**SRI MEENAKSHI GOVERNMENT ARTS COLLEGE FOR WOMEN (AUTONOMOUS),**

**MADURAI-625002**


**DEPARTMENT OF ZOOLOGY**

**Syllabus**

# B.Sc. Zoology

**For students who are admitted in the academic year 2024-2025**

**SRI MEENAKSHI GOVERNMENT ARTS COLLEGE FOR WOMEN (AUTONOMOUS), MADURAI-2**

**B. Sc. ZOOLOGY Programme (2024 – 2027)**

## SEMESTER–I

| Part | Course Type | Course Code | Title of the Course | Hrs/ Week | Credits | Exam Hrs | Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Int | Ext | Total |
| I | LC | **U231A1/ U231H1** | Tamil/Hindi | 6 | 3 | 3 | 25 | 75 | 100 |
| II | ELC | **U232A1** | English | 6 | 3 | 3 | 25 | 75 | 100 |
| III | CC1 (T) | **U23CZ1** | Invertebrata | 5 | 5 | 3 | 25 | 75 | 100 |
| III | CC2 (P) | **U23CZ2P** | Invertebrata Practical | 3 | 3 | 3 | 25 | 75 | 100 |
| III | GEC 1(T) | **U23GZ25** | Allied Zoology - I | 4 | 4 | 3 | 25 | 75 | 100 |
| III | GEC 2(P) | **U23GZ26P** | Allied Zoology Practical | 2 | - | - | - | - | - |
| IV | SEC1 | **U23SEZ1** | Ornamental Fish farming and Management | 2 | 2 | 3 | 25 | 75 | 100 |
| IV | Foundation Course | **U23GZ26P** | Fundamentals of Zoology | 2 | 2 | 3 | 25 | 75 | 100 |
| **Total** | | | | **30** | **22** | | | | **700** |

| Part | Course Type | Course Code | Title of the Course | Hrs/Week | Credits | Exam Hrs | Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Int | Ext | Total |
| I | LC | **U231A2/ U231H2** | Tamil/Hindi | 6 | 3 | 3 | 25 | 75 | 100 |
| II | ELC | **U232A2** | English | 6 | 3 | 3 | 25 | 75 | 100 |
| III | CC3 (T) | **U23CZ3** | Chordata | 5 | 5 | 3 | 25 | 75 | 100 |
| III | CC4 (P) | **U23CZ4P** | Chordata Practical | 3 | 3 | 3 | 25 | 75 | 100 |
| III | GEC 2(P) | **U23GZ26P** | Allied Zoology Practical | 2 | 2 | 3 | 25 | 75 | 100 |
| III | GEC 3(T) | **U23GZ27** | Allied Zoology - II | 4 | 4 | 3 | 25 | 75 | 100 |
| IV | SEC2 | **U23SEZ5** | Basics of Marine Biology | 2 | 2 | 3 | 25 | 75 | 100 |
| | SEC3 | **U23SEZ6** | Agricultural Entomology | 2 | 2 | 3 | 25 | 75 | 100 |
| **Total** | | | | **30** | **24** | | | | **800** |

## SEMESTER–II

**SEMESTER–III**

| Part | Course Type | Course Code | Title of the Course | Hrs/ Week | Credits | Exam Hrs | Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Int | Ext | Total |
| I | LC | **U231A3/ U231H3** | Tamil/Hindi | 6 | 3 | 3 | 25 | 75 | 100 |
| II | ELC | **U232A3** | English | 6 | 3 | 3 | 25 | 75 | 100 |
| III | CC5 (T) | **U23CZ5** | Animal Physiology | 5 | 4 | 3 | 25 | 75 | 100 |
| III | CC6 (P) | **U23CZ6P** | Animal Physiology Practical | 3 | 3 | 3 | 25 | 75 | 100 |
| III | GEC 4(T) | **U23GZ25** | Allied Zoology – I | 4 | 4 | 3 | 25 | 75 | 100 |
| III | GEC 5(P) | **U23GZ26P** | Allied Zoology Practical | 2 | - | - | - | - | - |
| IV | SEC4 | **U23SEZ2** | Biocomposting for Entrepreneurship | 1 | 1 | 3 | 25 | 75 | 100 |
| IV | SEC5/NM | **U23SEZ7** | Sericulture/NM Course | 2 | 2 | 3 | 25 | 75 | 100 |
| IV | E.V.S. | **U23EVS1** | E.V.S | 1 | -- | -- | -- | -- | -- |
| **Total** | | | | **30** | **20** | | | | **700** |

**SEMESTER–IV**

| Part | Course Type | Course Code | Title of the Course | Hrs/ Week | Credits | Exam Hrs | Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Int | Ext | Total |
| I | LC | **U231A4/ U231H4** | Tamil/Hindi | 6 | 3 | 3 | 25 | 75 | 100 |
| II | ELC | **U232A4** | English | 6 | 3 | 3 | 25 | 75 | 100 |
| III | CC7 (T) | **U23CZ7** | Core Industry Module - Medical Lab Technology | 4 | 4 | 3 | 25 | 75 | 100 |
| III | CC8 (P) | **U23CZ8P** | Medical Lab Technology Practical | 3 | 3 | 3 | 25 | 75 | 100 |
| III | GEC5 (P) | **U23GZ26P** | Allied Zoology Practical | 2 | 2 | 3 | 25 | 75 | 100 |
| III | GEC6 (T) | **U23GZ27** | Allied Zoology – II | 4 | 4 | 3 | 25 | 75 | 100 |
| IV | SEC6 | **U23SEZ8** | Bioinstrumentation | 2 | 2 | 3 | 25 | 75 | 100 |
| IV | SEC7 | **U23SEZ9** | Bioinformatics | 2 | 2 | 3 | 25 | 75 | 100 |
| IV | E.V.S. | **U23EVS1** | E. V. S | 1 | 2 | 3 | 25 | 75 | 100 |
| **Total** | | | | **30** | **25** | | | | **900** |
| **SUMMER INTERNSHIP/INDUSTRIALTRAINING** | | | | | | | | | |

**SEMESTER–V**

| Part | Course Type | Course Code | Title of the Course | Hrs/ Week | Credits | Exam Hrs | Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Int | Ext | Total |
| III | CC9 (T) | **U23CZ9** | Cell and Molecular Biology | 5 | 5 | 3 | 25 | 75 | 100 |
| III | CC10 (T) | **U23CZ10** | Biochemistry | 5 | 5 | 3 | 25 | 75 | 100 |
| III | CC11 | **U23CZ11** | Genetics | 4 | 4 | 3 | 25 | 75 | 100 |
| III | CC12 (P) | **U23CZ12P** | Cell and Molecular Biology, Biochemistry and Genetics Practical | 6 | 3 | 3 | 25 | 75 | 100 |
| III | DSEC1 | **U23DZ02** | Wild Life Conservation and Management | 4 | 3 | 3 | 25 | 75 | 100 |
| III | DSEC2 | **U23DZ05** | Environmental Biology | 4 | 3 | 3 | 25 | 75 | 100 |
| V | | **U23VE1** | Value Education | 2 | 2 | 3 | 25 | 75 | 100 |
| IV | | **U23SIZ1** | Summer Internship/Industry Training | -- | 2 | -- | -- | -- | 100 |
| **Total** | | | | **30** | **27** | | | | **800** |

**SEMESTER–VI**

| Part | Course Type | Course Code | Title of the Course | Hrs/ Week | Credits | Exam Hrs | Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Int | Ext | Total |
| III | CC13 | **U23CZ13** | Microbiology | 6 | 5 | 3 | 25 | 75 | 100 |
| III | CC14 | **U23CZ14** | Immunology | 6 | 5 | 3 | 25 | 75 | 100 |
| III | CC15(P) | **U23CZ15P** | Microbiology & Immunology Practical | 6 | 3 | 3 | 25 | 75 | 100 |
| III | DSEC3 | **U23DZ06** | Developmental Biology and Evolutionary Biology | 5 | 3 | 3 | 25 | 75 | 100 |
| III | DSEC4 | **U23DZ07** | Animal Biotechnology | 5 | 3 | 3 | 25 | 75 | 100 |
| IV | EXA | **U23EAZ** | Extension Activity | -- | 1 | -- | -- | -- | 100 |
| IV | | **U23PCZ1** | Professional Competency Skill – Statistics for Biologists | 2 | 2 | 3 | 25 | 75 | 100 |
| **Total** | | | | **30** | **22** | | | | **700** |

**COURSE STRUCTURE ABSTRACT**

FOR ALL B. Sc. Programmes

| Part | Course | Total No. of Papers | Hours | Credit | Marks |
|---|---|---|---|---|---|
| I | Tamil | 4 | 24 | 12 | 400 |
| II | English | 4 | 24 | 12 | 400 |
| III | Core Course -Major(CCM) | 15 | 69 | 60 | 1500 |
| III | GEC– Elective Course (Allied) | 6 | 24 | 20 | 600 |
| III | DSEC –Elective Course | 4 | 18 | 12 | 400 |
| III | Internship | 1 | -- | 2 | 100 |
| IV | Skill Enhancement Course (SEC-6 & NM) | 7 | 13 | 13 | 700 |
| IV | Foundation Course | 1 | 2 | 2 | 100 |
| IV | E.V.S. | 1 | 2 | 2 | 100 |
| IV | Value Education | 1 | 2 | 2 | 100 |
| IV | Extension Activity/NSS/NCC/SPORTS | 1 | - | 1 | 100 |
| IV | Professional Competency Skill | 1 | 2 | 2 | 100 |
| **Total** | | **46** | **180** | **140** | **4600** |

**SRI MEENAKSHI GOVERNMENT ARTS COLLEGE FOR WOMEN (AUTONOMOUS), MADURAI-625002**
**DEPARTMENT OF ZOOLOGY**

## List of Discipline Specific Elective Courses (DSECs)

| Sl. no. | Course Code | Course Title |
|---|---|---|
| 1 | **U23DZ01** | Animal Behaviour |
| 2 | **U23DZ02** | Wildlife Conservation And Management |
| 3 | **U23DZ03** | Nanobiology |
| 4 | **U23DZ04** | Human Reproductive Biology |
| 5 | **U23DZ05** | Environmental Biology |
| 6 | **U23DZ06** | Developmental Biology and Evolutionary Biology |
| 7 | **U23DZ07** | Animal Biotechnology |

## List of Skill Enhancement Courses (SECs)

| Sl. no. | Course Code | Course Title |
|---|---|---|
| 1 | **U23SEZ1** | Ornamental fish farming and management |
| 2 | **U23SEZ2** | Biocomposting for Entrepreneurship |
| 3 | **U23SEZ3** | Aquarium Keeping |
| 4 | **U23SEZ4** | Medical Laboratory Techniques |
| 5 | **U23SEZ5** | Basics of Marine Biology |
| 6 | **U23SEZ6** | Agricultural Entomology |
| 7 | **U23SEZ7** | Sericulture |
| 8 | **U23SEZ8** | Bioinstrumentation |
| 9 | **U23SEZ9** | Bioinformatics |

| Part | Course code | Title of the course | Whether syllabus revision was carried out in 2024-2025 | If yes, % content added or replaced |
|---|---|---|---|---|
| **Semester I** | | | | |
| III | **U23CZ1** | Invertebrata | Yes | 5% |
| III | **U23CZ2P** | Invertebrata Practical | Yes | 5% |
| III | **U23GZ25** | Allied Zoology - I | No | |
| III | **U23GZ26P** | Allied Zoology Practical | No | |
| IV | **U23SEZ1** | Ornamental Fish farming and Management | Yes | 5% |
| IV | **U23GZ26P** | Fundamentals of Zoology | No | |
| **Semester II** | | | No | |
| III | **U23CZ3** | Chordata | No | |
| III | **U23CZ4P** | Chordata Practical | No | |
| III | **U23GZ26P** | Allied Zoology Practical | No | |
| III | **U23GZ27** | Allied Zoology - II | Yes | 10% |
| IV | **U23SEZ5** | Basics of Marine Biology | Yes | 15% |
| | **U23SEZ6** | Agricultural Entomology | No | |
| **Semester III** | | | | |
| III | **U23CZ5** | Animal Physiology | No | |
| III | **U23CZ6P** | Animal Physiology Practical | No | |
| III | **U23GZ25** | Allied Zoology – I | No | |
| III | **U23GZ26P** | Allied Zoology Practical | No | |
| IV | **U23SEZ2** | Biocomposting for Entrepreneurship | No | |
| IV | **U23SEZ7** | Sericulture/NM Course | No | |
| **Semester IV** | | | | |
| III | **U23CZ7** | Core Industry Module - Medical Lab Technology | No | |

| | | | | |
|---|---|---|---|---|
| III | **U23CZ8P** | Medical Lab Technology Practical | No | |
| III | **U23GZ26P** | Allied Zoology Practical | No | |
| III | **U23GZ27** | Allied Zoology – II | No | |
| IV | **U23SEZ8** | Bioinstrumentation | No | |
| IV | **U23SEZ9** | Bioinformatics | No | |
| IV | **U23EVS1** | E. V. S | No | |
| **Semester V** | | | | |
| III | **U23CZ9** | Cell and Molecular Biology | No | |
| III | **U23CZ10** | Biochemistry | No | |
| III | **U23CZ11** | Genetics | No | |
| III | **U23CZ12P** | Cell and Molecular Biology, Biochemistry and Genetics Practical | No | |
| III | **U23DZ02** | Wild Life Conservation and Management | No | |
| III | **U23DZ05** | Environmental Biology | No | |
| V | **U23VE1** | Value Education | No | |
| IV | **U23SIZ1** | Summer Internship/Industry Training | No | |
| **Semester VI** | | | | |
| III | **U23CZ13** | Microbiology | No | |
| III | **U23CZ14** | Immunology | No | |
| III | **U23CZ15P** | Microbiology & Immunology Practical | No | |
| III | **U23DZ06** | Developmental Biology and Evolutionary Biology | No | |
| III | **U23DZ07** | Animal Biotechnology | No | |
| IV | **U23EAZ** | Extension Activity/NCC/NSS | No | |
| IV | **U23PCZ1** | Professional Competency Skill – Statistics for Biologists | No | |
| | | | | |

# SEMESTER - I

**Semester –I**

| Course Code CC1 (T) | Course Name | Category | L | T | P | S | Credits | Inst. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CIA | External | Total |
| U23CZ1 | INVERTEBRATA | Core | Y | - | - | - | 5 | 5 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | ✓ | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

| Learning Objectives | | | |
|---|---|---|---|
| CO1 | To understand the basic concepts of lower animals and observe the structure and functions. | | |
| CO2 | To illustrate and examine the systemic and functional morphology of various group of invertebrates. | | |
| CO3 | To differentiate and classify the various groups of animal modes of life and to estimate the biodiversity. | | |
| CO4 | To compare and distinguish the general and specific characteristics of reproduction in lower animals. | | |
| CO5 | To infer and integrate the parasitic and economic importance of invertebrate animals | | |
| **UNIT** | **Details** | **No. of Hours** | **Course Objectives** |
| I | **TAXONOMY:** Principles of Classification - types of Coelom, types of Symmetry, Binomial nomenclature. Classification up to class level with example (Flow Chart only)- General characters of the phyla with examples: i) Protozoa ii) Porifera iii) Coelenterata iv) Platyhelminthes v) Nematoda *vi)* Annelida, vii) Arthropoda viii) Mollusca, ix) Echinodermata | 15 | CO1 |
| II | **PROTOZOA AND PORIFERA** **Phylum**: **Protozoa** - Type study -Paramecium- General organization, cyclosis, contractile vacuole and conjugation only. Structure, Life history, prevention and control measures of i) *Plasmodium vivax* and ii) *Entamoeba histolytica.* **Phylum: Porifera**: Type study-*Leucosolenia* - general organization, Spicules, reproduction. Canal system in | 15 | CO2 |

| | | | |
|---|---|---|---|
| | Sponges. | | |
| III | **COELENTRATA AND HELMINTHES**<br>**Phylum:** Coelenterata: Type study- Obelia; structure of obelia colony, Medusa, Nematocyst, reproduction - Types of Corals- Ecological and Economic importance.<br>**Helminthes**: Type study- *Fasciola hepatica* - external characters, digestive system, excretion, reproduction and development (life cycle). Structure and control measures of *Ascaris* and *Wuchereria.* | 15 | CO3 |
| IV | **ANNELIDA AND ARTHROPODA**<br>**Phylum: Annelida**: Type study-Earth worm, External morphology, setae, nephridia, nerves system and reproductive system - Metamerism in Annelids.<br>**Phylum: Arthropoda**: Type study-***Penaeus indicus***- Marine Prawn - external morphology, appendages, digestive and excretory systems and reproductive system. -Affinities of Peripatus. | 15 | CO4 |
| V | **MOLLUSCA AND ECHINODERMATA**<br>**Phylum: Mollusca**: Type study – ***Pila globosa***- external morphology, digestive system, respiratory system, osphridium only. -Cephalopods as an advanced Mollusc.<br>**Phylum: Echinodermata;** Type study Star fish *(Asterias)*, external morphology, pedicellaria, --Water vascular system - Larval forms of Echinodermata. | 15 | CO5 |
| | **Total** | **75** | |

| **Course Outcomes** | | |
|---|---|---|
| **Course Outcomes** | On completion of this course, students will; | |
| **CO1** | Understand the basic concepts of invertebrate animals and recall its structure and functions. | PO1 |
| **CO2** | Illustrate and examine the systemic and functional morphology of various groups of invertebrata. | PO1, PO2 |
| **CO3** | Differentiate and classify the animal's mode of life in various taxa and estimate the biodiversity. | PO4, PO6 |
| **CO4** | To compare and distinguish the various physiological processes and organ systems in lower animals. | PO4, PO5, PO6 |
| **CO5** | Infer and integrate the parasitic and economic importance of invertebrate animals. | PO3, PO8 |

| **Text Books (Latest Editions)** | |
|---|---|
| 1. | EkambaranathaIyer,- Outlines of Zoology Viswanathan Publication |

**References Books**
**(Latest editions, and the style as given below must be strictly adhered to)**

| | |
|---|---|
| 1. | Ekambaranatha Iyar and T.N. Ananthakrishnian - A Manual of Zoology Invertebrata–Vol I:ViswanathanPublishers. |
| 2. | EkambaranathaIyar and T.N.Ananthakrishnan,-A Manual of Zoology-Invertebrata–VolII: Viswanathan Publishors. |
| 3. | EkambaranathaIyar and T.N. Ananthakrishnan,- A Manual of Zoology: Chordata Viswanathan Publishers. |
| 4. | Jordan E.L .and P.S. Verma-Invertebrate Zoology, S. Chand & Co. |
| **Web Resources** | |
| 1. | www.sanctuaryasia.com |
| 2. | www.iaszoology.com |

| **Methods of Evaluation** | | |
|---|---|---|
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |

| **Methods of Assessment** | |
|---|---|
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | | | S | | S | | |
| **CO 4** | | | | S | S | M | | |
| **CO 5** | | | S | | | | | S |

**S - Strong (3)** **M - Medium (2)** **L - Low (1)**

| Course Code CC2 (P) | Course Name | Category | L | T | P | S | Credits | Inst. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CIA | External | Total |
| U23CZ2P | **INVERTEBRATA PRACTICAL** | Core | Y | - | - | - | 3 | 3 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | ✓ | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

**Learning Objectives**

| | |
|---|---|
| CO1 | To identify the different groups of invertebrate animals by observing their external characteristics. |
| CO2 | To understand the organs, organ system and their functions in lower animals. |
| CO3 | To get knowledge about the different modes of life and their adaptation based on the environment. |
| CO4 | Able to dissect and display the internal organs and mount the mouthparts and scales of invertebrates. |

| UNIT | Details | No. of Hours | Course Objectives |
|---|---|---|---|
| I | **Major Dissection:** Cockroach: Digestive, and Nervous systems, Earthworm: Nervous System. | 12 | CO1 |
| II | **Minor Dissection:** Prawn appendages | 6 | CO2 |
| III | **Mounting:** Earthworm: Body setae; Mouth parts - Honey Bee, Cockroach. | 9 | CO3 |
| IV | **Observation of Larval forms:** Miracidium, Redia and Cercaria. Nauplius, Zoea and Mysis. Bipinnaria | 9 | CO4 |
| V | **Spotters: (i). Protozoa:** Amoeba, Plasmodium vivax **(ii). Porifera:** Sponge-Spicules and Gemmule **(iii). Coelenterata:** Obelia – Colony & Medusa, Aurelia, **(iv). Platyhelminthes:** Fasciola hepatica, **(v). Nemathelminthes:** Ascaris (Male & Female), **(vi). Annelida:** Nereis, Earthworm **(vii). Arthropoda:** peripatus, Centepede **(viii). Mollusca:** Chiton, Sepia, **(ix). Echinodermata:** Starfish, Sea cucumber | 9 | CO5 |
| | | **45** | |

| | | | |
|---|---|---|---|
| | **Total** | | |
| **Course Outcomes** | | | |
| **Course Outcomes** | On completion of this course, students will; | | |
| **CO1** | Identify and label the external features of different groups of invertebrate animals. | PO1 | |
| **CO2** | Illustrate and examine the circulatory system, nervous system and reproductive system of invertebrate animals. | PO1, PO2 | |
| **CO3** | Differentiate and compare the structure, function and mode of life of various groups of animals. | PO4, PO6 | |
| **CO4** | To compare and distinguish the dissected internal organs of lower animals. | PO4, PO5, PO6 | |
| **CO5** | Prepare and develop the mounting procedure of economically important invertebrates. | PO3, PO8 | |

| **Text Books (Latest Editions)** | |
|---|---|
| 1. | Ekambaranatha Iyyar and T. N. Ananthakrishnan, 1995 A manual of Zoology Vol.I (Part 1, 2) S. Viswanathan, Chennai |
| 2. | Ganguly, Sinha an d A dhikari , 2 0 11 . Biology of Animals: Volume I, New Central Book Agency; 3rd revised edition. 1008 pp. |
| 3. | Sinha, Chatterjee and Chattopadhyay, 2 0 1 4. Advanced Practical Zoology, Books & Allied Ltd; 3rd Revised edition, 1 07 0 pp. |
| 4. | Lal ,S. S, 2016 . Practical Zoology Invertebrate, Rastogi Publications. |
| 5. | Verma, P. S. 2010. A Manual of Practical Zoology: Invertebates, S Chand, 4 97pp. |

| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | |
|---|---|
| 1. | Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science. |
| 2. | Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition. Holt Saunders International Edition. |
| 3. | Barrington, E.J.W. (1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson |
| 4. | Boradale, L.A. and Potts, E.A. (1961). *Invertebrates: A Manual for the use of Students*. Asia Publishing Home. |
| 5. | Lal, S.S. 2005. A text Book of Practical Zoology: Invertebrate, Rastogi, Meerut |

| **Web Resources** | |
|---|---|
| 1. | https://nbb.gov.in/ |
| 2. | http://www.agshoney.com/training.htm |
| 3. | https://icar.org.in/ |
| 4. | http://www.csrtimys.res.in/ |

| | | |
|---|---|---|
| 5. | http://csb.gov.in/ | |
| | https://iinrg.icar.gov.in/ | |
| | https://www.nationalgeographic.com/animals/invertebrates/ | |
| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | | | S | | S | | |
| **CO 4** | | | | S | S | M | | |
| **CO 5** | | | S | | | | | S |

