, and progress of India's sericulture industry
- Government schemes, policies, and extension services for sericulturists
- Business planning and self-employment opportunities

Suggested Readings: (Latest Edition)

1. M. Madan Mohan Rao. An Introduction to Sericulture. Paras Publication, Delhi.
2. e-content on Silkworm Rearing Technology, Mulberry Cultivation & Physiology, Mulberry Crop Protection, Sericulture Extn. Management & Economics, Silkworm Crop Protection.

Learning Outcomes:

After successfully completing this course, the students will be able to:

- Develop an understanding of various prerequisites to successfully carry out sericulture.
- Understand various processes involved in silkworm rearing, cocoon management and reeling
- Be able to understand, analyze and explain the economic significance of silk and various methods of silk production

**B.SC. II SEMESTER
MULTI-DISCIPLINARY MAJOR
COURSE TITLE: MOLECULAR BIOLOGY & BIOINFORMATICS
COURSE CODE: ZOO-MDM-215
THEORY**

L	T	P	C
2	2	0	4

Objective: To gain basic understanding of Nucleic acids and Bioinformatics.

Unit I: Nucleic Acids as Genetic Material

- a. DNA as the genetic material – Griffiths experiments
- b. RNA as genetic material – Tobacco Mosaic Virus

Unit II: Structure of Nucleic Acids

- a. Structure and chemistry of DNA – Watson and Crick Model
- b. Forms of DNA – A, B and Z forms of DNA
- c. Structure of Cytoplasmic DNA

Unit III: Functions & Mechanisms of Nucleic Acids

- a. Semi-conservative model of DNA Replication
- b. non-conservative model of DNA Replication

Unit IV: Introduction to Bioinformatics

- a. Biological databases
- b. Nucleic acid sequence databases
- c. Protein databases

Unit V: Analytical Tools for Sequences Databanks

- a. Similarity and database searching tools – FASTA, BLAST
- b. BLAST, FASTA, pairwise alignment- Multiple alignment, ClustalW

Suggested Readings: (Latest Edition)

1. B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Molecular biology of the Cell. Garland Publishing Inc., New York.
2. Warren J. Ewens and Gregory R Grant. Statistical methods in Bioinformatics. Springer, New York.

Learning Outcomes: After successfully completing this course, the students will be able to:
learn basic structure of nucleic acid and basic tools used in bioinformatics.

**B.SC. II SEMESTER
MULTI-DISCIPLINARY MAJOR
COURSE TITLE: MOLECULAR BIOLOGY & BIOINFORMATICS
COURSE CODE: ZOO-MDM-216
PRACTICAL**

L	T	P	C
1	0	1	2

1. Structure of DNA using Models
2. Structural organization of different forms of DNA
3. Structure of different types of RNA
4. Operation databases: NCBI
5. Retrieving DNA sequences from GenBank
6. Preparation of FASTA Format
7. Preparation of Models/Charts

Semester III			
Nature of Course	Course Code	Course Title	Credits
Discipline Specific Major	ZOO-DSM-311	Physiology and Biochemistry-Theory	4
	ZOO-DSM-312	Physiology and Biochemistry-Practical	2
Ability Enhancement Course	ZOO-AEC-313	Science Communication and Popularization	2
Skill Enhancement Course	ZOO-SEC-314	Introduction to Apiculture	2
Multi-Disciplinary Major	ZOO-MDM-315 (MOOC)	Silkworm Rearing and Reeling Technology	4
Multi-Disciplinary Major	ZOO-MDM-316	Silkworm Rearing and Reeling Technology - Practical	2
			Total Credits 16

**B.SC. III SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: PHYSIOLOGY AND BIOCHEMISTRY
COURSE CODE: ZOO-DSM-311
THEORY**

L	T	P	C
4	0	0	4

Objective: To have a comprehensive understanding of the physiological and biochemical aspects of animal systems.

Unit I Digestion and Respiration

- Digestion and absorption of carbohydrates, proteins and fats; Gastrointestinal hormones.
- Mechanism and regulation of breathing; Transport of oxygen and carbon dioxide, Respiratory quotient.
- Blood buffers.
- Pulmonary ventilation, Respiratory volumes and capacities.
- Transport of Oxygen and carbon dioxide in blood.

Unit II Cardiovascular system, Excretion and Endocrine Glands in mammals

- Blood: Composition, Homeostasis.
- Heart structure, Origin and conduction of the cardiac impulse.
- Cardiac cycle.
- Structure and function of kidney
- Mechanism of Urine formation.
- Structure and function of pituitary, thyroid, parathyroid, pancreas and adrenal glands.

Unit III Nerve, Muscle and Coordination in mammals

- Structure of a neuron, Resting membrane potential and Graded potential.

- b. Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres.
- c. Ultrastructure of skeletal muscle, Molecular and chemical basis of muscle contraction.
- d. Vision: Structure of eye, retinal components, and photoreceptors: ionic basis of potential generation.
- e. Hearing: Structure of ear, mechanoreceptor: ionic basis of potential generation.

Unit- IV: Carbohydrate Metabolism and Lipid Metabolism

- a. Principle of bimolecular organization, configuration and conformation.
- b. Water as biological solvent.
- c. Carbohydrates and Lipids: Structure and biological importance.
- d. Classification - Reducing and non-reducing sugars, monosaccharides, Oligosaccharides (Disaccharides), polysaccharides (peptidoglycans and glycosaminoglycans).
- e. Glycolysis, Krebs cycle, Electron transport chain and ATP synthesis Phosphate pentose pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis.

Unit-V: Protein metabolism and nucleic acids:

- a. Amino acids -Structure, classification and properties, Ionization, titration curve.
- b. Protein: structures, fibrous and globular proteins.
- c. Enzymes: Nomenclature and classification, general properties, cofactors, Mechanism of action.
- d. Structure -Bases, nucleosides and nucleotides, DNA structure.
- e. Genetic code.

Suggested Readings: (Latest Edition)

1. Tortora, G.J.& Derrickson, B.H. Principles of Anatomy and Physiology, John Wiley & Sons, Inc.
2. Widmaier, E.P., Raff, H. &Strang, K.T. Vander's Human Physiology, McGraw Hill.
3. Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
4. Berg, J. M., Tymoczko, J. L. and Stryer, L. Biochemistry, W.H Freeman and Co.
5. Nelson, D. L., Cox, M. M. and Lehninger, A.L. Principles of Biochemistry, W.H Freeman and Co.

6. Murray, R. K., Granner, D. K., Mayes, P. A. and Rodwell, V. Harper's Illustrated Biochemistry, Lange Medical Books/Mc Graw Hill.

Learning Outcomes:

After the completion of the course, the students will able to-

- understand the physiology at cellular and system levels.
- understand how mammalian body gets nutrition from different biomolecules.

**B.SC. III SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: PHYSIOLOGY AND BIOCHEMISTRY
COURSE CODE: ZOO-DSM-312
PRACTICAL**

L	T	P	C
0	0	2	2

1. Qualitative tests for carbohydrates (Benedict's), proteins (Biuret), and lipids (Sudan III)
2. Spirometric measurement of tidal volume, vital capacity, and other respiratory capacities
3. Hemoglobin estimation (Sahli's) and total WBC/RBC counts via haemocytometer.
4. Preparation of casein from milk.
5. Examination of permanent slides of endocrine glands of mammalian pituitary, thyroid, parathyroid, pancreas, adrenal gland, testis and ovary.
6. Examination of permanent histological slides of spinal cord, duodenum, small intestine and large intestine, liver, lung, kidney, bone, cartilage.
7. Quantitative protein estimation by Lowry's method.
8. Separation of amino acids or proteins by paper chromatography.
9. Preparation of models of nitrogenous bases, nucleosides and nucleotides.

**B.SC. III SEMESTER COURSE
ABILITY ENHANCEMENT COURSE
COURSE TITLE: SCIENCE COMMUNICATION AND POPULARIZATION
COURSE CODE: ZOO-AEC-313
THEORY**

L	T	P	C
1	1	0	2

Objective: to emphasise the need of effectively disseminating scientific information and knowledge in order to enhance the overall welfare of Society.

Unit-I: Print Science Communication

- a. Role of science and technology in human development.
- b. Writing and communicating popular articles effectively.
- c. Case studies of celebrated works of science communicators including Cosmos by Carl Sagan, works of Bill Bryson, Richard Dawkins, Richard Feynman, Isaac Asimov, Carl Zimmer and Matt Riddley.
- d. Importance for communication through regional languages.

Unit-II: Visual Media Science Communication

- a. Science outreach through visual media: Creating science documentaries.
- b. Scripts, citing authentic sources, case study: Famous documentaries of Carl Sagan, David Attenborough and Prof. Yashpal.
- c. Cultural Studies of Science and Technology-technoscientific culture- Science Fiction Studies-cinema and Science.
- d. Science in Indian popular culture.

Unit-III: Internet Science Communication

- a. Science popularization through internet: Social media, Websites, Blogs, You tube, Podcast etc.
- b. Sensitization on important issues like climate change, deforestation, biodiversity loss, important of science etc.

Unit-IV: Science Outreach Talks

- a. Tactics for providing a charismatic and effective public talk.
- b. Use of metaphors, speaking in context.
- c. Museum displays and public exhibitions.

