



**THIRUVALLUVAR UNIVERSITY**

**SERKKADU, VELLORE-632115**

**B.Sc. ZOOLOGY**

**SEMESTER - II**

**SYLLABUS**

**FROM THE ACADEMIC YEAR**

**2023 - 2024**

| S.No.              | Part | Study Components  |              | Ins.<br>Hrs<br>/week | Credit    | Title of the Paper   | Maximum Marks |              |            |
|--------------------|------|---|--------------|----------------------|-----------|--|---------------|--------------|------------|
|                    |      | Course Title  |              |                      |           |  | CIA           | Uni.Ex<br>am | Total      |
| <b>SEMESTER II</b> |      |   |              |                      |           |  |               |              |            |
| 1.                 | I    | Language  | Paper-2      | 6                    | 3         | Tamil/Other Languages  | 25            | 75           | 100        |
| 2.                 | II   | English   | Paper-2      | 4                    | 3         | English  | 25            | 75           | 100        |
| 3.                 | II   | NMSDC: Language Proficiency for Employability           | Paper-1      | 2                    | 2         | Overview of English Communication  | 25            | 75           | 100        |
| 4.                 | III  | Core Course –CC III                                     | Paper-2      | 5                    | 5         | Chordata   | 25            | 75           | 100        |
| 5.                 | III  | Core Course –CC IV                                      | Practical -2 | 5                    | 5         | chordata Lab course  | 25            | 75           | 100        |
| 6.                 | III  | Elective II Generic/<br>Discipline Specific             | Elective II  | 4                    | 2         | Chemistry-II<br>Botany-II<br>(To choose any one)   | 25            | 75           | 100        |
|                    |      |   |              | 2                    | 1         | Allied Chemistry<br>practical<br>Allied Botany Practical<br>(To choose any one)  | 25            | 75           | 100        |
| 7.                 | IV   | Skill Enhancement Course<br>SEC-2                       | Paper2       | 2                    | 2         | 1.Ornamental fish farming and management.<br>2.Biocompostingfor entrepreneurship<br>3.Aquarium keeping<br>4.Medical laboratory techniques<br>(To choose any one )    | 25            | 75           | 100        |
| 8.                 | IV   | Skill Enhancement Course<br>SEC-3 (Discipline Specific) | Paper 1      | 2                    | 2         | 1.Biophysics and biostatistics<br>2.Basic course in ornithology<br>3.Basics of marine biology<br>4. Economic zoology<br>5..Bioinstrumentation<br>(To choose any one) | 25            | 75           | 100        |
|                    |      | <b>Sem. Total</b>                                       |              | <b>32</b>            | <b>25</b> |  | <b>225</b>    | <b>675</b>   | <b>900</b> |

## SEMESTER - II

| Course Code<br>CC3         | Course Name  | Category | L | T | P | S | Credits | Inst. Hours  | Marks                   |          |       |
|----------------------------|--|----------|---|---|---|---|---------|--------------|-------------------------|----------|-------|
|                            |  |          |   |   |   |   |         |              | CIA                     | External | Total |
|                            | <b>CHORDATA</b>  | Core     | Y | - | - | - | 5       | 4            | 25                      | 75       | 100   |
| <b>Learning Objectives</b> |  |          |   |   |   |   |         |              |                         |          |       |
| 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                          | <b>General Characters and Classification of Phylum Chordata:</b> Origin of Chordata, Differences between non-chordates and chordates, General characters, Affinities and Systematic position of Prochordates. Hemichordata ( <i>Balanoglossus</i> ), Urochordata ( <i>Ascidia</i> ), Cephalochordata ( <i>Amphioxus</i> ).   |          |   |   |   |   |         | 12           | CO1, CO2                |          |       |
| II                         | <b>Subphylum vertebrata.</b> Classification of Vertebrata upto Class level, Agnatha ( <i>Petromyzon</i> ), Gnathostomata.–Class: Pisces ( <i>Scoliodon sorrakowah</i> ) General characters and classification, Origin of fishes, Affinities of Dipnoi - Types of scales and fins - Accessory respiratory organs - Air bladder - Parental care - Migration - Economic importance. |          |   |   |   |   |         | 12           | CO1, CO2, CO4, CO5      |          |       |
| III                        | <b>Class: Amphibia :</b> General characters and classification - Origin of Amphibia - Type study - <i>Rana hexadactyla</i> - Adaptive features of Anura, Urodela and Apoda - Neoteny in Urodela - Parental care in Amphibia.   |          |   |   |   |   |         | 12           | CO1, CO2, CO3, CO4, CO5 |          |       |
| IV                         | <b>Class: Reptilia :</b> General characters and classification - Type study – ( <i>Calotes versicolor</i> (endoskeleton of <i>Varanus</i> ) - Origin of reptiles and effects of  |          |   |   |   |   |         | 12           | CO1, CO2, CO4, CO5      |          |       |