**S-Strong (3)** **M-Medium (2)** **L-Low (1)**

| Course Code GEC1 (T) | Course Name | Category | L | T | P | S | Credits | Inst. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CIA | External | Total |
| U23GZ25 | Allied Zoology – I | Core | Y | - | - | - | 4 | 4 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | ✓ | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

| | Learning Objectives |
|---|---|
| CO1 | To acquire a basic knowledge of diversity and organization of Protozoa, Coelenterata, Helminthes and Annelida |
| CO2 | To acquire a basic knowledge of diversity and organization of Arthropoda, Mollusca and Echinodermata |
| CO3 | To comprehend the taxonomic position and diversity among Protochordata, Pisces and Amphibia |
| CO4 | To comprehend the taxonomic position and diversity among Reptilia, Aves and Mammalia |
| CO5 | To acquire detailed knowledge of select invertebrate and chordate forms |

| UNIT | Details | No. of Hours | Course Objectives |
|---|---|---|---|
| I | **Diversity of Invertebrates–I**<br>Principles of taxonomy. Criteria for classification – Symmetry and Coelom–Binomial nomenclature. Classification of Protozoa, Coelenterata, Helminthes and Annelida upto classes with two examples. | 12 | CO1 |
| II | **Diversity of Invertebrates–II**<br>Classification of Arthropoda, Mollusca and Echinodermata upto class level with examples. | 12 | CO2 |
| III | **Diversity of Chordates–I**<br>Classification of Prochordata, Pisces and Amphibia upto orders giving two examples. | 12 | CO3 |
| IV | **Diversity of Chordates–II**<br>Classification of Reptilia, Aves and Mammalia upto | 12 | CO4 |

| | | | |
|---|---|---|---|
| | orders giving two examples. | | |
| V | **Animal organization**<br>Structure and organization of<br>(i) Earthworm<br>(ii) Rabbit/Rat<br>(iii) Prawn/Fish | 12 | CO5 |
| | **Total** | **60** | |

| **Course Outcomes** | | |
|---|---|---|
| **Course Outcomes** | On completion of this course, students will; | |
| **CO1** | Recall the characteristic features invertebrates and chordates. | PO1 |
| **CO2** | Classify invertebrates up to class level and chordates up to order level | PO1, PO2 |
| **CO3** | Explain and discuss the structural and functional organisation of some invertebrates and chordates | PO4, PO6 |
| **CO4** | Relate the adaptations and habits of animals to their habitat | PO4, PO5, PO6 |
| **CO5** | Analyse the taxonomic position of animals. | PO3, PO8 |

| **Text Books (Latest Editions)** | |
|---|---|
| 1. | EkambaranathaIyer,- Outlines of Zoology Viswanathan Publication |

| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | |
|---|---|
| 1. | Ekambaranatha Iyar and T.N. Ananthakrishnian - A Manual of Zoology Invertebrata – Vol I:ViswanathanPublishers. |
| 2. | EkambaranathaIyar and T.N.Ananthakrishnan,-A Manual of Zoology-Invertebrata–VolII: Viswanathan Publishors. |
| 3. | EkambaranathaIyar and T.N. Ananthakrishnan,- A Manual of Zoology: Chordata ViswanathanPublishers. |
| 4. | Jordan E.L .and P.S. Verma-Invertebrate Zoology, S. Chand & Co. |

| **Web Resources** | |
|---|---|
| 1. | www.sanctuaryasia.com |
| 2. | www.iaszoology.com |

| **Methods of Evaluation** | | |
|---|---|---|
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |

| | | |
|---|---|---|
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |

| **Methods of Assessment** | |
|---|---|
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | | | S | | S | | |
| **CO 4** | | | | S | S | M | | |
| **CO 5** | | | S | | | | | S |

**S - Strong (3)** **M - Medium (2)** **L - Low (1)**

| Course Code GEC2 (P) | Course Name | Category | L | T | P | S | Credits | Inst. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CIA | External | Total |
| **U23GZ26P** | **Allied Zoology – I (Botany) Practical** | Core | Y | - | - | - | 4 | 4 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | ✓ | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

**Learning Objectives**

| | |
|---|---|
| CO1 | To acquire a basic knowledge of diversity and organization of Protozoa, Coelenterata, Helminthes and Annelida |
| CO2 | To acquire a basic knowledge of diversity and organization of Arthropoda, Mollusca and Echinodermata |
| CO3 | To comprehend the taxonomic position and diversity among Protochordata, Pisces, Amphibia, Reptilia, Aves and Mammalia |
| CO4 | To enable students to learn basic concepts relating to aspects of respiratory, circulatory, excretory nervous and sensory physiology. |
| CO5 | To enable students to learn basic concepts of immunity and the working of immune organs and familiarize them with the recommended vaccination schedule, human genetics and patterns of inheritance, aspects of animal behaviour such as foraging, courtship, nest construction, parental care and learning |

| UNIT | Details | No. of Hours | Course Objectives |
|---|---|---|---|
| I | Protozoa- Entamoeba & Paramecium. Coelenterata-Hydra, Obelia & Sea anaemone. Helminthes-Ascaris & Tapeworm. Annelida-Earthworm & Leech. Arthropoda-Spider, Centepede, Shrimp & Rhinocerous beetle. Mollusca-Pila & Oyster. Echinodermata-Starfish & Sea urchin | 12 | CO1 |
| II | Prochordata-Amphioxus & Sea Squirts<br>Pisces-Echenis, Shark & Anguilla<br>Amphibia- Frog & Salamender<br>Reptila- Snake & Lizard<br>Aves-Pigeon & Horn bill<br>Mammalia- Bat & Rabbit | 12 | CO2 |
| III | Dissection: Earthworm-Body setae<br>Scales in fishes-Ctenoid & Placoid | 12 | CO3 |
| IV | Respiratory pigments, Excretory products, blood clotting, neuron, vision, hearing<br>Fertilization, cleavage, gastrulation in frog, placenta in mammals | 12 | CO4 |
| V | Structure of antibody, immune organs-bone marrow, thumus, lymph node and spleen.<br>X linked inheritance-Haemophilia and color blindness. Sex determination<br>Foraging, courtship behavior and nest construction of | 12 | CO5 |

| | | | |
|---|---|---|---|
| | birds, parental care in frog, learning process in mammals | | |
| | **Total** | **60** | |
| **Course Outcomes** | | | |
| **Course Outcomes** | On completion of this course, students will; | | |
| **CO1** | Recall the characteristic features invertebrates and chordates. | PO1 | |
| **CO2** | Classify invertebrates up to class level and chordates up to order level, structural and functional organisation of some invertebrates and chordates, adaptations and habits of animals to their habitat | PO1, PO2 | |
| **CO3** | Recall the parts and working of body organs and developmental stages, name the patterns of inheritance and list different types of animal behavior and to analyse the different developmental stages | PO4, PO6 | |
| **CO4** | Analyse the working of body and immune systems, understand the different patterns of inheritance | PO4, PO5, PO6 | |
| **CO5** | Gain the knowledge on relationship the behaviour of animals to physiology. Analyse the different types of behaviour | PO3, PO8 | |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | | | |
| 1. | Boradale, L.A. and Potts, E.A. (1961). *Invertebrates: A Manual for the use of Students*. Asia Publishing Home. | | |
| 2. | Lal, S.S. 2005. A text Book of Practical Zoology: Invertebrate, Rastogi, Meerut | | |
| 3. | Lal S S, 2009. Practical Zoology Vertebrate, Rajpal and Sons Publishing, 484pp. | | |
| 4. | Verma P.S,2000.AManual of Practical Zoology: Chordates, S.Chand Limited, 627pp. | | |
| **Methods of Evaluation** | | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks | |
| | Assignments | | |
| | Seminars | | |
| | Attendance and Class Participation | | |
| **External Evaluation** | End Semester Examination | 75 Marks | |
| | Total | 100 Marks | |
| **Methods of Assessment** | | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | | |
| **Application** | Suggest idea/concept with examples, Suggest formulae, Solve problems, | | |

| | |
|---|---|
| **(K3)** | Observe, Explain |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | | | S | | S | | |
| **CO 4** | | | | S | S | M | | |
| **CO 5** | | | S | | | | | S |

| **Course Code SEC1** | **Course Name** | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst. Hours** | **Marks** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | **CIA** | **External** | **Total** |
| **U23SEZ1** | **Ornamental Fish Farming and Management** | Core | Y | - | - | - | 2 | 2 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | | Entrepreneurship oriented | ✓ | Addresses Gender Sensitization | |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

**Learning Objectives**

| | |
|---|---|
| CO1 | To highlight the importance of ornamental fish culture in relation to entrepreneurship development. |
| CO2 | To enable the identification, culture and maintenance of commercially important ornamental fishes. |
| CO3 | To provide the knowledge on the techniques of ornamental fish breeding, rearing, disease control and economics of ornamental fish farming. |
| CO4 | To understand the knowledge on fish diseases and their control |
| CO5 | To address the awareness of marketing and management |

| UNIT | Details | No. of Hours | |
|---|---|---|---|
| I | Introduction to ornamental fish keeping. Scope and importance of ornamental fish culture.<br>Domestic and global scenario of ornamental fish trade and export potential.<br>Commercially important ornamental fishes - Indigenous and exotic varieties. | 6 | CO1 |
| II | Biology of egg layers and live bearers. Food and feeding in ornamental fishes. Formulated feed and Live feed; Live feed culture-Artemia. Breeding, hatchery and nursery management of egg layers (eg. Goldfish) and live bearers (eg.Guppy). | 6 | CO2 |
| III | Aquarium design and construction; Accessories - aerators, filters and lighting. Aquarium plants (Valliseneria, Salvinia, Bacopa, Elodea and Hydrilla). Maintenance of aquarium and water quality management. | 6 | CO3 |
| IV | Ornamental fish diseases, their prevention, control and treatment methods. | 6 | CO4 |
| V | Conditioning, packing, transport and quarantine methods. Economics and export marketing strategies. | 6 | CO5 |
| | **Total** | **30** | |

**Course Outcomes**

| Course Outcomes | On completion of this course, students will; | |
|---|---|---|
| **CO1** | The students will be able to identify, culture, maintain and market the commercially important ornamental fishes. | PO1 |
| **CO2** | The knowledge and skills gained on the different aspects of ornamental fish keeping will enable the students to develop entrepreneurship potential and help in self employment. | PO1, PO2 |

| | | |
|---|---|---|
| **CO3** | Understand the aquarium construction and management | PO4, PO6 |
| **CO4** | Gain the knowledge on fish diseases and their control strategies | PO4, PO5, PO6 |
| **CO5** | Envisage about entrepreneurship on Ornamental fish culture | PO3, PO8 |
| **Text Books (Latest Editions)** | | |
| 1. | Swain SK., Sarangi N. and Ayyappan S. 2010. Ornamental fish farming. ICAR, New Delhi. | |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | | |
| 1. | Living Jewels – A handbook on freshwater ornamental fish, MPEDA, Kochi. | |
| 2. | Dey V.K.A. 1997. A handbook on aquafarming ornamental fishes. MPEDA, Kochi. | |
| 3. | Ahilan, B., Felix N. and Santhanam R. 2008. Text book of aquariculture. Daya Publishing House, New Delhi. | |
| **Web Resources** | | |
| 1. | http://ecoursesonline.iasri.res.in/course/view.php?id=297 | |
| 2. | https://www.ofish.org/ | |
| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | S | | |
| **CO 2** | M | | | | | | | S |
| **CO 3** | | | S | | | S | M | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **CO 4** | | | | M | | S | S | |
| **CO 5** | S | | | | | | | M |

**S - Strong (8)** **M - Medium (4)** **L - Low (0)**

| Course Code | Course Name | Category | L | T | P | S | Credits | Inst. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CIA | External | Total |
| U23FZ1 | **Fundamentals of Zoology** | Part IV | Y | - | - | - | 2 | 2 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional | | Skill Development Oriented | ✓ | Addresses Environment and | |

| | | | | | |
|---|---|---|---|---|---|
| need | | | | Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

| Learning Objectives | | | |
|---|---|---|---|
| CO1 | To create an awareness about the various branches of Zoology, animal species and their characteristics and its scope | | |
| CO2 | To understand the diversity of animals, and their systematics | | |
| CO3 | To investigate various levels of organisation in animals and to learn about various cellular organelles and their function in Prokaryotes and Eukaryotes | | |
| CO4 | To understand the structure and functions of biomolecules and to comprehend the Mendelian inheritance and HGP | | |
| CO5 | To explore the Principles behind Molecular Biology , Biotechnology and Bioinformatics | | |
| **UNIT** | **Details** | **No. of Hours** | **Course Objectives** |
| I | Biology-Definition- Zoology-Branches of Zoology- Interdisciplinary areas of Zoology; Scope of Zoology.<br><br>Introduction to living organisms; Characteristics- Diversity and complexity of Living organisms. Properties of life-Order-Response to stimuli, Adaptation, Growth and Development, Reproduction, Homeostasis. | 6 | CO1 |
| II | Systematics: Classification of Living Organisms- Two kingdom and Five Kingdom Concept-Nomenclature of Living Organisms- Binomial Nomenclature; Diversity of Life- Invertebrates, Chordates, Bacteria. Virus and Fungi with examples | 6 | CO2 |
| III | Levels of Organisation Cells, Tissues, Organs, Organ systems-Symmetry-Diploblastic and triploblastic organisms-segmentation of body- Notochord<br><br>Introduction to cell structure- Prokaryotic and Eukaryotic organisms- Examples. Cellular components of Prokaryotic and Eukaryotic organisms | 6 | CO3 |
| IV | Chemistry of Life-Biomolecules-An overview of Structure and functions of important Biomolecules - Carbohydrates, Proteins, lipids and Nucleic acids.<br><br>Genetics- Chromosomes and Genes- Mendel's Laws of Inheritance-Karyotype – Human Genome Project | 6 | CO4 |
| V | Molecular Biology-A brief Introduction of Central Dogma-Replication-Transcription-Translation-Protein synthesis<br><br>Biotechnology- Definition- Recombinant DNA | 6 | CO5 |

| | | | |
|---|---|---|---|
| | technology- Gene Cloning.<br><br>Bioinformatics-Biological databases-types -significance | | |
| | | **30** | |
| **Course Outcomes** | | | |
| | On completion of this course, students will; | | |
| **CO1** | increase the awareness and appreciation of various animal species and their characteristics | PO1 | |
| **CO2** | develop an understanding about classification of animals and nomenclature | PO1, PO2 | |
| **CO3** | distinguish between Prokaryotic and Eukaryotic cells and analyse the various cellular organelles | PO4, PO5 | |
| **CO4** | comprehend the basic structure of biologically important molecules and also the basic Principles of Genetics | PO4, PO5, PO6 | |
| **CO5** | understand the core concepts and fundamentals of Molecular Biology , Biotechnology and Bioinformatics | PO3, PO8 | |
| **Text Books<br>(Latest Editions)** | | | |
| 1. | Ekambaranatha Iyer, 2000. A Manual of Zoology, 10th edition, Viswanathan, S., Printers & Publishers Pvt Ltd | | |
| 2. | Kotpal. R.L. A, Modern text book of Zoology Vertebrates- Rastogi publications. 2009 | | |
| 3. | Verma P.S. and Agarwal V.K. (2016) Cell Biology (Cytology, Biomolecules, Molecular Biology), Paperback, S. Chand and Company Ltd. | | |
| 4. | Verma P. S. and V. K. Agarwal., 2018. Genetics, S. Chand & Company Pvt Ltd. | | |
| 5. | Ignacimuthu, S., 2008. Basic Biotechnology, Tata McGraw hill, New Delhi. | | |
| **References Books<br>(Latest editions, and the style as given below must be strictly adhered to)** | | | |
| 1. | Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition. | | |
| 2. | Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press. | | |
| 3. | Powar, C.B., 1989. Essential of Cytology, Himalaya Publishing House, Bombay . | | |
| 4. | Russel, Peter J. 2013. iGenetics: A Molecular Approach, Pearson | | |
| 5. | Dubey R. C., 2014. A text Book of Biotechnology, S. Chand & Co Ltd, Ram Nagar, New Delhi | | |
| **Web Resources** | | | |
| 1. | https://www.nationalgeographic.com/animals/invertebrates/ | | |
| 2. | https://www.nationalgeographic.com/animals/vertebrates/ | | |
| 3. | https://go.nature.com/2XE8V1q | | |
| 4. | https://iopscience.iop.org/article/10.1088/1755-1315/492/1/012035/pdf | | |
| **Methods of Evaluation** | | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks | |
| | Assignments | | |

| | | |
|---|---|---|
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | | | S | S | | | |
| **CO 4** | | | | S | S | M | | |
| **CO 5** | | | S | | | | | S |

**S-Strong (3) M-Medium (2) L-Low (1)**

# SEMESTER-II

**SEMESTER - II**

| Course Code CC3 (T) | Course Name | Category | L | T | P | S | Credits | Inst. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CIA | External | Total |
| U23CZ3 | CHORDATA | Core | Y | - | - | - | 5 | 5 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | ✓ | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

| Learning Objectives | |
|---|---|
| CO1 | To understand the structures and distinct features of Phylum Chordata. |
| CO2 | To understand and able to distinguish the characteristic features of each subphylum and class. |
| CO3 | To understand the economic importance of vertebrates |
| CO4 | To know about the adaptations of vertebrates |
| CO5 | To understand the evolutionary position of different groups of vertebrates |

| UNIT | Details | No. of Hours | Course Objectives |
|---|---|---|---|
| I | **TAXONOMY AND PHYLUM CHORDATA**<br>Chordates characteristics, Outline classification up to class level with examples.<br>Cephalochordate -Amphioxus: External morphology, Digestive System and Excretory System only.<br>Uro-chordata – Tadpole larva and Retrogressive metamorphosis in Ascidian,<br>Hemichordate – Balanoglossus external morphology and Affinities of Hemichordate. | 15 | CO1 |
| II | **PISCES AND AMPHIBIANS**<br>General Characters and Classification of Fishes and Amphibians up to order level with examples.<br>Pisces -Shark: External Morphology and Digestive System only, Migration of Fishes-<br>Agnatha- Petromyzon -External morphology**,**<br>Amphibia: General characters and classification - *Rana hexadactyla* - External Morphology and Respiratory system only, Parental Care in Amphibians. | 15 | CO2 |
| III | **REPTILES**<br>General Characters and Classification of Reptiles up to orders with examples. Calotes: External Morphology, | 15 | CO3 |

| | | | |
|---|---|---|---|
| | Heart, Arterial and Venous system only.<br>Snakes of India - Poisonous and non-poisonous snakes – Identification and biting mechanism. Origin, Dominance and Decline of Mesozoic reptiles. | | |
| IV | **AVES**<br>General Characters and Classification of Aves up to orders with examples. ***Columba livia*** **-Pigeon:** External Morphology, Respiratory System, Synsacrum, Pectoral and Pelvic girdles only- Flightless Birds. | 15 | CO4 |
| V | **MAMMALS**<br>General Characters and Classification of Mammals up to orders with examples- General Characters of Prototherians, Metatherians and Eutherians with examples.<br>Rabbit: External Morphology, Excretory system and Reproductive System only - Dentition in mammals - Adaptation of aquatic mammals. | 15 | CO5 |
| | **Total** | **75** | |

**Course Outcomes**

| **Course Outcomes** | On completion of this course, students will; | |
|---|---|---|
| **CO1** | Classify, Identify and recall the name and distinct features of different subphylum belonging to phylum Chordata. | PO1 |
| **CO2** | Explain, and relate the origin, structural organization and evolutionary aspects of vertebrates. | PO1, PO2 |
| **CO3** | Analyze, compare and distinguish the developmental stages and describe the important biological process. | PO3, PO4, PO5 |
| **CO4** | Correlate the different modes of life and parental care among different vertebrates. | PO3, PO5, PO6 |
| **CO5** | Summarise the morphology and ecological adaptations in vertebrates and list out the economic importance. | PO2, PO3, PO5, PO8 |