Unit V: Public Sensitization in Science

- a. Science outreach for biodiversity conservation, sensitization of public.
- b. Science communication during disasters- Public Engagement with Science and Technology.
- c. Public sphere-multiple publics-the deliberative turn.

Suggested Readings: (Latest Edition)

1. Selected works of Carl Sagan, works of Bill Bryson, Richard Dawkins, Richard Feynman, Isaac Asimov, Carl Zimmer and Matt Riddley.
2. Gigante, E. Marie. Introducing Science Through Images: Cases of Visual Popularization (Studies in Rhetoric/Communication), University of South Carolina Press.

Learning outcomes:

After the completion of this course, the learner will be able to:

- Utilize visual media science communication for creating scripts and documentaries.
- Identify the need and role of science communication in human development.
- Contribute in science popularization through internet communication and public Sensitization.

**B.SC. III SEMESTER COURSE
SKILL ENHANCEMENT COURSE
COURSE TITLE: INTRODUCTION TO APICULTURE
COURSE CODE: ZOO-SEC-314
THEORY**

L	T	P	C
1	1	0	2

Objective: To acquire knowledge regarding apiculture for the purpose of commercial production of Honey and byproducts.

Unit I: Introduction to Apiculture

- a. History of Bees and Beekeeping.
- b. Systematics, Bee species, Bee morphology.
- c. Colony organization, Polymorphism, Caste system, Division of labour.
- d. Bee flora, Foraging and Honey flow periods.

Unit II: Bee keeping as an occupation

- a. Extent of Beekeeping in India.
- b. Limitations on the development of beekeeping,
- c. Advantages of extensive Beekeeping.
- d. Beekeeping equipment: Bee box and tools and initiation into keeping a colony.

Unit III: Beekeeping and Bee diseases

- a. Purchase of a colony, the Apiary site, how to manage a colony, the manipulation of a colony.
- b. Bee products: Honey, Bees wax, Pollens, Royal Jelly, Propolis and Bee venom.
- c. Bee diseases and enemies.

Unit IV: Beekeeping techniques

- a. Establishment of a colony. Bee flora and planned pollination services.
- b. Important Institutions pertinent to Apiculture: National Bee Board, Bee research and Training Institute, Apiaries.
- c. Economic importance and extension of Bee keeping.

Unit V: Apiary management

- a. Routine management.
- b. Seasonal management, Migratory beekeeping.
- c. Harvesting and marketing of bee products.
- d. The future of beekeeping.

Suggested Readings: (Latest Edition)

Abrol, D. P. Bees and Beekeeping. Kalyani Publisher, New Delhi.

Learning Outcome:

By the end of the course, the student should be able to:

- Identify and describe the fundamentals and scientific basis of beekeeping.
- Recognize biological principles applicable to many organisms by using the honey bee as a study subject.

**B.SC. III SEMESTER COURSE
MUTI-DISCIPLINARY MAJOR
COURSE TITLE: SILKWORM REARING AND REELING TECHNOLOGY
COURSE CODE: ZOO-MDM-315
THEORY**

L	T	P	C
2	2	0	4

MOOC: https://onlinecourses.swayam2.ac.in/cec25_ag05/preview

Objectives: To understand various techniques and principles involved in the rearing of silkworm and the reeling of silk fibers from cocoons.

Week 1 Modules: 1. Disinfection of rearing house and different methods of disinfection 2. Silkworm Rearing appliances 3. Different types of silkworm rearing

Week 2 Modules: 4. Environmental requirements for Silkworm rearing and spinning 5. Artificial diet 6. Silk worm Rearing methods

Week 3 Modules: 7. Young age silkworm 8. Importance of chawki rearing centers 9. Bed cleaning and spacing 10. Late age silkworm rearing

Week 4 Modules: 11. Cellular and mass rearing of silkworm 12. Cocoon formation 13. Cocoon spinning Devices 14. Cocoon harvesting process

Week 5 Modules: 15. Separation of different types of cocoons 16. Cocoon harvesting and marketing 17. Economics of chawki rearing centers

Week 6 Modules: 18. Mulberry cultivation for young age silkworm 19. Scope & Importance of Biotechnology 20. Factors influence for Successful late age Rearing 21. Economics of Silkworm rearing

Week 7 Modules: 22. Textile fibres 23. Sorting of cocoons and Defective cocoons 24. Cocoon stifling 25. Cocoon cooking

Week 8 Modules: 26. Water in reeling 27. Silk reeling 28. Raw silk Physical, Chemical & Mechanical properties 29. Raw silk testing & Grading

Week 9 Modules: 30. Silk throwing 31. Silk Degumming 32. Silk Bleaching 33. Silk Dyeing and printing

Week 10 Modules: 34. Silk Screen Printing 35. Silk Finishing 36. Fashion design

Week 11 Modules: 37. Physical & Chemical Properties of silk 38. By product of silk reeling and their utility 39. Economics of silk reeling 40. Byproduct of silk industry

Suggested readings:

1. Ganga, G. and Sulochana Chetty, J. (2010) Introduction to Sericulture. Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
2. Dr. R. K. Rajan & Dr. M. T. Himantharaj. Silkworm rearing technology, Central Silk Board, Bangalore.
3. M. C. Devaiah, K. C. Narayanaswamy and V. G. Maribashetty Advances in mulberry sericulture, CVG Publications, Bangalore.
4. FAO Agricultural Services Bulletin, Rome. (1987) Manual on sericulture.
5. Ullal, S.R. and Narasimhanna, M.N. (1994) Handbook of Practical Sericulture. Central Silk Board, Bangalore.
6. Dandin, S.B., Jayant Jayaswal and Giridhar, K. (2003) Handbook of Sericulture Technologies. Central Silk Board, Bangalore.

Learning Outcomes

At the end of this course, learners will be able to:

- Apply principles of silkworm rearing and cocoon production, evaluate mulberry cultivation and biotechnology and analyze silk processing, properties, and industrial applications

**B.SC. III SEMESTER COURSE
MUTI-DISCIPLINARY MAJOR
COURSE TITLE: SILKWORM REARING AND REELING TECHNOLOGY
COURSE CODE: ZOO-MDM-316
PRACTICAL**

L	T	P	C
1	0	1	2

1. Disinfection of silkworm rearing house and trays (prepare chart).
2. Identification and use of silkworm rearing appliances (presentation).
3. Recording temperature and humidity for rearing (presentation).
4. Rearing of young age (chawki) silkworms with bed cleaning (life cycle chart).
5. Observation of cocoon formation and harvesting (process chart).
6. Sorting of good and defective cocoons (comparative chart).
7. Demonstration of cocoon stifling and cooking (flow chart).
8. Simple reeling of silk thread and testing raw silk (processing chart + presentation).

Semester IV			
Nature of Course	Course Code	Course Title	Credits
Discipline Specific Major	ZOO-DSM-411	Genetics and Evolutionary Biology -Theory	4
	ZOO-DSM-412	Genetics and Evolutionary Biology -Practical	2
Ability Enhancement	ZOO-AEC-413	Human Nutrition	2
Skill Enhancement Course	ZOO-SEC-414	Toxicology	2
Multi-Disciplinary Major	ZOO-MDM-415	Animal Biotechnology- Theory	4
Multi-Disciplinary	ZOO-MDM-416	Animal Biotechnology-Practical	2
			Total Credits 16

**B.SC. IV SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: GENETICS AND EVOLUTIONARY BIOLOGY
COURSE CODE: ZOO-DSM-411
THEORY**

L	T	P	C
4	0	0	4

Objective: To gain knowledge about genetics and the evolutionary biology of animals.

Unit I: Introduction to Genetics

- a. Classical and Modern concept of Gene (Cistron, Muton, Recon), Alleles etc.
- b. Mendel's Principles of Inheritance, Incomplete dominance and co-dominance.
- c. Structure and function of genes, molecular basis of genetic variation.
- d. Multiple alleles, lethal alleles, Epistasis, Pleiotropy, Environmental effects on phenotypic expression.
- e. Sex linked inheritance, extra chromosomal inheritance involving mitochondria and chloroplast.

Unit II: Linkage, Crossing Over, Chromosomal Mapping and Sex Determination

- a. Linkage and crossing over.
- b. Somatic cell genetics – an alternative approach to gene mapping.
- c. Hormonal influence on sex determination-Freemartin and sex reversal.
- d. Role of environmental factors- *Bonellia* and Crocodile.

Unit III: Mutation and Quantitative Genetics

- a. Chromosomal Mutation: Deletion, Duplication, Inversion, Translocation, Transition and Transversion
- b. Aneuploidy and Polyploidy.
- c. Gene mutation: Induced versus Spontaneous mutations, Back versus Suppressor mutations.

- d. Karyotype, banding and nomenclature of chromosome subdivisions.
- e. Genetic disorders: chromosomal aneuploidy (Down, Turner and Klinefelter syndromes). Chromosome translocation (Chronic Myeloid Leukemia) and deletion ("cry du cat" syndrome), gene mutation (sickle cell anemia).

Unit IV: Evolutionary theories and origin of life:

- a. Lamarckism, Darwinism and Neo-Darwinism.
- b. Evidences of Evolution.
- c. Origin of Life.
- d. History of earth and formation of fossils.
- e. Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population).