|   |  |                    |                    |
|---|--|--------------------|--------------------|
|   | terrestrialisation, Extinct reptiles. Snakes of India. Poison apparatus and biting mechanism of poisonous snakes - Skull in reptiles as basis of classification  |                    |                    |
| V   | <b>Class: Aves and Mammalia :</b> Aves: General characters and classification – Type study - <i>Columba livia</i> - Origin of birds, Archaeopteryx. Flightless birds- Ratitae, Flight adaptations, Migration. A Mammalia: General characters and classification - Type study - Rabbit - Adaptive radiation in mammals - Egg laying mammals, Marsupials, Flying mammals, Aquatic mammals, Dentition in mammals. | 12                 | CO1, CO2, CO4, CO5 |
| <b>Total</b>  |  | <b>60</b>          |                    |
| <b>Course Outcomes</b>  |  |                    |                    |
| <b>Course Outcomes</b>  | On completion of this course, students will;   |                    |                    |
| <b>CO1</b>  | Classify, Identify and recall the name and distinct features of different subphylum belonging to phylum Chordata.  | PO1                |                    |
| <b>CO2</b>  | Explain, and relate the origin, structural organization and evolutionary aspects of vertebrates.   | PO1, PO2           |                    |
| <b>CO3</b>  | Analyze, compare and distinguish the developmental stages and describe the important biological process.   | PO3, PO4, PO5      |                    |
| <b>CO4</b>  | Correlate the different modes of life and parental care among different vertebrates.   | PO3, PO5, PO6      |                    |
| <b>CO5</b>  | Summarise the morphology and ecological adaptations in vertebrates and list out the economic importance.   | PO2, PO3, PO5, PO8 |                    |
| <b>Text Books<br/>(Latest Editions)</b>   |  |                    |                    |
| 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  |                    |                    |
| <b>References Books<br/>(Latest editions, and the style as given below must be strictly adhered to)</b> |  |                    |                    |
| 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. | <a href="http://tolweb.org/Chordata/2499">http://tolweb.org/Chordata/2499</a>                   |
| 2. | <a href="https://www.nhm.ac.uk/">https://www.nhm.ac.uk/</a>                                     |
| 3. | <a href="https://bit.ly/3Av1Ejg">https://bit.ly/3Av1Ejg</a>                                     |
| 4. | <a href="https://bit.ly/3kqTfYz">https://bit.ly/3kqTfYz</a>                                     |
| 5. | <a href="https://biologyeducare.com/aves/">https://biologyeducare.com/aves/</a>                 |
| 6. | <a href="https://www.vedantu.com/biology/mammalia">https://www.vedantu.com/biology/mammalia</a> |

#### Methods of Evaluation

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

#### Methods of Assessment

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

|             |  |  |   |   |   |   |  |   |
|-------------|--|--|---|---|---|---|--|---|
| <b>CO 4</b> |  |  | S | S | S | M |  |   |
| <b>CO 5</b> |  |  | S |   | S |   |  | S |

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

**SEMESTER - II**

| Course Code                | Course Name   | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|----------------------------|---|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                            |   |          |   |   |   |   |         |              | CIA               | External | Total |
|                            | <b>CHORDATA LAB COURSE</b>  | Core     | Y | - | - | - | 3       | 3            | 25                | 75       | 100   |
| <b>Learning Objectives</b> |   |          |   |   |   |   |         |              |                   |          |       |
| 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                          | <b>Dissections:</b> Frog - Digestive system, Urinogenital System – Male and Female (Demo Only).<br>Fish: External features, Digestive system, Arterial system, Venous system.   |          |   |   |   |   |         | 12           | CO1               |          |       |
| II                         | <b>Mounting:</b> Fish: Placoid and Ctenoid scales,<br>Frog: Hyoid apparatus and Brain (Demo Only).  |          |   |   |   |   |         | 12           | CO2               |          |       |
| III                        | <b>Spotters- Specimen and Slides:</b> (i) <b>Hemichordata:</b> Balanoglossus, Tornaria larva (ii). <b>Protochordata:</b> Amphioxus, Amphioxus T.S. through pharynx (iii). <b>Cyclostomata:</b> Petromyzon, Myxine, Ammocoetus larva.  |          |   |   |   |   |         | 12           | CO3               |          |       |
| IV                         | (iv) <b>Pisces:</b> Sphyrna Pristis, Torpedo, Channa, Pleuronectes, Hippocampus, Exocoetus, Echieneis, Labeo, Catla, Clarius, Auguilla, Protopterus, Scales: Placoid, Cycloid, Ctenoid (v). <b>Amphibia:</b> Ichthyophis, Amblystoma, Siren, Hyla, Rachophous, Bufo, Rana, Axolotal larva (vi). <b>Reptilia :</b> Draco, Chamaeleon, Gecko, Uromastix, Vipera russelli, Naja, Bungarus, Enhydrina, Typhlops, Testudo, Trionyx, Crocodilus, Ptyas. (vii). <b>Aves:</b> Archaeopteryx, Passer, Psittacula, Bubo, Alcedo, Columba, Corvus, Pavo; Collection and study of different types of feathers: Quill, Contour, Filoplume, Down (viii). <b>Mammalia:</b> Ornithorhynchus, Tachyglossus, Pteropus, Funambulus, Manis, Loris, Hedgehog |          |   |   |   |   |         | 12           | CO4               |          |       |