**Text Books**
**(Latest Editions)**


| | |
|---|---|
| 1. | Ayyar, E.K. and T.N. Ananthakrishnan, 1992. Manual of Zoology Vol. II (Chordata), S. Viswanathan (Printers and Publishers) Pvt Ltd., Madras, 891p. |
| 2. | Jordan, E.K. and P.S. Verma, 1995. Chordate Zoology and Elements of Animal Physiology, 10th edition, S. Chand & Co Ltd., Ram Nagar, New Delhi, 1151 pp. |
| 3. | Nigam, H.C., 1983. Zoology of Chordates, Vishal Publications, Jalandhar - 144008, 942. |
| 4. | Ganguly, Sinha,. Bharati Goswami and Adhikari, 2004. Biology of animals Vol.II - New central book Agency (p) Ltd. |

| | |
|---|---|
| 5. | Kotpal. R.L. A, Modern text book of Zoology Vertebrates- Rastogi publications. 2009 |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | |
| 1. | Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub. Co. |
| 2. | Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc. |
| 3. | Hickman, C.P. Jr., F.M.Hickman and L.S. Roberts, 1984. Integrated Principles of Zoology, 7th Edition, Times Merror/Mosby College Publication. St. Louis. 1065 pp. |
| 4. | Newman, H.H., 1981. The Phylum Chordata, Satish Book Enterprise, Agra – 282 003, 477 pp. |
| 5. | Parker and Haswell, 1964. Text Book of Zoology, Vol II (Chordata), A.Z.T,B.S. Publishers and Distributors, New Delhi - 110 051, 952 pp. |
| 6. | Pough H. Vertebrate life, VIII Edition, Pearson International. |
| 7. | Waterman, Allyn J. et al., 1971. Chordate Structure and Function, Mac Millan &Co., New York, 587 pp. |
| 8. | Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press. |
| **Web Resources** | |
| 1. | http://tolweb.org/Chordata/2499 |
| 2. | https://www.nhm.ac.uk/ |
| 3. | https://bit.ly/3Av1Ejg |
| 4. | https://bit.ly/3kqTfYz |
| 5. | https://biologyeducare.com/aves/ |
| 6. | https://www.vedantu.com/biology/mammalia |

**Methods of Evaluation**

| | | |
|---|---|---|
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |

**Methods of Assessment**

| | |
|---|---|
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge |
| **Evaluate** | Longer essay/ Evaluation essay, Critique or justify with pros and cons |

| | |
|---|---|
| **(K5)** | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | S | S | S | S | S | | S |
| **CO 4** | | | S | S | S | M | | |
| **CO 5** | | | S | | S | | | S |

**S-Strong (3) M-Medium (2) L-Low (1)**

| **Course Code** | **Course Name** | **C** | **L** | **T** | **P** | **S** | | | **Marks** |
|---|---|---|---|---|---|---|---|---|---|

| CC4 (P) | | ategory | | | | | Credits | Inst. Hours | CIA | External | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| U23CZ4P | CHORDATA PRACTICAL | Core | Y | - | - | - | 3 | 3 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | ✓ | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

**Learning Objectives**

| | |
|---|---|
| CO1 | To understand the structures and distinct features of phylum chordata. |
| CO2 | To understand and able to distinguish the characteristic features of each subphylum and class. |
| CO3 | To understand and compare the structure of various internal organs in different classes of vertebrates. |
| CO4 | To know about the classification, adaptations and affinities of chordate animals. |

| UNIT | Details | No. of Hours | Course Objectives |
|---|---|---|---|
| I | **Dissections**: Fish: External features, Digestive system, Male and female urinogenital system. | 12 | CO1 |
| II | **Mounting**: Fish: Placoid and Ctenoid scales, | 6 | CO2 |
| III | **Osteology**: Frog: Skull and lower jaw, Vertebral column, Pectoral Girdle, Pelvic girdle, Fore limb, Hind limb. Pigeon - skull and lower jaw, synsacrum. | 9 | CO3 |
| IV | Prochordata: Amphioxus, Amphioxus - T.S. through pharynx, Balanoglossus, Ascidian.<br>Agnatha: Petromyzon.<br>Pisces: Narcine, Echeneis, Hippocampus, Eel, Catla. Tilapia.<br>Amphibian: Bufo, Rhacophorus, Ichthiophis. Salamander.<br>Reptilia: Poisonous Snakes: Cobra, Krait, and Viper. Non-Poisonous Snakes: Dryophis and Ptyas.<br>Lizards - Chaemeleon and Draco.<br>Aves: Pectoral and Pelvic girdle of Pigeon, Archaeopteryx.<br>Mammals: Bat, Loris. | 15 | CO4 |
| V | Animal collection / Field trip to visit places of biological importance and recorded. | 3 | CO5 |
| | **Total** | **45** | |

| Course Outcomes | | |
|---|---|---|
| **Course Outcomes** | On completion of this course, students will; | |
| **CO1** | Identify and recall the name and distinct external and internal features of animals belonging to phylum Chordata. | PO1 |
| **CO2** | Explain the structural organization of various organs and systems in different classes of vertebrates. | PO1, PO2 |
| **CO3** | Analyse, compare and distinguish the morphological features and developmental stages of chordates | PO4, PO6 |
| **CO4** | Dissect and explain various organs and internal systems in different vertebrates and correlate its function. | PO4, PO5, PO6 |
| **CO5** | Summarise the morphology and ecological adaptations in vertebrates and list out the economic importance. | PO3, PO8 |
| **Text Books (Latest Editions)** | | |
| 1. | Lal S S, 2009. Practical Zoology Vertebrate, Rajpal and Sons Publishing, 484pp. | |
| 2. | VermaP.S,2000.AManual of Practical Zoology: Chordates, S.Chand Limited, 627pp. | |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | | |
| 1. | Robert William Hegner, 2015. Practical Zoology, BiblioLife, 522pp. | |
| 2. | Young, J,Z., 1972. The life of vertebrates. OxfordUni. London. | |
| **Web Resources** | | |
| 1. | https://www.youtube.com/watch?v=b04hc_kOY10 | |
| 2. | https://bit.ly/3CzTEy8 | |
| 3. | http://tolweb.org/Chordata/2499 | |
| 4. | https://www.nhm.ac.uk/ | |
| 5. | https://bit.ly/3Av1Ejg | |
| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application** | Suggest idea/concept with examples, Suggest formulae, Solve problems, | |

| | |
|---|---|
| **(K3)** | Observe, Explain |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | | | S | | S | | |
| **CO 4** | | | | S | S | M | | |
| **CO 5** | | | S | | | | | S |

**S-Strong (3)** **M-Medium (2)** **L-Low (1)**

| **Course** | **Course Name** | **C** | **L** | **T** | **P** | **S** | | | **Marks** |
|---|---|---|---|---|---|---|---|---|---|

| Code GEC3 (T) | | ategory | | | | | Credits | Inst. Hours | CIA | External | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| U23GZ27 | Allied Zoology – II | Core | Y | - | - | - | 4 | 4 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | ✓ | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

**Learning Objectives**

| | |
|---|---|
| CO1 | To enable students to learn basic concepts relating to aspects of respiratory, circulatory, excretory nervous and sensory physiology. |
| CO2 | To enable students to comprehend the processes involved during development |
| CO3 | To enable students to learn basic concepts of immunity and the working of immune organs and familiarize them with the recommended vaccination schedule |
| CO4 | To enable students to comprehend the basic concepts of human genetics and patterns of inheritance |
| CO5 | To enable students to learn about aspects of animal behaviour such as foraging, courtship, nest construction, parental care and learning |

| UNIT | Details | No. of Hours | Course Objectives |
|---|---|---|---|
| I | Respiration- Respiratory pigments and transport of gases. Mechanism of blood clotting. Typesofexcretoryproducts– Ornithinecycle.Structureofneuron–Conductionofnerve impulse. | 12 | CO1 |
| II | Fertilization, Cleavage, Gastrulation and Organogenesis of Frog-Development of brain in frog; Placentation in mammals. | 12 | CO2 |
| Immunity III | IInnate and Acquired - Active and Passive; Antigens and Antibodies; Immunological organs–responses in humans; Vaccination schedule | 12 | CO3 |
| IV | Human Genetics: Human Chromosomes – Sex Determination in Humans; Patterns of Inheritance: Autosomal Dominant, Autosomal Recessive, X-linked, Y-linked, Multiple Allelic inheritance-ABO blood group and Polygenic inheritance-skin color in man; Genetic Counselling | 12 | CO4 |

| | | | |
|---|---|---|---|
| V | Animal Behaviour: Foraging, Courtship Behaviour, Shelter and Nest Construction, Parental Care, Learning Behaviour | 12 | CO5 |
| | **Total** | **60** | |

| **Course Outcomes** | | |
|---|---|---|
| **Course Outcomes** | On completion of this course, students will; | |
| **CO1** | Recall the parts and working of body organs and developmental stages, name the patterns of inheritance and list different types of animal behaviour | PO1 |
| **CO2** | Analyse the different developmental stages | PO1, PO2 |
| **CO3** | Analyse the working of body and immune systems | PO4, PO6 |
| **CO4** | Analyse the different patterns of inheritance | PO4, PO5, PO6 |
| **CO5** | Relate the behaviour of animals to physiology. Analyse the different types of behaviour | PO3, PO8 |

| **Text Books (Latest Editions)** | |
|---|---|
| 1. | Verma P.S. & Agarwal - Developmental Biology, Chordata embryology S. Chand & Co. |

| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | |
|---|---|
| 1. | Owen, J. A., Punt, J. & Stranford, S. A. - Kuby Immunology. New York: W.H. Freeman & Company |
| 2. | Klug, W. S., Cummings, M. R. & Spencer, C - Concepts of Genetics. (12th ed.). New Jersey: Pearson Education |
| 3. | Mathur, R.- Animal Behaviour. Meerut: Rastogi. |
| 4. | VermaP.S.&Agarwal-DevelopmentalBiology,ChordataembryologyS.Chand&Co. |

| **Web Resources** | |
|---|---|
| 1. | Continuous Internal Assessment Test |
| 2. | Assignments |
| 3. | Seminars |
| 4. | Attendance and Class Participation |
| 5. | End Semester Examination |

| **Methods of Evaluation** | | |
|---|---|---|
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Simple definitions, MCQ, Recall steps, Concept definitions | |
| | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |

| | | |
|---|---|---|
| | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **External Evaluation** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | 75 Marks |
| | Longer essay/ Evaluation essay, Critique or justify with pros and cons | 100 Marks |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | | | S | | S | | |
| **CO 4** | | | | S | S | M | | |
| **CO 5** | | | S | | | | | S |

**S-Strong (3)** **M-Medium (2)** **L-Low (1)**

| **Course Code** | **Course Name** | **C** | **L** | **T** | **P** | **S** | | | **Marks** |
|---|---|---|---|---|---|---|---|---|---|

| SEC2 | | ategory | | | | | Credits | Inst. Hours | CIA | External | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| U23SEZ5 | BASICS OF MARINE BIOLOGY | Core | Y | - | - | - | 2 | 2 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | ✓ | Addresses Professional Ethics | |
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

**Learning Objectives**

| | |
|---|---|
| CO1 | To understand and learn the physical, chemical and biological aspects of marine environment and to gain knowledge about the management of oceans . |
| CO2 | To introduce students to the marine environment and its indigenous organisms |
| CO3 | To study the principles, concepts and facts through which the student can better understand and appreciate the nature of the sea and its inhabitants. |
| CO4 | To acquaint the student with the characteristics used to identify and classify marine plants and animals and to develop an awareness of the career possibilities available to students in this area. |

| UNIT | Details | No. of Hours | Course Objectives |
|---|---|---|---|
| I | **Marine Enviroment:** Marine environment- Classification of marine environment; Pelagic environment – Planktonic and Nektonic adaptations; Benthic environment - intertidal, interstitial and deep sea adaptations. | 6 | CO1 |
| II | **Physical Oceanography :** Physical Properties of Seawater- density, light, pressure, temperature distribution in the sea - El Nino/La Nina – global impact; Waves, Currents and Tides, Tsunami. | 6 | CO2 |
| III | **Chemical Oceanography**: Chemical composition of seawater- major and minor elements, trace elements- their importance, distribution. Chemistry of seawater constituents- concept of chlorinity and salinity - biogeochemical cycles.(nitrogen,oxygen & carbondioxide ) | 6 | CO3 |
| IV | **Biological Oceanography:** Sea as a biological environment- Plankton- classification -Phytoplankton and Zooplankton -. Primary productivity – factors affecting primary productivity. | 6 | CO4 |
| V | **Marine Pollution and Ocean Management**: Ocean pollution- kinds and quantities of pollutants, toxic effects and control measures – oil spills, plastics, nuclear waste disposal in marine environment, Eutrophication. Role of | 6 | CO5 |

| | | | |
|---|---|---|---|
| | National and international agencies and organizations in ocean management- DOD, IOI Malta, IUCN, SCAR, Marpol, Traffic. Ocean policy (India) | | |
| | **Total** | **30** | |

| **Course Outcomes** | | |
|---|---|---|
| **Course Outcomes** | On completion of this course, students will; | |
| **CO1** | Define marine ecosystem, recognize and describe the interrelationship between biology and ocean technology. | |
| **CO2** | Articulate and classify the dynamics and the physical attributes of the ocean, interpret the factors which affect the global climate. | |
| **CO3** | Identify and analyze the physical and biological factors of marine environments, and focus life in the open sea. | |
| **CO4** | Evaluate the impact of variations in abiotic factors in marine productivity and justify the role of human activities in the degradation of marine ecosystems. | |
| **CO5** | Categorize marine pollutants and develop controlling measures in collaboration with the institutions for ocean management. | |

| **Text Books (Latest Editions)** | |
|---|---|
| 1. | Thurman, Harold., 2001 Introduction to Oceanography, Prentice Hall Inc. New Jersey. 506 pp. |
| 2. | Bertness, M.D, S. D. Gaines and M.K. Hay 2000. Marine Community Ecology Sinauer Associates. |
| 3. | Grant Gross, M., 1993 Oceanography: A view of the earth (sixth edition). Prentice Hall Inc. New Jersey. |
| 4. | Fincham A. A, 1984. Basic Marine Biology. Cambridge University Press, England. 157 pp. |
| **Suggested readings** | |
| 1. | Barbara E. Curry, 2016. Advances in Marine Biology, Volume 74, Ist Edition. Academic Press ISBN: 9780128036075. |
| 2. | Peter Castro, Michael E. Huber, 2015. Marine Biology; Series Botany, Zoology, Ecology and Evolution. McGraw-Hill Education. |
| 3. | Philip V. Mladenov, 2013 Marine Biology: A very short introduction, Ist Edition. Oxford University Press. |
| 4. | Venkataraman K, Raghunathan C, Raghuraman R, Sreeraj C. R, 2012. Marine diversity in India. Zoological Survey of India, Kolkata.178 pp. |
| **Web Resources** | |
| 1. | https://www.livescience.com, |
| 2. | https://www.cbd.int |

| | | |
|---|---|---|
| 3. | https://www.icriforum.org | |
| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | L | | M | | S | | |
| **CO 4** | | | | S | S | L | | |
| **CO 5** | | | S | | | | | S |

**S - Strong (3)** **M - Medium (2)** **L - Low (1)**

| **Course Code SEC3** | **Course Name** | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst. Hours** | **Marks** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | **CIA** | **External** | **Total** |
| **U23SEZ6** | **AGRICULTURAL ENTOMOLOGY** | Core | Y | - | - | - | 2 | 2 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | ✓ | Addresses Professional | |

| | | | | | |
|---|---|---|---|---|---|
| | | | | Ethics | |
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

| **Learning Objectives** | |
|---|---|
| CO1 | Explain the basic concepts of entomology and observe the pest status of agriculture. |
| CO2 | Illustrate and examine the systemic and functional morphology of various group of agricultural insect pests. |
| CO3 | Acquire knowledge of economically important insects |
| CO4 | Compare and distinguish the general and specific characteristics integrated pest management. |
| CO5 | Highlight the applications of IPM |

| **UNIT** | **Details** | **No. of Hours** | |
|---|---|---|---|
| I | Outline classification of insects - Causes for insect assuming pest status - Methods of collection, mounting and preservation of insect pests | 6 | |
| II | Insect vectors of plant diseases, Insect pests of stored grains their preventive and curative methods, Most common insect pests of the following plants and their control measures: Paddy, Sugarcane, Groundnut, Coconut and Cotton. Locust and its control.Insect pollinators and scavenger. | 6 | |
| III | Apiculture: Introduction, types of honey bees, hive, apiary, selection of bees for apiary, Newton's bee hive, enemies and diseases of honey bees. Sericulture: Introduction, types of silk worms, silk worm races, life history of mulberry silk worm, features of sericulture industry, pests and diseases of silk worm. Lac Culture. | 6 | |
| IV | IPM, physical, mechanical, chemical and biological control methods, Pesticide application equipment. | 6 | |
| V | Introduction and steps towards IPM, Pheromones, antifeedents, repellents and biopesticide. | 6 | |
| | **Total** | **30** | |

**Course Outcomes**

| **Course Outcomes** | On completion of this course, students will; | |
|---|---|---|
| **CO1** | Examine and identify the systemic and functional morphology of various group of agricultural insect pests. | |
| **CO2** | Explain the pest status in agriculture and control measures. | |

| | | |
|---|---|---|
| **CO3** | List the economic importance of agricultural insect species. | |
| **CO4** | To compare the methods and outcomes of integrated pest management. | |
| **CO5** | Introduce the IPM methods to control the pests | |
| **Text Books (Latest Editions)** | | |
| 1. | David,BandAnanthakrishnan,T.N.2006.Generaland Applied Entomology, Second edition, Tata McGraw hill publishing company Ltd., New Delhi, India. | |
| 2. | Vasanthraj David, B. and Ramamurthy, VV. 2012. Elements of Economic Entomology, Seventh edition, Namrutha publications, Chennai. | |
| 3. | Pruthi,H.S.1969.Textbook on Agricultural Entomology, I.C.A.R.Publication, New Delhi. | |
| 4. | Awasthi, V.B. 2012. Introduction to General and Applied Entomology, third edition, Scientific publishers. | |
| **Suggested readings** | | |
| 1. | Abishek Shukla, D. 2009.A Hand Book of Economic Entomology, Vedamse Books, NewDelhi. | |
| 2. | Ministry of Agriculture,Government of India,1995.Manual on Integrated Pest Management in Rice and Cotton. | |
| 3. | John William S. 1995. Management of Natural Wealth, Loyola College Publications, Chennai. | |
| **Web Resources** | | |
| 1. | http://www.fao.org | |
| 2. | http://www.ipm.ucdavis.edu | |
| 3. | http://flybase.bio.indiana.edu/ | |
| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | | | | | S | | | |
| **CO 2** | S | | | | | | | |
| **CO 3** | | M | S | L | | M | M | S |
| **CO 4** | M | | | | | | | |
| **CO 5** | | | | | | | S | |

**S - Strong (5)** **M - Medium (4)** **L - Low (1)**

# SEMESTER-III

**SEMESTER - III**

| Course Code CC5 (T) | Course Name | Category | L | T | P | S | Credits | Inst. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CIA | External | Total |
| U23CZ5 | ANIMAL PHYSIOLOGY | Core | Y | - | - | - | 4 | 5 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | ✓ | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

| Learning Objectives | |
|---|---|
| CO1 | To familiarize students with the principles and basic facts of Animal Physiology |
| CO2 | To give students an insight about the molecular and cellular basis of physiological functions in animals. |
| CO3 | To give an idea about the regulation of organ system functions in a whole animal using a conceptual model of feedback to explain homeostasis. |
| CO4 | To make the students aware about how the structure-function relationships and its synchronization with the molecular signals. |

| UNIT | Details | No. of Hours | Course Objectives |
|---|---|---|---|
| I | **Nutrition & Respiration**<br>Nutrition: Digestion and absorption of carbohydrates proteins and lipids. Minerals &Vitamins–their deficiency. Hormonal control of digestion.<br>Types of Respiration, Respiratory pigments-structure of Haemoglobin, Transportation of gases-Bohr effect-Regulation of respiration - bronchitis, asthma. | 15 | CO1 |
| II | **Circulation & Excretion**<br>Blood- composition and functions, Mechanism of clotting. Heartbeat and its regulation - pace maker – Cardiac cycle – ECG - Pulse and blood pressure.<br>Nephron structure & mechanism of urine formation, Excretory products, Osmoregulation in fishes-salt loss and gain. | 15 | CO2 |
| III | **Muscle & Nerve Physiology**<br>Types of muscles – Ultra structure of striated muscle, Muscle contraction & properties, Neurons–structure & | 15 | CO3 |

| | | | |
|---|---|---|---|
| | types.<br>Impulse propagation, synaptic transmission, neurotransmitters - Reflex action, Nerve disorders – epilepsy, Alzheimer's disease, Parkinson's disease. | | |
| IV | **Sense Organs**<br>Structure of eye, physiology of vision, visual elements and pigments, photo chemistry of vision - Eye defects – myopia, hyperopia, presbyopia, astigmatism, cataract - Structure of ear and mechanism of hearing - Hearing impairments – deafness, labyrinthine disease - Olfactory, gustatory and tactile sense organs | 15 | CO4 |
| V | **Reproductive Physiology**<br>Endocrine glands in man - Hormones, action and disorders - Feed-back mechanism, Outlines of mechanism of hormonal activity.<br>Puberty, adolescence, pregnancy, parturition, lactation and birth control. | 15 | CO5 |
| | **Total** | **75** | |

| **Course Outcomes** | | |
|---|---|---|
| **Course Outcomes** | On completion of this course, students will; | |
| **CO1** | Be able to explain how the various organ systems are coordinated and controlled. | PO1 |
| **CO2** | Be able to list the functions of various organs in relation to physiological process. | PO1, PO2 |
| **CO3** | Be able to develop the idea of multilevel controlling and feedback mechanism in relation to various physiological functions. | PO4, PO6 |
| **CO4** | Be able to understand the basic physiological process related to adaptation, metabolism and major requirements. | PO4, PO5, PO6 |
| **CO5** | be able to correlate and understand human physiology. | PO3, PO8 |