Unit V: Species Concept and Speciation:

- a. Species concept (Advantages and Limitations).
- b. Modes of speciation (Allopatric, Sympatric).
- c. Macro-evolutionary Principles (Darwin's Finches).
- d. Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Role of extinction in evolution.
- e. Phylogenetic trees, multiple sequence alignment, construction of phylogenetic trees, interpretation of trees.

Suggested Readings: (Latest Edition)

- 1. Gardner, E.J, Simmons, M.J., Snustad, D.P. Principles of Genetics, Wiley India.
- 2. Snustad, D.P, Simmons, M.J. Principles of Genetics, John Wiley and Sons Inc.
- 3. Klug, W.S, Cummings, M.R., Spencer, C.A. Concepts of Genetics, Benjamin Cummings.
- 4. Russell, P. J. Genetics- A Molecular Approach, Benjamin Cummings.
- 5. Ridley, M. Evolution, Blackwell Publishing.
- 6. Hall, B. K. and Hallgrimsson, B. Evolution, Jones and Bartlett Publishers

Learning Outcomes:

After completion the course, students will be able to-

- Apply the principles of Mendelian inheritance.
- Enable the students to understand the evolution of universe and life.

**B.SC. IV SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR (DSM)
COURSE TITLE: GENETICS AND EVOLUTIONARY BIOLOGY
COURSE CODE: ZOO-DSM-412
PRACTICAL**

L	T	P	C
0	0	2	2

1. Study of Mendelian Inheritance and gene interactions (Non-Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test.
2. Study of Linkage, recombination, gene mapping using the data.
3. Pedigree analysis: Chart multi-generation family trees for X-linked and lethal traits; infer genotypes.
4. Polytene chromosome squashes: Prepare and stain salivary gland chromosomes; identify banding patterns and puffs
5. Fossil identification from plaster cast models and pictures: Examine fossil replicas (Trilobite, Archaeopteryx, Tiktaalik), discuss transitional features.
6. Study and verification of Hardy-Weinberg Law.
7. Study of Human Karyotypes (Normal and abnormal).
8. Study of homology and analogy from suitable specimens/ pictures.
9. Geological Timeline Project: Create a poster of Earth's history marking the "Big Five" extinctions and major fossil horizons.
10. Preparation of Models and Charts: Phylogeny of horse with diagrams/cut out of limbs and teeth of horse ancestors.
11. Darwin's Finches with diagrams/cut out of beaks of different species.

**B.SC. IV SEMESTER COURSE
ABILITY ENHANCEMENT COURSE (AEC)
COURSE TITLE: HUMAN NUTRITION
COURSE CODE: ZOO-AEC-413
THEORY**

L	T	P	C
1	1	0	2

Objective: To develop an understanding of a balanced diet and deficiencies caused by malnutrition.

Unit I: Carbohydrate, protein and Lipid as important food sources

- Biomedical importance of Carbohydrates, Proteins and Lipids.
- Brief outline of metabolism: glycogenesis & glycogenolysis (in brief), glycolysis, citric acid cycle-
Clinical significance.
- Proteins - Functions, classification, food sources, composition, essential & non-essential amino acids, protein deficiency-biomedical importance.

Unit II: Fat as a source of energy

- Fats & oils: Function of fats, classification, food sources, composition, saturated and unsaturated fatty acids, biomedical importance, essential fatty acids.
- Brief out line of metabolism: Beta oxidation of fatty acids, Ketosis, Cholesterol and its Clinical significance.
- Vitamins and minerals - sources and functions, deficiency status.
- Water: importance as a nutrient, function, sources, requirement, water balance and effect of deficiency.

Unit III: Nutritional requirements and calories of a balanced diet

- Basal metabolic rate, energy requirements of man, women, infants and children.
- Nutritional value of foods- cereals, fruits, milk, egg, meat, fish. Balanced diet.

- c. Nutrition requirements as per physiological stages of pregnancy, food selection, complication of pregnancy.
- d. Nutrition requirements during lactation and during infant growth and development, breast feeding, infant formula, introduction of supplementary diet.

Unit IV: Malnutrition and health requirements

- a. Nutritional requirement and growth in preschool children growth.
- b. Nutritional requirement of school children, importance of snacks, school lunch.
- c. Nutritional needs and feeding pattern during adolescence and adulthood.
- d. Geriatric nutrition: Factors affecting food intake and nutrition related problems.
- e. Food of nutritional value, Role of fibres in human nutrition; Effect of cooking and heat processing on the nutritive value of food; processed supplementary food; Food sanitation and hygiene.

Unit V: Addictive behaviour

- a. Anorexia nervosa, bulimia & alcoholism.
- b. Nutrient drug interaction.
- c. Feeding the patients - Psychology of feeding the patient, assessment of patient needs.

Suggested Readings:

1. Gopalan C., Ramasastri B.S. & Balasubramanian, S.C. Nutritive value of Indian foods. National Institute of Nutrition, Hyderabad.
2. Gopalan D. & Vijayaraghavan K. Nutrition atlas of India, ICMR, New Delhi.
3. Ghosh S. The feeding care of infants and young children, UNICEF, New Delhi.
4. Mudambi S.R. Fundamentals of food and nutrition. New age international, New Delhi.
5. Swaminathan M. Handbook of food and nutrition. Bappco, Bangalore.

Learning outcomes:

After the completion of this course, the students will be able to:

- Know about essential nutrients and required macro and micro nutrients
- Cultivate proper feeding habits.

**B.SC. IV SEMESTER COURSE
SKILL ENHANCEMENT COURSE (SEC)
COURSE TITLE: TOXICOLOGY
COURSE CODE: ZOO-SEC-414
THEORY**

L	T	P	C
1	1	0	2

Objective: To gain comprehensive understanding of the detrimental impact induced by xenobiotics.

Unit I: Basic Concept of Toxicology

- Introduction of toxicology, history of toxicology, definition of toxicology.
- Definition of poison, definition of toxicity and classification of toxicants.
- Mode of action of toxic agents.

Unit II: Xenobiotics

- Xenobiotics: Definition and Types.
- Mechanism of Xenobiotic metabolism.

Unit III: Pesticides and Heavy Metal Toxicity

- Pesticides and their toxicological effects.
- Classification of Pesticides, Insecticides, Mode of action of Insecticide.
- Heavy Metal Toxicity.

Unit IV: Evaluation of toxicity

- Acute, sub-Acute and chronic assays LD₅₀, LC₅₀.
- Maintenance and general handling of animals for toxicological laboratory.
- Ecotoxicology, clinical toxicology, occupational and nano-toxicology.

Unit V: Targets of toxic damages and Biochemical Mechanism of toxicity

- Damage caused by toxins/drugs on liver, kidney, gall bladder and lungs.
- Liver necrosis: Carbon tetrachloride, Valproic Acid, and Iproniazid.
- Kidney damage: Chloroform, antibiotics- gentamycin.
- Neurotoxicity: Isoniazid, Parquet, Primaquine, Cyclophosphamide.

Suggested Readings: (Latest Edition)

1. Williams P.L., James R. C., Roberts S.M. Principles of Toxicology: Environmental and Industrial Applications, John Wiley & Sons, Inc.
2. Klaassen C. Casarett and Doull's Toxicology The basic science of poisons, McGraw-Hill.
3. Duffs J. and Worth H. Fundamental Toxicology, RSC Publishing.

Learning outcomes:

After completing this course, the students will be able to-

- Examine the application, how xenobiotics disrupt normal cellular processes of genomics, proteomics, and metabolomics.
- Understand mechanisms of systemic and organ toxicity induced by xenobiotics.

**B.SC. IV SEMESTER COURSE
MUTI-DISCIPLINARY MAJOR
COURSE TITLE: ANIMAL BIOTECHNOLOGY
COURSE CODE: ZOO-MDM-415
THEORY**

L	T	P	C
2	2	0	4

Objectives: To understand the basic principles and applications of animal biotechnology.

Unit I: Introduction to Animal Biotechnology

- a. Definition, scope, and historical development of animal biotechnology
- b. Principles and Processes of Biotechnology
- c. Applications of animal biotechnology

Unit II: Animal Cell Culture

- a. Principles of animal cell culture: media composition, aseptic techniques
- b. Applications of animal cell culture: vaccine production and drug discovery
- c. Techniques for cell line maintenance and cryopreservation

Unit III: Transgenic Technologies

- a. Methods of transgenesis: microinjection
- b. Applications of transgenic animals
- c. Regulation of transgenic animal research and potential risks

Unit IV: Animal genomics

- a. Introduction to different breeds of cattle, buffalo, sheep, goats, pigs, camels, horses, canines and poultry
- b. Introduction to animal genomics
- c. Different methods for characterization of animal genomes

Unit V: Tools and Techniques in Biotechnology

- a. Gene Cloning
- b. DNA Fingerprinting
- c. Polymerase Chain Reaction
- d. Bioreactors
- e. Gene Therapy

Suggested Readings: (Latest Edition)

1. Gordon I. Reproductive Techniques in Farm Animals. CABI
2. Portner R. Animal Cell Biotechnology. Humana Press.
3. Spinger T.A. Hybridoma Technology in Biosciences and Medicine. Plenum Press.
4. Animal Biotechnology-M.M. Ranga, Agrobios (India)
5. Biotechnology-Fundamentals & Applications-S.S .Purohit& S.K. Mathur, Agro Botonics

Learning Outcome:

Following their successful completion of this course, the students will be able to-

- Demonstrate an understanding and the theoretical basis of the animal biotechnological applications.
- Learn the technique of animal biotechnology.
- Learn about the various techniques of cell culture and culture maintenance.
- Learn the theoretical basis of gene cloning DNA fingerprinting.

