

# VIVEKANANDA COLLEGE

**College with Potential for Excellence**

Residential & Autonomous – A Gurukula Institute of Life-Training  
Re-accredited (3<sup>rd</sup> Cycle) with 'A' Grade (CGPA 3.59 out of 4.00) by NAAC

Affiliated to Madurai Kamaraj University

(Managed by Sri Ramakrishna Tapovanam, Tirupparaitturai, Trichy)

**TIRUVEDAKAM WEST, MADURAI DISTRICT- 625 234**

**[www.vivekanandacollege.ac.in](http://www.vivekanandacollege.ac.in)**



*Department of Zoology*

Programme: M.Sc Zoology

## **Learning Outcomes based Curriculum Framework (LOCF)**

**(For those students admitted during the Academic Year 2022-23 and after)**

**POST GRADUATE AND RESEARCH DEPARTMENT OF ZOOLOGY**  
**M.Sc. ZOOLOGY**

**Vision**

- Unravel hidden research potentials & Entrepreneurial avenues in Zoology
- Bring a behavioural change in subject knowledge, scientific aptitude and instrumental skills to attract students with best caliber
- Raise students to international standards

**Mission**

- Strategic plans for translating goals and objectives by curriculum design, good teaching methods and evaluation
- Academic and research collaborations
- Biotrack –A forum to update knowledge
- Hands on training at Bio industries

**Programme Educational Objectives (PEO)**

A graduate of M.Sc. Zoology Programme after five years will

|              |   |
|--------------|---|
| <b>PEO 1</b> | Acquire comprehensive knowledge of zoology and excel in the chosen area.    |
| <b>PEO 2</b> | Develop confidence to prepare for competitive examinations.                 |
| <b>PEO 3</b> | Inculcate to pursue higher education.                                       |
| <b>PEO 4</b> | Make the students to develop an aptitude for research.                      |
| <b>PEO 5</b> | Empower the youth for self-employment generation to become an entrepreneur. |

**Graduate Attributes (GA)**

|              | <b>Attributes</b>                           | <b>Description</b>   | <b>Part</b>  |
|--------------|---|--|--------------|
| <b>GA 1</b>  | <b>Modern Tool Usage</b>                    | Application of appropriate techniques, resources and modern tools to complex activities with an understanding of the limitations                                       | <b>Hand</b>  |
| <b>GA 2</b>  | <b>Environment and Sustainability</b>       | Understanding the impact of solutions in societal and environmental contexts for sustainable development   | <b>Hand</b>  |
| <b>GA 3</b>  | <b>Technical and Entrepreneurial Skills</b> | Creating confidence to become an entrepreneur by providing entrepreneurial and technical skills  | <b>Hand</b>  |
| <b>GA 4</b>  | <b>Capacity</b>                             | Ability to face the realities of life and withstand current challenges   | <b>Hand</b>  |
| <b>GA 5</b>  | <b>Graduate and Society</b>                 | Application of reasoning to assess social health, safety, legal and cultural issues and the consequent responsibilities relevant to the social practice                | <b>Heart</b> |
| <b>GA 6</b>  | <b>Ethics and Values</b>                    | Application of ethical principles, professional ethics, responsibilities and norms of the life through value oriented life training                                    | <b>Heart</b> |
| <b>GA 7</b>  | <b>Creativity</b>                           | Demonstration of knowledge, understanding of management principles and application of these to one's own work to manage projects and in multidisciplinary environments | <b>Heart</b> |
| <b>GA 8</b>  | <b>Harmonious Development of Individual</b> | Making an individual as perfect man through the harmonious development of physical, emotional and intellectual cultures  | <b>Heart</b> |
| <b>GA 9</b>  | <b>Adaptability</b>                         | Accepting the ground realities and adapt to the situation to overcome frustrations and failures.   | <b>Heart</b> |
| <b>GA 10</b> | <b>Knowledge</b>                            | Application of knowledge of the respective discipline to the solution of complex problems in the day-to-day life   | <b>Head</b>  |
| <b>GA 11</b> | <b>Critical Thinking</b>                    | Analysis of problems to reach substantiated conclusion by using the principles of mathematics, natural and social sciences and by using research-                      | <b>Head</b>  |



|             |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| <b>PO 3</b> |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>PO 4</b> |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>PO 5</b> |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

## Assessment

Distribution of questions and marks

|                 |                                |
|-----------------|--------------------------------|
| <b>PG:</b>      | Section A – Remembering (K1)   |
| <b>LOCF</b>     | Section B – Understanding (K2) |
| <b>Syllabus</b> | Section C – Applying (K3)      |
|                 | Section D – Analyzing (K4)     |

### CIA Test Question Paper Pattern (PG) – 2 Hours

|                               |                   |
|-------------------------------|-------------------|
| Section - A: MCQs             | 5 X 1 = 5 Marks   |
| Section - B: VSA (5 out of 7) | 5 X 2 = 10 Marks  |
| Section - C: SA (3 out of 5)  | 3 X 5 = 15 Marks  |
| Section - D: LA (2 out of 3)  | 2 X 10 = 20 Marks |

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**Total**                    **50 Marks**  
 -----

### End Semester Examinations Question Paper Pattern (PG) – 3 Hours

|                                |                   |  |
|--------------------------------|-------------------|--|
| Section - A: MCQs              | 5 X 1 = 5 Marks   | (From Question Bank given by Course Teacher) |
| Section - B: VSA ((5 out of 7) | 5 X 2 = 10 Marks  |  |
| Section - C: SA (Either-or)    | 5 X 6 = 30 Marks  |  |
| Section - D: LA (3 out of 5)   | 3 X 10 = 30 Marks |  |

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**Total**                    **75 Marks**  
 -----

### Continuous Internal Assessment (CIA) - Distribution of Marks

|                                    | UG                      |                 | PG              |                 |
|------------------------------------|-------------------------|-----------------|-----------------|-----------------|
| <b>Part - I, II<br/>Part - III</b> | Test (Best Two)         | 15 Marks        | Test (Best Two) | 15 Marks        |
|                                    | Cycle Test (5 × 1 = 5)  | 5 Marks         | Quiz / Seminar  | 5 Marks         |
|                                    | Assignment (5 × 1 = 5)  | 5 Marks         | Assignment      | 5 Marks         |
|                                    | <b>Total</b>            | <b>25 Marks</b> | <b>Total</b>    | <b>25 Marks</b> |
| <b>Part- IV</b>                    | Test (Best Two for SEC) | 20 Marks        |                 |                 |
|                                    | Assignment              | 5 Marks         |                 |                 |
|                                    | <b>Total</b>            | <b>25 Marks</b> |                 |                 |

