# Sir P. T. Sarvajanik College of Science

## Autonomous

## Affiliated to Veer Narmad South Gujarat University, Surat

Re-Accredited 'A+' with CGPA 3.35

# SYLLABUS

# FOR

# SEM I

# Program: M.Sc.

# Course: ZOOLOGY

# For

# Academic year

# 2024-25

# (NEP-2020)

# Effective from June 2024

# Content

| Sr. No | Semester | Course | Course number | Course Code | Course title |
|---|---|---|---|---|---|
| 1 | I | Core Course - I | CC I | ZOOMSC-S1P1-4CR24 | Biology of Non- Chordates |
| 2 | | Core Course - II | CC II | ZOOMSC-S1P2-4CR24 | Biology of Chordates |
| 3 | | Core Course - III | CC III | ZOOMSC-S1P3-4CR24 | Ecology and Ethology |
| 4 | | Elective Course-I | EC-I | ZOOMSC-S1E1-4CR24 | Apiculture |
| | | | EC-II | ZOOMSC-S1E2-4CR24 | Animal Science in Pharmaceuticals |
| 5 | | Skill Based Elective Cousre-I | SEC-I | ZOOMSC-S1SEC1-2CR24 | Aquaculture |
| 6 | | PRACTICAL | CCP-I | ZOOMSC-S1PR1-6CR24 | Experimental Zoology |
| 1 | **II** | Core Course - IV | CC IV | ZOOMSC-S2P4-4CR24 | Animal physiology |
| 2 | | Core Course - V | CC V | ZOOMSC-S2P5-4CR24 | Wildlife Biology and Conservation |
| 3 | | Core Course - VI | CC VI | ZOOMSC-S2P6-4CR24 | Developmental Biology |
| 4 | | Elective Course-II | EC-III | ZOOMSC-S2E3-4CR24 | Sericulture |
| | | | EC-IV | ZOOMSC-S2E4-4CR24 | Food and Nutrition |
| 5 | | Skill Based Elective Cousre-II | SEC-II | ZOOMSC-S2SEC2-2CR24 | Economic Entomology |
| 6 | | PRACTICAL | CCP-II | ZOOMSC-S2PR2-6CR24 | Experimental Zoology-II |

## Programme Outcomes

| PO Number | PO Statement |
|---|---|
| PO1 | To impart basic knowledge of various branches of Zoology and to understand the unity of life with the rich diversity of organisms and their ecological and evolutionary significance. |
| PO2 | To appreciate the complexities of biological organisation and address scientifically controversial issues in a rational way. To acquire basic skills in the observation and study of nature, biological techniques, experimental skills and scientific investigation |
| PO3 | To assess the scope of animal biology and select particular areas for further study. To address the socio-economical challenges related to animal sciences and to facilitate students for taking up and shaping a successful career in Zoology and its related subjects |
| PO4 | To inculcate transformational impact on the quality of education and to inspire the students to adopt scientific temper and live with scientific values. |
| PO5 | To make the students aware of applications of Zoology and to highlight the potential of various branches to become an entrepreneur. |

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**M. Sc. (Zoology) SEMESTER I**

**Core Course-I (CC-1)**

**ZOOLOGY PAPER ZOOMSC-S1P1-4CR24 THEORY**

## Course Title : Biology of Non- Chordates [Invertebrates] (Credits -4)

| Course Learning Outcome |
|---|
| At the end of this course, Students will be able to:<br>• Enlist the salient features of non-chordates<br>• Classify and describe non-chordates up to class level.<br>• Divide invertebrate<br>• Study origin of Metazoa<br>• Understand Filter feeding in different animals<br>• Study Minor Phyla<br>• Study Reproduction –Larval lives |

| Module 1 | The General Principles of Systematics and Animal Classification upto class | [15L] |
|---|---|---|
| **Learning Objectives:**<br>This module is intended to<br>Introduce learner to detailed classification of non chordates. | | |
| **Learning Outcome:**<br>After the successful completion of the module, the learner will be able to<br>• Understand the basic concepts of lower animals and observe the structure and functions.<br>• Differentiate and classify the various groups of animal modes of life and to estimate the biodiversity. | | |
| 1.1 | Origin and Development of Systematics; Taxonomy; Systems of Classification; | 5L |
| 1.2 | Significance of Classification; Brief history of Classification; | 5L |
| 1.3 | Nomenclature of Organisms; Systematic Herarchy; Modern Molecular Methods in Taxonomy | 5L |
| **Module 2** | **The Invertebrates** | **[15L]** |

| |
|---|
| **Learning Objectives:**<br>This module is intended to<br>• To discuss about Minor phyla general characters.<br>• Discuss salient features of various phyla with examples |
| **Learning Outcome:** |