**B.SC. IV SEMESTER COURSE
MULTI-DISCIPLINARY MAJOR
COURSE TITLE: ANIMAL BIOTECHNOLOGY
COURSE CODE: ZOO-MDM-416
PRACTICAL**

L	T	P	C
1	0	1	2

1. Basic techniques in animal cell culture.
2. To study the genetically modified animals.
3. To study the different vaccines and their uses in disease prevention.
4. Demonstration of techniques used in biotechnology: PCR, DNA Fingerprinting, etc.
5. Case studies on applications of animal biotechnology.

Semester V			
Nature of Course	Course Code	Course Title	Credits
Discipline Specific Major	ZOO-DSM-511	Immunology -Theory	4
	ZOO-DSM-512	Immunology-Practical	2
Ability Enhancement Course	ZOO-AEC-513	History of Indian Science	2
Skill Enhancement Course	ZOO-SEC-514	Public Health and Hygiene	2
Multi-Disciplinary Major	ZOO-MDM-515 (MOOC)	Fish and Fisheries	4
Multi-Disciplinary Major	ZOO-MDM-516	Fish and Fisheries- Practical	2
Multi-Disciplinary Major	ZOO-ITEP-517	Vocational: Bee Keeping	10
Total Credits 26			

**B.SC. V SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR (DSM)
COURSE TITLE: IMMUNOLOGY
COURSE CODE: ZOO-DSM-511
THEORY**

L	T	P	C
4	0	0	4

Objective: To get a thorough understanding of immunology and its significance in maintaining state of health.

Unit I: Overview of the Immune system

- Introduction to basic concepts of Immunology.
- Principles of Innate and Adaptive Immune system.
- Cells of the Immune system.
- Haematopoiesis.
- Organs of Immune system (primary and secondary lymphoid organs).

Unit II: Antigen and Antibody

- Characteristics of antigen- antigenicity and Immunogenicity, epitopes, Haptens, Adjuvant.
- Classification, properties and functions of Immunoglobulins.
- Antigenic determinants: Isotype, Allotype and Idiotype.
- Antigen and antibody interactions, affinity, avidity.
- Monoclonal antibodies, Hybridoma technology.

Unit III: Immune Pathways

- Working of the immune system I- Structure and functions of MHC.

- b. Exogenous and endogenous pathways of antigen presentation and processing.
- c. Working of immune system II- Basic properties and functions of cytokines.
- d. Types and functions of complement system.

Unit IV: Acquired immunity, Hypersensitivity and autoimmune disorders

- a. Immune system in health and disease I- Hypersensitivity: types and functions.
- b. Introduction to concepts of autoimmunity and immunodeficiency.
- c. Immunotoxins and their applications.

Unit V: Immune system in disease

- a. Immune system in health and disease II- Infectious agents.
- b. Course of adaptive response to infection.
- c. General introduction to vaccines.

Suggested Readings: (Latest Edition)

1. Goldsby R.A., Kindt T.J. and Kuby J. Immunology, W. H. Freeman Publishers.
2. Roitt I., Brostoff J. and Male D. Immunology, Mosby Publishers.
3. Kimball John W., Introduction to Immunology, Macmillan USA.

Learning Outcomes:

After successfully completing this course, the students will be able to:

- Identify the major cellular and tissue components which comprise the innate and adaptive immune system.
- The role of immune system in health and diseases.

**B.SC. V SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR (DSM)
COURSE TITLE: IMMUNOLOGY
COURSE CODE: ZOO-DSM-512
PRACTICAL**

L	T	P	C
0	0	2	2

1. Study of lymphoid organs (by slides or micrographs): Spleen, Lymph nodes, thymus, bone marrow Bursa fabricus.
2. Preparation of Blood Smear and Identification of Immune Cells
3. ABO and Rh blood group determination.
4. Assess neutrophil oxidative burst by Nitroblue Tetrazolium (NBT) Reduction Test
5. Preparation of Antigen from Egg Albumin or BSA
6. Skin Prick Test Simulation (Using Non-Allergenic Substances)
7. Radial Immuno-diffusion.
8. Demonstration of Ouchterlony's double diffusion assay.
9. Preparation, cell count and percentage viability of Spleenocytes.
10. Demonstration of Enzyme Linked Immune Sorbent Assay (DOT-ELISA).
11. Demonstration of Rocket Immuno-electrophoresis.
12. Immunization schedule design

**B.SC. V SEMESTER COURSE
ABILITY ENHANCEMENT COURSE
COURSE TITLE: HISTORY OF INDIAN SCIENCE
COURSE CODE: ZOO-AEC-513
THEORY**

L	T	P	C
1	1	0	2

Objective: To develop a comprehensive knowledge of the history of Indian science.

Unit I: Science in Ancient and Medieval India

- a. History of development in astronomy, mathematics, engineering and medicine subjects in Ancient India.
- b. Influence of the Islamic world and Europe on developments in the fields of mathematics, chemistry, astronomy and medicine
- c. Innovations in the field of agriculture-new crop introduced, new techniques of irrigation.

Unit II: Indian Science before and after Independence

- a. Introduction of different surveyors, zoologists and doctors as early scientist in Colonial India.
- b. Indian perception and adoption for new scientific knowledge in Modern India.
- c. Establishment of premier research organizations like CSIR, DRDO, ICAR, IISERS and ICMR, IIT's, Establishment of Atomic Energy Commission.
- d. Launching of the space satellites, ISRO's accomplishments.
- e. Zoological survey of India (ZSI).

Unit III: Prominent Indian scientists

- a. Eminent scholars in mathematics and astronomy: Baudhayana, Aryabhatta, Brahmgupta, Bhaskaracharya, Varahamihira, and Nagarjuna.
- b. Medical science of Ancient India (Ayurveda and Yoga): Susruta, Charak.

- c. Scientists of Modern India: Srinivas Ramanujan, C.V. Raman, Jagdish Chandra Bose, Homi Jehangir Bhabha, Vikram Sarabhai etc.

Unit IV: Prominent research in Animal Sciences in Republic of India

- a. History of animal tissue culture with context to India; green, white and pink revolutions in India.
- b. The pioneers associated with First gene cloning, First genome sequencing from India.
- c. Premier Research institutes and current eminent scientists in India.
- d. GM organisms.

Unit V: Women in Indian Science

- a. Under representation of women in Science.
- b. Current status with regard to women in Science in the Indian context.
- c. Women achievers in Indian Science.

Suggested Readings: (Latest Edition)

1. Kuppuram G. History of Science and Technology in India, South Asia Books.
2. Handa O.C. Reflections on the history of Indian Science and Technology, Pentagon Press.
4. Habib I. A people's history of India 20: Technology in Medieval India, Tulika Books.
5. Rahman A. *et al.* Science and Technology in Medieval India – A Bibliography of Source Materials in Sanskrit, Arabic and Persian, New Delhi: Indian National Science Academy.
6. Subbarayappa B.V. & Sarma K.V. Indian Astronomy – A Source Book, Bombay.

Learning outcomes:

On completion of this course, the students will be able to-

- Develop understanding of various branches of science during different eras.
- Analyse the role played by different Indian organizations in science.
- Appraise the contribution of different Indian Scientists.

**B.SC. V SEMESTER COURSE
SKILL ENHANCEMENT COURSE
COURSE TITLE: PUBLIC HEALTH AND HYGIENE
COURSE CODE: ZOO-SEC-514
THEORY**

L	T	P	C
1	1	0	2

Objective: To comprehend the significance of cleanliness and health.

Unit I: Maintenance of Personal hygiene

- a. Introduction to public health and hygiene- determinants and factors.
- b. Pollution and health hazards; water and air borne diseases.
- c. Radiation hazards: Mobile Cell tower and electronic gadgets (recommended levels, effects and precautions).
- d. Personal hygiene, oral hygiene and sexual hygiene.

Unit II: Nutrient deficiency diseases

- a. Classification of food into micro and macro nutrients
- b. Balanced diet, dietary plan for an infant, child, normal adult, pregnant woman and old person.
- c. Importance of dietary fibres
- d. Malnutrition anomalies – Anaemia (Iron and Vitamin B12 deficiency), Kwashiorkor, Marasmus, Rickets, Goitre (cause, symptoms, precaution and cure)

Unit III: Communicable and contagious diseases

- a. Communicable viral diseases: Measles, Chicken pox, Poliomyelitis, Swine flu, Dengue, Corona, Chikungunya, Rabies, Leprosy and Hepatitis.

- b. Communicable bacterial diseases: Tuberculosis, Typhoid, Cholera, Tetanus, Plague, Whooping cough, Diphtheria, Leprosy.
- c. Sexually transmitted diseases- AIDS, syphilis and gonorrhoea.