### Abbreviations:

**MCQs:** Multiple Choice Questions  
**SA** : Short Answer

**VSA:** Very Short Answer  
**LA** : Long Answer

**Core Course , Discipline Specific Elective**

| Bloom's Taxonomy   | Continuous Internal Assessment (CIA) |  |  |  |  | End Semester Examinations (ESE) |  |  |  |  |                    |
|--------------------|--------------------------------------|--|--|--|--|---------------------------------|--|--|--|--|--------------------|
|                    |                                      |  |  |  |  |                                 |  |  |  |  | Total (M)<br>75    |
| Remembering (K1)   |                                      |  |  |  |  |                                 |  |  |  |  | Passing minimum 27 |
| Understanding (K2) |                                      |  |  |  |  |                                 |  |  |  |  |                    |
| Applying (K3)      |                                      |  |  |  |  |                                 |  |  |  |  |                    |

**Core Practical**

| Bloom's Taxonomy   | Continuous Internal Assessment (CIA) |       |          |        |                 | End Semester Examinations (ESE) |         |       |          |        |                  |
|--------------------|--------------------------------------|-------|----------|--------|-----------------|---------------------------------|---------|-------|----------|--------|------------------|
|                    | Major                                | Minor | Spotters | Record | Total           | Major 1                         | Major 2 | Minor | Spotters | Record | Total            |
| Remembering (K1)   | 5                                    | 2     | 4        | 5      | Total 40 marks) | 3.5                             | 3.5     | 2     | 5        | 5      | (Total 60 marks) |
| Understanding (K2) |                                      | 3     | 4        |        |                 |                                 |         | 4     | 5        |        |                  |
| Applying (K3)      | 10                                   | 3     | 4        |        |                 | 11.5                            | 11.5    | 4     | 5        |        |                  |

**POST GRADUATE AND RESEARCH DEPARTMENT OF ZOOLOGY**  
**Programme: M.Sc. Zoology (Under CBCS and LOCF)**  
 (For those students admitted during the Academic Year 2022 - 23 and after)  
**SCHEME OF EXAMINATIONS**  
**FIRST SEMESTER**

| Part         | Study Component | Course Code          | Course Title               | Hrs.      | Credits   | CIA Marks | ESE Marks | Total Marks |
|--------------|-----------------|----------------------|----------------------------|-----------|-----------|-----------|-----------|-------------|
| III          | Core Course     | 31CT11               | Biochemistry               | 6         | 5         | 25        | 75        | 100         |
|              | Core Course     | 31CT12               | Cell and Molecular Biology | 6         | 5         | 25        | 75        | 100         |
|              | Core Course     | 31CT13               | Microbiology               | 6         | 5         | 25        | 75        | 100         |
|              | Core Course     | 31CP14               | Practical – I              | 6         | 3         | 40        | 60        | 100         |
|              | DSE             | 31DS1A               | Bioinformatics             | 6         | 5         | 25        | 75        | 100         |
| 31DS1B       |                 | Research Methodology |                            |           |           |           |           |             |
| <b>TOTAL</b> |                 |                      |                            | <b>30</b> | <b>23</b> |           |           |             |

**SECOND SEMESTER**

| Part         | Study Component | Course Code   | Course Title          | Hrs.      | Credits   | CIA Marks | ESE Marks | Total Marks |
|--------------|-----------------|---------------|-----------------------|-----------|-----------|-----------|-----------|-------------|
| III          | Core Course     | 31CT21        | Immunology            | 6         | 5         | 25        | 75        | 100         |
|              | Core Course     | 31CT22        | Biostatistics         | 6         | 5         | 25        | 75        | 100         |
|              | Core Course     | 31CT23        | Developmental Biology | 6         | 5         | 25        | 75        | 100         |
|              | Core Course     | 31CP24        | Practical – II        | 6         | 3         | 40        | 60        | 100         |
|              | DSE             | 31DS2A        | Evolution             | 6         | 5         | 25        | 75        | 100         |
| 31DS2B       |                 | Endocrinology |                       |           |           |           |           |             |
| <b>TOTAL</b> |                 |               |                       | <b>30</b> | <b>23</b> |           |           |             |

**THIRD SEMESTER**

| Part         | Study Component | Course Code | Course Title                | Hrs.      | Credits   | CIA Marks | ESE Marks | Total Marks |
|--------------|-----------------|-------------|-----------------------------|-----------|-----------|-----------|-----------|-------------|
| III          | Core Course     | 31CT31      | Genetics                    | 6         | 5         | 25        | 75        | 100         |
|              | Core Course     | 31CT32      | Physiology                  | 6         | 5         | 25        | 75        | 100         |
|              | Core Course     | 31CT33      | Principles of Biotechnology | 6         | 5         | 25        | 75        | 100         |
|              | Core Course     | 31CP34      | Practical – III             | 6         | 3         | 40        | 60        | 100         |
|              | GEC             | 31GE31      | Economic Zoology            | 6         | 5         | 25        | 75        | 100         |
| <b>TOTAL</b> |                 |             |                             | <b>30</b> | <b>23</b> |           |           |             |

**FOURTH SEMESTER**

| Part                              | Study Component | Course Code | Course Title           | Hrs.       | Credits   | CIA Marks | ESE Marks | Total Marks |
|-----------------------------------|-----------------|-------------|------------------------|------------|-----------|-----------|-----------|-------------|
| III                               | Core Course     | 31CT41      | Applied Biotechnology  | 6          | 5         | 25        | 75        | 100         |
|                                   | Core Course     | 31CT42      | Environmental Biology  | 6          | 5         | 25        | 75        | 100         |
|                                   | Core Course     | 31CP43      | Practical – IV         | 6          | 3         | 40        | 60        | 100         |
|                                   | Core Course     | 31PV44      | Project & Viva         | 6          | 3         | 40        | 60        | 100         |
|                                   | DSE             | 31DS4A      | Bio-farming Technology | 6          | 5         | 25        | 75        | 100         |
| 31DS4B                            |                 | Entomology  |                        |            |           |           |           |             |
| <b>TOTAL</b>                      |                 |             |                        | <b>30</b>  | <b>21</b> |           |           |             |
| <b>TOTAL NO. OF HOURS/CREDITS</b> |                 |             |                        | <b>120</b> | <b>90</b> |           |           |             |

## DEPARTMENT OF ZOOLOGY

Programme: M.Sc., Zoology, (Under CBCS and LOCF)

(For those students admitted during the Academic Year 2021 - 22 and after)

|                                   |                          |                         |
|-----------------------------------|--------------------------|-------------------------|
| PART – III : Core Course          |                          | SEMESTER - I            |
| Course Title: <b>BIOCHEMISTRY</b> |                          |                         |
| Course Code: <b>31CT11</b>        | Hours per week: <b>6</b> | Credits: <b>4</b>       |
| CIA: <b>25 Marks</b>              | ESE: <b>75 Marks</b>     | Total: <b>100 Marks</b> |

### Preamble

Students will understand the chemistry of biomolecules like Carbohydrates, Proteins and Lipids and have a comprehensive account on the metabolic pathways /reactions in human.