| | | |
|---|---|---|
| After the successful completion of the module, the learner will be able to<br>• Understand the evolutionary significance of different functional adaptations in different groups of invertebrates.<br>• Understand salient features of various phyla with examples | | |
| 2.1 | Define invertebrates, importance of invertebrates,Invertebrate phyla,Invertebrata versus Non- Chordata,<br>Diversity of invertebrates, Phylogeny of invertebrates, Outline classification of invertebrates. | 5L |
| 2.2 | Origin of Metazoa: Define metazoa, Metazoan versus Metaphyla, Lower and Higher Metaphyla , metazoan Organization, Symmetry and its Significance,Cephalization and polarity, Body Cavity or Coelom, Level or Grades of organization. | 5L |
| 2.3 | Organization of Metazoa: Introduction, Premetazoan Ancestors, Theories of origin of metazoan.<br>Organization of Bilateria : - Bilateral Phyla, -Theories of origin of Bilateria. | 5L |
| **Module 3** | **Aspects of Metabolism** | **[15L]** |
| **Learning Objectives:**<br>This module is intended to<br>□ Show Filter feeding among the small- to medium-sized invertebrates. | | |
| **Learning Outcome:**<br>After the successful completion of the module, the learner will be able to<br>□ Learn different method of obtaining food in which food particles or microscopic creatures are randomly filtered from the water. | | |
| 3.1 | **Filter Feeding:** Filter Feeding in polychates, Filter Feeding and Digestion in molluscs, Filter Feeding and Digestion in Deuterostomia, Filter Feeding in Crustacea. | 8L |

| | | |
|---|---|---|
| 3.2 | **Information and Control:**<br>Sources of Information: Coded signals, properties of Recepters, Mechanoreception, Chemoreception, photoreception. | 7L |
| **Module 4** | **Reproduction: Larval Lives** | **[15L]** |

**Learning Objectives:**

This module is intended to

- Different forms of larval forms of free-living invertebrates.
- Discuss the evolutionary significance of larval forms of invertebrates

**Learning Outcome:**

After the successful completion of the module, the learner will be able to
 Understand larval forms, affinities and their behavior.

| | | |
|---|---|---|
| 4.1 | **Reproduction: Larval Lives**- Competition and Cooperation, Marine larvare and habitat selection, Larval life in fresh water. | 5L |
| 4.2 | **Minor Phyla:** Pseudocoelomate-Rotifera : Historical, Derivation of name, Definition, Ecology, general morphology, Reproduction, Importance, Distinctive characters, Classification, Affinites. | 5L |
| 4.3 | **Coelomate-Brachiopoda** : Historical, Derivation of name, Definition : General account, Distinctive characters, Classification, Affinites. Invertebrata versus Non- Chordata, Diversity of invertebrates, Phylogeny of invertebrates, Outline classification of invertebrates. | 5L |

**References:**

1. Hyman, L.H. The invertebrates, Nol. Protozoa through Ctenophora, McGraw Hill Co., New York
2. Barrington, E.J.W. Invertebrate structure and function. Thomas Nelson & Sons Ltd., London.
3. Hyman, L.H. The Invertebrates. Vol. 2. McGraw Hill Co., New York.
4. Hyman, L.H. The Invertebrates. Vol. 8. McGraw Hill Co., New York and London.
5. Barnes, R.D. Invertebrates Zoology, III edition. W.B. Saunders Co. Philadelphia.
6. Russel-Hunter, W.D. A biology of higher invertbrates, the Macmillan Co. Ltd., London.
7. Read, C.P. Animal Parasitism. Parasitism prentice Hall Inc., New Jersey.
8. Sedgwick, A.A. Student text book of Zoology. Vol. I,II& III. Central Book Depot, Allahabad.
9. Parker, T.J., Haswell W.A. Text book of Zoology, Macmillan Co., London.

Mapping of CO- PO

| Course Learning Outcomes | Programme Outcomes | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Enlist the salient features of non-chordates | X | | | | | |
| Classify and describe non-chordates upto Class level. | | X | | | | |
| Divide invertebrate | X | | | | | |
| Study origin of Metazoa | X | | | | | |
| Understand Filter feeding in different animals | | X | | | | |
| Study Minor Phyla | X | | | | | |
| Study Reproduction –Larval lives | X | | | | | |

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**M. Sc. (ZOOLOGY) SEMESTER I**