Unit IV: Non-communicable diseases and cure

- a. Non-communicable diseases such as hypertension, stroke, coronary heart disease, myocardial infarction.
- b. Osteoporosis, osteoarthritis and rheumatoid arthritis-cause, symptoms, precautions.
- c. Diabetes- types and their effect on human health.
- d. Gastrointestinal disorders- acidity, peptic ulcer, constipation, piles (cause, symptoms, precaution and remedy).

Unit V: Other Common diseases

- a. Obesity (Definition and consequences).
- b. Mental illness (depression and anxiety).
- c. Oral and lung cancer and their preventive measures.
- d. Breast cancer, Uterine cancer and their preventive measures.

Suggested Readings: (Latest Edition)

1. Mary Jane Schneider. Introduction to Public Health.
2. Muthu V.K. A Short Book of Public Health.
3. Detels R. Oxford Textbook of Public Health.
4. Gibney, M.J. Public Health Nutrition.
5. Wong K.V. Nutrition, Health and Disease.

Learning outcomes:

After successfully completing the course, the students will be able to

- Identify current national and global public health problems.
- Generate awareness about the issues of food safety, water safety, vaccination, exercise and obesity, exposure to toxins.

**B.SC. V SEMESTER COURSE
MULTI-DISCIPLINARY MAJOR
COURSE TITLE: FISH AND FISHERIES
COURSE CODE: ZOO-MDM-515
THEORY**

L	T	P	C
2	2	0	4

MOOC: https://onlinecourses.swayam2.ac.in/cec25_bt14/preview

Objective: To provide students with a comprehensive understanding of fish and fisheries with a view to understanding the importance and use of aquaculture

Week 1: General Description of Fish, Classification of Fishes (Upto Classes)

Week 2: Classification of Fishes Based on Feeding Habits, Classification of Fishes Based on Habitat and Manner of Reproduction

Week 3: Types of Fish Fins and their Modifications, Locomotion in Fishes

Week 4: Fish Hydrodynamics Types of Fish Scales and Uses of Scales, Gills and Gas Exchange in Fishes

Week 5: Swim Bladder Types and Buoyancy in Fishes, Osmoregulation in Fishes

Week 6: Reproductive Strategies in Fishes, Electric Organs in Fishes, Bioluminescence in Fishes, Mechanoreceptors in Fishes

Week 7: Schooling, Parental Care and Migration in Fishes, Inland Fisheries

Week 8: Marine Fisheries, Environmental Factors influencing the Seasonal Variations in Fishes, Fishing Crafts and Gears

Week 9: Depletion of Fisheries Resources, Application of Remote Sensing and GIS in Fisheries, Fisheries Laws and Regulations

Week 10: Sustainable Aquaculture, Induced Breeding of Fish, Management of Finfish Hatcheries

Week 11: Preparation and Maintenance of Fish Aquarium, Preparation of Compound Diets for Fish and Role of Water Quality in Aquaculture, Fish Diseases

Week 12: Preservation and Processing of Harvested Fish, Fishery By-Products, Transgenic Fish and Zebrafish as a Model Organism in Research

Suggested Readings (Latest edition)

- 1 Bone and R. Moore: Biology of Fishes.
- 2 D. H. Evans and J. D. Claiborne: The Physiology of Fishes.
- 3 von der Emde, R. J. Mogdans and B. G. Kapoor: The Senses of Fish, Adaptations for the Reception of Natural Stimuli.
- 4 C. B. L. Srivastava: Fish Biology.
- 5 J. R. Norman: A History of Fishes.
- 6 S. S. Khana and H. R. Singh: A Textbook of Fish Biology and Fisheries.

Learning outcomes:

After completing this course, the students will be able to-

- Understand fish diversity, biology, aquaculture techniques, and sustainable fishery practices.
- Apply knowledge for resource assessment, conservation, and management of fisheries.

**B.SC. V SEMESTER COURSE
MUTI-DISCIPLINARY MAJOR
COURSE TITLE: FISH AND FISHERIES
COURSE CODE: ZOO-MDM-516
PRACTICAL**

L	T	P	C
1	0	1	2

1. Morphological study of various kinds of food fish in marketed and museum specimens
2. Rearing of food fish with different kinds of fish feed and comparison of growth
3. Estimation of protein content in fish tissue
4. Observation of gut parasites in food fish species

**B.SC. V SEMESTER COURSE
MUTI-DISCIPLINARY MAJOR
COURSE TITLE: VOCATIONAL: BEE KEEPING
COURSE CODE: ZOO-ITEP-517
THEORY**

L	T	P	C
10	0	0	10

MOOC

Objective: To understand the practice of bee-keeping, management of beehives, controlling diseases, and the commercial and entrepreneurial aspects of bee-keeping with a view to taking it up as a vocation

Week 01 –Introduction to Beekeeping

Week 02 –Introduction to Beekeeping (Contd...)

Week 03 –Introduction to Beekeeping (Contd...)

Week 04 –The World of Honeybees

Week 05 –The World of Honeybees (Contd...)

Week 06 –The World of Honeybees (Contd...)

Week 07 –Equipment for Beekeeping

Week 08 –Equipment for Beekeeping (Contd...)

Week 09 –Selection of Apiary Site

Week 10 –Selection of Apiary Site (Contd...)

Week 11 –Apiary Management

Week 12 –Apiary Management (Contd...)

Week 13 – Management of Pests and Diseases of Honeybees

Week 14 –Management of Pests and Diseases of Honeybees (Contd...)

Week 15 –Reproduction in Honeybees

Week 16 –Reproduction in Honeybees (Contd...)

Week 17 –Migration of Colonies (Transhumance)

Week 18 –Migration of Colonies (Transhumance) (Contd...)

Week 19 –Production, Processing, and Marketing of Bee Products

Week 20 –Production, Processing, and Marketing of Bee Products (Contd...)

Week 21 –Entrepreneurial Skills in Beekeeping

Week 22 –Entrepreneurial Skills in Beekeeping (Contd...)

Week 23 – Revision

Week 24 – **Revision**

Week 25 – **Revision**

Week 26 – **Revision**

Suggested Readings: (Latest Edition)

1. Singh, S. (2018). *Beekeeping in India* – ICAR Publication (covers Indian context, management, pests, and products).
2. Crane, E. (1999). *The World History of Beekeeping and Honey Hunting* – Comprehensive global perspective.
3. Kumar, J., & Rathore, D.S. (2017). *Handbook of Beekeeping* – Practical guide for apiary practices.
4. Adjare, S.O. (1990). *Beekeeping in Africa* – FAO Agricultural Services Bulletin, useful for traditional and modern practices.
5. Ruttner, F. (1988). *Biogeography and Taxonomy of Honeybees* – For advanced learners.

Learning outcomes:

After completing this course, the students will be able to-

- Understand honeybee biology, equipment, and scientific methods of beekeeping for sustainable management.
- Apply knowledge of colony care, pest control, product processing, and entrepreneurial skills in apiculture.

Semester VI			
Nature of Course	Course Code	Course Title	Credits
Discipline Specific Major	ZOO-DSM-611	Applied Zoology -Theory	4
	ZOO-DSM-612	Applied Zoology Practical	2
Ability Enhancement Course	ZOO-AEC-61	Good Laboratory Practices	2
Skill Enhancement Course	ZOO-SEC-614	Computer Application	2
Multi-Disciplinary	ZOO-MDM-615	Biostatistics & Computer Application- Theory	4
Multi-Disciplinary Major	ZOO-MDM-616	Biostatistics & Computer Application - Practical	2
Total Credits 16			

**B.SC. VI SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR (DSM)
COURSE TITLE: APPLIED ZOOLOGY
COURSE CODE: ZOO-DSM-611
THEORY**

L	T	P	C
4	0	0	4

Objective: To develop comprehension regarding natural resources and their application for the betterment of human well-being.

Unit I: Fish culture

- Fish Culture, different types of ponds.
- Cultivable fishes.
- Integrated fish farming.
- Processing and Preservation of fish.
- By products of fishing industry and common fish diseases.

Unit II: Culture other than fishes

- Pearl Culture.
- Prawn culture.
- Molluscan Fisheries.

Unit III: Commercially important Insects

- Apiculture: Morphology and Biology of honey bees, Species of honey bees in India, Methods of Bee keeping.
- Lac culture: Lac insect and its life cycle, Cultivation of lac insect, host plants, processing and uses of lac.

- c. Sericulture: Types of silk, silkworms and their host plants, life history of silkworm.

Unit IV: Common Pest of Crops

- a. Biology, control and damage caused by stored grain pests: *Callosobruchus chinensis*, *Sitophilus oryzae* and *Tribolium castaneum*.
- b. Biology, control and damage caused by major agricultural pests: *Helicoverpa armigera*, *Pyrilla perpusilla* and *Papilio demoleus*,
- c. Biology, Control and damage caused by vegetable and crop insects: *Sylepta derogate*, *Scipophaga incertulas*, *Emmalocera depraessella*.
- d. Biology, Control and damage caused by common fruit Insects: *Chaetanaphothrips signipennis*, *Idioscopus clypealis*, *Deudorix Isocrates*.