### Course Outcomes (CO)

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

| No.  | Course Outcome  | Knowledge Level (according to Bloom's Taxonomy) |
|------|---|---|
| CO 1 | Acquire knowledge on classification, structure, properties and importance of biomolecules.                | K1, K2 &K5                                      |
| CO 2 | Understand the types of Carbohydrates and metabolic pathways in human.                                    | K2, K4  |
| CO 3 | Differentiate the behaviour of amino acids and their metabolic reactions                                  | K3 & K5   |
| CO 4 | Remember the importance of fatty acids, phospholipids, Cholesterol and their metabolic reactions in human | K2, K4 & K5                                     |
| CO 5 | Distinguish the structure, biosynthesis and catabolism of purines, pyrimidines and nucleic acids.         | K2, K4 & K5                                     |

K1-Remembering K2-Understanding K3-Applying K4- Analyzing K5- Evaluating

### Mapping of CO with PO

|       | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO6 | PLO7 |
|-------|-------|-------|-------|-------|-------|------|------|
| CLO 1 | 9     | -     | -     | -     | -     | -    | 3    |
| CLO 2 | 9     | -     | 3     | -     | 3     | 1    | 3    |
| CLO 3 | 9     | -     | 3     | -     | 3     | 1    | 3    |
| CLO 4 | 9     | -     | 3     | -     | 3     | 1    | 3    |
| CLO 5 | 9     | -     | 3     | -     | 3     | 1    | 9    |
|       | 45    | -     | 12    | -     | 12    | 4    | 21   |

### Mapping of CO with PSO

|       | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|-------|-------|-------|-------|-------|-------|
| CLO 1 | 3     | 3     | -     | 9     | -     |
| CLO 2 | 3     | 9     | 3     | 9     | -     |
| CLO 3 | 3     | 3     | 3     | 9     | -     |
| CLO 4 | 3     | 3     | -     | 9     | -     |
| CLO 5 | 3     | 3     | -     | 9     | -     |
|       | 15    | 21    | 6     | 45    |       |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

### Syllabus

#### UNIT-I: Bio-molecular chemistry:

(18 Hrs)

- Carbohydrates, Proteins, Lipids – Classes, structure, chemical properties
- Enzymes – classes, mechanism of action, kinetics, Isoenzymes, precursors.

- c) Vitamins, Minerals and Pigments – Chemistry and metabolic importance
- d) Hormones – Classes, mechanism of action, Messenger system, metabolic role.

**UNIT-II: Carbohydrate metabolism: (18 Hrs)**

- a) Glycolysis, TCA cycle, Glycogenolysis, Glycogenesis, Gluconeogenesis and intermediary metabolism
- b) HMP Shunt and metabolic integration
- c) Metabolism of uronic acid and polysaccharides

**UNIT- III: Protein metabolism: (18 Hrs)**

- a) Transamination, Transdeamination, Deamination Transmethylation, Transcarboxylation and Ornithine cycle
- b) Metabolism of Glutamate Family of amino acids,
- c) Metabolism of Aspartate Family of amino acids
- d) Metabolism of Pyruvate Family of amino acids.

**UNIT- IV: Lipid metabolism: (18 Hrs)**

- a) Fatty acids- Biosynthesis and oxidation
- b) Metabolism of Phospholipids and ketone bodies
- c) Metabolism of cholesterol and steroid hormones
- d) Metabolism of Arachidonates (Prostaglandins).

**UNIT- V: Nucleic Acid Metabolism: (18 Hrs)**

- a) Biosynthesis and catabolism of purines
- b) Biosynthesis and catabolism of pyrimidines
- c) Biosynthesis and catabolism of nucleotide co-enzymes
- d) Various classes of DNA and RNA – structures and significances.

**Text Books**

- Ambika Shanmugam (2003). Fundamentals of Biochemistry, MMC, Chennai
- Satyanarayana and Chakrapani, (2006). Biochemistry, Books and Allied (P) Ltd., Kolkata.

**Reference Books**

- A. L Lehninger, 1990. Principles of Biochemistry. CBS publishers & distributors pvt Ltd. International edition, New York.
- Geoffrey Zubay 1989. Biochemistry 2nd edition. Maxwell-Macmillan
- Harold and Harper et al (1977). Review of Physiological Chemistry. The kottari's book
- Voet .D and Voet G Judith (1990). Biochemistry. John Wiley and sons New York
- M.N.Chatterjee and Rana Shinde 2005. A Text book of Medical Biochemistry, JP bro, Delhi
- Mathews et al., (2000), Biochemistry, Pearson Education Pvt. Ltd. New Delhi.
- Abraham Mazur and Benjamin Harrow 1971. Text Book of Biochemistry, W.B Saunders Company, Philadelphia.

**Pedagogy**

- Chalk & Talk, Group Discussion, PPT

**Teaching Aids**

- Green Board, LCD Projector, Chart models, Interactive White Board

**Course Contents and Lecture Schedule**

| Module No.                               | Topic   | No. of Lectures | Content Delivery Method | Teaching Aids      |
|--|---|-----------------|-------------------------|--------------------|
| Unit -1 Bio-molecular chemistry (18 hrs) |   |                 |                         |                    |
| 1.1                                      | Introduction to Bio-molecular chemistry                     | 1               | Discussion              | Green Board Charts |
| 1.2                                      | Classes, structure, properties of carbohydrates             | 3               | Chalk & Talk            | Green Board        |
| 1.3                                      | Classes, structure, properties of proteins                  | 3               | Chalk & Talk            | Green Board        |
| 1.4                                      | Classes, structure, properties of lipids                    | 3               | Chalk & Talk            | Green Board        |
| 1.5                                      | Enzymes- classes, mechanism of action, kinetics, Isoenzymes | 2               | Chalk & Talk            | Green Board        |