**Core Course-II (**CC II)

**ZOOLOGY PAPER ZOOMSC-S1P2-4CR24 THEORY**

## Course Title : Biology of Chordates [Vertebrates] (Credits -4)

| **Course Learning Outcome** | | |
|---|---|---|
| At the end of this course, Students will be able to:<br>• Describe Phylogeny, salient features, classification up to order of Hemichordate-Mammals.<br>• Explain Methods of Vertebrate Taxonomy.<br>• Describe respiration and structure of Air bladder.<br>• Explain Neoteny and Metamorphosis<br>• Know structure of carapace and plastron<br>• Compare and explain anatomy of Brain, Aortic Arch and Heart of vertebrates.<br>• Describe human osteology | | |
| **Module 1** | Taxonomy | **[15L]** |
| **Learning Objectives:**<br>This module is intended to<br>• Evolutionary significance of different functional adaptations in different groups of Vertebrates.<br>• Classification of chordates.<br>• Salient features of different class. | | |
| **Learning Outcome:**<br>After the successful completion of the module, the learner will be able to<br>• Understand the basic concepts of lower vertebrates and observe the structure.<br>• Differentiate and classify the various groups of animal modes of life and to estimate the biodiversity. | | |
| 1.1 | Zoological nomenclature – ICZN | 5L |
| 1.2 | **Classification up to orders of** Protochordates, Cyclostomata, Pisces, Amphibia, Reptilia, Aves, Mammals | 5L |
| 1.3 | Nomenclature of Organisms; Systematic Herarchy; Modern | 5L |

| | | |
|---|---|---|
| | Molecular Methods in taxonomy | |
| **Module 2** | **The Vertebrates** | **[15L]** |
| **Learning Objectives:**<br>This module is intended to<br>• Salient features of different class. | | |
| **Learning Outcome:**<br>After the successful completion of the module, the learner will be able to<br>• Analyze, compare and distinguish the developmental stages and describe the important biological process.<br>• Correlate the different modes of life among different vertebrates. | | |
| 2.1 | **Cyclostomata** – Phylogenetic Status, Parasitic adaptation<br>**Pisces** – Respiration and Air Bladder | 5L |
| 2.2 | **Amphibia** - Neoteny, Metamorphosis<br>**Reptilia** – Carapace and Plastron, Jacobson's Organ | 5L |
| 2.3 | **Aves** – Affinities of Birds, Archaeopteryx and its significance<br>**Mammals** – Sweat gland, Oil gland structure and function | 5L |
| **Module 3** | **Comparative Anatomy** | **[15L]** |
| **Learning Objectives:**<br>This module is intended to<br>• Anatomy of Brain, Aortic Arch and Heart of vertebrates | | |
| **Learning Outcome:**<br>After the successful completion of the module, the learner will be able to<br>• Compare and explain anatomy of Brain, Aortic Arch and Heart of vertebrates. | | |
| 3.1 | Brain of Vertebrates | 5L |
| 3.2 | Aortic arch of Vertebrate | 5L |
| 3.3 | Heart of Vertebrate | 5L |
| **Module 4** | **Human Osteology** | **[15L]** |

**Learning Objectives:**

This module is intended to

- Human Osteology include skull, vertebral column, fore limbs, Hind limbs and Girdles.

**Learning Outcome:**

After the successful completion of the module, the learner will be able to

- Explain human bones and structures which include skull, vertebral column, Fore limbs, Hind limbs and Girdles.
- Explain the structure of vertebrate axial and appendicular skeleton and its significance.

| | | |
|---|---|---|
| 4.1 | Skull, Vertebral Column | 5L |
| 4.2 | Fore limbs and Hind Limbs | 5L |
| 4.3 | Pectoral and Pelvic Girdles | 5L |

**References:**

1. Modern Text Book of Zoology, Vertebrates by R.L. Kotpal
2. Chordate Zoology by E.L. Jordan
3. Chordate Zoology – Majupuria
4. Text Book of Chordates – Thangamani, S. Prasanna Kumar
5. Young, J.Z. (2004) The Life of Vertebrates, III Edition, Oxford University Press
6. Outline of comparative anatomy of Vertebrate- Kingesley J.S. , Central Book depot, Allahabad
7. Vertebrate Zoology – An Experimental field Approach – Nelson G.Hairston, Cambridge University Press,1994
8. Chordate Zoology – Agrawal and Dalela, JayprashNath& co. Meerut
9. Text Book ofZoology – R. D. Vidhyarthi, S. Chand
10. Practical Zoology Vertebrate – S.S. Lal, Rastogi publication Meerut

Mapping CO_PO

| **Course Learning Outcomes** | **Programme Outcomes** | | | | | |
|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** |
| Describe Phylogeny, salient features, classification up to order of Hemichordate- Mammals. | | **X** | | | | |
| Explain Methods of Vertebrate Taxonomy. | | **X** | | | | |
| Describe respiration and structure of Air bladder. | | **X** | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Explain Neoteny and Metamorphosis | | **X** | | | | |
| Know structure of carapace and plastron | **X** | | | | | |
| Compare and explain anatomy of Brain, Aortic Arch and Heart of vertebrates. | | | | **X** | | |
| Describe human osteology | | **X** | | | | |