**Text Books**
**(Latest Editions)**


| | |
|---|---|
| 1. | Agarwal R A., Anil K Srivastava., Kaushal Kumar.,1978. Animal Physiology and Biochemistry, S. Chand & Co. Ltd., New Delhi Publishing., 377 pp. |
| 2. | Ambika Shanmugam, 2001. Fundamentals of Biochemistry for Medical students, Karthik Offset Printers, Chennai, 590pp |
| 3. | Berry A.K.1998. A text book of Animal Physiology and Biochemistry. Emkay Publications, New Delhi, 320 pp. |
| 4. | Parameswaran, Ananta krishnan and Ananta Subramanian, 1975. Outlines of |

| | | |
|---|---|---|
| | Animal Physiology, S. Viswanathan (Printers & Publishers) Pvt. Ltd., 329 p p. | |
| 5. | Verma P.S., Tyagi B.S & Agarwal V.K., 2010. Animal Physiology, S. Chand & Co. Ltd., New Delhi Publishing., 417 pp. | |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | | |
| 1. | Guyton, A.C. and Hall, J.B., 2011. Text Book of Medical Physiology, 9th Edition, W.B. Sanders Company, Prism Books (Pvt.) Ltd., Bangalore., 1064 pp. | |
| | Ganong, W.F., 2019. Review of Medical Physiology, McGraw Hill, New Delhi., 340 pp. | |
| | Hill, W.R., Wyse, G.A and Anderson, M. 2016. Animal Physiology (4thedn). Sinauer Associates is an imprint of Oxford University Press; USA, 828 pp. | |
| 2. | Hoar, W.S. 1983. General and Comparative Physiology. Prentice Hall of India, New Delhi, 928 pp. | |
| 3. | Prosser C.L., 1985. Comparative Animal Physiology, Satish Book Enterprise, Agra - 282 003, 966 pp. | |
| 4. | Sarada Subrahmanyam, Madhavan Kutty, K., & Singh H.D., 2018. Text Book of Human Physiology, S. Chand & Co, New Delhi. | |
| 5. | Singh, H.R and Kumar, N. 2017. Animal physiology and biochemistry, Vishal publishing company, Jalandhar, 864 pp. | |
| 6. | Sreekumar, S. 2010. Basic physiology, PHI learning private ltd., New Delhi.210 pp | |
| 7. | Tortora G.J. & Derrickson B., 2016. Principles of Anatomy and Physiology, John Sons, Inc. 1232 pp. | |
| | Wood, D.W., 1968. Principles of Animal Physiology, Edward Arnold Ltd, London., 342 pp. | |
| **Web Resources** | | |
| 1. | https://microbenotes.com/category/biochemistry/ | |
| 2. | https://www.stem.org.uk/resources/collection/3931/animal-physiology | |
| 3. | https://animalphys4e.sinauer.com | |
| 4. | https://nptel.ac.in/courses/102/104/102104042/ | |
| 5. | https://biochem.oregonstate.edu | |
| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |

| | |
|---|---|
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | | | S | | S | | |
| **CO 4** | | | | S | S | M | | |
| **CO 5** | | | S | | | | | S |

**S-Strong (3) M-Medium (2) L-Low (1)**

| **Course Code CC6 (P)** | **Course Name** | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst. Hours** | **Marks** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | **CIA** | **External** | **Total** |
| **U23CZ6P** | **ANIMAL PHYSIOLOGY LAB COURSE** | Core | Y | - | - | - | 3 | 3 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | ✓ | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

| **Learning Objectives** | |
|---|---|
| CO1 | To understand the physiological processes that regulate body functions |
| CO2 | To strive to demonstrate the role of experimentation in developing our understanding of living animals. |
| CO3 | To measure and interpret experimental data and demonstrate laboratory skills in animal physiology. |

| | | | |
|---|---|---|---|
| CO4 | To attain knowledge and develop skills to identify the important biomolecules such as carbohydrates, proteins and lipids. | | |
| CO5 | To understand the functions of physiological apparatus, sense organs and endocrine glands. | | |
| **UNIT** | **Details** | **No. of Hours** | **Course Objectives** |
| I | Ptyalin activity in relation to temperature and pH in human saliva.<br>Osmoregulation- Estimation of salt gain and salt loss | 9 | CO1 |
| II | Estimation of Haemoglobin by Haemoglobinometer.<br>WBC - total and differential counts.<br>Total erythrocytes count by Haemocytometer. | 9 | CO2 |
| III | ABO and Rh blood grouping<br>Bleeding time and Clotting time<br>Haemin crystals | 9 | CO3 |
| IV | **Qualitative Detection of Biomolecules**:<br>Qualitative tests for identification of carbohydrates, proteins and lipids.<br>Analysis of Excretory products | 9 | CO4 |
| V | Spotters<br>Sphygmomanometer, ECG<br>Types of muscles – Striated, Non striated and cardiac<br>Neuron – structure<br>Photograph – Alzheimer's, Parkinson's diseases.<br>Structure of eye<br>Eye defects – myopia, hyperopia, presbyopia, astigmatism.<br>Structure of Ear<br>Endocrine glands in man – Pituitary and Adrenal | 9 | CO5 |
| | **Total** | **45** | |
| **Course Outcomes** | | | |
| **Course Outcomes** | On completion of this course, students will; | | |
| **CO1** | List and recall the basic equipment used in physiology and ecology lab and develop skill about quantitative determination of biomolecules and quantitative analysis of blood. | PO1 | |
| **CO2** | Demonstrate the instruments, discuss the clinical importance and its applications, and explain the principle of bioinstruments. | PO1, PO2 | |

| | | |
|---|---|---|
| **CO3** | Understand and identify the chemical composition of major and minor nutrients and analyse Physio - chemical parameters that regulate metabolism. | PO4, PO6 |
| **CO4** | Evaluate and Examine the various parameters of haematology and biochemistry and Identify the nitrogenous waste products of animals. | PO4, PO5, PO6 |
| **CO5** | Summarise the effect of various physical and chemical factors on enzyme activity/. Compile the changes in various physiological parameters in man and other animals using various tools and techniques. | PO3, PO8 |
| **Text Books (Latest Editions)** | | |
| 1. | Widmaier, E.P., Raff, H. and Strang, K.T. 2008. Vander's Human Physiology, XI Edition., McGraw Hill., 770 PP. | |
| 2. | Bishop, ML.,Fody, E.P., Schoeff, LE. 2010. Clinical Chemistry: Principles, Procedure, correlations. Wolters Kluwer, Inida, 298 PP. | |
| 3. | Burtis, C.A. and Ashwood, E.R. 2008. Tietztext book of Fundamentals of clinical chemistry and molecular diagnostics, Elsevier, Philadelphia. | |
| 4. | Tortora G.J.&Derrickson B.., 2016. Principles of Anatomy and Physiology, John Wiley and Sons, Inc. 1232 PP. | |
| 5. | Agarwal R A., Anil K Srivastava.,Kaushal Kumar.,1978. Animal Physiology and Biochemistry, S. Chand & Co. Ltd., New Delhi Publishing., 377 PP. | |
| 6. | Abhijit Dutta, 2009. Experimental biology: A Laboratory Science, Narosa, New Delhi. | |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | | |
| 1. | Hoar, W.S. 1983. General and Comparative Physiology. Prentice Hall of India, New Delhi., 928 PP. | |
| 2. | Prosser C.L., 1985. Comparative Animal Physiology, Satish Book Enterprise, Agra - 282 003, 966 PP. | |
| 3. | Wood, D.W., 1968. Principles of Animal Physiology, Edward Arnold Ltd, London.,342 PP. | |
| 4. | Guyton, A.C. and Hall, J.B., 2011. Text Book of Medical Physiology, 9th Edition, W.B. Sanders Company, Prism Books (Pvt.) Ltd., Bangalore., 1064 PP. | |
| 5. | Wilson, J.A. 1984, Principles of Animal Physiology, Macmillan Publishing., 426 PP. | |
| **Web Resources** | | |
| 1. | https://bit.ly/3hNyeFN | |
| 2. | https://www.medicinenet.com/alp_test/article.htm | |
| 3. | https://vlab.amrita.edu/?sub=3&brch=63 | |
| 4. | https://www.asbmb.org/education/online-teaching/online-lab-work | |

| | | |
|---|---|---|
| | | |
| 5. | https://open.umn.edu/opentextbooks/textbooks/687 | |
| | https://bit.ly/3lO29yP | |
| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | | | S | | S | | |
| **CO 4** | | | | S | S | M | | |
| **CO 5** | | | S | | | | | S |

**S-Strong (3)** **M-Medium (2)** **L-Low (1)**

| Course Code GEC4 (T) | Course Name | Category | L | T | P | S | Credits | Inst. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CIA | External | Total |
| | **Allied Zoology – I (Chemistry)** | Core | Y | - | - | - | 4 | 4 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | ✓ | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

**Learning Objectives**

| | |
|---|---|
| CO1 | To acquire a basic knowledge of diversity and organization of Protozoa, Coelenterata, Helminthes and Annelida |
| CO2 | To acquire a basic knowledge of diversity and organization of Arthropoda, Mollusca and Echinodermata |
| CO3 | To comprehend the taxonomic position and diversity among Protochordata, Pisces and Amphibia |
| CO4 | To comprehend the taxonomic position and diversity among Reptilia, Aves and Mammalia |
| CO5 | To acquire detailed knowledge of select invertebrate and chordate forms |

| UNIT | Details | No. of Hours | Course Objectives |
|---|---|---|---|
| I | **Diversity of Invertebrates–I**<br>Principles of taxonomy. Criteria for classification – Symmetry and Coelom–Binomial nomenclature. Classification of Protozoa, Coelenterata, Helminthes and Annelida upto classes with two examples. | 12 | CO1 |
| II | **Diversity of Invertebrates–II**Classification of Arthropoda, Mollusca and Echinodermata upto class level with examples. | 12 | CO2 |
| III | **Diversity of Chordates–I**<br>Classification of Prochordata, Pisces and Amphibia upto orders giving two examples. | 12 | CO3 |
| IV | **Diversity of Chordates–II**<br>Classification of Reptilia, Aves and Mammalia upto orders giving two examples. | 12 | CO4 |
| V | **Animal organization**<br>Structure and organization of | 12 | CO5 |

| | | | |
|---|---|---|---|
| | (i) Earthworm<br>(ii) Rabbit/Rat<br>(iii) Prawn/Fish | | |
| | **Total** | **60** | |
| **Course Outcomes** | | | |
| **Course Outcomes** | On completion of this course, students will; | | |
| **CO1** | Recall the characteristic features invertebrates and chordates. | PO1 | |
| **CO2** | Classify invertebrates up to class level and chordates up to order level | PO1, PO2 | |
| **CO3** | Explain and discuss the structural and functional organisation of some invertebrates and chordates | PO4, PO6 | |
| **CO4** | Relate the adaptations and habits of animals to their habitat | PO4, PO5, PO6 | |
| **CO5** | Analyse the taxonomic position of animals. | PO3, PO8 | |
| **Text Books (Latest Editions)** | | | |
| 1. | EkambaranathaIyer,- Outlines of Zoology Viswanathan Publication | | |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | | | |
| 1. | Ekambaranatha Iyar and T.N. Ananthakrishnian - A Manual of Zoology Invertebrata – Vol I:ViswanathanPublishers. | | |
| 2. | EkambaranathaIyar and T.N.Ananthakrishnan,-A Manual of Zoology-Invertebrata–VolII: Viswanathan Publishors. | | |
| 3. | EkambaranathaIyar and T.N. Ananthakrishnan,- A Manual of Zoology: Chordata ViswanathanPublishers. | | |
| 4. | Jordan E.L .and P.S. Verma-Invertebrate Zoology, S. Chand & Co. | | |
| **Web Resources** | | | |
| 1. | www.sanctuaryasia.com | | |
| 2. | www.iaszoology.com | | |
| **Methods of Evaluation** | | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks | |
| | Assignments | | |
| | Seminars | | |
| | Attendance and Class Participation | | |
| **External Evaluation** | End Semester Examination | 75 Marks | |
| | Total | 100 Marks | |
| **Methods of Assessment** | | | |

| | |
|---|---|
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | | | S | | S | | |
| **CO 4** | | | | S | S | M | | |
| **CO 5** | | | S | | | | | S |

**S - Strong (3)** **M - Medium (2)** **L - Low (1)**

| **Course Code** | **Course Name** | **C** | **L** | **T** | **P** | **S** | | | **Marks** |
|---|---|---|---|---|---|---|---|---|---|

| GEC5 (P) | | ategory | | | | | Credits | Inst. Hours | CIA | External | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Allied Zoology – I (Chemistry) Practical** | Core | Y | - | - | - | 4 | 4 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | ✓ | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

**Learning Objectives**

| | |
|---|---|
| CO1 | To acquire a basic knowledge of diversity and organization of Protozoa, Coelenterata, Helminthes and Annelida |
| CO2 | To acquire a basic knowledge of diversity and organization of Arthropoda, Mollusca and Echinodermata |
| CO3 | To comprehend the taxonomic position and diversity among Protochordata, Pisces, Amphibia, Reptilia, Aves and Mammalia |
| CO4 | To enable students to learn basic concepts relating to aspects of respiratory, circulatory, excretory nervous and sensory physiology. |
| CO5 | To enable students to learn basic concepts of immunity and the working of immune organs and familiarize them with the recommended vaccination schedule, human genetics and patterns of inheritance, aspects of animal behaviour such as foraging, courtship, nest construction, parental care and learning |

| UNIT | Details | No. of Hours | Course Objectives |
|---|---|---|---|
| I | Protozoa- Entamoeba & Paramecium. Coelenterata- Hydra, Obelia &Sea anaemone. Helminthes-Ascaris & Tapeworm. Annelida-Earthworm & Leech. Arthropoda- Spider, Centepede, Shrimp & Rhinocerous beetle. Mollusca-Pila & Oyster. Echinodermata-Starfish & Sea urchin | 12 | CO1 |
| II | Prochordata-Amphioxus & Sea Squirts<br>Pisces-Echenis, Shark & Anguilla<br>Amphibia- Frog & Salamender<br>Reptila- Snake & Lizard<br>Aves-Pigeon & Horn bill<br>Mammalia- Bat & Rabbit | 12 | CO2 |
| III | Dissection: Earthworm-Body setae<br>Scales in fishes-Ctenoid & Placoid | 12 | CO3 |
| IV | Respiratory pigments, Excretory products, blood clotting, neuron, vison, hearing | 12 | CO4 |

| | | | |
|---|---|---|---|
| | Fertilization, cleavage, gastrulation in frog, placenta in mammals | | |
| V | Structure of antibody, immune organs-bone marrow, thumus, lymph node and spleen.<br>X linked inheritance-Haemophilia and color blindness. Sex determination<br>Foraging, courtship behavior and nest construction of birds, parental care in frog, learning process in mammals | 12 | CO5 |
| | **Total** | **60** | |

| **Course Outcomes** | | |
|---|---|---|
| **Course Outcomes** | On completion of this course, students will; | |
| **CO1** | Recall the characteristic features invertebrates and chordates. | PO1 |
| **CO2** | Classify invertebrates up to class level and chordates up to order level, structural and functional organisation of some invertebrates and chordates, adaptations and habits of animals to their habitat | PO1, PO2 |
| **CO3** | Recall the parts and working of body organs and developmental stages, name the patterns of inheritance and list different types of animal behavior and to analyse the different developmental stages | PO4, PO6 |
| **CO4** | Analyse the working of body and immune systems, understand the different patterns of inheritance | PO4, PO5, PO6 |
| **CO5** | Gain the knowledge on relationship the behaviour of animals to physiology. Analyse the different types of behaviour | PO3, PO8 |

**References Books**
**(Latest editions, and the style as given below must be strictly adhered to)**


| | |
|---|---|
| 1. | Boradale, L.A. and Potts, E.A. (1961). *Invertebrates: A Manual for the use of Students*. Asia Publishing Home. |
| 2. | Lal, S.S. 2005. A text Book of Practical Zoology: Invertebrate, Rastogi, Meerut |
| 3. | Lal S S, 2009. Practical Zoology Vertebrate, Rajpal and Sons Publishing, 484pp. |
| 4. | Verma P.S,2000.AManual of Practical Zoology: Chordates, S.Chand Limited, 627pp. |


**Methods of Evaluation**

| | | |
|---|---|---|
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External** | End Semester Examination | 75 Marks |

| Evaluation | | |
|---|---|---|
| | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | | | S | | S | | |
| **CO 4** | | | | S | S | M | | |
| **CO 5** | | | S | | | | | S |

| **Course Code** | **Course Name** | **C** | **L** | **T** | **P** | **S** | | | **Marks** |
|---|---|---|---|---|---|---|---|---|---|

| SEC4 | | ategory | | | | | Credits | Inst. Hours | CIA | External | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| U23SEZ2 | **BIOCOMPOSTING FOR ENTREPRENEURSHIP** | Core | Y | - | - | - | 1 | 1 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | | Entrepreneurship oriented | ✓ | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

**Learning Objectives**

| | |
|---|---|
| CO1 | To highlight the importance of Biocomposting for entrepreneurship in waste management. |
| CO2 | To enable students for setting up Biocompost units and bins for waste reduction. |
| CO3 | To acquire the methods to prepare biocompostpit |
| CO4 | To understand the applications and their products of biocomposting |
| CO5 | To gain the knowledge on entrepreneurship for biocomposting |

| UNIT | Details | No. of Hours | |
|---|---|---|---|
| I | Biocomposting – Definition, types and ecological importance. | 3 | |
| II | Types of Biocomposting technology – Field pits/ground heaps/ tank/large-scale/batch and continuous methods. | 3 | |
| III | Preparation of Biocompost pit and bed using different amendments. | 3 | |
| IV | Applications of Biocompost in soil fertility maintenance, promotion of plant growth, value added products, waste reduction, etc. | 3 | |
| V | Economics of establishment of a small biocompost unit – project report proposal for Self Help Group (Income and employment generation). | 3 | |
| | **Total** | **15** | |

**Course Outcomes**

| Course Outcomes | On completion of this course, students will; | |
|---|---|---|
| **CO1** | The students will gain knowledge about the process of | PO1 |

| | | |
|---|---|---|
| | Biocomposting. | |
| **CO2** | Students will be able to demonstrate Biocomposting techniques for various end applications like solid waste management, industrial waste recycling using sugarcane bagasse, etc. | PO1, PO2 |
| **CO3** | Acquiring knowledge on biocomposting pits | PO4, PO6 |
| **CO4** | Address about biocompost products | PO4, PO5, PO6 |
| **CO5** | To gain knowledge about the economic cost of establishing small Biocompost units as a cottage industry. | PO3, PO8 |

| **References Books**<br>**(Latest editions, and the style as given below must be strictly adhered to)** | |
|---|---|
| 1. | Boradale, L.A. and Potts, E.A. (1961). *Invertebrates: A Manual for the use of Students*. Asia Publishing Home. |
| 2. | Lal, S.S. 2005. A text Book of Practical Zoology: Invertebrate, Rastogi, Meerut |
| 3. | Lal S S, 2009. Practical Zoology Vertebrate, Rajpal and Sons Publishing, 484pp. |
| 4. | Verma P.S,2000.AManual of Practical Zoology: Chordates, S.Chand Limited, 627pp. |

| **Methods of Evaluation** | | |
|---|---|---|
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |

| **Methods of Assessment** | |
|---|---|
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | | | S | | S | | |
| **CO 4** | | | | S | S | M | | |
| **CO 5** | | | S | | | | | S |

| **Course Code SEC5** | **Course Name** | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst. Hours** | **Marks** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | **CIA** | **External** | **Total** |
| **U23SEZ7** | **SERICULTURE** | SEC | Y | - | - | - | 2 | 2 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | ✓ | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

**Learning Objectives**

| | |
|---|---|
| CO1 | To understand the development of Sericulture in India and cultivation of mulberry plant. |
| CO2 | To distinguish the mulberry and non-mulberry silkworm and different stages of mulberry silkworm. |
| CO3 | To demonstrate the methods of rearing of silkworm and rearing appliances. |
| CO4 | To illustrate processing of cocoon and reeling operations. |
| CO5 | To differentiate the diseases of silkworm larva and infer information on raw silk. |

| **UNIT** | **Details** | **No. of Hours** | **Course Objectives** |
|---|---|---|---|
| I | Introduction to sericulture - history of sericulture – sericulture industry in India – role of Central Silk Board. Moriculture - varieties of mulberry – optimum conditions for mulberry growth – planting systems – methods of Propagation. | 6 | CO1 |
| II | Non-mulberry silkworms (Eri, Muga and Tasar) - Morphology of mulberry silkworm - sexual dimorphism in larva, pupa and adult. Structure and function of silk gland – life cycle of *Bombyx mori* | 6 | CO2 |
| III | Rearing of silkworm, rearing appliances, rearing | 6 | CO3 |

| | | | |
|---|---|---|---|
| | operation, maintenance of optimum temperature and humidity, chawki rearing and late age rearing. Types of Mountage. | | |
| IV | Harvesting and marketing of cocoons. Cocoon processing and reeling, Stifling, sorting, riddling and deflossing of cocoons. Appliances used for reeling and Reeling operation | 6 | CO4 |
| V | Diseases of silkworm: Protozoan – Pebrine, Bacterial - Septicemia, Viral - NPV and Fungal -Muscardine.<br>Pests of silkworm - Uzifly, Dermestid.<br>Raw silk and marketing, Raw silk testing, Silk conditioning | - - 6 | CO5 |
| | **Total** | **30** | |

**Course Outcomes**

| **Course Outcomes** | On completion of this course, students will; | |
|---|---|---|
| **CO1** | Understand the development of Sericulture in India and cultivation of mulberry plant. | PO1, PO2 |
| **CO2** | Distinguish the mulberry and non-mulberry silkworm and different stages of mulberry silkworm. | PO4, PO5, PO6 |
| **CO3** | Demonstrate the methods of rearing of silkworm and rearing appliances. | PO3, PO7 |
| **CO4** | Illustrate processing of cocoon and reeling operations. | PO4, PO5 |
| **CO5** | Differentiate the diseases of silkworm larva and infer information on raw silk. | PO3, PO6, PO8 |

**Text Books**
**(Latest Editions)**


1. Johnson, M and Kesary, M. 2008. Sericulture. 4th Edn., CSI Press.


**References Books**
**(Latest editions, and the style as given below must be strictly adhered to)**


1. Ganga, G and Sulochana Chetty, J. 2004. An Introduction to Sericulture. 2nd Edn., Oxford and IBH Pub., New Delhi.
2. Rangasamy G. 1991. Sericulture Manual I - Mulberry cultivation. Oxford and IBH Pub., Bombay.
3. Lakshmi Narasiah, M and Jaya Raji, G. 1999. Development of Sericulture. Discovery Pub., New Delhi.
4. Zing, Z.T. and Maben. 1994. Mulberry Cultivation. Oxford and IBH Pub., New Delhi.
5. Krishnaswami S. 1991. Sericulture Manual II - Silkworm rearing. Oxford & IBH Pub., Bombay.
6. Sandhya Rani G. 1998. Sericulture and Rural Development. Discovery Pub., New Delhi.