|   |  |               |                              |                    |
|---|--|---------------|------------------------------|--------------------|
| 1.6   | Chemistry and metabolic importance of vitamins, minerals and pigments      | 3             | Chalk & Talk                 | Green Board        |
| 1.7   | Hormones – Classes, mechanism of action, Messenger system, metabolic role. | 3             | Chalk & Talk, PPT            | Green Board, LCD   |
| <b>Unit -2 Carbohydrate metabolism (18 hrs)</b> |  |               |                              |                    |
| 2.1   | Introduction to Carbohydrate metabolism                                    | 1             | Lecture                      |                    |
| 2.2   | Glycolysis   | 3             | Chalk & Talk                 | Green Board        |
| 2.3   | TCA Cycle  | 3             | Chalk & Talk, display models | Green Board, Chart |
| 2.4   | Glycogenolysis,  | 3             | Chalk & Talk, PPT            | Green Board, LCD   |
| 2.5   | Glycogenesis,  | 1             | Chalk & Talk, PPT            | Green Board, LCD   |
| 2.6   | Gluconeogenesis  | 1             | Chalk & Talk, PPT            | Green Board, LCD   |
| 2.7   | HMP shunt and metabolic integration  | 2             | Chalk & Talk                 | Green Board        |
| 2.8   | Metabolism of uronic acid  | 2             | Chalk & Talk, PPT            | Green Board, LCD   |
| 2.9   | Metabolism of polysaccharides  | 2             | Chalk & Talk                 | Green Board        |
| <b>Unit -3 Protein metabolism (18 hrs)</b>      |  |               |                              |                    |
| 3.1   | Introduction to Protein metabolism   | 3             | Chalk & Talk                 | Green Board        |
| 3.2   | Transamination, Transdeamination   | 3             | Chalk & Talk                 | Green Board        |
| 3.3   | Deamination, Transmethylation  | 2             | Chalk & Talk                 | Green Board        |
| 3.4   | Transcarboxylation   | 2             | Chalk & Talk                 | Green Board        |
| 3.5   | Ornithine cycle  | 2             | PPT                          | LCD                |
| 3.6   | Metabolism of Glutamate Family of amino acids                              | 3             | Chalk & Talk                 | Green Board        |
| 3.7   | Metabolism of Aspartate Family of amino acids                              | 3             | Chalk & Talk                 | Green Board        |
| 3.8   | Metabolism of Pyruvate Family of amino acids                               | 2             | Chalk & Talk                 | Green Board        |
| <b>Unit -4 Lipid metabolism (18 hrs)</b>        |  |               |                              |                    |
| 4.1   | Introduction to Lipid metabolism   | 1             | Discussion                   | Smart Board        |
| 4.2   | Fatty acids – Biosynthesis and oxidation                                   | 3             | Chalk & Talk                 | Green Board        |
| 4.3   | Metabolism of Phospholipids  | 4             | Chalk & Talk                 | Green Board        |
| 4.4   | Metabolism of ketone bodies  | 2             | Chalk & Talk                 | Green Board        |
| 4.5   | Metabolism of cholesterol  | 4             | Lecture                      |                    |
| 4.7   | Metabolism of Arachidonates (Prostaglandins)                               | 4             | Chalk & Talk                 | Green Board        |
| <b>Unit -5 Nucleic Acid Metabolism (18 hrs)</b> |  |               |                              |                    |
| 5.1   | Introduction to Nucleic Acid Metabolism                                    | 2             | Lecture                      | Green Board        |
| 5.2   | Biosynthesis and catabolism of purines                                     | 4             | Chalk & Talk                 | Green Board        |
| 5.3   | Biosynthesis and catabolism of pyrimidines                                 | 4             | Chalk & Talk                 | Green Board        |
| 5.4   | Biosynthesis and catabolism of nucleotide co-enzymes                       | 4             | Chalk & Talk                 | Green Board        |
| 5.5   | Various classes of DNA and RNA – structures and significances              | 4             | Chalk & Talk                 | Green Board        |
| <b>Total</b>                                    |  | <b>90 hrs</b> |                              |                    |

### E-Resources

1. [https://youtu.be/mH\\_4cr0tU7k](https://youtu.be/mH_4cr0tU7k)
2. <https://www.slideshare.net/thana123/endocrine-system-11539713>

3. <https://www.slideshare.net/DrSubirKumar/carbohydrate-metabolism-interconnection-of-metabolism-with-respiratory-chain>
4. <https://youtu.be/L4cJ8uq31kY>
5. <https://www.slideshare.net/BiochemistrySGRDIMSAR/cholesterol-synthesis>
6. [http://www.powershow.com/view0/8d52ef-MDUwN/Hexose\\_monophosphate\\_shunt\\_powerpoint\\_ppt\\_pr](http://www.powershow.com/view0/8d52ef-MDUwN/Hexose_monophosphate_shunt_powerpoint_ppt_pr)
7. <https://www.slideshare.net/astralfilledsky/metabolism-b>
8. <https://youtu.be/MPwXzV58eIY>
9. <https://www.slideshare.net/GloriaOffor/amino-acid-biosynthesis-grp-assignment-ppt>
10. <https://www.slideshare.net/YESANNA/uronic-acid-pathway>

## DEPARTMENT OF ZOOLOGY

Programme: M.Sc., Zoology, (Under CBCS and LOCF)

(For those students admitted during the Academic Year 2021 - 22 and after)

|   |                          |                         |
|---|--------------------------|-------------------------|
| PART – III : Core Course                        |                          | SEMESTER - I            |
| Course Title: <b>CELL AND MOLECULAR BIOLOGY</b> |                          |                         |
| Course Code: <b>31CT12</b>                      | Hours per week: <b>6</b> | Credits: <b>4</b>       |
| CIA: <b>25 Marks</b>                            | ESE: <b>75 Marks</b>     | Total: <b>100 Marks</b> |

### Preamble

To enable the students understand structure and functions of cell organelles and acquire the knowledge on replication of DNA, mechanism of protein synthesis and the principles of gene regulation.

### Course Outcomes (CO)

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

| No.  | Course Outcome  | Knowledge Level (according to Bloom's Taxonomy) |
|------|---|---|
| CO 1 | Understand the structure and molecular organisation of cell membrane, mitochondria and their dynamics | K1 & K3   |
| CO 2 | Learn the cell matrices, its functions, detoxifications and recycling                                 | K1, K2, & K5                                    |
| CO 3 | Study the concepts of cell development, its regulation and abnormality                                | K1 & K3   |
| CO 4 | Able to describe the structure of hereditary material, its manifestation and its properties           | K1, K2, K3 & K4,                                |
| CO 5 | Gain knowledge on molecular mechanisms of gene expression and their regulations                       | K2 & K5   |

K1-Remembering K2-Understanding K3-Applying K4- Analyzing K5- Evaluating

### Mapping of CO with PO

|       | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO6 | PLO7 |
|-------|-------|-------|-------|-------|-------|------|------|
| CLO 1 | 9     | -     | 3     | -     | -     | 1    | 3    |
| CLO 2 | 3     | -     | 3     | -     | -     | 3    | 1    |
| CLO 3 | 9     | -     | 9     | 1     | 3     | 3    | 3    |
| CLO 4 | 3     | -     | -     | -     | -     | 3    | 3    |
| CLO 5 | 9     | -     | 3     | -     | 3     | 3    | 9    |
|       | 33    |       | 18    | 1     | 6     | 13   | 19   |

### Mapping of CO with PSO

|       | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|-------|-------|-------|-------|-------|-------|
| CLO 1 | 3     | 9     | -     | -     | -     |
| CLO 2 | -     | 3     | 9     | 3     | -     |
| CLO 3 | 3     | 9     | -     | 3     | -     |
| CLO 4 | -     | 9     | -     | 3     | -     |
| CLO 5 | -     | 9     | 3     | 3     | -     |
|       | 6     | 39    | 12    | 12    |       |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

### Syllabus

#### UNIT-I: Structure and function of the cell surface and Mitochondria (18 Hrs)

- Molecular dynamics of cell membrane – Composition – Molecular models – Liposome - Unit membrane - Fluid mosaic model – Cell permeability – Transport mechanisms – Differentiation- Cell recognition and inter cellular communication.

b) Molecular organization of mitochondria and transduction of energy – Mitochondrial DNA – ultra structure of F<sub>1</sub> particles Bioenergetics.