Unit V: Vermiculture

- a. Vermicomposting Worms.
- b. Rearing of earthworms for the production of compost.
- c. Vermiwash Collection.
- d. Vermimeal.

Suggested Readings: (Latest Edition)

1. Shukla G.S. and Upadhyaya, V.B. Economic Zoology, Rastogi Publishers.
2. Mani M.S. Insects, NBT, India.
3. Jabde P.V. Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac culture. Discovery Publishing Pvt. Ltd.

Learning outcomes:

After successfully completing this course, the students will be able to:

- Understand the culture techniques of commercially important animals.

**B.SC. VI SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: APPLIED ZOOLOGY
COURSE CODE: ZOO-DSM-612
PRACTICAL**

L	T	P	C
0	0	2	2

1. Morphological characterization of edible fish species.
2. Identification of two major carps – *Labeo rohita* and *Catla catla*.
3. Study of permanent slide of cycloid scales.
4. Identification of pearl oyster species and study of pearl formation
5. Identification of prawn species (*Macrobrachium*, *Penaeus*) and larval stage
6. Study of social behaviour in bees.
7. Worker honey bee with emphasis on leg modifications (through specimens/charts) and whole mount preparation of legs.
8. Life cycle of mulberry silkworm, *Bombyx mori* (model/chart/specimens) and life cycle of tasar silkworm *Antheraea mylitta*.
9. Life cycle of lac insect *Laccifer lacca*.
10. Identification of stored grain pests: *Callosobruchus chinensis*, *Sitophilus oryzae*, *Tribolium castaneum*
11. Identification of composting earthworm species (*Eisenia fetida*, *Eudrilus eugeniae*)
12. Demonstration of vermicomposting setup

**B.SC. VI SEMESTER COURSE
ABILITY ENHANCEMENT COURSE
COURSE TITLE: GOOD LABORATORY PRACTICES
COURSE CODE: ZOO-AEC-613
THEORY**

L	T	P	C
1	1	0	2

Objective: To acquire knowledge on the proper handling and regulation of laboratory facilities.

Unit I: General Laboratory Practices

- a. Understanding the details on the label of reagent bottles.
- b. Molarity and normality of common acids and bases.
- c. Dilutions, Percentage solutions, Molar, Molal and Normal solutions.
- d. Technique of handling micropipettes.
- e. Knowledge about common corrosive and toxic chemicals and safety measures.

Unit II: Tissue Micro-Techniques

- a. Weighing and staining procedures.
- b. Classification and chemistry of stains.
- c. Staining equipment.
- d. Reactive dyes and fluoro-chromes (GFP and other tags).

Unit III: Methods to Study Tissue Structure

- a. Whole mounts, squash preparations, clearing, maceration and sectioning.
- b. Tissue preparation: living vs fixed, physical vs chemical fixation, coagulating fixatives, non-coagulant fixatives.
- c. Tissue dehydration using graded solvent series.

- d. Paraffin; Preparation of thin and ultrathin sections.

Unit IV: Overview of Biological Problems

- a. History; Key relevant problems associated with Zoology research areas, their solution and basic understanding of animal models.
- b. Identifying sources of hazards: Poisonous chemicals, broken glass, Explosion, Fire.
- c. Sample collection, recording of data.
- d. Safety/First aid measures: Fume hoods, eye fountain, emergency shower, fire extinguisher, eye protection gear.

Unit V: Laboratory hierarchy and SOP

- a. Levels of Laboratories.
- b. Log Book Maintenance.
- c. Basic SOPs for instrument handling and Maintenance.

Suggested Readings: (Latest Edition)

1. Seiler J.P. Good Laboratory Practices: the why and how. Springer-Verlag Berlin and Heidelberg GmbH & Co. K
2. Garner W.Y., Barge M.S. and Ussary P.J. Good Laboratory Practice Standards: Application for field and Laboratory studies. Wiley.

Learning outcomes:

After completing this course, the students will be able to:

- Apply practical skills in science courses with the understanding of general laboratory practices.
- Use various micro techniques used in Zoology.

**B.SC. VI SEMESTER COURSE
SKILL ENHANCEMENT COURSE
COURSE TITLE: COMPUTER APPLICATION
COURSE CODE: ZOO-SEC-614
THEORY**

L	T	P	C
1	1	0	2

Objective: To acquire proficiency in the utilisation of computer technologies for biological study.

Unit I: about PC, operating system and software

- a. Introduction to PC and Window operating system, application software (MS word, Excel).
- b. Introduction of spreadsheet (MS Excel): application, formula and functions.
- c. Creating basic graphs using spreadsheet applications.
- d. MS Power point application and functions.

Unit II: Computer Networking

- a. Introduction to computer networking, data communication, components of data communication.
- b. LAN, MAN, WAN, wireless LAN.

Unit III: Internet Resources and Multimedia

- a. The Internet and Multimedia: Internet History, Multimedia on the Web.
- b. Text and pictures for the web page.
- c. Video Conferencing, e-Commerce, m-Commerce, VOIP, blogs.

Unit IV: Bibliography management

- a. Advanced Google search operators.
- b. Introduction to Google Scholar and accessing scholarly literature from Internet.

- c. Introducing bibliography management software, Styles and Templates.

Unit V: Artificial Intelligence (AI) Tools for biologists

- a. Role of AI in Biological research.
- b. AI tools for Zoologists.

Suggested Readings: (Latest Edition)

1. User manual and online user manual of respective software for the most updated content.

Learning outcomes

After the completion of this course the learner will be able to:

- Apply the basic operations of spreadsheet applications.
- Recognize advanced resources for accessing scholarly literature from internet.

**B.SC. VI SEMESTER COURSE
MUTI-DISCIPLINARY MAJOR
COURSE TITLE: BIOSTATISTICS & COMPUTER APPLICATION
COURSE CODE: ZOO-MDM-615
THEORY**

L	T	P	C
2	2	0	4

Objective: To equip students with foundational knowledge and practical skills in biostatistics and computer applications, enabling them to apply statistical methods to biological and health-related data, effectively analyze and interpret results using software tools, and contribute to research and decision-making in public health, medicine, and life sciences.

Unit I: Introduction to Biostatistics

- a. Father of Biostatistics – Sir Francis Galton and his contribution
- b. Data Collection, classification & diagrammatic representation
- c. Frequency distribution, measures of central tendency: mean, median and mode

Unit II: Inferential Statistics

- a. Measures of dispersion: range, mean deviation, variance, standard deviation and error
- b. Skewness, kurtosis, regression & correlation
- c. Chi-square test, student's t-test, Parametric and non-parametric test
- d. ANOVA and other statistical computer packages.

Unit III: Computer packages and tools

- a. Creating and formatting documents with Microsoft word.
- b. MS-Excel applicability and significance
- c. Use of open resource bioinformatics software

Unit IV: Applications of Computer aided techniques in Biology

- a. Definition, history, scope and applications of computers aided techniques in Biology
- b. Biological Databases: primary & secondary databases
- c. Literature Databases: Open access and open sources
- d. PubMed, PLoS, Biomed Central

Unit V: Computer applicability and use in genetics and evolutionary biology

- a. Sequence alignment techniques in deriving phylogenetic relatedness
- b. Database similarity searches: BLASTA & FASTA

- c. Protein and RNA structure prediction
- d. Analyzing and retrieving databases

Suggested Readings: (Latest Edition)

1. Daniel, W.W. Biostatistics: A Foundation for Analysis in Health Sciences, John Wiley.
2. Milton, J.S. & Tsokos, J.O. Statistical Methods in the Biological and Health Sciences, McGraw Hill.
3. Zar, J.H. Biostatistical Analysis, Pearson.
4. Barnes, M.R. and Gray, I.C. Bioinformatics for geneticists, Wiley.
5. Mount, D.W. Bioinformatics, CBS.

Learning outcomes:

Capable of identifying/mobilizing appropriate resources required for their education and research development, and manage course to completion. They will be able to develop:

- Good observation skills
- A logical approach to problem-solving
- Good oral and written communication abilities

**B.SC. VI SEMESTER COURSE
MULTI-DISCIPLINARY MAJOR
COURSE TITLE: BIOSTATISTICS & COMPUTER APPLICATION
COURSE CODE: ZOO-MDM-616
PRACTICAL**

L	T	P	C
1	0	1	2

1. Calculation of mean, standard deviation and standard error.
2. Calculation of correlation coefficient values and finding out the probability
3. Calculation of 'F' value and finding out the probability value for the F value.
4. Student's t-test: Independent and dependent. Hand calculation and calculation using MS Excel.
5. ANOVA and Tukey's HSD: Hand calculation and calculation using MS Excel.
6. Handling and interpretation of Nucleic acid and protein databases.
7. Sequence retrieval from databases.
8. Pair-wise alignment of sequences (BLAST) and interpretation of the output
9. Sequence homology and Gene annotation. Translation of a nucleotide sequence and selection of the correct reading frame of the polypeptide from the output sequences
10. Construction of phylogenetic tree.
11. Comparative analysis of different databases in metabolomics.