**Web Resources**

1. https://silks.csb.gov.in/

| | | |
|---|---|---|
| | | |
| 2. | https://agritech.tnau.ac.in/sericulture/ | |
| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | M | | | | | | |
| **CO 2** | | | | S | M | M | | |
| **CO 3** | | | S | | | | M | |
| **CO 4** | | | | M | S | | | |
| **CO 5** | | | M | | | | | S |

**S-Strong (3) M-Medium (2) L-Low (1) B N**

# SEMESTER -IV

**SEMESTER - IV**

| Course Code<br>CC7 (T) | Course Name | Category | L | T | P | S | | | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Total |
| U23CZ7 | **Core Industry Module - MEDICAL LAB TECHNOLOGY** | Core | Y | - | - | - | 4 | 4 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | ✓ | Addresses Professional Ethics | |
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

**Learning Objectives**

| | |
|---|---|
| CO1 | To understand the different protocols and procedures to collect clinical samples. |
| CO2 | To explain the characteristics of clinical samples. |
| CO3 | To demonstrate skill in handling clinical equipment. |
| CO4 | To evaluate the safety precautions while handling clinical samples. |
| CO5 | To summarize the control measures to avoid contamination of clinical samples. |

| UNIT | Details | No. of Hours | Course Objectives |
|---|---|---|---|
| I | **Laboratory Safety and Human Health and Hygiene :** Laboratory safety –toxic chemicals and biohazards waste- biosafety level- good laboratory practice – hygiene and health issue – physiology effect of alcohol, tobacco, smoking & junk food & its treatment - biomedical waste management. | 12 | CO1 |
| II | **Haematology :** Composition of blood and their function- collection of blood & lab procedure- haemopoiesis- types of anaemia- mechanism of blood coagulation- bleeding time- clotting time- determination of hemoglobin.Total count of RBC & WBC- Differential count WBC- blood grouping and typing- haemostasis- bleeding disorder of man. | 12 | CO2 |

| | | | |
|---|---|---|---|
| III | **Medical Microbiology and Instrumentation Techniques :** Definition and scope of microbiology- structure and function of cells - parasites - Entamoeba- Plasmodium- Leishmania and Trypanosome- Computer tomography (CT scan) – Magnetic Resonance imaging – treadmill test – PET. | 12 | CO3 |
| IV | **Medical Physiology** : Cardiovascular system- Blood pressure - Pulse – regulation of heart rate, cardiac shock. Heart sounds, Electrocardiogram (ECG) – significance – ultra sonography- Electroencephalography (EEG). | 12 | CO4 |
| V | **Diagnostic Pathology**: Handling and labelling of histology specimens - Tissue processing - processing of histological tissues for paraffin embedding, block preparation. Microtomes – types of microtome- sectioning, staining –staining methods- vital staining - mounting- problems encountered during section cutting and remedies - Frozen section techniques- freezing microtome. | 12 | CO5 |
| | **Total** | **60** | |

| **Course Outcomes** | | |
|---|---|---|
| **Course Outcomes** | On completion of this course, students will; | |
| **CO1** | Understand protocols and procedures to collect clinical samples for blood analysis and to study human physiology. | PO1 |
| **CO2** | Explain the characteristics of clinical samples. | PO1, PO2 |
| **CO3** | Demonstrate skill in handling clinical equipment. | PO4, PO6 |
| **CO4** | Evaluate the hematological and histological parameters of biological samples. | PO4, PO5, PO6 |
| **CO5** | Elaborate the role of medical laboratory techniques in health care industry. | PO3, PO8 |

| **Text Books (Latest Editions)** | |
|---|---|
| 1. | Godker, P. B. and Darshan, P, Godker, 2011. Text book of medical Laboratory Technology, Mumbai. |

| | | |
|---|---|---|
| 2. | Guyton and Hall, 2000. Text Book of medical Physiology, 10th edition, Elseiner, New Delhi. | |
| 3. | Mukerjee, K.L, 1999. Medical Laboratory Technology- Vol,I,II,III. Tata MC GrawHill, New Delhi. | |
| 4. | Sood, R, 2009. Medical Laboratory technology, Methods and interpretation | |
| **References Books**<br><br>**(Latest editions, and the style as given below must be strictly adhered to)** | | |
| 1. | Manoharan,A, and Sethuraman, 2003. Essential of Clinical Heamatology, Jeypee brothers, New Delhi. | |
| 2. | Richard, A, McPherson, Mathew, R, Pincus, 2007. Clinical and management by laboratory methods, Elsevier, Philadelphia.Published by Tata McGraw-Hill Education Pvt. Ltd., | |
| 3. | Ochei. J., A. Kolhatkar (2000). Medical Laboratory science: Theory and practice, Published by Tata McGraw-Hill Education Pvt. Ltd, First edition. | |
| **Web Resources** | | |
| 1. | https://bit.ly/3tUs8In | |
| 2. | https://bit.ly/2XKu7mT | |
| 3. | https://bit.ly/3hNS1EP | |
| 4. | https://bit.ly/2ZgrLga | |
| 5. | https://bit.ly/3hTBO1b | |
| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, Recall steps, Concept definitions | |

| | |
|---|---|
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview |
| **Application (K3)** | Suggest idea/concept with examples, Observe, Explain. |
| **Analyze (K4)** | Finish a procedure in many steps, Differentiate between various ideas, Map knowledge |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | | | S | | S | | |
| **CO 4** | | | | S | S | M | | |
| **CO 5** | | | S | | | | | S |

**S-Strong (3)** **M-Medium (2)** **L-Low (1)**

| Course Code CC8 (P) | Course Name | Category | L | T | P | S | Credits | Inst. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CIA | External | Total |
| U23CZ8P | MEDICAL LABORATORY TECHNOLOGY - LAB COURSE | Core | Y | - | - | - | 3 | 3 | 40 | 60 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | ✓ | Addresses Professional Ethics | |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

| **Learning Objectives** | |
|---|---|
| CO1 | To understand the basics of laboratory safety measures, handling of chemicals, first-aid methods and biomedical waste management. |
| CO2 | To analyse and evaluate blood samples for vital physiological parameters |
| CO3 | To estimate blood glucose level andinterpret changes in blood parameters. |
| CO4 | To gain knowledge on parasites and understand the functioning of biomedical instruments |
| CO5 | To demonstrate laboratory skills in tissue processing and analyse histological variations. |

| **UNIT** | **Details** | **No. of Hours** | **Course Objectives** |
|---|---|---|---|
| I | 1.Laboratory Safety Measures<br>2. Signs and Symbols of Biotoxic chemicals and Biosafety<br>3. First Aid – Burns, bleeding, injury, insect bites & allergy, lab accidents.<br>4. Methods of Biomedical waste disposal – open dumps, sanitary landfills, incineration | 10 | CO1 |
| II | 1. Separation of Blood components by centrifugation<br>2. Erythrocyte Sedimentation Rate – Westergren method<br>3. Haemoglobin estimation – Sahli's method<br>4. Total count of RBC & WBC<br>5. Bleeding time & Clotting time | 16 | CO2 |
| III | 1. Blood glucose estimation<br>2. Blood Pressure<br>3. Pulse rate | 10 | CO3 |
| IV | Spotters: Entamoeba, Plasmodium, Leishmania, Trypanosoma, CT, MRI, PET,ECG and EEG | 8 | CO4 |
| V | Histology – Tissue Processing – sectioning, staining and mounting - Observation | 16 | CO5 |
| | **Total** | **60** | |

| **Course Outcomes** | | |
|---|---|---|
| **Course Outcomes** | On completion of this course, students will; | |
| **CO1** | List and recall the basic laboratory safety procedures, develop skills about handling chemicals and learn first-aid methods | PO1 |
| **CO2** | Examine and evaluate various parameters of blood and | PO1, PO2 |

| | | |
|---|---|---|
| | identify abnormalities related to blood | |
| **CO3** | Estimate and interpret changes in blood glucose and blood pressure. | PO2, PO5, PO6 |
| **CO4** | Understand and summarizethe disease-causing parasites and explain the functionality of bio instruments | PO3, PO6, PO8 |
| **CO5** | Demonstrate the method of tissue processing and identify tissue pattern & changes | PO3, PO4, PO8 |
| **Text Books (Latest Editions)** | | |
| 1. | Text Book of Medical Laboratory Technology. 2006, Ramnik Sood. Jaypee Publishers. | |
| 2. | Text Book of Medical Laboratory Technology (2nd Edn). 2022, Mrinalini Sant. CBS Publishers | |
| | | |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | | |
| 1. | Medical Laboratory Technology (4th Edn.). 2022, Kanai L. Mukherjee, CBS Publishers | |
| 2. | Medical Lab Technician – Practical. 2022, Dhanalaxmi and Ramadevi. Frontline Publications | |
| 3. | Text Book of Medical Laboratory Technology. 2014, Darshan and Praful. CBS Publishers | |
| **Web Resources** | | |
| 1. | https://acikders.ankara.edu.tr . First Aid in Laboratories | |
| 2. | https://www.youtube.com/watch?v=f4MiHUJii2k ESR | |
| 3. | https://www.youtube.com/watch?v=0f9p9JX4qJk blood count | |
| 4. | https://www.youtube.com/watch?v=SwzN0rqIFcA blood glucose estimation | |
| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 40 Marks |
| | Submission of observation note books | |
| | Record completion | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 60 Marks |
| | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | Interpretation of results | |
| **Application (K3)** | Observe and explain the protocol, apply concepts for morbidity identification. | |

| | |
|---|---|
| **Analyze (K4)** | Analyse the results and gain practical knowledge based on application of concepts |
| **Evaluate (K5)** | Justify the report based on results and reading parameters |
| **Create (K6)** | Check knowledge in specific health conditions, Discussion, Debating or Presentations |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | M | | | S | S | | |
| **CO 4** | | | S | | | S | | M |
| **CO 5** | | | S | M | | | | M |

**S-Strong (7)** **M-Medium (5)**

| **Course Code GEC6 (T)** | **Course Name** | **Category** | **L** | **T** | **P** | **S** | **Credits** | **--** | **Marks** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | **CIA** | **External** | **Total** |
| **U23GZ27** | **Allied Zoology – II (Chemistry)** | Core | Y | - | - | - | 4 | 4 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | ✓ | Entrepreneurship oriented | | Addresses Gender Sensitization | |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

| **Learning Objectives** | | | |
|---|---|---|---|
| CO1 | To enable students to learn basic concepts relating to aspects of respiratory, circulatory, excretory nervous and sensory physiology. | | |
| CO2 | To enable students to comprehend the processes involved during development | | |
| CO3 | To enable students to learn basic concepts of immunity and the working of immune organs and familiarize them with the recommended vaccination schedule | | |
| CO4 | To enable students to comprehend the basic concepts of human genetics and patterns of inheritance | | |
| CO5 | To enable students to learn about aspects of animal behaviour such as foraging, courtship, nest construction, parental care and learning | | |
| **UNIT** | **Details** | **No. of Hours** | **Course Objectives** |
| I | Respiration- Respiratory pigments and transport of gases. Mechanismofbloodclotting.Typesofexcretoryproducts– Ornithinecycle.Structureofneuron–Conductionofnerve impulse, Mechanism of vision andhearing. | 12 | CO1 |
| II | Fertilization, Cleavage, Gastrulation and Organogenesis of Frog; Placentation in mammals | 12 | CO2 |
| Immunity III | Innate and Acquired - Active and Passive; Antigens and Antibodies; Immunological organs–responses in humans; Vaccination schedule | 12 | CO3 |
| IV | Human Genetics: Human Chromosomes – Sex Determination in Humans; Patterns of Inheritance: Autosomal Dominant, Autosomal Recessive, X-linked, Y-linked, Mitochondrial, Multiple Allelic and Polygenic; Genetic Counselling | 12 | CO4 |
| V | Animal Behaviour: Foraging, Courtship Behaviour, Shelter and Nest Construction, Parental Care, Learning Behaviour | 12 | CO5 |
| | **Total** | **60** | |
| **Course Outcomes** | | | |
| **Course Outcomes** | On completion of this course, students will; | | |

| | | |
|---|---|---|
| **CO1** | Recall the parts and working of body organs and developmental stages, name the patterns of inheritance and list different types of animal behaviour | PO1 |
| **CO2** | Analyse the different developmental stages | PO1, PO2 |
| **CO3** | Analyse the working of body and immune systems | PO4, PO6 |
| **CO4** | Analyse the different patterns of inheritance | PO4, PO5, PO6 |
| **CO5** | Relate the behaviour of animals to physiology. Analyse the different types of behaviour | PO3, PO8 |
| **Text Books (Latest Editions)** | | |
| 1. | Verma P.S. & Agarwal - Developmental Biology, Chordata embryology S. Chand & Co. | |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | | |
| 1. | Owen, J. A., Punt, J. & Stranford, S. A. - Kuby Immunology. New York: W.H. Freeman & Company | |
| 2. | Klug, W. S., Cummings, M. R. & Spencer, C - Concepts of Genetics. (12th ed.). New Jersey: Pearson Education | |
| 3. | Mathur, R.- Animal Behaviour. Meerut: Rastogi. | |
| 4. | VermaP.S.&Agarwal-DevelopmentalBiology,ChordataembryologyS.Chand&Co. | |
| **Web Resources** | | |
| 1. | Continuous Internal Assessment Test | |
| 2. | Assignments | |
| 3. | Seminars | |
| 4. | Attendance and Class Participation | |
| 5. | End Semester Examination | |
| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Simple definitions, MCQ, Recall steps, Concept definitions | |
| | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **External Evaluation** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | 75 Marks |
| | Longer essay/ Evaluation essay, Critique or justify with pros and cons | 100 Marks |

**Mapping with Programme Outcomes:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | | | S | | S | | |
| **CO 4** | | | | S | S | M | | |
| **CO 5** | | | S | | | | | S |

**S-Strong (3)** **M-Medium (2)** **L-Low (1)**

| Course Code SEC6 | Course Name | Category | L | T | P | S | Credits | Inst. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CIA | External | Total |
| **U23SEZ8** | **BIOINSTRUMENTATION** | Core | Y | - | - | - | 2 | 2 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | ✓ | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

**Learning Objectives**

| | | | |
|---|---|---|---|
| CO1 | To become familiar with uses of biological instruments | | |
| CO2 | To understand the principles and functions of microscopes | | |
| CO3 | To gain knowledge about centrifugation and spectrophotmetric methods | | |
| CO4 | To study the various biomedical instruments | | |
| CO5 | To understand the molecular techniques in Biology | | |
| **UNIT** | **Details** | **No. of Hours** | |
| I | **Good Laboratory Practices** : Guide lines, Laboratory symbols; Cleaning and sterilization of labware and reagents; handling and care of laboratory animals; Laminar flow hood: types and use; Concepts of molecular weight, atomic weight, preparation of solutions of a particular molarity and percentage; Buffers: definition and preparation of buffers, pH meter; Safety and ethical issues in laboratory settings | 6 | |
| II | **Microscopy** - Light microscope, SEM, TEM, Atomic force microscope; Cryopreservation - principle and procedure; Fluorescence activated cell sorting; X-ray crystallography. | 6 | |
| III | **Centrifugation** - working principle and types of centrifugation; Spectrophotometry; Mass spectrometry; Chromatography - principle and types of chromatography | 6 | |
| IV | **Biomedical Instrumentation** : ESR measurement, haemoglobin measurement, blood pressure, blood flow, ECG, cardiac pacemakers; X- ray imaging, CT scan and NMR imaging; Ultrasound imaging; medical applications of laser; Biosensors - glucose biosensor, alcohol biosensor, artificial retina, environmental biosensors, cantilever-based biosensors, DNA biosensor. | 6 | |
| V | **Molecular Techniques** : Isolation of DNA, RNA and proteins; Electrophoresis of DNA and proteins; Polymerase chain reaction; ELISA; Immunofluorescence; Fluorescent in situ hybridization; Southern and Western blotting. Crisper cross technology; Next generation sequencing, Sanger | 6 | |

| | | | |
|---|---|---|---|
| | sequencing, gene editing and gene silencing | | |
| | **Total** | **30** | |
| **Course Outcomes** | On completion of this course, students will; | | |
| **CO1** | To induce interest in the use of various biological instrumentation and employ them for the study of cells, tissues and genetic material. | | PO1 |
| **CO2** | To help students to map the use of specific bioinstrumentation for specific biological experiments and infer the results of such experiments. | | PO1, PO2 |
| **CO3** | To study the working principle of different bioinstrumentation and their applications. | | PO4, PO6 |
| **CO4** | To enable students to design experiments and justify them with the underlying principles of bioinstrumentation. | | PO4, PO5, PO6 |
| **CO5** | To acquire knowledge about molecular techniques | | PO3, PO8 |
| **Text Books (Latest Editions)** | | | |
| 1. | SabariGhosal and Anupama Sharma Avasthi, 2018. Fundamentals of Bioanalytical Techniques and Instrumentation, 2nd Ed., Phi Learning Pvt. Ltd., New Delhi, India. | | |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | | | |
| 1. | Sue Carson, Heather Miller, Melissa Srougi and Scott Witherow, 2019. Molecular Biology Techniques: A Classroom Laboratory Manual, Academic Press, New York, USA. | | |
| 2. | Aysha Divan, Janice Royds, 2013. Tools and Techniques in Biomolecular Science, Oxford Univeristy Press, UK. | | |
| 3. | Gordon M.H., Macrae R., 2012. Instrumental Analysis in the Biological Sciences, Blackie & Son Ltd., UK | | |
| 4. | Leonard Davis, Mark Dibner and James Battey, 2012. Basic Methods in Molecular Biology, Elsevier Science Publishing Co., New York, USA. | | |
| **Web Resources** | | | |
| 1. | https://bit.ly/3i5flym | | |
| 2. | https://pbiol.rsb.org.uk | | |
| 3. | https://www.nature.com/subjects/biological-techniques | | |
| **Methods of Evaluation** | | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | | 25 Marks |
| | Simple definitions, MCQ, Recall steps, Concept definitions | | |
| | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | | |
| | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | | |
| **External Evaluation** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | | 75 Marks |

| | | |
|---|---|---|
| | Longer essay/ Evaluation essay, Critique or justify with pros and cons | 100 Marks |

**Mapping with Programme Outcomes:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | S | | M |
| **CO 2** | | | S | | | | S | |
| **CO 3** | M | | | | | S | | |
| **CO 4** | S | | | | | | M | S |
| **CO 5** | M | | | | | S | | M |

**S-Strong (8)** **M-Medium (5)** **L-Low (0)**

| Course Code SEC7 | Course Name | Category | L | T | P | S | Credits | Inst. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CIA | External | Total |
| U23SEZ9 | BIOINFORMATICS | Core | Y | - | - | - | 2 | 2 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | ✓ | Addresses Professional Ethics | |
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

**Learning Objectives**

| | |
|---|---|
| CO1 | To expose themselves to the emerging field of Bioinformatics |
| CO2 | To acquire knowledge about types of biological databases |
| CO3 | To use data retrieval techniques and analyse database similarity search tools and phylogenetic studies |
| CO4 | To understand prediction of structure and function of proteins and visualization |
| CO5 | To enrich knowledge about computational drug designing methods |

| UNIT | Details | No. of Hours | Course Objectives |
|---|---|---|---|
| I | History and scope of bioinformatics. Bioinformatics and internet.. Useful bioinformatics sites., Applications of Bioinformatics | 6 | CO1, CO2 |
| II | Biological databases- classification- Nucleotide sequence databases - protein sequence databases- organism specific databases.-miscellaneous databases. Computational biology of PERL and Python-basic principle | 6 | CO1, CO2, CO4, CO5 |
| III | Data retrieval- retrieving tools –Entrez and SRS., Sequence Analysis tools – BLAST and FASTA. Sequence alignment- simple and multiple sequence alignment – local and global alignment- CLUSTAL.W . Phylogenetic studies-phylogenetic trees-PHYLIP. | 6 | CO1, CO2, CO3, CO4, CO5 |
| IV | Prediction of structure and function of proteins-Structure prediction tools and softwares- homology modelling - Visualisation tools-RASWIN, Swiss PDB viewer | 6 | CO1, CO2, CO4, CO5 |
| V | Computer Aided Drug Designing- target-lead-Structure based and ligand based designing- - Application of | 6 | CO1, CO2, CO4, CO5 |

| | | | |
|---|---|---|---|
| | Bioinformatics in drug discovery Docking (definition only). | | |
| | **Total** | **30** | |

| **Course Outcomes** | | |
|---|---|---|
| **Course Outcomes** | On completion of this course, students will | |
| **CO1** | understand the importance of Bioinformatics | PO1 |
| **CO2** | the biological databases available in the web | PO1, PO2, PO3 |
| **CO3** | retrieve the data available biological data | PO3, PO4, PO5 |
| **CO4** | know how to predict the structure of proteins | PO2, PO3, PO5, PO6, PO8 |
| **CO5** | apply the tools to design the drugs by docking | PO3, PO4, PO5, PO6, PO7, PO8 |

| **Text Books (Latest Editions)** | |
|---|---|
| 1. | Mani K and Vijayraj N. Bioinformatics for beginners. KalaikathirAchagam, 2004 |
| 2. | Bosu Oand Thukral SK. Bioinformatics-Databases, Tools and Algorithms. Oxford University Press, 2009 |
| 3. | Westhed and Twyman K. Bioinformatics. Viva books Ltd., 2006. |

| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | |
|---|---|
| 1. | Bergeron B. Bioinformatics Computing. Prentice Hall India, EE Edn., 2006 |

| **Web Resources** | |
|---|---|
| 1. | www.ncbi/nlm/gov/us |
| 2. | www.expasy.org |
| 3. | www.raswin.org |
| 4. | www.swissmodel.org |

| **Methods of Evaluation** | | |
|---|---|---|
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |

| **Methods of Assessment** | |
|---|---|
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge |

| | |
|---|---|
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | | S | S | S | S | | | S |
| **CO 3** | | S | S | S | S | S | | S |
| **CO 4** | | S | M | | | M | | |
| **CO 5** | | | | S | S | S | | S |