**UNIT-II: Protein sorting, secretion and endocytosis (18 Hrs)**

a) The Endoplasmic reticulum and Golgi complex – Structure and molecular constituents – Movements of proteins through ER and Golgi complex – The mechanisms of sorting and distributing proteins – Signal hypothesis

b) Lysosomes – Enzymes – Functions - Endocytosis and autophagy

**UNIT- III: The Nucleus-cell cycle and cell division (18 Hrs)**

a) The molecular organization of interphase nucleus – Nuclear envelop –Chromatin-Chromosome-Nucleolus – r RNA Synthesis.

b) Cell cycle-phases of cell cycle – Cell cycle regulations - Cell aging and cell death.

c) Cell division – Mitosis and meiosis – General description (self study) - Mitotic apparatus.

d) Cancer Biology- Characteristics, causes, carcinogens

**UNIT- IV: Fundamentals of molecular biology (18 Hrs)**

a) The genetic material –DNA and RNA – experimental evidences.

Nucleic acids: The basic units and their arrangements – bonds - Watson and crick model – Different forms of DNA – denaturation and renaturation – Molecular hybridization – Structure of RNA.

**b. DNA replication and genetic code**

Replication and synthesis of DNA – Meselson and Stahl's experiment –Bacterial DNA replication – Role of enzymes in DNA replication.

Genetic code – Deciphering the code – Properties of genetic code – Coding dictionary.

**UNIT- V: Protein synthesis (18 Hrs)**

a) Transcription in prokaryotes and eukaryotes – Synthesis of mRNA —splicing mechanisms.

Translation – Role of ribosomes – Activation of tRNA – Stages of polypeptide synthesis– Inhibitors of protein synthesis.

**b. Regulation of gene activity**

Principles of gene regulation- regulatory genes

Lac operon – Arabinose operon- Trp operon

Gene regulation in Eukaryotes.

#### Text Books

- De Robertis E.D.P and De Robertis E.M.F. 2005. Cell and Molecular Biology, 8<sup>th</sup> Edition, B.I Publications PVT.Ltd.India.

#### Reference Books

- Gerald Karp, 2010. Cell Biology John Wiley&Sons, Pvt.Ltd. Singapore.
- Gupta P.K. 2010. Cell and Molecular Biology, Rastogi Publications, Meerut, India.
- Craig & Co –authors, 2010. Molecular Biology Oxford University Press, UK.
- Jayanta K.Pal and Saroj S.Ghaskadbi 2009. Fundamentals of Molecular Biology, Oxford University Press, NewDelhi.
- Bruce Alberts& Co-authors, 2008. Molecular Biology of the Cell Garland Science, NewYork.
- Russel P.J. &Co-authors 2004. Cell and Molecular Biology, Cengage learning, Pvt.Ltd, NewDelhi.

#### Pedagogy

- Chalk & Talk, Group Discussion, PPT

#### Teaching Aids

- Green Board, LCD Projector, Interactive White Board

#### Course Contents and Lecture Schedule

| Module No. | Topic | No. of Lectures | Content Delivery Method | Teaching Aids |
|------------|-------|-----------------|-------------------------|---------------|
|            |       |                 |                         |               |

| <b>Unit -1 Structure and function of the cell surface and Mitochondria</b> |  |   |                  |             |
|--|--|---|------------------|-------------|
| 1.1  | Molecular dynamics of cell membrane – Composition  | 1 | Discussion       | Green Board |
| 1.2  | Molecular models – Liposome - Unit membrane - Fluid mosaic model   | 3 | Lecture          | Green Board |
| 1.3  | Cell permeability – Transport mechanisms – Differentiation   | 3 | Lecture          | Green Board |
| 1.4  | Cell recognition and inter cellular communication  | 3 | Discussion       | Green Board |
| 1.5  | Molecular organization of mitochondria and transduction of energy —  | 3 | Lecture          | Green Board |
| 1.6  | Mitochondrial DNA  | 3 | Chalk & Talk     | Green Board |
| 1.7  | ultra structure of F <sub>1</sub> particles Bioenergetics.   | 2 | Chalk & Talk     | Green Board |
| <b>Unit -2 Protein sorting, secretion and endocytosis</b>                  |  |   |                  |             |
| 2.1  | The Endoplasmic reticulum and Golgi complex – Structure and molecular constituents   | 5 | Lecture          | Green Board |
| 2.2  | Movements of proteins through ER and Golgi complex   | 4 | Chalk & Talk     | Green Board |
| 2.3  | The mechanisms of sorting and distributing proteins – Signal hypothesis  | 4 | Chalk & Talk     | Green Board |
| 2.4  | Lysosomes – Enzymes – Functions - Endocytosis and autophagy.   | 5 | Chalk & Talk     | Green Board |
| <b>Unit -3 The Nucleus-cell cycle and cell division</b>                    |  |   |                  |             |
| 3.1  | The molecular organization of interphase nucleus – Nuclear envelop –Chromatin-Chromosome-Nucleolus – r RNA Synthesis.  | 4 | Chalk & Talk     | Green Board |
| 3.2  | Cell cycle-phases of cell cycle – Cell cycle regulations - Cell aging and cell death.  | 5 | Lecture          | Green Board |
| 3.3  | Cell division – Mitosis and meiosis – General description (self study) - Mitotic apparatus   | 5 | Discussion       | Green Board |
|  | Cancer Biology- Characteristics, causes, carcinogens   | 4 | PPT              | LCD         |
| <b>Unit -4 Fundamentals of molecular biology</b>                           |  |   |                  |             |
| 4.1  | The genetic material –DNA and RNA – experimental evidences.  | 4 | Discussion       | Green Board |
| 4.2  | Nucleic acids: The basic units and their arrangements – bonds - Watson and crick model – Different forms of DNA – denaturation and renaturation – Molecular hybridization – Structure of RNA – Restriction mapping – RFLP. | 5 | Chalk & Talk     | Green Board |
| 4.3  | Replication and synthesis of DNA – Neselson and Stahl’s experiment –Bacterial DNA replication – Role of enzymes in DNA replication.  | 5 | Chalk & Talk     | Green Board |
|  | Genetic code – Deciphering the code – Properties of genetic code – Coding dictionary.  | 4 | Table discussion | Smart Board |
| <b>Unit -5 Protein synthesis , Regulation of gene activity</b>             |  |   |                  |             |
| 5.1  | Transcription in prokaryotes and eukaryotes – Synthesis of mRNA —splicing mechanisms.  | 4 | Lecture          | Smart Board |
| 5.2  | Translation – Role of ribosomes – Activation of tRNA – Stages of polypeptide synthesis– Inhibitors of protein synthesis.   | 5 | Chalk & Talk     | Green Board |

|     |   |           |              |             |
|-----|---|-----------|--------------|-------------|
| 5.3 | Principles of gene regulation- regulatory genes                             | 5         | Chalk & Talk | Green Board |
|     | Lac operon – Arabinose operon- Trp operon<br>Gene regulation in Eukaryotes. | 4         |              |             |
|     | <b>Total</b>  | <b>90</b> |              |             |

### E-Resources

<https://www.slideshare.net/angella2010/cell-mitochondria-ppt>

<https://www.slideshare.net/Dilippandya/mitochondria-46636401>

<https://www.slideshare.net/LOKESH PANIGRAHI/mitochondria-structure-mt-dna-protein-transportetoxidative-phosphorylation-79468063>