**M. Sc. (Zoology) SEMESTER I**

**Core Course-III (CC III)**

**ZOOLOGY PAPER ZOOMSC-S1P3-4CR24 THEORY**

## Course Title : Ecology and Ethology (Credits-4)

| Course Learning Outcome | | |
|---|---|---|
| At the end of this course, Students will be able to:<br>• To understand the major principles of evolutionary theory, and ranges from the origins of life through the evolution of animals to the evolution of behaviour.<br>• Explain population ecology.<br>• Analyse biological data mathematically and statistically.<br>• Define Ecology and its component.<br>• Understand and can explain different behavioural pattern and its Neuroenocrine control. | | |
| **Module 1** | **Ecology** | **[15L]** |
| **Learning Objectives:**<br>This module is intended to<br>□ Interacts of two closely related species with their environments. | | |
| **Learning Outcome:**<br>After the successful completion of the module, the learner will be able to<br>• Studying population growth gives scientist insite into how organism interacts with each other and with their environments.<br>• Differentiate and classify the various groups of animal modes of life and to estimate the biodiversity. | | |
| 1.1 | Basic concepts of ecology, Concept of productivity, Ecological succession and niches. | 7L |
| 1.2 | Concept of Limiting factors, Ecological footprints, Carbon footprints. | 8L |
| **Module 2** | **Population Ecology** | **[15L]** |
| **Learning Objectives:**<br>This module is intended to<br>□ About population, Natality, Mortality etc | | |

| | | |
|---|---|---|
| **Learning Outcome:**<br>After the successful completion of the module, the learner will be able to<br>• Can define population ,population size , density , geographic range, exponential growth , logistic growth and carrying capacity | | |
| 2.1 | Population density and indices of Relative abundance, | 8L |
| | Population Demographicunits; Life Tables and Survivorship curves, Age distribution, Population growth forms and "carrying capacity". | |
| 2.2 | Population dispersal and fluctuations, Population selection - Life history strategies, r and K selection,<br>Clutch size and sex ratios in populations,<br>Types of interspecific interactions. | 7L |
| **Module 3** | **Methods of Studying Animal Behaviour** | **[15L]** |
| **Learning Objectives:**<br>This module is intended to<br>• Different methods of studying animal behavior | | |
| **Learning Outcome:**<br>After the successful completion of the module, the learner will be able to<br>• . Can understand and can explain different behavioural pattern and its Neuroenocrine control. | | |
| 3.1 | • Methods of Studying Sensation and Perception.<br>• Study of the Neural Mechanism<br>• Role of Hormones in Behaviour | 5L |
| 3.2 | • Methods for the Study of Exploratory Behaviour<br>• Study of Conflict Behaviour, Agonistic Behaviour | 5L |
| 3.3 | • Study of Communication – Correlation technique<br>• Experimental technique<br>• Training | 5L |
| **Module 4** | **Neuroendocrine control of Behaviour** | **[15L]** |
| **Learning Objectives:**<br>This module is intended to<br>• Different Methods (Patterns ) of Behaviour. | | |

**Learning Outcome:**

After the successful completion of the module, the learner will be able to

- Interpret the evolutionary process associate with theories, and molecular tools to assess animal behaviour like communication, aggression, cooperation while interacting with the environment.
- Explain different pattern of behaviour.

| | | |
|---|---|---|
| 4.1 | Introduction<br>Hypothalamic- Hypophyseal Relations | 5L |
| 4.2 | Neuroendocrine control Mechanisms:<br>Neuroendocrine control of reproduction<br>Neuroendocrine control of mammalian reproduction. | 5L |
| 2.3 | Behavioural Patterns as examples of Neuro-Endocrine | 5L |
| | Integrations<br>- Maternal Behaviour<br>- Domestication<br>- Migration<br>- Aggression and fear<br>- Sexual Behaviour | |

**References:**

1. Animal Behaviour –Vinod Kumar, Himalaya Publishing House
2. Animal Behaviour – Mohan P. Arora, Himalaya Publishing House
3. Evolution and Behaviour – Mathur, Tomar, Singhand Co. San Francisco. U.S.A.
4. Hobart M. Smith,1960Evolution of Chordate Structure, Holt, Rinehart & Winston Inc. New York
5. Hyman L.H.1966 Comparative Vertebrate Anatomy. The University of Chicago Press, Chicago
6. Colinvaux, P. A. (Latest edition) Ecology (2nd edition) Wiley, John and Sons, Inc.
7. Krebs, C. J. (Latest edition) Ecology (6th edition) Benjamin Cummings. 57
8. Odum, E.P., (Latest edition) Fundamentals of Ecology. Indian Edition. Brooks/Cole.
9. Ecology and Environment. Seventh Edition. Rastogi Publication. Meerut. Kormondy, E. J. (Latest edition)
10. Concepts of Ecology. Latest Edition. Prantice Hall of India Pvt. Ltd., New Delhi.
11. Ricklefs, R.E. (2000) Ecology (5th edition) Chiron Press.
12. Southwood, T.R.E. and Henderson, P.A. (2000) Ecologial Methods (3rd edition) Blackwell Sci.
13. Kendeigh, F C. (1984) Ecology with Special Reference to Animal and Man. Prentice Hall Inc.
14. Stiling, P. D. (2012) Ecology Companion Site: Global Insights and Investigations. McGraw HillEducation.