|   |   |               |           |
|---|---|---------------|-----------|
| V   | <b>Osteology:</b> Frog:Skullandlowerjaw,Vertebralcolumn,Pectoral girdle,Pelvicgirdle,Forelimb,Hindlimb.Chelonia-Anapsidskull,Pigeon - skull and lower jaw, synsacrum. | 12            | CO5       |
| <b>Total</b>  |   | <b>60</b>     |           |
| <b>Course Outcomes</b>  |   |               |           |
| <b>Course Outcomes</b>  | On completion of this course, students will;  |               |           |
| <b>CO1</b>  | Identify and recall the name and distinct external and internal features of animals belonging to phylum Chordata.   | PO1           |           |
| <b>CO2</b>  | Explain the structural organization of various organs and systems in different classes of vertebrates.  | PO1, PO2      |           |
| <b>CO3</b>  | Analyse, compare and distinguish the morphological features and developmental stages of chordates   | PO4, PO6      |           |
| <b>CO4</b>  | Dissect and explain various organs and internal systems in different vertebrates and correlate its function.  | PO4, PO5, PO6 |           |
| <b>CO5</b>  | Summarise the morphology and ecological adaptations in vertebrates and list out the economic importance.  | PO3, PO8      |           |
| <b>Text Books<br/>(Latest Editions)</b>   |   |               |           |
| 1.  | Lal S S, 2009. Practical Zoology Vertebrate, Rajpal and Sons Publishing, 484pp.   |               |           |
| 2.  | VermaP.S,2000.AManual ofPracticalZoology:Chordates,S.ChandLimited, 627pp.   |               |           |
| <b>References Books<br/>(Latest editions, and the style as given below must be strictly adhered to)</b> |   |               |           |
| 1.  | Robert William Hegner, 2015. Practical Zoology, BiblioLife, 522pp.  |               |           |
| 2.  | Young, J,Z., 1972. The life of vertebrates. OxfordUni. London.  |               |           |
| <b>Web Resources</b>  |   |               |           |
| 1.  | <a href="https://www.youtube.com/watch?v=b04hc_kOY10">https://www.youtube.com/watch?v=b04hc_kOY10</a>   |               |           |
| 2.  | <a href="https://bit.ly/3CzTEy8">https://bit.ly/3CzTEy8</a>   |               |           |
| 3.  | <a href="http://tolweb.org/Chordata/2499">http://tolweb.org/Chordata/2499</a>   |               |           |
| 4.  | <a href="https://www.nhm.ac.uk/">https://www.nhm.ac.uk/</a>   |               |           |
| 5.  | <a href="https://bit.ly/3Av1Ejg">https://bit.ly/3Av1Ejg</a>   |               |           |
| <b>Methods of Evaluation</b>  |   |               |           |
| <b>Internal Evaluation</b>  | Continuous Internal Assessment Test   |               | 25 Marks  |
|   | Assignments   |               |           |
|   | Seminars  |               |           |
|   | Attendance and Class Participation  |               |           |
| <b>External Evaluation</b>  | End Semester Examination  |               | 75 Marks  |
|   | Total   |               | 100 Marks |
| <b>Methods of Assessment</b>  |   |               |           |
| <b>Recall (K1)</b>  | Simple definitions, MCQ, Recall steps, Concept definitions  |               |           |
| <b>Understand/Comprehend (K2)</b>   | MCQ, True/False, Short essays, Concept explanations, Short summary or overview  |               |           |



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

## Chordata lab course

### MARKS DISTRIBUTION FOR PRACTICAL EXAM

Time: 3hrs

Max.Marks: 75

| Question no. | Experiment                  | Marks       |
|--------------|-----------------------------|-------------|
| I.           | Major Practical -Dissection | 25          |
| II.          | Minor Practical -Mounting   | 10          |
| III.         | Spotters                    | 30 (6x5=30) |
| IV.          | Record                      | 10          |
|              | Total                       | 75          |

## ORNAMENTAL FISH FARMING & MANAGEMENT

### Learning Objectives:

- To highlight the importance of ornamental fish culture in relation to entrepreneurship development.
- To enable the identification, culture and maintenance of commercially important ornamental fishes.
- To provide the knowledge on the techniques of ornamental fish breeding, rearing, disease control and economics of ornamental fish farming.

### Unit I:

Introduction to ornamental fish keeping. Scope and importance of ornamental fish culture. Domestic and global scenario of ornamental fish trade and export potential. Commercially important ornamental fishes - Indigenous and exotic varieties.

### Unit II:

Biology of egg layers and live bearers. Food and feeding in ornamental fishes. Formulated feed and Live feed; Live feed culture. Breeding, hatchery and nursery management of egg layers (eg. Goldfish) and live bearers (eg. Guppy).

### Unit III:

Aquarium design and construction; Accessories - aerators, filters and lighting. Aquarium plants and their propagation. Maintenance of aquarium and water quality management. Ornamental fish diseases, their prevention, control and treatment methods.

### Unit IV

Conditioning, packing, transport and quarantine methods. Economics, trade regulations, domestic and export marketing strategies.

### Unit –V

Identification of locally available ornamental fishes - Egg layers and live bearers.  
Identification of locally available live feed organisms.

### References:

1. Swain SK., Sarangi N. and Ayyappan S. 2010. Ornamental fish farming. ICAR, New Delhi.
2. Living Jewels – A handbook on freshwater ornamental fish, MPEDA, Kochi.
3. Dey V.K.A. 1997. A handbook on aquafarming ornamental fishes. MPEDA, Kochi.
4. Ahilan, B., Felix N. and Santhanam R. 2008. Text book of aquaculture. Daya Publishing House, New Delhi.

### Web links:

1. <http://ecoursesonline.iasri.res.in/course/view.php?id=297>
2. <https://www.ofish.org/>
3. <https://krishijagran.com/agripedia/income-generation-by-ornamental-fish-culture/>
4. <https://99businessideas.com/ornamental-fish-farming/>

### Course Outcome:

- The students will be able to identify, culture, maintain and market the commercially important ornamental fishes.
- 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.