Level: Semester VII			
Nature of Course	Course Code	Course Title	Credits
Discipline Specific Major	ZOO-DSM-711	Molecular Taxonomy-Theory	4
Discipline Specific Major	ZOO-DSM-712	Molecular Taxonomy- Practical	2
Discipline Specific Major	ZOO-DSM-713	Fundamental of Neuroscience-Theory	4
Discipline Specific Major	ZOO-DSM-714	Fundamental of Neuroscience- Practical	2
Multi-Disciplinary Major	ZOO-MDM-715	Research Methodology - Theory	4
Multi-Disciplinary Major	ZOO-MDM-716	Research Methodology - Practical	2
Skill Enhancement Course	ZOO-SEC-717	Internship/experiential learning/ Field work/minor project- Practical	2

**B.SC. VII SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: MOLECULAR TAXONOMY
COURSE CODE: ZOO-DSM-711**

THEORY

L	T	P	C
4	2	0	4

Objective : To explore the principles, methods, and applications of classifying and naming organisms and integration of traditional morphological approaches with molecular and computational techniques.

Unit I: Foundations of Taxonomy

- a. Introduction to taxonomy and systematics.
- b. History of taxonomic thought (Linnaeus to modern phylogenetics).
- c. The concept of species and species delimitation.
- d. Biological Nomenclature

Unit II: Methods in Taxonomy

- a. Morphological character analysis.
- b. Collection and preservation techniques.
- c. Identification keys and taxonomic literature.
- d. Museum collections

Unit III: Molecular Taxonomy and Bioinformatics

- a. DNA sequencing and molecular markers (e.g., mtDNA, rDNA, microsatellites).
- b. Phylogenomics and next-generation sequencing.
- c. Bioinformatics tools for sequence alignment, phylogenetic analysis, and database searching.
- d. Using online databases for taxonomic information.

Unit IV: Applications of Taxonomy

- a. Biodiversity assessment and monitoring.
- b. Conservation biology and species management.
- c. Biogeography and evolutionary studies.
- d. Forensic science, medical and Agricultural applications.

Unit V: Current Topics and Challenges

- a. Taxonomic impediment and data deficiency.
- b. Integrative taxonomy and the use of multiple data sources.

- c. Species concepts and cryptic species.
- d. Cyberinfrastructure for taxonomy.
- e. Ethical and legal considerations in taxonomy.

Suggested Readings: (Latest Edition)

Mayr, E. *Principles of Systematic Zoology*. Cambridge, MA: Harvard University Press.

Mayr, E., & Ashlock, P. D. *Principles of Systematic Zoology*. New York

Williams, D. M., & Smith, M. D. *The Tree of Life: A Phylogenetic Classification*. Boca Raton: CRC Press.

Wiley, E. O., & Lieberman, B. S. *Phylogenetics: Theory and Practice of Phylogenetic Systematics*. Hoboken, NJ: Wiley-Blackwell.

Narendran, T. C. *An Introduction to Taxonomy*. Kolkata: Zoological Survey of India.

Learning Outcomes:

After successfully completing this course, the students will be able to:

- To utilize online databases and bioinformatics tools to access, analyze, and apply taxonomic information for biodiversity assessment and species identification.
- To construct and interpret phylogenetic trees using both morphological and molecular data, demonstrating an understanding of modern phylogenetic principles.

**B.SC. VII SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: MOLECULAR TAXONOMY
COURSE CODE: ZOO-DSM-712**

PRACTICAL

L	T	P	C
0	2	2	2

1. Collection, preservation, and Museum Specimen Curation.
2. Morphological Character Analysis & Identification
3. Identification of 15 specimens of fishes, insects, or other animals up to the family or genus level.
4. Construction of Dichotomous Keys
5. Phylogenetic Tree Construction (Morphological Data and Molecular Data)
6. Molecular Data Retrieval & Sequence Alignment (NCBI or other databases, perform sequence alignments using software like ClustalW or MUSCLE, and assess the quality of the alignment.)

**B.SC. VII SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: FUNDAMENTAL OF NEUROSCIENCE
COURSE CODE: ZOO-DSM-713**

THEORY

L	T	P	C
2	2	0	4

Objective: To gain understanding of the basic structure and function of the nervous system, identify key components of the central and peripheral systems and explain the roles of various cells of the nervous system.

Unit I: Introduction to the nervous system

- a. Basic structure and function of the central and peripheral nervous systems.
- b. Subcortical structures: thalamus, hypothalamus, basal ganglia, limbic system.
- c. Electrical properties of excitable membranes and the role of ionic movement.
- d. Membrane potential and role of sodium and potassium pumps

Unit II: Neurotransmission

- a. Structure of Synapse and Synaptic transmission at nerve-muscle synapses
- b. Principles of synaptic transmission: Electrical and chemical synapses
- c. Control of transmitter release
- d. Synthesis and trafficking of neuronal proteins

Unit III: Sensory and motor control and memory

- a. Somatosensory systems (vision and hearing)
- b. Motor functions: Spinal Cord and Brainstem
- c. Memory: Working Memory, Short & Long-Term Memory
- d. Neuroplasticity and learning across sensory-motor and memory systems

Unit IV: Neuropathology and behaviour

- a. Brain and behavior: sleep, motivation.
- b. Neurodegenerative Diseases: Senile Dementia, Parkinson's disease, Alzheimer's disease and Epilepsy.
- c. Neuropsychiatric Disorders: Mood Disorders (Depression, Bipolar Disorder), Schizophrenia
- d. Neuroimaging Techniques: CAT, PET and MRI

Unit V: Neural and Molecular Mechanism of Circadian Clocks

- a. Ubiquity of circadian rhythms across different organisms.
- b. Molecular Mechanisms of Circadian Clocks
- c. Physiological and Behavioral Outputs of the Circadian Clock
- d. Circadian Disruption and Health

Suggested Readings: (Latest Edition)

1. Balinsky, B.I. *An introduction to Embryology*. 5th ed. Cengage learning, Stamford, USA.
2. Bear, M.F., Connors, B.W. and Paradiso, M.A. *Neuroscience: Exploring the Brain*. Williams & Wilkins, Baltimore, USA.
3. Browder, L.W. *Developmental Biology*. Saunders, Philadelphia, USA.
4. Gilbert, S.F. *Developmental Biology*. 10th ed. Sinauer Associates, MA, USA.
5. Kandel, E.R., Schwartz, Z.H. and Jessel, T.M. *Principles of Neural Science*. 4th ed. Elsevier, New York, USA.
6. Wolpert, L. *Developmental Biology*. Oxford University Press, Oxford, UK.

Learning Outcomes:

After successfully completing this course, the students will be able to:

- Understand fundamental neuroanatomy and neurophysiology.
- Comprehending the relationship between brain function and behavior.

**B.SC. VII SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: FUNDAMENTAL OF NEUROSCIENCE
COURSE CODE: COURSE CODE: ZOO-DSM-714**

PRACTICAL

L	T	P	C
1	0	1	2

1. Dissection and display of the nervous system in vertebrates (Poultry Fowl brain).
2. Temporary stained preparation of Neuron using Poultry fowl brain.
3. Permanent stained preparation coronal sections of Poultry fowl brain and identification of major regions (Cerebrum and Cerebellum).
4. Permanent stained preparation sagittal sections of Poultry fowl brain and identification of major regions (Cerebrum and Cerebellum).
5. Understanding of Electroencephalography (EEG) Recordings
6. Understanding the Structure and Principle of MRI, CT.
7. Understanding the Structure and Principle of PET.
8. Neurotoxicological studies of any chemical/metal/environmental factor using any suitable model system.
9. Studies on learning and memory in suitable model.
10. Observation of circadian rhythms and measurement and analysis of circadian rhythm parameters.
11. Photomicrograph of histoarchitecture of brain of neurodegenerative diseases.

**B.SC. VII SEMESTER COURSE
MULTI-DISCIPLINARY MAJOR
COURSE TITLE: RESEARCH METHODOLOGY
COURSE CODE: ZOO-MDM-715**

THEORY

L	T	P	C
4	2	0	4

Unit 1: Introduction to Research

- a. Types of research (basic, applied, exploratory, descriptive, explanatory)
- b. Identifying and defining research problems
- c. Formulating research questions and hypotheses
- d. Research design: types and selection (experimental, quasi-experimental, survey, case study, ethnographic, grounded theory)

Unit II: Research Methods

- a. Sampling techniques (probability and non-probability)
- b. Data collection methods: surveys, questionnaires, experiments
- c. Inferential statistics: hypothesis testing, t-tests, ANOVA, correlation, regression
- d. Validity and reliability in qualitative research

Unit III: Research Writing and Presentation

- a. Structure and components of a research report/thesis
- b. Referencing and citation styles (APA, MLA, Chicago)
- c. Preparing and delivering oral presentations
- d. Creating effective tables and figures.

Unit IV: Research Ethics

- a. Research Involving Human and Animal Subjects
- b. Authorship and Publication Ethics
- c. Intellectual property and copyright, Patents
- d. Plagiarism & Academic integrity and Predatory journals

Unit V: Current Trend in Zoological Research

- a. Interdisciplinary Approaches
- b. Technological Advancements
- c. Conservation Focus
- d. Data Analysis

Suggested Readings (Latest):

1. Kothari, C. R. Research Methodology: Methods and Techniques, New Age International Publishers, New Delhi.
2. Day, R. A. How to Write & Publish a Scientific Paper, 5th edition, Oryx Press. Bell, F. D. Brown, W. C. Basic Biostatistics: Concepts for the Health Sciences. McGrawHill.
3. Wilson, K. and Walker, J. M. Principles and Techniques of Biochemistry and Molecular Biology, 8th Edition, Cambridge University Press.