**Mapping CO_PO**

| Course Learning Outcomes | Programme Outcomes |
|---|---|

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Understand the major principles of evolutionary theory, and ranges from the origins of life through the evolution of animals to the evolution of behaviour. | | X | | | | |
| Explain population ecology. | | X | | | | |
| Describe respiration and structure of Air bladder. | | X | | | | |
| Analyse biological data mathematically and statistically. | | | | X | | |
| Define Ecology and its component. | X | | | | | |
| Understand and can explain different behavioural pattern and its Neuroenocrine control. | | X | | | | |

**M. Sc. (Zoology) SEMESTER I**

**Elective Course-I (EC-I)**

**ZOOLOGY PAPER ZOOMSC-S1E1-4CR24 THEORY**

## Course Title : EC-I-Apiculture (Credits -4)

| Course Learning Outcome | | |
|---|---|---|
| At the end of this course, Students will be able to:<br>• Identification of honey bee Species<br>• Explain morphology, Individuals, Caste and life cycle.<br>• Know behaviour and communication in honey bee.<br>• Explain Diseases & enemies of Honey bee.<br>• Understand position of Honey Bee species among the insects.<br>• Identify, weather its behavior is social or solitary.<br>• Acquire knowledge about distribution of species of honey bees.<br>• Apply, practical and theoretical concept to identify species and casts of bees.<br>• Get acquaint about communication system among the casts in the colony | | |
| **Module 1** | **Honey bee Species** | **[15L]** |
| **Learning Objectives:**<br>This module is intended to<br>▯ Identification, General morphology, and behaviour. | | |
| **Learning Outcome:**<br>After the successful completion of the module, the learner will be able to<br>▯ Differentiate and classify the various groups of animal modes of life and to estimate the biodiversity. | | |
| 1.1 | Identifying characters: A. *dorsata,* A. *cerana,* A *florae,* A. *trigona,* A . *mellifera.* | 7L |
| 1.2 | Comparative morphology of Apis species, & individual castes in Apis species, life cycle. | 8L |
| **Module 2** | **Behavior and communications in bees** | **[15L]** |
| **Learning Objectives:**<br>This module is intended to<br>▯ Behaviour and communication in honey bee. | | |

**Learning Outcome:**

After the successful completion of the module, the learner will be able to

- Understand position of Honey Bee species among the insects.
- Describe social behaviour of honey bee.

| | | |
|---|---|---|
| 2.1 | Sense organs, | 5L |
| 2.2 | Division of labour, Social behavior | 5L |
| 2.3 | Bee dance, Chemical communication- pheromones | 5L |
| **Module 3** | **Nesting behavior** | **[15L]** |

**Learning Objectives:**

This module is intended to

- Explain different castes of honey bee.
- Their behavior

**Learning Outcome:**

After the successful completion of the module, the learner will be able to

- Explain formation of honey hive.
- Describe function of each caste and their importance.

| | | |
|---|---|---|
| 3.1 | Colony and organization of honey bees. | 5L |
| 3.2 | The castes- queen, drone and workers. | 5L |
| 3.3 | Bee foraging. | 5L |
| **Module 4** | **Diseases and Enemies of Honey-bee** | **[15L]** |

**Learning Objectives:**

This module is intended to

- **Diseases and Enemies of Honey-bee**.

**Learning Outcome:**

After the successful completion of the module, the learner will be able to

- Understand different Diseases and Enemies of Honey-bee.
- Learn the pests of bee's colonies.
- Analyze the diseases associated with honey bee.

| | | |
|---|---|---|
| 4.1 | A. Diseases of honey-bee: | 8L |
| 4.2 | B. Enemies of bees. | 7L |

**References:**

1. Apiculture, 1987 (Translated from French in English by R.K.Kauls 1994),
2. P.Jean-Prost, Oxford and IBH Publication, New Delhi.
3. Bee Genetica and Breeding 1986, T.E.Reinderer, Academic Press Inc., London.
4. Bees and Bee Keeping Science, Prentice & World Resources, 1990 – Eva Crane, Heinemann Newnes, Oxford, UK.
5. Bees and Mankind 1982, J.B.Free, George Allen &Unwin (Pub.), Limited London, UK. 25 . Biogeography and Taxonomy of Honeybees 1985, F.Ruttnar, Springer-Verlag, Berlin, Jermany.
6. Bee Biology of the Honey Bee, 87, M.Winston, Harvard University Press, Cambridge, England.
7. Manual of Practical Zoology Vol. I, II, III – P.K.G. Nair, Himalaya Publishing House