## **BIOCOMPOSTING FOR ENTREPRENEURSHIP**

### **Learning Objectives:**

- To highlight the importance of Biocomposting for entrepreneurship in waste management.
- To enable students for setting up Biocompost units and bins for waste reduction.

### **Course outcomes:**

- The students will gain knowledge about the process of Biocomposting.
- Students will be able to demonstrate Biocomposting techniques for various end applications like solid waste management, industrial waste recycling using sugarcane bagasse, etc.
- To gain knowledge about the economic cost of establishing small Biocompost units as a cottage industry.

### **Unit – I**

Biocomposting – Definition, types and ecological importance.

### **Unit – II**

Types of Biocomposting technology – Field pits/ground heaps/ tank/large-scale/batch and continuous methods.

### **Unit – III**

Preparation of Biocompost pit and bed using different amendments.

### **Unit – IV**

Applications of Biocompost in soil fertility maintenance, promotion of plant growth, value added products, waste reduction, etc.

### **Unit – V**

Economics of establishment of a small biocompost unit – project report proposal for Self Help Group (Income and employment generation).

### **Practical**

- Preparation procedures for Biocompost pit.
- Selection of Biocompost material, separation of Compostable and Non-compostable materials.
- Packing and marketing of Biocompost.
- Field visit to Biocomposting unit.

### **References**

Bikas R. Pati & Santi M. Mandal (2016). Recent trends in composting technology.

Van der Wurff, A.W.G., Fuchs, J.G., Raviv, M., Termorshuizen, A.J. (Editors) 2016. Handbook for Composting and Compost Use in Organic Horticulture. BioGreenhouse COST Action FA 1105, [www.biogreenhouse.org](http://www.biogreenhouse.org).

## **AQUARIUM KEEPING**

### **Learning Objectives**

- To create knowledge on self employment opportunity of ornamental fishes
- To provide the knowledge of ornamental fishes and their equipment
- To understand the different breeding techniques of ornamental fishes

### **UNIT I**

Introduction and scope - Aquarium fish keeping as hobby and cottage industry. Commercial aspects like national and international market. To create knowledge on self employment opportunity.

### **UNIT II**

External morphology of a typical fish. Exotic and endemic varieties of ornamental fishes.

### **UNIT III**

Aquarium preparation and maintenance - Kinds of tanks, tank setting, biological filter and aeration, water management, planting, lighting and feeds. Budget for setting up an Aquarium Fish Farm as a Cottage Industry

### **UNIT IV**

Live fish transport- handling, feeding and forwarding techniques of fish. Fish Diseases and their control.

### **UNIT V**

Breeding – Common characters and sexual dimorphism of Fresh water and Marine aquarium ornamental fish varieties such as Guppies, Mollies, Sword tails, Platy, Siamese fighters and Gold fish, Butterfly fish, Blue morph and Anemone fish.

### **REFERENCE BOOKS:**

1. Santhanam, P., Sukumaran, N. & P. Natarajan, A manual of freshwater aquaculture (1987), Reprint 1999, Oxford & IBH Publishing Company Pvt., Ltd., New Delhi.
2. Cliff Harrison, A colour guide to Tropical Fish (1980), Chartwell Books, INC, Cerkshire, printed in Hon Kong.
3. O'Connell, R. F., The freshwater aquarium (1977), Arco Publishing Company, INC New York.
4. Jingran V.G., 1991: Fish and Fisheries in India – Hindustan Publ.co. New Delhi
5. Mill Dick, 1993: Aquarium Fish, Daya Pub.co., New Delhi

### **Course Outcome:**

- Students to learn about different ornamental fishes and identify the diseases of them
- To develop entrepreneur potential in the field of aquarium and get self employment.

## MEDICAL LABORATORY TECHNIQUES

### Learning Objectives

1. To understand the different protocols and procedures to collect clinical samples.
2. To explain the characteristics of clinical samples.
3. To demonstrate skill in handling clinical equipment.
4. To evaluate the safety precautions while handling clinical samples.
5. To summarise the control measures to avoid contamination of clinical samples.

**Unit 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.

**Unit 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-erythrocyte sedimentations rate- packed cell volume- Total count of RBC & WBC- Differential count WBC- blood grouping and typing-haemostasis- bleeding disorder of man - Haemolytic disease of newborn, Platelet count, reticulocytes count, Absolute Eosinophil count.

**Unit 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 – flowcytometry – treadmill test – PET.

**Unit IV: Medical Physiology :** Cardiovascular system- Blood pressure - Pulse – regulation of heart rate, cardiac shock. Heart sounds, Electrocardiogram (ECG) – significance – ultra sonography- Electroencephalography (EEG).

**Unit 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.

## **Text Books**

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, 10<sup>th</sup> 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.

## **Suggested Readings**

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>

## **Course Outcomes (COs)**

1. Understand protocols and procedures to collect clinical samples for blood analysis and to study human physiology.
2. Explain the characteristics of clinical samples.
3. Demonstrate skill in handling clinical equipment.
4. Evaluate the hematological and histological parameters of biological samples.
5. Elaborate the role of medical laboratory techniques in health care industry.