<https://www.slideshare.net/anupisal/protein-sorting-and-transport>

<https://www.slideshare.net/cheluvaraya20/protein-sorting-and-targeting>

<https://www.slideshare.net/ssmvjunwani/protein-targeting-138410680>

<https://www.slideshare.net/anatomy2013/protein-sorting-in-golgi-bodies>

<https://www.slideshare.net/Wabworld/the-cell-cycle-and-cell-division>

<https://www.slideshare.net/poojasingh676/cell-cycle-and-cell-division-128043690>

<https://www.slideshare.net/adurganaveen/dna-replication-56267455>

<https://www.slideshare.net/namarta28/dna-replication-11967263>

<https://www.slideshare.net/MUBOSScz/synthesis-of-proteinsregulation11>

<https://www.slideshare.net/ShitalMagar2/concept-of-gene-and-protein-synthesis>

**DEPARTMENT OF ZOOLOGY**

Programme: M.Sc., Zoology, (Under CBCS and LOCF)

(For those students admitted during the Academic Year 2021 - 22 and after)

|                                   |                          |                         |
|-----------------------------------|--------------------------|-------------------------|
| <b>PART – III : Core Course</b>   |                          | <b>SEMESTER - I</b>     |
| <b>Course Title: MICROBIOLOGY</b> |                          |                         |
| Course Code: <b>31CT13</b>        | Hours per week: <b>6</b> | Credits: <b>4</b>       |
| CIA: <b>25 Marks</b>              | ESE: <b>75 Marks</b>     | Total: <b>100 Marks</b> |

**Preamble**

To enable the students to understand basic aspects, classification, and culture of microbes, role of microbes in selected human diseases and applications of microbes in industries and environment

**Course Outcomes (CO)**

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

| No.         | Course Outcome  | Knowledge Level (according to Bloom's Taxonomy) |
|-------------|---|---|
| <b>CO 1</b> | Acquire knowledge on principles of microbial classification- Bergey's manual, characteristics and morphology of bacteria, fungi, algae, virus and protozoa. | K1 & K2   |
| <b>CO 2</b> | Understand the nutritional requirements, culture media and culture of microbes.   | K1, K2 & K3                                     |
| <b>CO 3</b> | Understand the infectious diseases caused by microbes in man and general concepts of pathogenicity.   | K4 & K5   |
| <b>CO 4</b> | Study the diversity and distribution of micro organisms in soil, water, air and their applications.   | K1 & K3   |
| <b>CO 5</b> | Differentiate food spoilage, food poisoning by microbes and preservation methods. Industrial application of microbes.                                       | K1, K3, K4, K5,                                 |

**K1-Remembering K2-Understanding K3-Applying K4- Analyzing K5- Evaluating**

**Mapping of CO with PO**

|              | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO6 | PLO7 |
|--------------|-------|-------|-------|-------|-------|------|------|
| <b>CLO 1</b> | 3     | -     | 1     | -     | -     | 1    | 3    |
| <b>CLO 2</b> | 3     | -     | 3     | -     | 3     | 3    | 3    |
| <b>CLO 3</b> | 3     | -     | 9     | -     | 3     | 3    | 3    |
| <b>CLO 4</b> | 3     | -     | 3     | -     | 3     | 9    | 3    |
| <b>CLO 5</b> | 3     | -     | 3     | 1     | 3     | 3    | 3    |
|              | 15    |       | 19    | 1     | 12    | 19   | 15   |

**Mapping of CO with PSO**

|              | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|--------------|-------|-------|-------|-------|-------|
| <b>CLO 1</b> | 9     | 3     | 1     | -     | -     |
| <b>CLO 2</b> | -     | 3     | 9     | 1     | -     |
| <b>CLO 3</b> | -     | 1     | 9     | 9     | 3     |
| <b>CLO 4</b> | 9     | 3     | 3     | 3     | 3     |
| <b>CLO 5</b> | 9     | 3     | 3     | 9     | 1     |
|              | 27    | 13    | 25    | 22    | 7     |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

**UNIT-I: Principles of microbial classification and Microbial morphology (18 Hrs)**

- a) History of microbiology –Koch's postulates-Five kingdom concepts-recent status of classification-Bergey's manual of systematic bacteriology-Distinctive characteristics of the major groups of micro organisms-Bacteria, Fungi, Algae, Virus and

Protozoa.

- b) Comparison of prokaryotic and Eukaryotic microorganisms, gross morphological and ultra structure of typical prokaryotic cell-morphology of bacteria, fungi, algae and protozoa.

**UNIT-II: Nutritional requirements, culture/ cultivation, of microorganisms (18 Hrs)**

- a) Nutrients-nutritional requirements of microbes-nutritional classification of microorganisms – Mass culture.  
b) Physical condition for activation of microorganisms- Reproduction and growth of microorganisms- batch, synchronous and continuous growth of bacterial culture- synchronous growth methods-quantification of microorganisms.

**UNIT- III: Microorganism and diseases- Classification- Pharmaceutical microbiology (18 Hrs)**

- a) Normal flora of the healthy human host-effect of normal flora on the human host. General concepts of pathogenicity and principles of epidemiology-host parasite interaction-antibiotics-natural and synthetic antiviral drugs-other chemotherapeutic agents.  
b) Infectious disease of man.  
i) Bacterial-Tuberculosis  
ii) Viral- Polio, COVID-19.  
iii) Fungal- *Candida albicans*

**UNIT- IV: Environmental microbiology (18 Hrs)**

- a) Soil microorganisms- The Rhizosphere and the phyllosphere-Factors influencing soil microbial population-interaction among the soil microorganisms-the role of microorganisms in recycling nitrogen, carbon, sulphur and phosphorus.  
b) Aquatic microorganisms-factors influencing aquatic microbial population-distribution of microorganism in aquatic environment and their role in aquatic environment – probiotics – siderophores.  
c) Microbiology of potable water and waste water-biological treatment of waste and pollutants.

**UNIT- V: Food and Industrial microbiology (18 Hrs)**

- a) Food as medium-microbial examination of foods-microorganisms found in fresh foods-spoilage of food-food preservation-food poisoning-food products by micro organisms.  
b) Microbial processes, production and optimization. Fermentation: fermenter design, types, kinetics, and bioprocess monitoring - Down stream processing and strain improvement - Production, recovery, stability and formulation of bacterial and fungal enzymes  
c) FSSAI (Food Safety and Standards Authority of India)

**Text Books**

- Michael J.Pelczar, J.R. Ecschan, Noel R Krieg 2010. Microbiology an Application Based Approach, Tata McGraw Hill Education Private Ltd, NewDelhi
- Ananthanarayanan and Panicker 2009. Text book of Microbiology, Universities Press,

**Reference Books**

- Tortara, G.J. 2011. Microbiology An introduction, Addison Wisely, Newyork.
- Puvanakrishnan, R. 2012. Microbial Technology, MJP Publishers, Chennai
- Aneja, K.R. 2009. A text book of Basic and Applied Microbiology, New Age International Publishers, New Delhi.
- Willey, 2008. Microbiology, Mc Graw Hill, Boston, N.S. Subba Rao, fourth edition. Oxford and IBH. Pub. New Delhi.
- Subba Rao N.S., 2008. Soil Microbiolgoy, Scoence Publishing INC, New Delhi
- Pommerville 2014. Alcamos fundamentals of Microbiology, Jones and Bartlette learning, New Delhi.