Mapping CO_PO

| Course Learning Outcomes | Programme Outcomes | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Identification of honey bee Species | | X | | | | |
| Explain morphology, Individuals, Caste and life cycle. | | X | | | | |
| Know behaviour and communication in honey bee. | | X | | | | |
| Understand position of Honey Bee species among the insects. . | | X | | | | |
| Acquire knowledge about distribution of species of honey bees. | X | | | | | |
| Identify, weather its behavior is social or solitary. | | X | | | | |
| Explain Diseases & enemies of Honey bee. | | X | | | | |

**M. Sc. (Zoology) SEMESTER I**

**Elective Course-I (EC-II)**

**ZOOLOGY PAPER ZOOMSC-S1E2-4CR24 THEORY**

## Course Title : EC-II Animal Science in Pharmaceuticals (Credits -4)

| Course Learning Outcome |
|---|
| At the end of this course, Students will be able to:<br>• Know Scope of Animal science in Pharmaceuticals<br>▯ Explain animal oriented medicine.<br>• Know use of animal Products in traditional medicine<br>▯ Understand animal source for perfume formation. |

| Module 1 | Introduction | [15L] |
|---|---|---|
| **Learning Objectives:**<br>This module is intended to<br>▯ Introduction about Pharmaceuticals of animals. | | |
| **Learning Outcome:**<br>After the successful completion of the module, the learner will be able to<br>▯ Know Scope of Animal science in Pharmaceuticals | | |
| ▯ Explain animal oriented medicine. | | |
| 1.1 | Introduction & Scope of Pharmaceuticals animals. | 7L |
| 1.2 | Background & Religious restrictions. | 8L |
| **Module 2** | **Animal oriented Medicines** | **[15L]** |
| **Learning Objectives:**<br>This module is intended to<br>▯ Application of animal for certain treatment | | |
| **Learning Outcome:**<br>After the successful completion of the module, the learner will be able to<br>▯ Understand how animals are used for treatment directly/ indirectly. | | |
| 2.1 | Animal oriented Medicines- Invertebrates | 7L |
| 2.2 | Animal oriented Medicines- Vertebrates | 8L |

| Module 3 | Use of animal products in traditional medicines | [15L] |
|---|---|---|
| **Learning Objectives:**<br>This module is intended to<br>▯ Basic formulation of medicine from animal. | | |
| **Learning Outcome:**<br>After the successful completion of the module, the learner will be able to<br>▯ Know use of animal Products in traditional medicine ▯ Understand animal source for perfume formation. | | |
| 3.1 | Ecological Approach & Cultural Approach. | 5L |
| 3.2 | Economic Approach. | 5L |
| 3.3 | Sanitary Approach. | 5L |
| **Module 4** | **Animal source for perfume formation** | **[15L]** |
| **Learning Objectives:**<br>This module is intended to<br>▯ Products from animal (scents). | | |
| **Learning Outcome:**<br>After the successful completion of the module, the learner will be able to<br>▯ Specification of organ/gland/waste used for perfume | | |
| 4.1 | Source & Castoreum | 8L |
| 4.2 | Civet & Hyraceum | 7L |
| **Zoology Practicals (Elective Paper** Animal Science in Pharmaceuticals **)** | | |
| 1. Study of drugs prepared from animals.<br>2. Study of animal oriented Medicines.<br>3. Study of animal products in traditional medicines.<br>4. Animal source for perfume | | |

**Reference :**

1. Carté BK. 1996. Biomedical potential of marine natural products. BioScience 46: 271–286. 2. Clarke BT. 1997. The natural history of amphibian skin secretions, their normal functioning and potential medical applications. Biol Rev 72: 365–379.
2. Colwell RR. 1997. Microbial biodiversity and biotechnology. In: Reaka-Kudla ML et al. (Ed), Biodiversity II: understanding and protecting our biological resources, Washington, D.C.: Joseph Henry Press, p. 77–78.
3. Costa-Neto EM. 1999a. Healing with animals in Feira de Santana city, Bahia, Brazil. J Ethnopharm 65: 225–230.
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6. Costa-Neto EM and Marques JGW. 2000. Faunistic resources used as medicines by artisanal fishermen from Siribinha Beach, State of Bahia, Brazil. J Ethnobiol 20: 93–109.
7. Costa-Neto EM and Oliveira MVM. 2000. Cockroach is good for asthma: zootherapeutic practices in Northeastern Brazil. Hum Ecol Rev 7: 41–51.
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Mapping CO_PO

| Course Learning Outcomes | Programme Outcomes | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Know Scope of Animal science in Pharmaceuticals | X | | | | | |
| Explain animal oriented medicine. | | X | | | | |
| Know use of animal Products in traditional medicine | | X | | | | |
| Understand animal source for perfume formation. | X | | | | | |