# BIOPHYSICS AND BIOSTATISTICS

## Learning objectives

1. To understand the concepts of diffusion, osmosis, centrifugal force, surface tension.
2. To understand the techniques for the separation of biomolecules.
3. To understand radiology, sonography, Laser techniques for biological and medical application.
4. To know to calculate standard deviation, correlation coefficient, chi-square analysis and student 't' test using the formula.

## Unit I:

**Biophysical Principles:** Physical laws in living system: diffusion – Factors affecting diffusion – types of diffusion – Fick's law – Biological significance of diffusion – Osmosis – Osmotic pressure (endocytosis, pinocytosis, phagocytosis, exocytosis, plasmolysis and haemolysis) Principles of viscosity – Brownian movement – surface tension – turgor pressure – Centrifugation: Principle – types – applications.

**Unit II: Applications of Biophysics:** Principle and applications of colorimeter – electrophoresis – principle, instrumentation – applications of gel electrophoresis. Radioactivity: Types of radioactive decay – Radioactive isotopes – Autoradiography – biological impacts – Geiger-Muller counter: Principle – working procedure – advantages and disadvantages. Medical and biological uses of X-rays, Ultrasound and Laser

**Unit III: Collection and Classification of Data:** Introduction to biostatistics: Definition – characteristics, importance and applications of biostatistics. Collection of data: Primary – secondary data. Statistical population and sampling in biological studies. Types of Classification: Qualitative – quantitative. Variables: discrete – continuous. Frequency distributions.

**Unit IV: Presentation of Data: Tabulation:** Types – Components – advantages. Diagrammatic and graphical representations of data: Bar diagrams (Simple, multiple, subdivided and percentage) – Pie diagram – Frequency diagram: histograms – frequency polygon – frequency curve – line graphs.

**Unit V: Descriptive & Inferential Statistics:** Measure of central tendency: Arithmetic mean – median – mode. Measures of dispersion: Standard deviation – Standard error – Coefficient of variance. Test of significance: Chi-square test for goodness of fit – Student 't' test.



## Text Books

1. Das, D., 1996. Biophysics and Biophysical Chemistry for Medical and Biology students, Academic, Calcutta. 302pp.
2. Subramanian, M. A., 2016. Biophysics—Principles and Techniques, MJP, Chennai. 324pp.
3. Gurumani, N., 2005. An introduction to Biostatistics, MJP, Chennai, 250pp.
4. Palanichamy, S. and M. Shanmugavelu, 1991. Principles of Biostatistics. Palani Paramount, India. 350pp
5. Roy, R. N. 1996. A Text Book of Biophysics, New Central Book Agency Ltd, Calcutta. 992pp.

## Suggested Readings

1. Antonisamy, B., Solomon Christopher and P. Prasanna Samuel, 2011. Biostatistics: Principles and practices. MacGraw Hill Education Pvt. Ltd. New Delhi. 349pp.
2. Betty Karasek, 2015. Advanced concepts of biophysics, Callisto Reference, 198pp.
3. Daniel, W. W., 2000. Biostatistics: A foundation for analysis in the health sciences, 7<sup>th</sup> Ed. John Wiley & Sons Ltd. New York. 328pp.
4. Edward K. Yeager, 2018. Basic Biophysics for Biology, CRC Press, USA. 195pp
5. Gurumani, N., 2006. Research methodology for biological sciences, MJP, Chennai. 753pp.
6. Harvey Motulsky, 2015. Essentials of Biostatistics. A non mathematical approach. Oxford University Press. New York. 208pp.
7. Michael C., Whitlock and Dolph Schluter, 2009. The analysis of biological data, 2<sup>nd</sup> Ed. MacMillan Publishers, New York, USA. 818pp.
8. Narayanan, R., 2010. Essentials of biophysics, II Ed., New age International publishers, Chennai. 546pp.
9. Pranab Kumar Banerjee, 2014. Introduction to biostatistics (A Text Book of Biometry), S. Chand & Company Ltd. New Delhi, India. 208pp.
10. Rodney M. J. Cotterill, 2002. Biophysics: An introduction, John Wiley & Sons Ltd. New York. 400pp.
11. Ronser, B., 2006. Fundamentals of Biostatistics, Thomson Brooks/Cole, 6<sup>th</sup> Ed. Duxbury press, Singapore. 784pp
12. Sail Bose, 2000, Elementary Biophysics, Vijaya printers, Madurai.
13. Tanford, C., 1961. Physical chemistry of macromolecules, John Wiley & Sons Ltd. England. 710pp.
14. Yadav, B. S., 2020. Textbook of biophysics, Arjun Publishing House, New Delhi.

## Web Resources:

1. <https://bit.ly/2XGFuML>
2. <http://www.life.uiuc.edu/molbio/geldigest/electro.html>
3. [http://users.stat.ufl.edu/~winner/sta6934/st4170\\_int.pdf](http://users.stat.ufl.edu/~winner/sta6934/st4170_int.pdf)
4. <http://www.biostathandbook.com/analysissteps.html>
5. <https://bit.ly/3nXUIrD>
6. [https://onlinecourses.nptel.ac.in/noc19\\_bt19](https://onlinecourses.nptel.ac.in/noc19_bt19)

### **Course outcomes (COs)**

1. Understand and recall the basic biophysical concepts, statistical data and formula.
2. Apply suitable physical techniques and statistical methods to solve biological problems.
3. Identify and relate the bioanalytical techniques and statistical principles for the application of biological experiments.
4. Select suitable biophysical techniques to study the biological process and statistical approach to assess the experimental results.
5. Integrate the bioanalytical techniques and statistical methods to validate research investigations.