## Pedagogy

- Chalk & Talk, Group Discussion, PPT

## Teaching Aids

- Green Board, LCD Projector, Chart models, Interactive White Board

## Course Contents and Lecture Schedule

| Module No.   | Topic   | No. of Lectures | Content Delivery Method       | Teaching Aids      |
|--|---|-----------------|-------------------------------|--------------------|
| <b>Unit -1 Principles of microbial classification and Microbial morphology</b>         |   |                 |                               |                    |
| 1.1  | Discovering the microbial world –Koch's postulates-Five kingdom concepts  | 2               | Discussion                    | Green Board        |
| 1.2  | recent status of classification-Bergy's manual of systematic bacteriology   | 4               | Chalk & Talk                  | Green Board        |
| 1.3  | Distinctive characteristics of the major groups of micro organisms-Bacteria, Fungi, Algae, Virus and Protozoa.  | 4               | Chalk & Talk                  | Green Board        |
| 1.4  | Comparison of prokaryotic and Eukaryotic microorganisms   | 3               | Chalk & Talk                  | Green Board        |
| 1.5  | gross morphological and ultra structure of typical prokaryotic cell   | 2               | Chalk & Talk                  | Green Board        |
| 1.6  | morphology of bacteria, fungi, algae and protozoa.  | 3               | Chalk & Talk, PPT             | Green Board, LCD   |
| <b>Unit -2 Nutritional requirements, culture/ cultivation, of microorganisms</b>       |   |                 |                               |                    |
| 2.1  | Nutrients-nutritional requirements of microbes-nutritional classification of micro organisms-Mass culture   | 5               | Lecture                       |                    |
| 2.2  | Physical condition for activation of microorganisms- Reproduction and growth of microorganisms  | 6               | Chalk & Talk, PPT             | Green Board, LCD   |
| 2.3  | batch, synchronous and continuous growth of bacterial culture- synchronous growth methods-quantification of microorganisms  | 7               | Chalk & Talk, display models, | Green Board, Chart |
| <b>Unit -3 Microorganism and diseases- Classification- Pharmaceutical microbiology</b> |   |                 |                               |                    |
| 3.1  | Normal flora of the healthy human host-effect of normal flora on the human host.  | 4               | Chalk & Talk                  | Green Board        |
| 3.2  | General concepts of pathogenicity   | 3               | Chalk & Talk                  | Green Board        |
| 3.3  | Principles of epidemiology-host parasite interaction-antibiotics-natural and synthetic antiviral drugs-other chemotherapeutic agents.   | 4               | Chalk & Talk                  | Green Board        |
| 3.4  | Bacterial-Tuberculosis  | 3               | Chalk & Talk                  | Green Board        |
| 3.5  | Viral- Polio  | 2               | PPT                           | LCD                |
| 3.6  | Fungal- <i>Candida albicans</i>   | 2               | Chalk & Talk                  | Green Board        |
| <b>Unit -4 Environmental microbiology(15 hrs)</b>                                      |   |                 |                               |                    |
| 4.1  | Soil micro organisms- The Rhizosphere and the phyllosphere-Factors influencing soil microbial population-interaction among the soil micro organisms-the role of micro organisms in recycling nitrogen, carbon, sulphur and phosphorous. | 6               | Discussion                    |                    |
| 4.2  | Aquatic micro organisms-factors influencing aquatic microbial population-distribution of micro organism in aquatic environment and  | 6               | Chalk & Talk                  | Green Board        |

|  |   |               |              |             |
|--|---|---------------|--------------|-------------|
|  | their role in aquatic environment – probiotics.   |               |              |             |
| 4.3  | Microbiology of potable water and waste water-biological treatment of waste and pollutants.                                     | 6             | Chalk & Talk | Green Board |
| <b>Unit -5 Food and Industrial microbiology (12 hrs)</b> |   |               |              |             |
| 5.1  | Food as medium-microbial examination of foods-microorganisms found in fresh foods-.   | 5             | Lecture      |             |
| 5.2  | spoilage of food-food preservation-food poisoning-food products by micro organisms  | 5             | Chalk & Talk | Green Board |
| 5.3  | Microbial processes, production and optimization. Fermentation: fermenter design, types, kinetics, and bioprocess monitoring    | 5             | Chalk & Talk | Green Board |
| 5.4  | Down stream processing and strain improvement - Production, recovery, stability and formulation of bacterial and fungal enzymes | 3             | Chalk & Talk | Green Board |
| <b>Total</b>   |   | <b>90 hrs</b> |              |             |

### **E-Resources**

[https://youtu.be/ASv\\_L\\_hwW6g](https://youtu.be/ASv_L_hwW6g)

<https://www.slideshare.net/SujitKakade/classification-of-microorganism-236743340>

<https://www.slideshare.net/Rubzzzz/bohomolets-microbiology-lecture1>

<https://youtu.be/xHQWhHqsykc>

<https://youtu.be/44go2W8CbbM>

<https://www.slideshare.net/plus100years/tuberculosis-53634155>

<https://www.slideshare.net/RameshPandi4/poliomyelitis-249253736>

<https://www.slideshare.net/bala1957/soil-microorganisms>

<https://www.slideshare.net/zainabsarfraz4/impact-of-sewage-and-sewage-treatment-on-surface>

<https://www.slideshare.net/RameshPandi4/candida-albicans-249254095>

## DEPARTMENT OF ZOOLOGY

Programme: M.Sc., Zoology, (Under CBCS and LOCF)

(For those students admitted during the Academic Year 2021 - 22 and after)

|                             |                   |                  |
|-----------------------------|-------------------|------------------|
| PART – III : Core Practical |                   | SEMESTER - I     |
| Course Title: PRACTICAL - I |                   |                  |
| Course Code: 31CP14         | Hours per week: 6 | Credits: 3       |
| CIA: 40 Marks               | ESE: 60 Marks     | Total: 100 Marks |

### Preamble

To enable the students to test the quantity and quality of the biological molecules, identification of cell organelle, genetic materials through microscopy, prepared materials and micro technique. Also able to employ the proliferation technique, identify, assimilate the microorganisms.