**S-Strong (3) M-Medium (2) L-Low (1)**

# SEMESTER - V

**SEMESTER - V**

| Course Code CC9 (T) | Course Name | Category | L | T | P | S | Credits | Inst. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CIA | External | Total |
| U23CZ9 | CELL AND MOLECULAR BIOLOGY | Core | Y | - | - | - | 5 | 5 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | ✓ | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

**Learning Objectives**

| | |
|---|---|
| **CO1** | Acquire the knowledge about the classification of fisheries breeding technique and fish preservation. |
| **CO2** | Describe, relate and summarize the structure and functions of cell organelles in the cell. Knowing the components of cells and how they work is fundamental to all biological sciences. |
| **CO3** | Understand and familiarize the structure and functions of nuclear components. Discuss the cyclic events, types of cell division and distinguish between mitosis and meiosis. |
| **CO4** | Analyze the structure and functions of DNA and RNA and their types in the cell. Discuss the mechanism associated with Gene expression and its regulation. Explain that the growth, development, and behavior of organisms are activated through the expression of genetic information in context. |
| **CO5** | Summarize that biological systems grow and change by processes based upon chemical transformation pathways and identify social and historical dimensions of biological investigation. Define and identify different types of mutations and explain the causes of mutation. |

| UNIT | Details | No. of Hours | Course Objectives |
|---|---|---|---|
| **I** | Cell Theory, structure of Prokaryotic and Eukaryotic cell, difference between Prokaryotic and Eukaryotic cell. Ultra structure and chemical composition of plasma membrane (Lamellar - model, micellar model and fluid mosaic model). Functions of plasma membrane | 15 | CO1 |
| **II** | **Mitochondria** - structure of mitochondria, biogenesis | 15 | CO2 |

| | | | |
|---|---|---|---|
| | and functions of mitochondria (Respiratory chain complex and Electron transport mechanism). Endoplasmic Recticulum, Ribosome, Golgi Bodies and Lysosomes - structure, functions and importance. | | |
| **III** | **Nucleus** - structure, functions and importance. Chromosomes - types. Giant chromosomes, Polytene chromosome and Lampbrush chromosome. Cell Division - Mitosis (cell cycle stages, cytokinesis) Meiosis (reproductive cycle stages, synoptonemal complex, recombination nodules). Comparison between meiosis and mitosis. | 15 | CO3 |
| **IV** | **DNA** - Chemical composition and structure of DNA (Watson And Crick). Types of DNA - A, B and Z, replication of DNA . Structure, types and function of RNA. | 15 | CO4 |
| **V** | **Genetic Code -**Types and Properties. Protein Synthesis - Transcription - initiation, elongation and termination; Translation - initiation, elongation and termination. Gene regulation - Operon hypothesis. Mutation - mutogens and its types. | 15 | CO5 |
| | **Total** | **75** | |
| **Course Outcomes** | | | |
| **Course Outcomes** | On completion of this course, students will; | | |
| **CO1** | Understand and appreciate the diversity of life and illustrate that fundamental structural units define the function of all living things. | PO1 | |
| **CO2** | Describe, relate and summarize the structure and functions of cell organelles in the cell. Knowing the components of cells and how they work is fundamental to all biological sciences | PO1, PO2 | |
| **CO3** | Understand and familiarize the structure and functions of nuclear components. Discuss the cyclic events, types of cell division and distinguish between mitosis and meiosis. | PO4, PO6 | |
| **CO4** | Analyze the structure and functions of DNA and RNA and their types in the cell. Discuss the mechanism associated with Gene expression and its regulation. Explain that the growth, development, and behavior of organisms are activated through the expression of genetic information in context. | PO4, PO5, PO6 | |
| **CO5** | Summarize that biological systems grow and change by processes based upon chemical transformation pathways and identify social and historical dimensions of biological investigation. Define and identify different types of mutations and explain the causes of mutation. | PO3, PO8 | |
| | **Reference Books:** | | |
| 1 | Power CB. Cell Biology. 3rd Edn., Himalaya Pub., 1983. | | |

| | | |
|---|---|---|
| | | |
| 2 | Benjamin Lewi. Genes VII. Oxford University Press, New York., 2000 | |
| 3 | David Ferifelder. Essentials of Molecular Biology. Narosa Pub., 2001 | |
| 4 | Twyman R. M. Advanced Molecular Biology. Viva Books Pvt., 2002 | |
| 5 | Verma P. S and Agarwal V. K. A Text Book of Cytology. S. Chand and Company, 1979. | |
| Internal Evaluation | Continuous Internal Assessment Test | 25 |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| External Evaluation | End Semester Examination | 75 |
| | Total | 100 |
| | **Methods of Assessment** | |
| Recall (K1) | Simple definitions, MCQ, Recall steps, Concept definitions | |
| Understand/ Comprehend (K2) | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| Application (K3) | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| Analyze (K4) | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| Evaluate (K5) | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| Create (K6) | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes**:

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** |
|---|---|---|---|---|---|---|---|---|
| **CO1** | **S** | | | | | | | |
| **CO2** | **S** | **M** | | | | | | |
| **CO3** | | | | **M** | | **S** | | |
| **CO4** | | | | **S** | **M** | **S** | | |
| **CO5** | | | **S** | | | | | **M** |

S-Strong (6) M-Medium (4) L-Low (-)

| Course Code CC10 (T) | Course Name | Category | L | T | P | S | Credits | Inst. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CIA | External | Total |
| U23CZ10 | BIOCHEMISTRY | Core | Y | - | - | - | 5 | 5 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | ✓ | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

**Learning Objectives**

| | |
|---|---|
| CO1 | Learn the structure, properties and functions of biomolecule – Carbohydrate |
| CO2 | Illustrate the structure of protein, aminoacids and their biological significance |
| CO3 | Know the structure of lipids ,its biological importance |
| CO4 | Analyze enzymes, concepts of Bioenergetics and Vitamins |
| CO5 | Understand metabolism of carbohydrate, protein and lipid |

| UNIT | Details | No. of Hours | Course Objectives |
|---|---|---|---|
| I | Classification and structure of Carbohydrates - Monosaccharides - glucose; Dissacharides - sucrose; Polysaccharides - Homopolysaccharides - starch; heteropolysaccharides - glycoprotein; Biological importance of carbohydrates | 15 | CO1 |
| II | Proteins: Classification of amino acids based on structure, solubility, size and shape. Structure of proteins - primary, secondary, tertiary and quaternary. Proteins of biological importance: Haemoglobin, Collagen. | 15 | CO2 |
| III | Lipids - Classification and functions of lipids. Simple lipids - tripalmitin, Compound lipids – lecithin, Derived lipid - cholesterol; fatty acids - classification, nomenclature, structure and properties of unsaturated fatty acids. Essential fatty acids, biological significance of fats. Complex lipids: glycerophospholipids | 15 | CO3 |
| IV | Enzymes: Properties, classification, kinetics – Michaelis Menton hypothesis; Factors affecting enzyme activity - pH, temperature, substrate concentration and enzyme concentration. Coenzymes - NADH, FAM.<br><br>Vitamins : Dietary sources, deficiency manifestation | 15 | CO4 |

| | | | |
|---|---|---|---|
| | and biological functions of fat soluble and water soluble vitamins | | |
| V | Carbohydrate metabolism– Glycolysis, Citric acid cycle. Protein metabolism - deamination, transamination and Ornithine cycle. Lipid metabolism – β oxidation of fatty acids. | 15 | CO5 |
| | **Total** | **75** | |

| **Course Outcomes** | | |
|---|---|---|
| **Course Outcomes** | On completion of this course, students will; | |
| **CO1** | Acquire knowledge in biomolecule structure with respect to Carbohydrate. | PO1 |
| **CO2** | Be able to understand the Protein - classification, properties and biological importance. | PO1, PO2 |
| **CO3** | Be able to understand the Lipid - structure and classification. | PO4, PO6 |
| **CO4** | Be able to understand the Biological significance of Enzymes and Vitamins. | PO4, PO5, PO6 |
| **CO5** | Be able to understand the metabolic pathways of biomolecules. | PO3, PO8 |

| | **Reference Books:** |
|---|---|
| I | Dr. J.L. Jain, Sunjaj Jain, Nitin Jain. (2010). - Fundamentals of biochemistry for university andCollege Students in India and Abroad S. Chand & Company Ltd., Ram Nagar, New Delhi- 110 055. |
| 2 | PremPrakash Gupta. (2009). Text book of biochemistry CBS Publishers & Distributors, New Delhi. |
| 3 | AmbikaShanmugam., (2001). Fundamentals of Biochemistry for Medical students.KartikOffsetPrinters, Chennai. 4. |
| 4 | T. Van Bruggen., (2004). Edward Staunton West, Wilbert R. Todd, Howard S. Mason, and John TextBook of Biochemistry.4th edition, Oxford and IBH Publicity Co, PVT, LTD, New Delhi. |
| 5 | Geoffrey L. Zubay., (1996). Biochemistry.4th edition, New Delhi. |
| 6 | David.L.Nelson and Michael.M.Cox (2008). Lehninger's Principles of Biochemistry. 4th edition,W.H. Freeman and CO., New York. |
| 7 | David.L.Nelson and Michael.M.Cox (2008). Lehninger's Principles of Biochemistry. 4th edition,W.H. Freeman and CO., New York. |
| 8 | Christopher K.Mathews and K.E. Van Holde (1996).Biochemistry. 2nd edition, . The BenjaminCummings Publishing Company Inc,Menlo Park. |
| 9 | Sawhney S.K., (1996). Introductory Practical Biochemistry.Narosa Publishing House, Mumbai |
| 10 | Leninger – Principles of Biochemistry. |
| 11 | West and Todd – Biochemistry 12 Hames and Hooper – Biochemistry 2nd Edn, Viva Books Pvt. Ltd. |

| | | |
|---|---|---|
| 12 | Hames and Hooper – Biochemistry 2nd Edn, Viva Books Pvt. Ltd. | |
| **Methods of Evaluation** | | |
| Internal Evaluation | Continuous Internal Assessment Test | 25 |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| External Evaluation | End Semester Examination | 75 |
| | Total | 100 |
| | **Methods of Assessment** | |
| Recall (K1) | Simple definitions, MCQ, Recall steps, Concept definitions | |
| Understand/ Comprehend (K2) | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| Application (K3) | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| Analyze (K4) | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| Evaluate (K5) | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| Create (K6) | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes**:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| **CO1** | **S** | | | | | | | |
| **CO2** | **S** | **M** | | | | | | |
| **CO3** | | | | **M** | | **S** | | |
| **CO4** | | | | **S** | **M** | **S** | | |
| **CO5** | | | **S** | | | | | **M** |

**S-Strong (6) M-Medium (4) L-Low (-)**

| Course Code CC11 (T) | Course Name | Category | L | T | P | S | Credits | Inst. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CIA | External | Total |
| U23CZ11 | **GENETICS** | Core | Y | - | - | - | 4 | 4 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | ✓ | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional | | Skill Development Oriented | | Addresses Environment and | |

| | | | | | |
|---|---|---|---|---|---|
| need | | | | Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

| Learning Objectives | | | |
|---|---|---|---|
| CO1 | To understand the basic concepts of genetics | | |
| CO2 | To understand the genetic variation | | |
| CO3 | To know the causes of mutation and its importance in evolution | | |
| CO4 | To acquire knowledge in human chromosomal defects and microbial genetics. | | |
| CO5 | To understand the role of genetic elements in the expression of genes | | |
| **UNIT** | **Details** | **No. of Hours** | **Course Objectives** |
| I | **Mendelian Genetics and Inheritance:** Mendelian genetics: Mendelian experiments, laws of Mendel, Monohybrid, Dihybrid, back and test cross; Interaction of genes: Incomplete dominance, co dominance, complementary genes, supplementary genes, inhibiting genes, lethal genes and atavism. Inheritance: Polygenic inheritance- skin colour; multiple alleles- ABO blood groups and coat colour in rabbit; extra chromosomal inheritance- shell coiling, kappa particles; sex linked inheritance – eye colour in Drosophila, colour blindness and hemophilia in man. | 12 | CO1 |
| II | **Linkage and Crossing Over**: Linkage: Linked genes, complete and incomplete linkage. Crossing over: molecular mechanisms of crossing over, kinds of crossing over, models of recombination. Chromosome mapping: inference and coincidence, haploid mapping, somatic cell hybridization. | 12 | CO2 |
| III | **Cytogenetics**: Variation in chromosome number and structure: position effect, chromosomal mutation and evolution. Gene mutation: types, molecular basis of mutation, mutational hot spots, reversion; radiation and chemical agents as mutagens; Detection of mutation - ClB method and muller-5 method. | 12 | CO3 |
| IV | **Human and Microbial Genetics:** Human genetics: Karyotype and ideogram; sex determination - Barr body technique, drumstick method; chromosomal abnormalities in humans, Pedigree analysis; diagnosis of genetic abnormalities; Eugenics, Euphenics, and Euthenics. Population genetics and evolution: gene | 12 | CO4 |

| | | | |
|---|---|---|---|
| | pool, gene frequency and genotype frequency; Hardy-Weinberg law of equilibrium. Bacterial genetics: Conjugation, transformation, transduction and chromosome mapping . | | |
| V | **Molecular Genetics:** Insertion elements, transposable elements, retro elements; integrons and antibiotic resistance cassettes; the lactose system and operon model, tryptophanoperon, role and relative positions of promoters and operators, feedback mechanism. | 12 | CO5 |
| | **Total** | **60** | |

| **Course Outcomes** | | |
|---|---|---|
| **Course Outcomes** | On completion of this course, students will; | |
| **CO1** | Understand the basis of inheritance and expression of genes. | PO1 |
| **CO2** | Correlate changes in genetic map and phenotypic changes in progeny. | PO1, PO2 |
| **CO3** | Analyse the causes of variations in cytogenetics | PO4, PO6 |
| **CO4** | Explain the role of cellular processes and different genetic elements human and microbial genes. | PO4, PO5, PO6 |
| **CO5** | Compile the factors which contribute to changes in gene expression and specify the changes which contribute to evolution. | PO3, PO8 |

| | **Text Books:** |
|---|---|
| I | David E Sadava, 1993. Cell Biology - Organelle Structure and Function, Jones Bartlett Publishers. |
| 2 | Guptha G. K., 2013. Genetics Classical to Modern, Rastogi publishers, Meerut. |
| 3 | Lewin B., 2008. Genes IX, Jones and Bartlett publishers. |
| 4 | Veer Bala Rastogi., 2019. Text Book of Genetics, Medtech |
| 5 | Verma P.S and Agarwal V.K., 2006. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Company Ltd. |
| | **References Books**<br>**(Latest editions, and the style as given below must be strictly adhered to)** |
| 1 | Cooper, Geoffrey M., 2018. The cell: A Molecular Approach, Eighth Edition, Oxford University Press. |
| 2 | De Robertis, E. D. P and E.M.F Robertis, 2017. Cell and Molecular Biology 8th Edition, LWW. |
| 3 | Dobzhansky T., 1982. Genetics and The Origin of Species, Columbia University. |

| **Web Resources** |
|---|
| https://go.nature.com/2XE8V1q |

| | | |
|---|---|---|
| https://bit.ly/3zoTt6B | | |
| https://bit.ly/2XAm7oa | | |
| **Methods of Evaluation** | | |
| Internal Evaluation | Continuous Internal Assessment Test | 25 |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| External Evaluation | End Semester Examination | 75 |
| | Total | 100 |
| | **Methods of Assessment** | |
| Recall (K1) | Simple definitions, MCQ, Recall steps, Concept definitions | |
| Understand/ Comprehend (K2) | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| Application (K3) | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| Analyze (K4) | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| Evaluate (K5) | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| Create (K6) | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes**:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| **CO1** | S | | | | | | | |
| **CO2** | | S | S | | S | | | M |
| **CO3** | | | M | M | S | L | | |
| **CO4** | | M | | | | | | |
| **CO5** | | S | S | S | M | S | | |

**S-Strong (8) M-Medium (5) L-Low (1)**

| Course Code CC12 (P) | Course Name | Category | L | T | P | S | Credits | Inst. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CIA | External | Total |
| **U23CZ12P** | **Cell and Molecular Biology, Biochemistry and Genetics Practical** | Core | Y | - | - | - | 3 | 6 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender | |

| | | | | | |
|---|---|---|---|---|---|
| | | | | Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | ✓ | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

| Learning Objectives | | | |
|---|---|---|---|
| CO1 | To understand the basic techniques to work with cells. To identify the various stages of mitosis. | | |
| CO2 | To understand and familiarize the structure and functions of nuclear components. | | |
| CO3 | To demonstrate and apply the Knowledge on biomolecule and analyze in the form of various experiments | | |
| CO4 | To understand the basis of inheritance and expression of genes. | | |
| CO5 | To understand the various chromosomal aberrations and Karyotype in man | | |
| | **Details** | **No. of Hours** | **Course Objectives** |
| **UNIT I** | **Cell Biology**<br>Blood as liquid tissue - demonstrating the different types of blood cells.<br>Preparation and identification of Salivary gland polytene chromosomes from Chironomous sp. Larva.<br>Staining for different stages of mitosis in *Allium cepa* (Onion)<br>Preparation and identification of Squamous epithelium. | 9 | CO1 |
| **UNIT II** | **Molecular Biology**<br>Genomic DNA Isolation<br>**Spotters:**<br>Structure of DNA<br>Structure of tRNA<br>Structure of mRNA<br>Structure of rRNA<br>Proteins - Structure - Primary | 9 | CO2 |
| **UNIT III** | **Biochemistry**<br>Qualitative test for Carbohydrate, Protein and Lipid.<br>Separation of amino acids by Circular Paper Chromatography.<br>Qualitative estimation of Protein – Lowry et al., method.<br>Measurement of pH in various water sample using digital pH meter. | 9 | CO3 |
| **UNIT IV** | **Genetics**<br>A Survey of Mendelian traits in man (in Class Population)<br>Identification of Barr body from human buccal smear<br>Verification of Monohybrid cross<br>Verification of Dihybrid cross.<br>Determination of Blood Grouping in man | 9 | CO4 |
| **UNIT V** | **Spotters:**<br>Identification of male and female drosophila<br>Test Cross | 9 | CO5 |

| | | | |
|---|---|---|---|
| | Klinefelter's syndrome<br>Turner 's syndrome,<br>Down Syndrome ,<br>Human Karyotype - male and female,<br>Pedigree analysis – Preparation of Pedigree chart | | |
| | **Total** | **45** | |
| **Course Outcomes** | | | |
| **Course Outcomes** | On completion of this course, students will; | | |
| **CO1** | Understand the basic techniques to work with cells and able to identify the various stages of mitosis. | PO1 | |
| **CO2** | Understand and familiarize the structure and functions of nuclear components. | PO1, PO2 | |
| **CO3** | Gain knowledge on biomolecules and their significances in the living system | PO4, PO6 | |
| **CO4** | Understand the basis of inheritance and expression of genes. | PO4, PO5, PO6 | |
| **CO5** | Understand various chromosomal aberrations and Karyotype in man | PO3, PO8 | |
| | | | |
| **1** | **REFERENCES:**<br>Poddar T, Mokhopadhyay B and Das SK. An advanced Laboratory Manual of Zoology. Macmillan Pub., 2010. | | |
| **2** | K. V. Chaitanya. Cell And Molecular Biology : A Lab Manual. Kindle Edition. PHI Publishers., 2013. | | |
| **3** | Verma PS. A Manual of Practical Zoology. S. Chand and Company Ltd., 2007. | | |
| **4** | Rajan S and Selvi Christy; Experimental Procedures in Life Sciences, Anjaana Book house., 2012 | | |
| **5** | Poddar T. Mukhopadhyays, Das S.K; An Advanced Laboratory manual of Zoology, Rajiv Beri for Mac millan. | | |
| | **Web Resources** | | |
| | www.ncbi/nlm/gov/us | | |
| | www.expasy.org | | |
| | www.raswin.org | | |
| | www.swissmodel.org | | |
| **Methods of Evaluation** | | | |
| Internal Evaluation | Continuous Internal Assessment Test | 25 | |
| | Assignments | | |
| | Seminars | | |
| | Attendance and Class Participation | | |

| | | |
|---|---|---|
| External Evaluation | End Semester Examination | 75 |
| | Total | 100 |
| | **Methods of Assessment** | |
| Recall (K1) | Simple definitions, MCQ, Recall steps, Concept definitions | |
| Understand/ Comprehend (K2) | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| Application (K3) | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| Analyze (K4) | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| Evaluate (K5) | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| Create (K6) | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes**:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| **CO1** | **S** | | | | | | | |
| **CO2** | **S** | **M** | | | | | | |
| **CO3** | | | | **M** | | **S** | | |
| **CO4** | | | | **S** | **M** | **S** | | |
| **CO5** | | | **S** | | | | | **M** |