## **BASIC COURSE IN ORNITHOLOGY**

### **Learning Objectives**

- To equip students with the required knowledge to understand the taxonomic position and role played by birds in the ecosystem, their importance to humans and their evolution
- To enable students to comprehend the biological evolution of birds and their structural adaptations
- To enable students to understand and learn aspects of bird behaviour
- To enable students to learn about the breeding biology of birds
- To equip students with a knowledge of macroecology of birds, bird populations and communities, bird diseases, bird conservation and on the role of citizen science in ornithology.

### **Unit I**

Introduction to Ornithology; Bird Lore; Birds and Humans; Classification of Birds, Bird Evolution and Speciation; Endemism

### **Unit II**

External Morphology of the Bird; Structure of bird feather, Internal Structure of the Bird; Adaptations to Flight

### **Unit III**

Bird Behaviour: Foraging, Roosting, Vocalization, Imprinting, Feather care, Bird Intelligence, Social Behaviour, Mixed Species Flocks, Migration

### **Unit IV**

Breeding Biology: Differential investment of sexes; territoriality, courtship and display behaviour, nesting, eggs, incubation and care of young, brood parasitism

### **Unit V**

Studying bird populations and communities, sampling methods; Macro ecology; Molecular Techniques in Ornithology; Avian Disease; Citizen Science and Ornithology; Threats faced by birds; Bird Conservation with case studies

### **COURSE LEARNING OUTCOME**

On successful completion of the course, students will be able to

- Recall the taxonomic position of birds, their external morphology and internal parts, types of bird behaviour, sampling methods and types of avian diseases.
- Identify the external parts of the bird, internal structures of the bird and different types of bird behaviour
- Differentiate birds based on their morphology, foraging strategies and other behaviour
- Explain and discuss how birds evolved, bird adaptations to flight, different aspects of bird behaviour, threats to birds and the role of citizen science in ornithology
- Discuss and analyse case studies relating to bird conservation

## **BOOKS FOR REFERENCE**

- 1.Lovette, I.J and Fitzpatrick, J.W. (2016). *Handbook of Bird Biology*, 3<sup>rd</sup> ed. Wiley.
- 2.Birkhead, T. (2013). *Bird Sense: What it's like to be a bird?* Bloomsbury, NY.
- 3.Birkhead, T., Wimpenny, J., and Montgomerie, B. (2014). *Ten Thousand Birds:*
- 4.*Ornithology since Darwin*. Princeton University Press, Princeton, NJ.
- 5.Gill, F.B, and Prum, R.O. (2019). *Ornithology*, 4<sup>th</sup> ed. Macmillan.

## BASICS OF MARINE BIOLOGY

### Learning Objective

1. To understand and learn the physical, chemical and biological aspects of marine environment and to gain knowledge about the management of oceans.
2. To introduce students to the marine environment and its indigenous organisms.
3. To study the principles, concepts and facts through which the student can better understand and appreciate the nature of the sea and its inhabitants.
4. 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 I: Marine Ecology** : Marine environment- ecological factors- light, temperature, salinity, pressure; Classification of marine environment; Pelagic environment – Planktonic and Nektonic adaptations; Benthic environment - intertidal, interstitial and deep sea adaptations; Distribution and ecological role of other coastal environments - coral reefs, estuaries, mangroves, seagrass beds, kelp forests polar seas and hydrothermal vents.

**Unit II: Physical Oceanography** : Physical Properties of Seawater- density, viscosity, surface tension, conductivity and their relationship; temperature distribution in the sea - heat budget, UV radiation; El Nino/La Nina – global impact; Dynamics of the ocean-general surface circulation, Waves, Currents and Tides, Tsunami.

**Unit III: Chemical Oceanography** : Chemical composition of seawater- ionic, major and minor constituents, constancy- ionic compositions and factors affecting constancy- major and minor elements, trace elements- their importance, distribution. Chemistry of seawater constituents- concept of chlorinity and salinity - methods of measurements, nutrients - biogeochemical cycles.

**Unit IV: Biological Oceanography** : Sea as a biological environment- Plankton-classification based on size, mode of life and habitat. Phytoplankton and Zooplankton - methods of collection, estimation of standing crop-wet and dry weight estimation-plankton volume settling and displacement methods.Oxidation as carbon (as organic matter).Primary productivity – estimation and factors affecting primary productivity.

**Unit 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 National and international agencies and organizations in ocean management-FAO, UNEP, DOD, WOCE, WHOI, IOI Malta, IMO INMARSAT- IUCN, SCAR, SCOR, Marpol, Traffic. Ocean policy (India) - research and management.

### Text Books

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.
5. John Resch Jr. 1979, Marine Biology. Reston Publishing Company, Virginia. 257 pp.