**M. Sc. (ZOOLOGY) SEMESTER I**

**COURSE CODE: ZOOMSC-S1SEC1-2CR24**

## Course Title: SEC-I Aquaculture

## Skill Enhancement Course [CREDITS - 02]

| Course Learning Outcome | | |
|---|---|---|
| After the successful completion of the Course, the learner will be able to:<br>1. Define Aquaculture:<br>2. Explain prawn fishery.<br>3. Know importance of prawn culture.<br>4. Understand different method of prawn preservation and processing.<br>5. Explain fish culture.<br>6. Understand different method of fish preservation and processing. | | |
| **Module 1** | **Prawn Fishery** | **[15L]** |
| **Learning Objectives:**<br>This module is intended to<br>1. Complete culture of prawn. | | |
| **Learning Outcome:**<br>After the successful completion of the module, the learner will be able to<br>1. Explain different types of prawn fishery and species of prawn. | | |
| 1.1 | Introduction, Types of Prawn Fishery, Species of Prawn, Prawn as a food. | 7L |
| 1.2 | **Culture of Prawn:** Culture of Fresh water prawn, Culture of Marine Prawn, Preparation of farm: -Method of Prawn Fishing, Preservation and Processing | 8L |
| **Module 2** | **Fish culture** | **[15L]** |
| **Learning Objectives:** 1. Types of fish culture | | |
| **Learning Outcome:**<br>After the successful completion of the module, the learner will be able to<br>1. Identify different types of pond for fish culture | | |
| 2.1 | Introduction**:** Aim of fish culture, Qualities of cultivable fish, Types of cultivable fish. | 8L |
| 2.2 | Breeding pond, Method of Fishing, Preservation of Fish | 7L |

**References:**


- A textbook on Fish biology and fisheries by H.R. Singh
- Aquaculture: Farming aquatic animals by Olando Martin
- Aquaculture Principles and Practices by TVR Pillay& MN Kutty


**Mapping CO_PO**

| Course Learning Outcomes | Programme Outcomes | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Define Aquaculture | X | | | | | |
| Explain prawn fishery | | X | | | | |
| Know importance of prawn culture. | | X | | | | |
| Understand different method of prawn preservation and processing. | | X | | | | |
| Understand different method of fish preservation and processing. | | X | | | | |
| Explain fish culture. | | X | | | | |

**M. Sc. (ZOOLOGY) SEMESTER I**

**PRACTICAL CCP-I**

**COURSE CODE: ZOOMSC-S1PR1-6CR24**

## Course Title: Experimental Zoology- I (Credits -6)

| **Course Learning Outcome** | | |
|---|---|---|
| After the successful completion of the Course, the learner will be able to:<br>▯ Develop practical knowledge of Invertebrates & Vertebrate by museum study, and display of dissections by LCD as dissection of animals is banned. | | |
| **Module 1** | (Biology of Non- Chordates [Invertebrates]) | **[3L]** |
| **Learning Objectives:**<br>This module is intended to<br>• Classification of lower phyla.<br>• Specification of filter feeding. | | |
| **Learning Outcome:**<br>After the successful completion of the module, the learner will be able to<br>• Learn an idea about certain specific features of different animals of lower phyla.<br>• Understand the evolutionary aspect of animals through the growing hierarchy. | | |
| 1.1 | **1. Classification of different phylum of invertebrates**<br>a) Protozoa : Trypanosoma, Vorticella<br>b) Porifera : Grantia, Leusillia<br>c) Cnidaria : Pericolpa, Porpita<br>d) Platyhelminthes : Rhabditophora | 3L |

| | | |
|---|---|---|
| | e) Aschelminthes : Horse hair worm, Hookworm<br>f) Annelida : Tomopteris, Syllis<br>g) Mollusca : Murex, Mya<br>h) Arthropoda : Gryllus, Aranea<br>i) Echinodermata : Luidia, Antedon<br>2. To study the filter feeding appendages: Terebella, Sabella, Mytilus, Ostrea, cephalodiscus, Daphnia and Calanus.<br>4. To study the Different type of symmetry in different animal with the help of charts.<br>5. Observation of Larvae Marine water and fresh water .<br>6. Different types of receptors and effector neuron<br>7. To study the receptor organ in different animals<br>- Mechanoreceptor : Insects, Crustancean<br>- Chemoreceptor : Mollusca<br>-Photoreceptor : Inscets, Mollusca | |
| **Module 2** | **Biology of Vertebrates** | **[3L]** |

**Learning Objectives:**

This module is intended to

- Phylogeny, salient features, classification up to order of Hemichordate to Mammals.
- Methods of Vertebrate Taxonomy.
- Neoteny and Metamorphosis
- Structure of carapace and plastron.