Learning Outcome:

After complete the course, the students will able to:

- explore different type of research and to formulate the hypothesis of the Research.
- use the different computer programs to execute the research data.

**B.SC. VII SEMESTER COURSE
MULTI-DISCIPLINARY MAJOR
COURSE TITLE: RESEARCH METHODOLOGY
COURSE CODE: ZOO-MDM-716**

PRACTICAL

L	T	P	C
0	2	0	2

1. Research Question Development: Students will identify a topic of interest and refine it into specific research questions.
2. Literature Review Mapping: Students will create visual maps to identify key themes, gaps, and connections in the literature.
3. Research Ethics Role-Play: Students will role-play different stakeholders (e.g., researchers, ethics committees) in ethical case studies.
4. Hypothesis Formation: Formulate hypotheses for a given dataset or problem statement
5. Statistical Software Training: Hands-on workshops for tools like SPSS, R, or Excel.
6. Research Poster Competition: Create and showcase a research poster summarizing key findings.

Level: Semester VIII			
Nature of Course	Course Code	Course Title	Credits
Discipline Specific Major	ZOO-DSM-811	Aquatic Ecosystem Management-Theory	4
Discipline Specific Major	ZOO-DSM-812	Aquatic Ecosystem Management--Practical	2
Discipline Specific Major	ZOO-DSM-813	Clinical Biology-Theory	4
Discipline Specific Major	ZOO-DSM-814	Clinical Biology-Practical	2
Discipline Specific Dissertation	ZOO-DSM-815	Discipline Specific Dissertation	12
Total			24

**B.SC. VIII SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: AQUATIC ECOSYSTEM MANAGEMENT
COURSE CODE: ZOO-DSM-811**

THEORY

L	T	P	C
2	2	0	4

Objective: To understand the fundamentals of aquatic ecosystems, bioindicators, ecosystem health assessment, and governmental conservation efforts.

Unit I: Introduction to Aquatic Ecosystem

- a. Types of aquatic ecosystems
- b. Ecological classification of aquatic ecosystem
- c. Ecosystem structure and function
- d. Importance of aquatic ecosystems; Ecosystem services

Unit II: Ecosystem Health assessment

- a. Biological quality elements/ Bioindicators
- b. Biological Indices based on multiple organism groups (Microbial community, Plankton, Periphyton, macrophytes, macroinvertebrates, fish)
- c. Exotic and indigenous indices
- d. Traditional and modern ecological assessment methods

Unit III: Physical and Chemical Environment

- a. Physical and chemical characteristics of freshwater and marine ecosystem
- b. Organic load and pollution
- c. Dissolved Organic Matter (DOM)
- d. Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)

Unit V: Threats to the aquatic ecosystems

- a. Major threats at local scale and large scale
- b. Mega developmental activities
- c. Environmental flows: Importance for the aquatic flora & fauna.
- d. Impact of climate change

Unit IV: Management and Conservation

- a. Ganga Action Plan 1985, National Mission for Clean Ganga (NMCG)
- b. National river conservation directorate (NRCD)
- c. National Plan for Conservation of Aquatic Eco-systems (NPCA) GoI
- d. Water census; Water Act 1974

Suggested Readings: (Latest Edition)

1. Edmondson, W.T. *Fresh Water Biology*. John Wiley and Sons Inc., New York.
2. Trivedy, R. K., & Goel, P. K. *Chemical and biological methods for water pollution studies*. Environmental publications.
3. Barnes, R.S.K. and Mann K. H. *Fundamental of Aquatic Ecology*. Blackwell Science Ltd.
4. Nautiyal, P. & Singh H. R. *Biodiversity & Ecology of Aquatic Environments*. Narendra Publishing House, New Delhi, India
5. Vishwas S. *Advances in aquatic Ecology*. Daya Publishing house, India

Learning outcomes:

Students will be able to understand components of aquatic ecosystems and their importance.
identify the threats to these ecosystems

- assess the level of degradation and hence determine the health of aquatic ecosystem
- gain practical knowledge of field sample collection and understanding the ecological data.

**B.SC. VIII SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: AQUATIC ECOSYSTEM MANAGEMENT
COURSE CODE: ZOO-DSM-812**

PRACTICAL

1. Different Sampling -techniques for the floral and faunal components aquatic ecosystems
2. Identification of Phytoplankton
3. Identification of Zooplankton
4. Identification of Periphyton
5. Identification of Benthic macroinvertebrates and fish
6. Determination of DO, Free CO₂, pH, Total Alkalinity, Hardness, Nitrate and Phosphate
7. BOD and COD analysis
8. Estimation of Dissolved Organic Matter
9. Study and application of biotic indices
10. Water quality indices
11. Ecological analysis of data

**B.SC. VIII SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: CLINICAL BIOLOGY
COURSE CODE: ZOO-DSM-813**

THEORY

L	T	P	C
4	2	0	4

Objective: To understand the fundamental principles of clinical biology and its application in healthcare.

Unit I: Introduction to Clinical Biology and Human Diseases

- a) Overview of human physiology and pathology
- b) Infectious diseases: Pathogens, immunity, and host-pathogen interactions
- c) Non-infectious diseases: Diabetes, cardiovascular disorders, cancer, and genetic disorders
- d) Role of clinical biology in healthcare and diagnostics

Unit II: Clinical Biochemistry

- a) Laboratory techniques: Microscopy, spectrophotometry, and electrophoresis
- b) Molecular diagnostics: PCR, ELISA, and DNA sequencing
- c) Blood chemistry: Analysis of glucose, cholesterol, and urea
- d) Biomarkers and their role in disease diagnosis

Unit III: Hematology and Immunology

- a) Blood cell analysis and blood typing
- b) Coagulation tests and blood disorders
- c) Immunodeficiency disorders (e.g., HIV/AIDS)
- d) Immunological tests: Antigen-antibody reactions, immunoassay

Unit IV: Infectious Disease Diagnostics and Clinical Genetics

- a) Culture methods and identification of pathogens
- b) Techniques for detecting viral, bacterial, and fungal infections
- c) Genetic basis of diseases: Mutations and chromosomal abnormalities
- d) Techniques for genetic testing: Karyotyping, FISH, and NGS

Unit V: Laboratory Management and Safety

- a) Laboratory accreditation and quality control.

- b) Biosafety levels and protocols.
- c) Ethical considerations in clinical biology.
- d) Patient Data Confidentiality and Management

Suggested Readings: (Latest Edition)

1. Tripathi, K. D. Essentials of Medical Pharmacology. Jaypee Brothers Medical Publishers (P) Ltd.
2. Katzung, B. G. Basic and Clinical Pharmacology, McGraw-Hill Education / Lange
Crook, M. A. Clinical Biochemistry and Metabolic Medicine Boca Raton, FL: CRC Press.
3. Strachan, T., & Read, A. P. Human Molecular *Genetics* New York, NY: Garland Science

Learning Outcomes:

After successfully completing this course, the students will be able to:

- Explain the biological basis of diseases and their clinical implications.
- Perform basic laboratory techniques used in clinical diagnostics.

**B.SC. VIII SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: CLINICAL BIOLOGY
COURSE CODE: ZOO-DSM-814**

PRACTICAL

L	T	P	C
0	2	2	2

1. Estimation of hemoglobin levels, red blood cell counts, white blood cell counts, and platelet counts.
2. Estimation of an individual's ABO and Rh blood group.
3. Demonstration of BP by Sphygmomanometer.
4. Demonstration of Sterilization techniques.
5. Estimation of Protein.
6. Estimation of glucose.
7. Estimation serum creatinine.
8. Estimation of serum albumin and bilirubin.
9. Estimation of serum triglycerides and cholesterol
10. Estimation of serum urea.
11. Estimation of total protein, AG Ratio, Globulin Fraction.
12. Demonstration of spectrophotometer.

**B.SC. VIII SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: DISCIPLINE SPECIFIC DISSERTATION
COURSE CODE: ZOO-DSM-815**

PRACTICAL

L	T	P	C
0	0	12	12

Objective :

1. To guide students in conducting independent research and producing a scholarly thesis.
2. The experiment may be conducted with in the university or in an external setting beyond the university.

Class	Subject	Semester	Course Code	Course Title	Marks	Credit
B.Sc.	Zoology	VIII	ZOO- DSM- 815	Dissertation	Mid Sem – 40 End Sem - 60	12

Evaluation

- | | |
|---|------------|
| a) First periodic assessment of the progress | :20 Marks |
| b) Second periodic assessment of the progress | : 20 Marks |
| c) End semester examination will consist of | |
| i) Evaluation of Thesis/presentation | :50 Marks |
| ii) Viva-Voce of the project | :10 Marks |

Learning Outcomes:

By the end of this program, students will be able to:

- Critically analyze and interpret scientific literature.
- Conduct in-depth research through lab or field studies.
- Produce a well-researched and structured thesis that showcases their expertise