### **Suggested Readings**

1. Barbara E. Curry, 2016. Advances in Marine Biology, Volume 74, 1st 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, 1st 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.
5. Amy Hill. 2002. Marine Biology: An Introduction to Ocean Ecosystems (Marine Biology Ser) Walch publishing.
6. Pickard, G.L. and W.J. Emery 1995. Descriptive Physical Oceanography. Pergamon Press, London.
7. Gage. J.D. and P.A. Tyler, 1991. Deep Sea Biology, Cambridge University Press, Cambridge
8. Raymond J. E. G., 1980. Plankton and Productivity in the oceans: Volume 1: Phytoplankton, Pergamon Press.
9. Van Der Spoel, S. and Pierrot-Bults, A. C (Eds) 1979. Zoogeography and diversity of plankton. Bungs Scientific Publishers Utrecht, 410pp.
10. Riley, J.P. and Skirrow, 1975-1984. Chemical Oceanography Vols. 1 to 8. Academic Press, London

### **Web Resources**

1. <https://www.livescience.com>
2. <https://www.icriforum.org>
3. <https://www.cbd.int>

### **Course Outcomes (COs)**

1. Define marine ecosystem, recognize and describe the interrelationship between biology and ocean technology.
2. Articulate and classify the dynamics and the physical attributes of the ocean, interpret the factors which affect the global climate.
3. Identify and analyze the physical and biological factors of marine environments, and focus life in the open sea.
4. Evaluate the impact of variations in abiotic factors in marine productivity and justify the role of human activities in the degradation of marine ecosystems.
5. Categorize marine pollutants and develop controlling measures in collaboration with the institutions for ocean management.

## ECONOMIC ZOOLOGY

### Learning Objective

1. To understand the culturing techniques and production methods of different farm animals.
2. To know the life history of animals and disease control methods used in farming.
3. To understand the concept of breeding, cross breeding and the importance of high yield varieties.
4. To know about the marketing strategies.

**Unit I: Economic Entomology** : Apiculture: Species of honey bees – Social organisation of honey bee – selection of bees and location for apiary – Newton’s bee hive – products of bee keeping – enemies and diseases of honey bees. Sericulture: Species of silkworm – life history of mulberry silkworm – Rearing of silkworm – pests and diseases of silkworm.

Lac Culture: Introduction – Life history – Host plants – cultivation of Lac – Enemies of lac cultivation – Economic importance of Lac.

**Unit II: Vermiculture** : Introduction: Types of earthworms – ecological classifications of earthworms – Physical, chemical and biological changes caused by earthworms in the soil – Natural enemies of earthworms. Vermicomposting: vermicomposting methods – factors affecting vermicomposting – Vermiculture unit. Harvesting of vermicompost – vermicast – advantages of vermicompost – vermiwash and its applications.

**Unit III: Aquaculture** : Fresh water aquaculture: Carp culture – types of ponds – preparation – maintenance – harvesting and management. Integrated and composite culture. Prawn culture. Marine Aquaculture: Edible – pearl oyster culture. Ornamental fish culture: Aquarium fishes– Aquarium maintenance in home.

**Unit IV: Poultry Farming** : Poultry industry in India – Poultry for sustainable food production and livelihood - Commercial poultry farming – Nutritive value of egg and meat- Broiler management (Definition; Housing and equipment; Brooding, feeding and health cover of broilers; Record keeping; Broiler integration) – Layer management (Brooder; Grower and layer management; Culling of layers; Marketing of eggs and meat). Women in backyard poultry farming.

**Unit V: Dairy Farming** : Dairy farming – advantages of dairying – classification of breeds of cattle – Indigenous and exotic breeds – Selection of dairy cattle. Breeding – artificial insemination – Dairy cattle management – housing – water supply – cattle nutrition feeding standards – Common contagious diseases. Milk - Composition of milk – milk spoilage – pasteurization – Role of milk and milk products in human nutrition – Dairying as a source of additional income and employment.



## **Text Books**

1. Sastry, N.S.R., C.K.Thomas and R.A.Singh, 2015. Livestock Production Management, 4<sup>th</sup>Ed.Kalyani Publishers, New Delhi.
2. ICAR, 2013. Hand book of Animal Husbandry, 4<sup>th</sup> Ed., ICAR Publication, Pusa, New Delhi.
3. Awasthi, V.B., 2012. Introduction to General and Applied Entomology, third edition, Scientific publishers, India.
4. Vasanthraj David, B and Ramamurthy, VV., 2012. Elements of Economic Entomology, Seventh edition, Namrutha publications, Chennai.
5. Shukla &Upadhyay, 2014. Economic Zoology, 5<sup>th</sup> edn. Rastogi Publication, Meerut New Delhi.
6. Gupta, S.M., 2010. Text book of fishery, Ann Backer, Mumbai.
7. ShailendraGhosh, 2009. Fisheries and aquaculture management, Adhyayan, New Delhi.
8. David, B and Ananthkrishnan, T. N., 2006. General and Applied Entomology, Second edition, Tata McGraw hill publishing company Ltd., New Delhi, India.
9. Jagadish Prasad, 2002. Principles and practices of Dairy Farm Management, 3<sup>rd</sup> Ed. Kalyani Publishers, Ludhiana.
10. Sukumar, D.E., 2002. Outline of Dairy Technology, Oxford University, New Delhi.
11. Rath, R.K., 2000. Freshwater Aquaculture. Scientific Publishers (India), Jodhpur.
12. Ismail, S.A., 1997. Vermitechnology, The biology of earthworms, Orient Longman, India.
13. Prabakaran, R. 1998. Commercial Chicken production. Published by P. Saranya, Chennai.
14. Hafez, E. S. E., 1962. Reproduction in Farm Animals, Lea &Fabiger Publisher.