**Learning Outcome:**

After the successful completion of the module, the learner will be able to

- Describe Phylogeny, salient features, classification up to order of Hemichordate-Mammals.
- Explain Methods of Vertebrate Taxonomy.
- Describe respiration and structure of Air bladder.

| | | |
|---|---|---|
| 2.1 | 1. Classification of following animals up to orders Salpa, Dolilum, Maxine, Electric Ray, Sea horse, Labeo, Salamander, Ichthyophis, Calotes, Chaemeleon, Kingfisher, Ostrich, Duckbilled platypus, Bat, Whale<br>2. Study of Difference between Lamprey and Myxine | 3L |

| | | |
|---|---|---|
| | 3. Types of Air bladder in Pisces.<br>4. Study of Metamorphosis in frog by charts/Photographs.<br>5. To Study plastron and carapace with the help of charts or photographs.<br>6. Study of Archaeopteryx as connecting link<br>7. To Study comparative Anatomy of Brain, Heart and Aortic arch of Vertebrates<br>8. To Study Human Osteology with the help of harts/photographsor Models.<br>(a) Skull (b) Vertebral Column (c) Fore limbs and Hind Limbs<br>(d) Pectoral and Pelvic Girdles | |

**Course Learning Outcome**

After the successful completion of the Course, the learner will be able to:

- To understand the major principles of evolutionary theory, and ranges from the origins of life through the evolution of animals to the evolution of behaviour.
- Explain population ecology.
- Analyse biological data mathematically and statistically.

| **Module 3** | Ecology and Ethology | **[3L]** |
|---|---|---|

**Learning Objectives:**

This module is intended to

 Interaction of two closely related species with their environments.

**Learning Outcome:**

After the successful completion of the module, the learner will be able to

 Define Ecology and its component.

 Understand and can explain different behavioural pattern and its Neuroendocrine control.

| | | |
|---|---|---|
| 3.1 | 1. To Study the population density by Quadrate method<br>2. To Study the interspecific interaction in milk bacteria<br>3. To Study the carbon footprints by Model.<br>4. To Study Exploratory Behaviour with the help of charts /Photographs<br>5. Study of Conflict and Agonistic Behaviour by charts /Photographs<br>6. Study of Hypothalamic – Hypophyseal Relations by | 3L |
| | Photographs/Charts<br>7.To Study Neuroendocrine Control of Mammalian Reproduction (Male- Female) By charts/Photographs | |
| **Module 4** | **Apiculture** | **[3L]** |
| **Learning Objectives:**<br>This module is intended to<br>□ Identification, General morphology, and behaviour. | | |
| **Learning Outcome:**<br>After the successful completion of the module, the learner will be able to<br>□ Identify, weather its behavior is social or solitary.<br>• Acquire knowledge about distribution of species of honey bees.<br>• Apply, practical and theoretical concept to identify species and casts of bees.<br>• Get acquaint about communication system among the casts in the colony.<br>• Evaluates the strength of colony, brood, food condition. | | |
| 4.1 | 1. Study of bee species and castes.<br>2. Comparative measurement of body size of various bee species.<br>3. Study of nesting behavior of bee species.<br>4. Observe behavior and communication in bees. | 3L |

| | |
|---|---|
| References: | 1. A manual Zoology Practical Zoology Chordates - Dr. P.S. Verma, S. Chand Publications<br>2. Practical Vertebrate Zoology ByAgrawl& Jindal, PragatiPrakashan.<br>3. Manual of Practical Zoology Vol. I, II, III – P.K.G. Nair, Himalaya Publishing House<br>4. Principles of systematic Zoology (2 nd Edition) by E. Mayr and P.D. Ashlock<br>5. A Textbook of Zoology Vol. I by Parker and Haswell (Revised)<br>6. The Invertebrates Vol. I to Vol. VI by L. H. Hyman 4 Invertebrate structure and function by E. J. W. Barrington<br>7. Invertebrate Zoology by P. A. Meglitsch (Oxford Press)<br>8. Life of Invertebrates by Russel Hunte |

Mapping CO_PO

| Course Learning Outcomes | Programme Outcomes | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Learn an idea about certain specific features of different animals of lower phyla. | X | | | | | |
| Understand the evolutionary aspect of animals through the growing hierarchy. | | X | | | | |
| Describe Phylogeny, salient features, classification up to order of Hemichordate- Mammals. | | X | | | | |
| Explain Methods of Vertebrate Taxonomy. | | X | | | | |
| Describe respiration and structure of Air bladder. | | X | | | | |
| Explain neoteny and Metamorphosis | | X | | | | |
| Know structure of carapace and plastron | X | | | | | |
| To understand the major principles of evolutionary theory, and ranges from the origins of life through the evolution of animals to the evolution of behaviour. | | X | | | | |
| Explain population ecology. | | X | | | | |
| Analyse biological data mathematically and statistically. | | | | X | | |
| Identify, weather its behavior is social or solitary. | | X | | | | |
| Acquire knowledge about distribution of species of honey bees. | X | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Apply, practical and theoretical concept to identify species and casts of bees. | | | X | | | |
| Evaluates the strength of colony, brood, food condition | | | | | X | |