**S-Strong (6) M-Medium (4) L-Low (-)**

| Course Code DSEC2 | Course Name | Category | L | T | P | S | Credits | Inst. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CIA | External | Total |
| **U23DZ02** | **WILDLIFE CONSERVATION AND MANAGEMENT** | Core | Y | - | - | - | 3 | 4 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | ✓ | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

| **Learning Objectives** | |
|---|---|
| CO1 | To understand and discuss the importance of wildlife, its values, modern concepts in wildlife management, and relevant conservation policies. |

| | |
|---|---|
| CO2 | To assess and instill strong foundations on wildlife policies and be familiar with a variety of laws and regulations. |
| CO3 | To analyse and design appropriate approaches to turn conflict into tolerance and coexistence, with an emphasis on the human dimensions of human-wildlife interactions. |
| CO4 | To evaluate and integrate all the related areas like Fundamentals in Ecology, Forestry, Natural Resource Conservation approaches and develop the role PVA models for protection of Endangered species. |
| CO5 | To explain the advanced scientific basis for wildlife management and discuss National and International Efforts for successful wildlife conservation. |

| UNIT | Details | No. of Hours | Course Objectives |
|---|---|---|---|
| I | **Biodiversity Extinction and Conservation Approaches**: Perspectives and Expressions. Identification and prioritization of Ecologically sensitive area (ESA). Coarse filter and fine filter approaches. Regional and National approaches for biodiversity conservation. | 12 | CO1 |
| II | **Theory and Analysis of Conservation of Populations** :<br><br>Stochastic perturbations - Environmental, Demographic, spatial and genetic stochasticity.Population viability analysis-conceptual foundation, uses of PVA models. Management Decisions for small populations using PVA models. Minimum viable populations & recovery strategies for threatened species. | 12 | CO2 |
| III | **National and International Efforts for Conservation** :<br><br>International agreements for conserving marine life, Convention on wetlands of International Importance (Ramsar convention), Conservation of Natural Resources.Overview of conservation of Forest &Grassland resources. CITES, IUCN, CBD National Forest Policy, 1988, National Wildlife Action Plan 2017-2031, Wildlife Protection Act 1972, National and State Biodiversity Action Plans and other Forests and Environmental Acts. | 12 | CO3 |
| IV | **Wildlife in India**: Wildlife wealth of India & threatened wildlife, Reasons for wildlife depletion in India, Wildlife conservation approaches and limitations. Wild life Habitat: Characteristic, Fauna and Adaptation with special reference to Tropical forest. Protected Area concept: National Parks, Sanctuaries and Biosphere Reserves, cores and Buffers, Nodes and corridors. Community Reserve and conservation Reserves. | 12 | CO4 |
| V | **Management of Wildlife**: Distribution, status. Habitat | 12 | CO5 |

| | | | |
|---|---|---|---|
| | utilization pattern, threats to survival of Slender Loris, Musk deer, Great Indian Bustard, Olive Ridley turtle. Wild life Trade & legislation, Assessment, documentation, Prevention of trade, Wild life laws and ethics. | | |
| | **Total** | **60** | |
| **Course Outcomes** | | | |
| **Course Outcomes** | On completion of this course, students will; | | |
| **CO1** | Understand and discuss the importance of wildlife, its values, modern concepts in wildlife management, and relevant conservation policies. | PO1, PO2 | |
| **CO2** | Assess and instill strong foundations on wildlife policies and be familiar with a variety of laws and regulations. | PO4, PO5 | |
| **CO3** | Analyze and design appropriate approaches to turn conflict into tolerance and coexistence, with an emphasis on the human dimensions of human-wildlife interactions. | PO3, PO6, PO8 | |
| **CO4** | Evaluate and integrate all the related areas like Fundamentals in Ecology, Forestry, Natural Resource Conservation approaches and develop the role PVA models for protection of Endangered species. | PO5, PO7 | |
| **CO5** | Explain the advanced scientific basis for wildlife management and discuss National and International Efforts for successful wildlife conservation. | PO5, PO6, PO8 | |
| **Text Books (Latest Editions)** | | | |
| 1. | Sutherland, W.J 2000. The conservation handbook: Research, Management and Policy. Blackwell Science. | | |
| 2. | Singh, S.K, 2005. Text Book of Wildlife Management. IBDC, Lucknow. | | |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | | | |
| 1. | Katwal/Banerjee, 2002. Biodiversity conservation in managed and protected areas, Agrobios, India. | | |
| 2. | Sharma, B.D, 1999. Indian Wildlife Resources Ecology and Development, Daya Publishing House, Delhi. | | |
| 3. | Moulton, M. P. & J. Sanderson, 1997. Wildlife Issues in a Changing World. St. Lucie Press. | | |
| 4. | Stephen, H.B. and V.B. Saharia,1995. Wildlife research and management. Asian and American Approaches, Oxford University Press, Delhi. | | |
| 5. | Negi, S.S. 1993. Biodiversity and its conservation in India, Indus Publishing Co., New Delhi. | | |
| 6. | Gopal, Rajesh,1992. Fundamentals of Wildlife Management, Justice Home, Allahabad, India. | | |
| **Web Resources** | | | |
| 1. | https://bit.ly/39oPj44 | | |
| 2. | https://bit.ly/3lHdEYJ | | |
| **Methods of Evaluation** | | | |

| | | |
|---|---|---|
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | M | | | | | | |
| **CO 2** | | | | S | S | | | |
| **CO 3** | | | M | | | S | | S |
| **CO 4** | | | | | M | | S | |
| **CO 5** | | | | | M | S | | S |

**S-Strong (3) M-Medium (2) L-Low (1)**

| Course Code DSEC1 | Course Name | Category | L | T | P | S | Credits | Inst. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CIA | External | Total |
| U23DZ05 | ENVIRONMENTAL BIOLOGY | Core | Y | - | - | - | 3 | 4 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | |
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | ✓ |
| Relevant to Local need | | | | Addresses human Values | |

**Learning Objectives**

| | |
|---|---|
| CO1 | To understand the structure and functions of the ecosystem. |
| CO2 | To explain the relationship between biotic and abiotic factors in an ecosystem. |
| CO3 | To know the causes and effects of climate change and habitat loss. |
| CO4 | To bring awareness about the impact of socio-economic development on the environment and the solutions put forward by the government to reduce Environmental damage. |

| UNIT | Details | No. of Hours | Course Objectives |
|---|---|---|---|
| I | **Ecosystem** : Concept of an ecosystem-Structure and function of an ecosystem- Producers, consumers and decomposers-Energy flow in the ecosystem-Ecological succession-Food chains, food webs and ecological pyramids-Introduction, types, characteristic features, structure and function of the following ecosystem : Forest ecosystem-Grassland ecosystem-Desert ecosystem-Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). | 12 | CO1 |

| | | | |
|---|---|---|---|
| II | **Population And Biological Cycles :** Structure and distribution – Growth curves - Groups, natality, Mortality - Density indices, Life study tables - factors affecting population growth -Carrying capacity. Population regulation and human population control. Complete and incomplete biogeochemical cycles - Sedimentary cycle. | 12 | CO2 |
| III | **Environmental Stresses And Management** :Global climatic pattern, global warming, atmospheric ozone, acid and nitrogen deposition. Uptake, biotransformation, elimination and accumulation of toxicants. Factors influencing bioaccumulation from food and trophic transfer. Pesticides and other chemical in agriculture, industry and hygiene and their disposal. Bio indicator and biomarkers of environmental health. Biodegradation and bioremediation of chemicals. El-Nino southern oscillation, COP Summit and Global conservation on Environment | 12 | CO3 |
| IV | **Environmental Pollution**: Definition- cause, effects and control measures of: -Air pollution - Water pollution - Soil pollution -Marine pollution - Noise pollution - Thermal pollution -Nuclear hazards. | | CO4 |
| V | **Biodiversity Conservation**: Biodiversity crisis – habitat degradation, poaching of wild life. - Socio economic and political causes of loss of biodiversity. - In situ and ex situ conservation of biodiversity -Hot spots of Biodiversity. Green peace movement - Chipko Movement - Role of government agencies: Central and State Pollution Control Boards - Ministry of Environment and Forests- National Biodiversity Authority. Awareness, Programme, NGOs, Natural Disaster Management, Legislations for environmental Protection, Bio villages – sustainable utilization and development, Environmental ethics. | 12 | CO5 |
| | **Total** | **60** | |

**Course Outcomes**

| **Course Outcomes** | On completion of this course, students will; | |
|---|---|---|
| **CO1** | Understand the fundamental structure and functions of the ecosystem. | PO1 |
| **CO2** | Assess the inter-relationship between organisms and between | PO1, PO2 |

| | | |
|---|---|---|
| | biotic and abiotic factors in an ecosystem. | |
| **CO3** | Analyze the factors that cause pollution, climate change, loss of biodiversity and depletion of resources. | PO4, PO6 |
| **CO4** | Evaluate the impact of human population growth and socio-economic development on the structure and function of the ecosystem. | PO4, PO5, PO6 |
| **CO5** | Design plans to scientifically solve environmental problems using biological tools, technologies and government policies. | PO3, PO8 |

| **Text Books (Latest Editions)** | |
|---|---|
| 1. | Matthew R. Fisher, 2018. Environmental Biology.Open Oregon Educational Resources. James Madison University. |
| 2. | Asthana, D.K. and Meera, A. 2009. A text book of environmental studies, S. Chand, New Delhi. |
| 3. | Sanyal, K. Kundu, M. and Rana, s. 2009. Ecology and environment, Books and allied, Kolkata. |
| 4. | Grant, W.E. and Swannack, T.M., 2008, Ecological Modelling, Blackwell. |
| 5. | Matthew R. Fisher, 2018. Environmental Biology.Open Oregon Educational Resources. James Madison University. |

| **References Books**<br>**(Latest editions, and the style as given below must be strictly adhered to)** | |
|---|---|
| 1. | Odum E.P.1983. Basic Ecology, Saunders, New York |
| 2. | Wilkinson, D.M., 2007, Fundamental Processes in Ecology: An Earth system Approach, Oxford University Press, UK. |
| 3. | Saha, T.K. 2010. Ecology and Environmental biology, Books and Allied, Kolkata. |

| **Web Resources** | |
|---|---|
| 1. | https://bit.ly/2VYWOM5 |
| 2. | https://bit.ly/2VZQFiT |
| 3. | https://bit.ly/3kqdXYA |
| 4. | https://bit.ly/39rvvgt |

| **Methods of Evaluation** | | |
|---|---|---|
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |

| | | |
|---|---|---|
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |

| **Methods of Assessment** | |
|---|---|
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | | | S | | S | | |
| **CO 4** | | | | S | S | M | | |
| **CO 5** | | | S | | | | | S |

**S-Strong (3)** **M-Medium (2)** **L-Low (1)**

# SEMESTER - VI

**SEMESTER - VI**

| Course Code CC13 | Course Name | Category | L | T | P | S | | | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Total |
| U23CZ13 | GENERAL MICROBIOLOGY | Core | Y | - | - | - | 5 | 6 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | ✓ | Addresses Professional Ethics | |
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

**Learning Objectives**

| | |
|---|---|
| CO1 | To become familiar with the foundation concepts of history of Microbiology |
| CO2 | To understand the structure and functions of a typical prokaryotic cell |
| CO3 | To gain the knowledge of microscopy and staining concepts |
| CO4 | To understand and implement disposal and safety measures |

| UNIT | Details | No. of Hours | Course Objectives |
|---|---|---|---|
| I | **Introduction to microbiology**<br><br>Scope and branches of microbiology. Historical development and contributions - Leeuwanhoek, Jenner, Pasteur, Koch and Fleming. Microbial diversity – classification and taxonomy of microorganism - 5 kingdom classification of Whittaker and 3 kingdom classification of Carl Woese. Comparison of Bacteria, Archaea, Eukarya (tabular and diagrammatic). | 18 | CO1 |
| II | **Microbial techniques**<br><br>Microscopy - Principles of microscopy of Compound microscope (Monocular and Binocular microscopes). Phase contrast and Fluorescent microscopes, dark field microscope and Electron microscope. Sterilization – | 18 | CO2 |

| | | | |
|---|---|---|---|
| | principles – dry heat, moist heat, radiation, filtration and disinfection. Staining techniques – simple strain, negative stain, differential stain and acid fast stain. Cultivation of microorganism – culture media, culture methods and cultural characteristics. | | |
| III | **Introductory Mycology**<br><br>General characteristics and outline classification of fungi, Morphology of some common fungi - Mucor, Rhizopus, Aspergillus, Penicillium and Fusarium. Yeasts: General characteristics and outline classi<br><br>fication of yeasts 3. General characteristics of Lichens and Mycorrhiza. | 18 | CO3 |
| IV | **Introductory Bacteriology**<br><br>Bacterial cell structure and composition. Bacterial growth – Nutritional requirements. Factors affecting bacterial growth. Bacterial metabolism – aerobic and anaerobic respiration. Fermentation. Modes of reproduction. Role of bacteria in ecosystem. | 18 | CO4 |
| V | **Introductory Virology**<br><br>Virus Structure and Classification. Virus Entry and Viral Pathogenesis. Positive-strand RNA viruses: Picornaviruses, Flaviviruses, Togaviruses, Coronaviruses. Negative-strand and double-strand RNA viruses: Paramyxoviruses, Rhabdoviruses, Filoviruses, Bunyaviruses, Orthomyxoviruses and Reoviruses. DNA viruses: Parvoviruses, Polyomaviruses, Papillomaviruses, Adenoviruses and Baculoviruses, Herpes viruses and Poxviruses. | 18 | CO5 |
| | **Total** | **90** | |
| **Course Outcomes** | | | |
| **Course Outcomes** | On completion of this course, students will; | | |
| **CO1** | To understand history, relevance of microbiology and | PO1 | |

| | | |
|---|---|---|
| | classification of bacteria | |
| **CO2** | To understand the principles and application of various microscopes to demonstrate proficiency in handling aseptic bacteriological specimen and to learn different methods of staining bacteria | PO1, PO3,PO4, PO6, PO8, PO11 |
| **CO3** | To gain knowledge of various fungi | PO1, PO6 |
| **CO4** | To understand the structure of bacterial cells, its organelles and physiology. | PO1, PO3, PO4, PO6 |
| **CO5** | To gain knowledge on morphology and pathogenesis of variou viruses. | PO1, PO3, PO4, PO6, PO8 |
| **Text Books**<br>**(Latest Editions)** | | |
| 1. | Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom Cultivation , New Age International, New Delhi. | |
| 2. | Atlas R.M., Microbiology – fundamentals and applications, Macmillan Publishing Company, New York. | |
| 3. | Ravindra Nath, Fundamentals of Biology Courses for Biotechnology, - Vol.1, Special Bangalore University edition, Kalayani Publishers. | |
| 4. | Greenwood D, Richard CD, John S and Peuther F (1992). Medical Microbiology, 16th edition. ELBS, Churchill living stone. | |
| **References Books**<br>**(Latest editions, and the style as given below must be strictly adhered to)** | | |
| 1. | Alexopoulos C.J. and Mims C.W., Introductory Mycology, New Age International, New Delhi. | |
| 2. | Thomas M. Bell, 1965. An Introduction to General Virology, William Heinemann Medical books, London. | |
| 3. | Stanier R.Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi. | |
| 4. | Salle A.J., Fundamental Principles of Bacteriology, Tata McGraw – Hill Publishing Company Limited, New Delhi. | |

| | | |
|---|---|---|
| 5. | Pelczar .J. Chan E.C.S. and Krieg N.R., Microbiology, McGraw Hill Book Company, New York. | |
| 6. | Benson Harold J, Microbiological Applications, WCB McGraw – Hill, New York. | |
| 7. | Brock T.D. and Madigan M.T., Biology of Microorganisms, Prentice Hall of India Private Limited. | |
| 8. | Collins CH, Patricia M, and Lyne JM (1995). Collins and Lynes Microbiological Methods 7th edition. Grange, Butter Worth, Oxford. | |
| 9. | Cappucino JG and Sherman N (1996). Microbiology, A Laboratory Manual 4th edition. Benjamin Cumings Inc. California. | |
| 10. | Pelczar MJ, Chan ECS and Krieg NR (1993). Microbiology 5th edition, Tata McGraw Hill. | |
| 11. | Madigan MT, Martinko JM and Parker J (2012). Brock Biology of Microorganism, 11th edition Prentice Hall International Inc. London. | |
| **Web Resources** | | |
| 1. | https://vlab.amrita.edu/?sub=3&brch=73 | |
| 2. | https://learn.chm.msu.edu/vibl/ | |
| 3. | https://mvi-au.vlabs.ac.in/ | |
| 4. | https://virtuallab.tlc.ontariotechu.ca/intro.php | |
| 5. | https://www.merlot.org/merlot/viewMaterial.htm?id=79694 | |
| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |

| | |
|---|---|
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations |

**Mapping with Programme Outcomes:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | | | S | | S | | |
| **CO 4** | | | | S | S | M | | |
| **CO 5** | | | S | | | | | S |

**S-Strong (3) M-Medium (2) L-Low (1)**

| Course Code CC14 | Course Name | Category | L | T | P | S | Credits | Inst. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CIA | External | Total |
| U23CZ14 | **IMMUNOLOGY** | Core | Y | - | - | - | 5 | 6 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | ✓ | Addresses Professional Ethics | |
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

| **Learning Objectives** | |
|---|---|
| CO1 | To understand the fundamentals of immunology in protection against disease and also the key principles of antigen- antibody reaction in the immune system. |
| CO2 | To list basic mechanisms that regulate immune responses, describe the main steps |

| | | | |
|---|---|---|---|
| | in the generation of cells and organs of the immune system. | | |
| CO3 | To describe the basic mechanisms that provide innate immunity and antigen processing and presentation. | | |
| CO4 | To differentiate B and T cell receptors, organs, and microenvironments of the Immune System. | | |
| CO5 | To promote critical thinking and provide students with knowledge on how the immune system works building on their previous knowledge from biochemistry, genetics and cell biology. | | |
| **UNIT** | **Details** | **No. of Hours** | **Course Objectives** |
| I | **Immune Cells and Organs**: Overview of Immune System - General concepts and Haematopoeisis. Cells of the immune system - T and B-lymphocytes, NK cells; Monocytes and macrophages; Neutrophils, eosinophils, and basophils -Mast cells and dendritic cells. Organs of the Immune system: Primary lymphoid organs - Thymus and bone marrow; Secondary Lymphoid organs - Lymph nodes and spleen; Lymphatic tissues - Peyer's patches and Kupffer cells, MALT, GALT and CALT. | 18 | CO1 |
| II | **Innate and Adaptive Immunity:** Innate and Adaptive Immunity; Anatomical barriers, Inflammatory response, Cells and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral). Receptors and Signaling: Cytokines and Chemokines - General Properties of Cytokines and Chemokines. Major Histocompatibility Complex (MHC): Organization and inheritance of the MHC. Structure and cellular distributionof HLA antigens. | 18 | CO2 |
| III | **Antigen and Antibodies**: Antigens- Antigenicity and immunogenicity: Properties -foreignness, molecular size, heterogeneity. B & T epitopes, T-dependent and T-independent B cell responses. Antibodies: Structure, function and properties of the Immunoglobulins, Different classes of Immunoglobulins; antigenic determinants on antibodies (isotype, allotype and idiotype). Hybridoma technology - production of monoclonal antibodies and catalytic antibodies (abzymes). Antigens and antibody interactions – applications of agglutination and precipitation reaction. Complement - activation - classical and alternative | 18 | CO3 |

| | | | |
|---|---|---|---|
| | pathway. | | |
| IV | **Hypersensitivity and Autoimmune Diseases**: Hypersensitivity: classification and brief description of various types of hypersensitivities. Autoimmunity: cause of autoimmune diseases - classification of autoimmune diseases. Transplantation immunology: Types of grafts, immunologic basis of graft rejection, immunosuppressive therapy and clinical transplantation. | 18 | CO4 |
| V | **Clinical Immunology:** Immunity and tumors- tumor antigens (TSTA and TAA), immune response to tumors. Tumor evasion of the immune system, Immunotherapy for tumors. Immunity against - viral, bacterial and parasitic infections. Vaccines: Types and uses - Immunization schedule for children. | 18 | CO5 |
| | **Total** | **90** | |

| **Course Outcomes** | | |
|---|---|---|
| **Course Outcomes** | On completion of this course, students will; | |
| **CO1** | Understand and recall the basic structural and functional components of the immune system, compare and contrast cells with respect to origin and maturation. | PO1 |
| **CO2** | Classify and explain types of immunity, state the significance of antigen and examine their relevance to immunizations. | PO1, PO2 |
| **CO3** | Describe and differentiate the biological characteristics of the antibodies, analyze and formulate the procedure for antibody production | PO4, PO6 |
| **CO4** | Compare and rate the mechanism of various types of hypersensitivity reactions, assess and identify the different types of autoimmune diseases. | PO4, PO5, PO6 |
| **CO5** | Summarize immune responses against pathogens | PO3, PO8 |