## **Suggested Readings**

1. Glenn Munroe, 2017. Manual of on-Farm vermicomposting and vermiculture, Holdanca Farms Ltd, Wallace, Nova Scotia.
2. Hanifa, M.A., 2011. Aquatic resources and aquaculture, Dominent, New Delhi.
3. Gupta, P.K., 2008. Vermicomposting for sustainable agriculture, 2<sup>nd</sup> Edition, Agrobios, India.
4. Talashikar, S.C., 2008. Earthworms in Agriculture, Agrobios, India.
5. Abishek Shukla, D ., 2 0 0 9 . A Hand Book of Economic Entomology, Vedamse Books, New Delhi .
6. Banerjee, G.C., 2006. Text book of Animal Husbandry 8<sup>th</sup>Ed.Oxford and IBH Publishing Company Ltd., New Delhi.
7. Walstra, P. Wouters, J.T.M. and Geurts, T.J. 2006. Dairy Science and Technology. CRC Press, New York.
8. Dunham, R.A., 2004. Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications, U.K.

9. Donald.D Bell and William. D. Weaver, 2002. Commercial chicken meat and egg production, Springer, New York.
10. Eckles C.H. and Anthony, E.L., 2001. Dairy Cattle and milk production, Biotech. Tata McGraw Hill Publishing Co.Pvt.Ltd., New Delhi.
11. Edwards, C.A., and Bother, B., 1996. Biology of earthworms, Chapman Hall Publication company.
12. ICAR, 1997. Handbook of Animal Husbandary– The Indian Council of Agricultural Research, New Delhi.
13. Banerjee G.C., 1992. Poultry, Oxford and IBH, New Delhi.
14. Jhingran, AVG, 1991. Fish and Fisheries of India. Hindustan Publishing Co. New Delhi.
15. James. N. Marner, 1975. Principles of dairy processing, wiley eastern limited, New Delhi.
16. Baradach, JE. Ryther. JH. and, MC larney WO., 1972. Aquaculture. The farming and Husbandry of Freshwater and Marine Organisms. Wiley InterScience, New York.

### Web Resources

1. <https://bit.ly/3tXHjk8>
2. <https://bit.ly/3tUTHBu>
3. <https://bit.ly/3hVv96q>
4. <https://bit.ly/39nztH1>
5. <https://bit.ly/3CzasVO>
6. [https://agritech.tnau.ac.in/org\\_farm/orgfarm\\_vermicompost.html](https://agritech.tnau.ac.in/org_farm/orgfarm_vermicompost.html)
7. <https://bit.ly/3nYvgSF>
8. <http://caa.gov.in/farms.html>
9. <http://www.csrtimys.res.in/>
10. <http://www.agshoney.com/training.htm>

### Course Outcomes (COs)

1. To identify the breeds and varieties of poultry, fish, bees, and cattle and understand the basic aspects of farming.
2. To assess and integrate the available tools and techniques to increase the productivity in farms.
3. To analyse the pros and cons of different methods of farming and marketing strategies of products.
4. To evaluate the use of available resources in improving the breeds, vermicomposting, farm products etc..
5. To design new methods to improve farm animals with increased productivity and disease resistance and to construct new methods in vermicomposting.

# BIOINSTRUMENTATION

## Course outcomes

1. To induce interest in the use of various biological instrumentation and employ them for the study of cells, tissues and genetic material.
2. To help students to map the use of specific bioinstrumentation for specific biological experiments and infer the results of such experiments.
3. To study the working principle of different bioinstrumentation and their applications.
4. To enable students to design experiments and justify them with the underlying principles of bioinstrumentation.

**Unit 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

**Unit II: Microscopy** - Light microscope, SEM, TEM, Atomic force microscope; Cryopreservation - principle and procedure; Fluorescence activated cell sorting; X-ray crystallography.

**Unit III: Centrifugation** - working principle and types of centrifugation; Spectrophotometry; Mass spectrometry; Chromatography - principle and types of chromatography

**Unit 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.

**Unit 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.

## Text Books

1. SabariGhosal and Anupama Sharma Avasthi, 2018. Fundamentals of Bioanalytical Techniques and Instrumentation, 2nd Ed., Phi Learning Pvt. Ltd., New Delhi, India.
2. Veerakumari L., 2015. Bioinstrumentation, MJP Publishers, Chennai, India.
3. Prakash Singh Bisen, Anjana Sharma, 2012. Introduction to Instrumentation in Life Sciences, CRC Press, Taylor & Francis Group, New York, USA.
4. Gupta P.C., 2010. Biological Instrumentation and Methodology (Tools & Techniques), S. Chand & Company Limited, New Delhi, India.

5. Ghatak K. L., 2010. Techniques and Methods in Biology, Phi Learning Pvt. Ltd., New Delhi, India.

### **Suggested Readings**

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 University 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.
5. Wilson, K.M. and Walker, J.M., 2010. Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, UK.

### **Web Resources**

1. <https://bit.ly/3i5flym>
2. <https://pbiol.rsb.org.uk>
3. <https://www.nature.com/subjects/biological-techniques>
4. <https://www.ibiology.org>

### **Course outcomes (COs)**

1. To describe and explain the steps in the use of various biological instrumentation that are used in the study of different animal specimens.
2. To relate the applications of biological techniques and employ them for the study of cells, tissues and genetic material.
3. To correlate and appraise the use of specific bioinstrumentation for specific biological experiments and infer the results of such experiments.
4. To compare the working principle of different bioinstrumentation and to summarize their applications.
5. To devise experiments and justify them with the understanding of the underlying principles of bioinstrumentation that are ecofriendly, ethical and have national and global relevance.