**Text Books**
**(Latest Editions)**


| | |
|---|---|
| 1. | Kuby, J, Punt, J, Stranford, S, Jones,Pand Owen, J, 2018. Immunology, 8th Edition, W.H.Freeman Publishing, New York, 944 pp. |
| 2. | Roitt, M, Peter J. Delves, Seamus J. Martin and Dennis R. Burton, 2017. Essential Immunology, 13th Edition, Wiley-Blackwell Publishing,USA, 576 pp. |
| 3. | Coleman,R.M., 2014. Fundamental Immunology, 2nd Edition, Published by Mc Graw Hill Education India, 357 pp. |
| 4. | Raj Khanna, 2011. Immunology, Oxford University press, New Delhi. 428 pp. |
| 5. | Rao.C.V. 2011. Immunology, Narosa Publishing House, New Dehli, 426 pp. |

| References Books<br>(Latest editions, and the style as given below must be strictly adhered to) | | |
|---|---|---|
| 1. | Abul A. Andrew, Lichtman. H, Shiv. P, 2014. Cellular and Molecular Immunology, 8th Edition, Published by W.B. Saunders, 544 PP. | |
| 2. | Chapel. H, Haeney. M, Misbah. S, and Snowden. N, 2006. Essentials of Clinical Immunology, 5th Edition. Blackwell Publishing, 368 PP. | |
| 3. | William R. Clark, 1985. The Experimental Foundations of Modern Immunology, Published by Johns Hopkins University Press, New York. 326 PP. | |
| 4. | Kenneth Murphy & Casey Weaver, 2016. Janeway's Immunology, Garland Science publishers, 924 pp. | |
| **Web Resources** | | |
| 1. | https://www.aaaai.org/ | |
| 2. | https://www.bsaci.org/ | |
| 3. | https://www.immunology.org/ | |
| 4. | https://nptel.ac.in/courses/102/103/102103038/ | |
| 5. | https://microbenotes.com/category/immunology/ | |
| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **CO 3** | | | | S | | S | | |
| **CO 4** | | | | S | S | M | | |
| **CO 5** | | | S | | | | | S |

**S-Strong (3)** **M-Medium (2)** **L-Low (1)**

| **Course Code CC15 (P)** | **Course Name** | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst. Hours** | **Marks** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | **CIA** | **External** | **Total** |
| **U23CZ15P** | **Microbiology & Immunology Practical** | Core | Y | - | - | - | 3 | 6 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | ✓ | Addresses Professional Ethics | |
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

**Learning Objectives**

| | |
|---|---|
| CO1 | To understand the concepts of basic techniques of microbiology |
| CO2 | To impart the skills required to cultivate and analyse the morphology and cultural characteristics of microorganisms |
| CO3 | To develop competence in handling various techniques in immunology |
| CO4 | To gain expertise in serodiagnostic techniques |
| CO5 | To encourage students to report and justify the results of experiments in an accurate and meaningful manner |

| | **Details** | **No. of Hours** | **Course Objectives** |
|---|---|---|---|
| I | Preparation of culture media for Bacteria and Fungi<br>Isolation and cultivation of pure cultures – serial dilution, pour plate method, spread plate, streak plate method<br>Staining techniques – Negative staining, Gram's staining, Spore staining | 18 | CO1 |
| II | Cultivation of molds<br>Study on the morphology of molds | 18 | CO2 |

| | | | |
|---|---|---|---|
| | Study on yeast morphology and cultural characteristics<br>Serodiagnosis of viral infection | | |
| III | Preparation of antigen<br>Differential leucocyte count<br>Separation of lymphocytes from blood<br>Antigen – antibody interaction – precipitation reaction – Rapid Plasma Reagin Test<br>Ouchtertory Double Immuno Diffusion Test (ODD) – demonstration<br>Rocket Immuno Electrophoresis Test - demonstration | 18 | CO3 |
| IV | Agglutination Reaction – Blood grouping test – ABO and Rh<br>Widal Test – Slide test and Tube test<br>Rheumatoid Arthritis test (RA)<br>Anti streptolysin O test (ASO) | 18 | CO4 |
| V | **Spotters**<br>Compound Microscope<br>Autoclave<br>Hot Air Oven<br>Incubator<br>Colony counter<br>Lymphoid organs<br>Hybridoma Technology<br>Fermentor<br>Cell culture technique | 18 | CO5 |
| | **Total** | **90** | |

| **Course Outcomes** | | |
|---|---|---|
| **Course Outcomes** | On completion of this course, students will; | |
| **CO1** | Handle the microscope, learn methods of sterilization and preparation of various culture media, purification techniques and staining techniques | PO1, PO6 |
| **CO2** | Learn to cultivate molds and yeasts and demonstrate their cultural characteristics. Assess viral infections | PO3, PO6 |
| **CO3** | Prepare antigen, count the blood cells and learn the precipitation reaction | PO3, PO4, PO5, PO6 |
| **CO4** | Acquire practical training for qualitative and quantitative analysis of antigen and antibody interactions. | PO4, PO5, PO6, PO8 |
| **CO5** | Gain knowledge about the various instruments in Immunology and Microbiology | PO1, PO6 |

**Mapping with Programme Outcomes:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | S | | |
| **CO 2** | | | S | | | M | | |
| **CO 3** | | | M | S | M | S | | |
| **CO 4** | | | | S | M | S | | S |
| **CO 5** | M | | | | | S | | |

**S-Strong (9)** **M-Medium (5)**

| **Course Code DSEC3** | **Course Name** | **Category** | **L** | **T** |
|---|---|---|---|---|
| **U23DZ06** | **DEVELOPMENTAL BIOLOGY AND EVOLUTIONARY BIOLOGY** | Core | Y | - |

| | | | |
|---|---|---|---|
| Relevant to Global need | | Employability Oriented | |
| Relevant to National need | ✓ | Entrepreneurship oriented | |
| Relevant to Regional need | | Skill Development Oriented | |
| Relevant to Local need | | | |

| **Learning Objectives** | |
|---|---|
| CO1 | To provide knowledge on basic concepts of Developmental Biology and to understand the process of blastulation and gastrulation. |
| CO2 | To develop the understanding of organ formation and human reproductive technologies. |
| CO3 | To give an idea on applied embryology and evolution |
| CO4 | To know the role of Lamarkism, Darwinism, Mutation and Speciation in evolution |
| CO5 | To understand the evolutionary genomics and fossil records and to apply the knowledge of human evolutionary history to simulate how genetic variation within and among human populations affects risk, diagnosis, and treatment of modern diseases. |

| **UNIT** | **Details** | **No. of Hours** | **Course Objectives** |
|---|---|---|---|
| I | Basic concepts of developmental biology. Spermatogenesis – Oogenesis. Fertilization – mechanism – Parthenogenesis. | 15 | CO1 |

| | | | |
|---|---|---|---|
| | **Blastulation -** Cleavage - Planes and Patterns, - Fate map. Blastulation – Morphogenetic movements - **Gastrulation** of frog. | | |
| II | **Organogenesis** - Development of Brain in Frog. Development of Nervous system in chick. Placentation in Mammals.<br>**Human Embryology** - Reproductive organs, Menstrual cycle and menopause - Pregnancy – trimesters – development. Twins – types. Infertility – causes - Test tube baby and Assisted Reproductive Technology. | 15 | |
| III | **Applied Embryology -** Organizer concept. Nuclear transplantation - teratogenesis – Embryonic stem cells & significance. Methods to culture embryo.<br><br>**Evolution:** History of evolutionary thought. Origin of prokaryotes and eukaryotes. | | |
| IV | **Lamarckism** - Neo Lamarckism - Darwinism - Neo Darwinism. Mutation and their role in evolution - Animal colouration and Mimicry. Isolating mechanisms - Modes of speciation. Convergence and parallelism - Evolutionary constancy. | 15 | |
| V | **Geographical evidences** -Palaeontological evidences. Dating of fossils - Fossil records of man. Natural selection in action of man- level of selection. Human Genome Project – Evolution and ethics. | 15 | |
| | **Total** | **75** | |

| **Course Outcomes** | | |
|---|---|---|
| **Course Outcomes** | On completion of this course, students will; | |
| **CO1** | To describe and illustrate the significance of cellular processes in embryonic development. | PO1, P02 |
| **CO2** | To relate the factors that contribute to the developmental process and illustrate the steps in morphogenesis and organogenesis. | PO1, PO2 |
| **CO3** | To correlate the involvement of specific cell types in the formation of specific organs and explain the importance of morphogens and to understand the Primordial earth and theories on origin of life | PO4, PO6 |
| **CO4** | To integrate and assess Lamarckism - Neo Lamarckism – Darwinism and to analyse various fossil records of man | PO4, PO5, PO6 |

| | | |
|---|---|---|
| **CO5** | To construct and compile the role of Human Genome Project, Evolution in the diagnosis, and treatment of diseases. | PO3, PO8 |
| **Text Books (Latest Editions)** | | |
| 1. | Lewis Wolpert 2007. Principles of development, 3rd edition, Oxford University Press, New Delhi, India | |
| 2. | Subramoniam, T. 2003. Developmental Biology, Narosa Publishing House, New Delhi, India. | |
| 3. | Ridley, M., 2004. Evolution. III Edition. Blackwell Publishing. | |
| 4. | Lull, R.S. 2010. Organic evolution, The Macmillan, New York. | |
| 5. | Minkoff, E. C. (1983). Evolutionary biology. Reading, MA: Addison-Wesley Publishing Company | |
| 6. | Sober, E. (1994). Conceptual issues in evolutionary biology. Cambridge, MA: MIT Press. | |
| 7. | Dr. Kishore R. Pawar, Dr. Ashok E. Desai, 2019. A text book of Organic Evolution, Nirali Prakashan, | |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | | |
| 1. | Gilbert S.F. 2010. Developmental Biology, Sinauer Associates, Massachusetts, USA. | |
| 2. | Balinsky, B.I. 1970. Introduction to Embryology, Philadelphia & London, UK. | |
| 3. | Berril, N.J.1971. Developmental Biology, McGraw Hill, New York, USA. | |
| 4. | Russ Hodge 2010. Developmental Biology, Facts on File, Inc., New York, USA. | |
| 5. | Levine L. 1969. Biology of the Gene. Toppan. | |
| 6. | Pedder IJ. 1972. Genetics as a Basic Guide. W. Norton & Company, Inc. | |
| 7. | Rastogi VB. 1991. A Text Book of Genetics. Kedar Nath Ram Nath Publications, Meerut, Uttar Pradesh, India. | |
| **Web Resources** | | White M |
| 1. | https://www.cdc.gov/ncbddd/developmentaldisabilities/facts.html | |
| 2. | https://anatomypubs.onlinelibrary.wiley.com/doi/full/10.1002/dvdy.20468 | |
| 3. | https://bit.ly/2XvcCXl | |
| 4. | https://bit.ly/2XAL1Vh | |
| **Methods of Evaluation** | | |

| | | |
|---|---|---|
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |

| **Methods of Assessment** | |
|---|---|
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | | | S | | S | L | |
| **CO 4** | | | | S | S | M | | |
| **CO 5** | | | S | | | | | S |

**S-Strong (8)** **M-Medium (2)** **L-Low (1)**

| Course Code DSEC4 | Course Name | Category | L | T | P | S | Credits | Inst. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CIA | External | Total |
| U23DZ07 | ANIMAL BIOTECHNOLOGY | Core | Y | - | - | - | 3 | 5 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | ✓ | Addresses Professional Ethics | |
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

| Learning Objectives | |
|---|---|
| CO1 | To impart the skills required to explain the protocols for genetically manipulating cells and produce transgenic animals. |
| CO2 | To encourage the use of the apt molecular techniques to evaluate and analyze animal traits and diseases at the genomic level and employ methods for easy taxonomical identification and classification for biodiversity and environmental studies. |
| CO3 | To study methods of transgenesis and to consider their use in improving animal husbandry and animal health. |
| CO4 | To motivate students to review the ethics and speculate on the environmental implications of animal biotechnological methods |

| UNIT | Details | No. of Hours | Course Objectives |
|---|---|---|---|
| I | **Fundamentals of Biotechnology** : Animal cell culture: Basic requirements and techniques of cell culture, natural and synthetic culture media, primary culture and cell lines; Stem cells: types, culture and applications; r-DNA technology: Enzymes; Vectors – pBR322, Phage lambda, Cosmid, HAC, BAC, YAC; Host cells; Gene cloning: steps in cloning, | 15 | CO1 |

| | | | |
|---|---|---|---|
| | selection of clones. | | |
| II | **Techniques in Animal Biotechnology**: Isolation and purification: DNA and mRNA; Blotting techniques: Methods of different types of blotting; DNA sequencing: Sanger method, DNA chips, microarray; PCR: principle, types and application; Gene library: screening with probes; Site directed mutagenesis: principle and application; Gene transfer in animal cells: transfection, liposomal, viral mediated, electroporation, biolistic, direct DNA injection. | 15 | CO2 |
| III | **Transgenic Animal Technology**: Transgenesis: Concept, transgenes, transgenic animal models - knock out mice, sheep; Applications of transgenesis : Molecular farming, Transgenic fishes, transgenic live stocks. | 15 | CO3 |
| IV | **Animal Biotech and Health Care**: Medical biotechnology: Monoclonal antibodies, recombinant vaccines –hepatitis B, hormones – insulin. DNA diagnostic systems: tuberculosis, AIDS, genetic diseases; Gene therapy: Ex vivo and in vivo, role in cancer treatment; Molecular markers: RFLP, RAPD, DNA fingerprinting and application. | 15 | CO4 |
| V | **Applications and Ethics**: Human genome project: Mapping of human genome, applications, ethics; Industrial biotechnology: Bioreactors - Basic concepts of fermentation, bioreactor design, production of ethanol; Ethics: Socio ethical problem, recent trends in animal biotechnology, ethical implications. | 15 | CO5 |
| | **Total** | **75** | |
| **Course Outcomes** | | | |
| **Course Outcomes** | On completion of this course, students will; | | |
| **CO1** | To describe the methodologies for handling animal cells based on their diverse characteristics and identify the correct biotechnological tools to obtain the desired products from the cells. | PO1 | |
| **CO2** | To develop and explain the protocols for genetically manipulating cells and produce transgenic animals | PO1, PO2 | |
| **CO3** | To select the apt molecular techniques to evaluate and analyze animal traits and diseases at the genomic level and devise methods for easy taxonomical identification | PO4, PO6 | |

| | | |
|---|---|---|
| | and classification for biodiversity and environmental studies. | |
| **CO4** | To choose the correct methods of transgenesis and to consider their use in improving animal husbandry nationally and globally | PO4, PO5, PO6 |
| **CO5** | To speculate on the environmental implications of animal biotechnological methods and design responsible, ethical solutions to livestock production and health issues. | PO3, PO8 |
| **Text Books (Latest Editions)** | | |
| 1. | Singh B. D., 2015. Biotechnology: Expanding horizon, Kalyani publishers. | |
| 2. | Sasidhara, R., 2015. Animal biotechnology, MJP publishers. | |
| 3. | Dubey R. C., 2014. A text Book of Biotechnology, S. Chand & Co Ltd, Ram Nagar, New Delhi. | |
| 4. | Dubey S. K., Bandana Ghosh, 2012. Fish biotechnology, Wisdom Press. | |
| 5. | Dubey R.C., 2014. Advanced Biotechnology, S. Chand Publication. | |
| 6. | Ruby, R.C., 2012. A text book of biotechnology, S. Chand Company, New Delhi. | |
| 7. | Sambamurthy K., Ashutosh Kar., 2009. Pharmaceutical Biotechnology, New Age International (P) Ltd. | |
| 8. | Ramdoss P.,2009. Animal Biotechnology- Recent concepts and developments, MJP publishers. | |
| 9. | Sathyanarayran U., 2008. Biotechnology, Books and Allied, Kolkata. | |
| 10. | Ignacimuthu, S., 2008. Basic Biotechnology, Tata McGraw hill, New Delhi. | |
| 11. | Rastogi S. C., 2007. Biotechnology: Principles and applications, Alpha Science publishers. Ranga, M.M., 2003. Animal biotechnology, Agrobios, New Delhi. | |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | | |
| 1. | Veer Bala Rastogi, 2016. Principles of Molecular biology, Medtech, Maine, USA. | |
| 2. | Michael Crichton, 2014. Essentials of Biotechnology, Medtech, Maine, USA. | |
| 3. | Godbey W.T., 2014. An Introduction to Biotechnology, Academic press, New York, USA. | |
| 4. | Peters, P., 2009. Biotechnology – A guide to genetic engineering, WMC brown publisher, UK. | |
| 5. | Ramawat, K.G and Shailey Goyal, 2009. Comprehensive biotechnology, S.Chand company, New Delhi, India. | |
| 6. | Primrose S.B., R. M. Twyman and R. W. Old, 2001. Principles of gene manipulation, Wiley- Blackwell, UK. | |
| 7. | Primrose S. B., 2001. Molecular Biotechnology, Panima Publishing Corporation, New Delhi, India. | |

| | |
|---|---|
| 8. | Hames B.D. and Higgins S.J. 1995. Gene Probes: A Practical Approach, Oxford University Press, UK. |
| **Web Resources** | |
| 1. | https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3612824/ |
| 2. | https://www.isaaa.org/resources/publications/pocketk/40/default.asp |
| 3. | https://www.ncbi.nlm.nih.gov/books/NBK207574/ |
| 4. | https://iopscience.iop.org/article/10.1088/1755-1315/492/1/012035/pdf |
| 5. | https://go.nature.com/3zAZmO9 |

| **Methods of Evaluation** | | |
|---|---|---|
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |

| **Methods of Assessment** | |
|---|---|
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | | | S | | S | | |
| **CO 4** | | | | S | S | M | | |
| **CO 5** | | | S | | | | | S |

**S-Strong (3)** **M-Medium (2)** **L-Low (1)**

| Course Code | Course Name | Category | L | T | P | S | | | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Total |
| U23PCZ1 | STATISTICS FOR BIOLOGISTS | Core | Y | - | - | - | 2 | 2 | 25 | 75 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| Relevant to Global need | | Employability Oriented | | Addresses Professional Ethics | ✓ |
| Relevant to National need | | Entrepreneurship oriented | | Addresses Gender Sensitization | |
| Relevant to Regional need | | Skill Development Oriented | | Addresses Environment and Sustainability | |
| Relevant to Local need | | | | Addresses human Values | |

**Learning Objectives**

| | |
|---|---|
| CO1 | To understand the importance and applications of Biostatistics. |
| CO2 | To know the methods of collection of data. |
| CO3 | To gain the knowledge of diagrammatic and graphical representation of data. |
| CO4 | To know to calculate standard deviation, correlation coefficient, chi-square analysis and student 't' test using the formula. |

| UNIT | Details | No. of Hours | Course Objectives |
|---|---|---|---|
| I | **Collection of Data:** Introduction to biostatistics: Definition – characteristics, importance and applications of biostatistics. Collection of data: Primary – secondary data. | 6 | CO1 |
| II | **Classification of Data** Statistical population and sampling in biological studies. Types of Classification: Qualitative – quantitative. Variables: discrete – continuous. Frequency distributions. | 6 | CO2 |
| III | **Presentation of Data:** Tabulation: Types – Components – advantages. Diagrammatic and graphical | 6 | CO3 |

| | | | |
|---|---|---|---|
| | representations of data: Bar diagrams (Simple, multiple, subdivided and percentage) – Pie diagram – Frequency diagram: histograms – frequency polygon – frequency curve – line graphs. Descriptive & Inferential Statistics. | | |
| IV | **Measure of central tendency:** Arithmetic mean – median– mode. Measures of dispersion: Standard deviation – Standard error. | 6 | CO4 |
| V | Coefficient of variance. Test of significance: Chi-square test for goodness of fit – Student 't' test. | 6 | CO5 |
| | **Total** | **30** | |

| **Course Outcomes** | | |
|---|---|---|
| **Course Outcomes** | On completion of this course, students will; | |
| **CO1** | Understand and recall the basic concepts, statistical data and formula. | PO1 |
| **CO2** | Apply suitable statistical methods to solve biological problems. | PO1, PO2 |
| **CO3** | Identify and relate the statistical principles for the application of biological experiments. | PO4, PO6 |
| **CO4** | To study the biological process and statistical approach to assess the experimental results. | PO4, PO5, PO6 |
| **CO5** | Integrate the statistical methods to validate research investigations. | PO3, PO8 |

**Text Books**

**(Latest Editions)**

| | |
|---|---|
| 1. | Gurumani,N.,2005.An introduction to Biostatistics, MJP, Chennai, 250pp. |
| 2. | Palanichamy, S and M. Shanmugavelu, 1991. Principles of Biostatistics. Palani Paramount. India. 350pp |

**References Books**

**(Latest editions, and the style as given below must be strictly adhered to)**

| | |
|---|---|
| 1. | Antonisamy, B., Solomon Christopher and P. Prasanna Samuel, 2011. |

| | | |
|---|---|---|
| | Biostatistics: Principles and practices. MacGrawHill Education Pvt. Ltd. New Delhi. 349pp. | |
| 2. | Daniel, W. W., 2000. Biostatistics: A foundation for analysis in the health sciences, 7th Ed. John Wiley & Sons Ltd. NewYork. 328pp. | |
| 3. | Gurumani, N., 2006. Research methodology for biological sciences, MJP, Chennai. 753pp. | |
| 4. | Harvey Motulsky, 2015. Essentials of Biostatistics. A non mathematical approach. Oxford University Press. NewYork. 208pp. | |
| 5. | Michael C., Whitlock and Dolph Schluter, 2009.The analysis of biological data, 2nd Ed. MacMillan Publishers, NewYork, USA. 818pp. | |
| 6. | Pranab Kumar Banerjee, 2014. Introduction to biostatistics (A Text Book of Biometry, S. Chand & Company Ltd. NewDelhi, India. 208pp. | |
| 7. | Ronser, B., 2006. Fundamentals of Biostatistics, Thomson Brooks/Cole, 6th Ed. Duxbury press,Singapore.784pp | |
| **Web Resources** | | |
| 1. | https://bit.ly/2XGFuML | |
| 2. | http://users.stat.ufl.edu/~winner/sta6934/st4170_int.pdf | |
| 3. | http://www.biostathandbook.com/analysissteps.html | |
| 4. | https://bit.ly/3nXUIrD | |
| 5. | https://onlinecourses.nptel.ac.in/noc19_bt19 | |
| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |
| **Methods of Assessment** | | |

| | |
|---|---|
| **Recall (K1)** | Simple definitions, formula, Recall steps, Concept definitions |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | | | | | | | |
| **CO 2** | M | S | | | | | | |
| **CO 3** | | | | S | | S | | |
| **CO 4** | | | | S | S | M | | |
| **CO 5** | | | S | | | | | S |

**S-Strong (3)** **M-Medium (2)** **L-Low (1)**