### Course Outcomes (CO)

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

| No.  | Course Outcome  | Knowledge Level (according to Bloom's Taxonomy) |
|------|---|---|
| CO 1 | Acquire the knowledge on quantity and quality testing of biological molecules.                                  | K1, K2 & K5                                     |
| CO 2 | Understand the action of salivary amylase on substrates under various factors.                                  | K2, K4  |
| CO 3 | Identify, measure and mount the cellular and genetic materials by biological techniques and prepared materials. | K3 & K5   |
| CO 4 | Able to employ techniques of culture, identification and testing microorganisms                                 | K2, K4 & K5                                     |
| CO 5 | Able to trace the appropriate instrumentation and their associated materials for microbes.                      | K2, K4 & K5                                     |

K1-Remembering K2-Understanding K3-Applying K4- Analyzing K5- Evaluating

### Mapping of CO with PO

|       | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|-------|------|------|------|------|------|------|------|
| CLO 1 | 3    | -    | 3    | 1    | 3    | 3    | 3    |
| CLO 2 | 3    | -    | 1    | -    | -    | 3    | 1    |
| CLO 3 | 3    | -    | 1    | -    | 1    | -    | -    |
| CLO 4 | 3    | -    | 3    | 1    | 3    | 3    | 9    |
| CLO 5 | 9    | -    | -    | -    | 1    | 1    | 3    |
|       | 21   |      | 8    | 2    | 8    | 10   | 16   |

### Mapping of CO with PSO

|       | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|-------|-------|-------|-------|-------|-------|
| CLO 1 | 1     | 3     | 1     | -     | 9     |
| CLO 2 | 1     | -     | 3     | -     | -     |
| CLO 3 | 1     | 3     | 3     | 9     | 1     |
| CLO 4 | -     | 3     | 9     | 9     | 9     |
| CLO 5 | 3     | 1     | 3     | 9     | 9     |
|       | 6     | 10    | 19    | 27    | 28    |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

### Syllabus

#### BIOCHEMISTRY

1. Estimation of sugar by Folin- Wu method.
2. Isolation and estimation of glycogen from Goat liver by Anthrone method.
3. Estimation of protein by Lowry's method.
4. Estimation of cholesterol in blood serum (colorimetric).

5. Estimation of ascorbic acid by titrimetric method.
6. Effect of Temperature on enzyme action (Colorimetric method).

### **CELL AND MOLECULAR BIOLOGY**

**2 Hours/Week**

1. Principles and application of phase contrast and electron microscopy
2. Micrometry- Measurements of cells using Ocular and Stage micrometer
3. Microtome technique – Fixation, sectioning and staining – preparation of permanent slides of animal tissues
4. Observation of succinic acid dehydrogenase activity in liver homogenate

#### **Spotters:**

- a) Semi conservative model
- b) Transcription steps
- c) Translation steps
- d) tRNA
- e) Lac Operon

### **MICROBIOLOGY**

*2 Hours/Week*

- 1) Simple staining of Bacteria (Direct and negative).
- 2) Differential staining of Bacteria (Gram's stain)
- 3) Preparation and sterilization of culture medium (nutrient agar)
- 4) Determining number of microbes – quantitative plating techniques-spread plate & pour plate methods.
- 5) Turbidometric estimation of bacterial growth.
- 6) Effect of temperature and pH on bacterial growth,
- 7) Bacteriological examination of Raw and Pasteurized milk.
- 8) Degradation (Fermentation) of Starch by bacteria.
- 9) Testing the sensitivity of bacteria to the antibiotics.

#### **Spotters: Laminar flow hood**

1. Autoclave
2. Colony counter
3. Anerobic jar
4. Colony morphology –Identification
5. Millipore filter apparatus
6. Counting chamber Culture systems-Continuous, batch and synchronous. Nif gene cluster

### **Text Books**

- Balinsky, B.I. and Fabian 2012, An introduction to embryology. Cengage Learning India Pvt, New Delhi.
- Inderbir Singh & Pal G.P. 2013, Human Embryology, 9th edition MacMillan India. Ltd. Chennai.

### **Reference Books**

- Subramanian M.A 2012, Developmental Biology. MJP Publishers, Chennai
- Berril, N.J. 1976- Development. Tata Mc.Graw. Hill .Pub.Co.Ltd.
- Scott F. Gilbert 1988. Developmental biology, Sinauer Associates and Pub. Massachutes.
- Verma, P. S and Agarwal, V.K. 2005, Chordate Embryology, S.Chand & Co, New Delhi.
- Jain P.C. 2007. Elements of developmental biology. Vishal Publication Jalandhar- Delhi

### **Pedagogy**

Chalk & Talk, Group Discussion, PPT

### **Teaching Aids**

Green Board, LCD Projector, Chart models, Interactive White Board

### **Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Practicals | Content Delivery Method | Teaching Aids |
|------------|-------|-------------------|-------------------------|---------------|
|------------|-------|-------------------|-------------------------|---------------|

|    |  |   |                                     |  |
|----|--|---|-------------------------------------|--|
| 1  | <b>BIOCHEMISTRY</b><br>Estimation of sugar by Folin- Wu method   | 2 | Chalk & Talk<br>Dissection<br>Tools | Green Board<br>Charts                      |
| 2  | Isolation and estimation of glycogen from Goat liver by Anthrone method  | 2 | Chalk & Talk<br>Dissection<br>Tools | Green Board<br>Microscope<br>Charts        |
| 3  | Estimation of protein by Lowry's method  | 2 | Chalk & Talk<br>Dissection<br>Tools | Green Board<br>Microscope<br>Charts        |
| 4  | Estimation of cholesterol in blood serum (colorimetric)  | 2 | Chalk & Talk<br>Dissection<br>Tools | Green Board<br>Microscope<br>Charts        |
| 5  | Estimation of ascorbic acid by titrimetric method  | 2 | Chalk & Talk<br>Dissection<br>Tools | Green Board<br>Microscope<br>Charts        |
| 6  | Effect of Temperature on enzyme action (Colorimetric method)   | 4 | Software<br>Internet with<br>Wifi   | Smart Board<br>Charts<br>Models<br>Laptops |
| 7  | <b>CELL AND MOLECULAR BIOLOGY</b><br>Principles and application of phase contrast and electron microscopy                    | 1 | Discussion                          | Green Board                                |
| 8  | Micrometry- Measurements of cells using Ocular and Stage micrometer  | 1 | Discussion                          | Green Board                                |
| 9  | Microtome technique – Fixation, sectioning and staining – preparation of permanent slides of animal tissues                  | 1 | Chalk & Talk<br>Discussion          | Preserved<br>animalcules and<br>slides     |
| 10 | Observation of succinic acid dehydrogenase activity in liver homogenate  | 1 | Chalk & Talk<br>Discussion          | Preserved<br>animalcules and<br>slides     |
| 11 | <b>Spotters:</b><br>a) Semi conservative model<br>b) Transcription steps<br>c) Translation steps<br>d) tRNA<br>e) Lac Operon | 1 | Chalk & Talk<br>Discussion          | Preserved<br>animals and<br>slides         |
| 12 | <b>MICROBIOLOGY</b><br>Simple staining of Bacteria (Direct and negative)   | 1 | Chalk & Talk<br>Discussion          | Preserved<br>animals and<br>slides         |
| 13 | Differential staining of Bacteria (Gram's stain)   | 1 | Chalk & Talk<br>Discussion          | Preserved<br>animals and<br>slides         |
| 14 | Preparation and sterilization of culture medium (nutrient agar)  | 4 | Discussion<br>PPT<br>Photographs    | Live farms and<br>demonstration            |
| 15 | Determining number of microbes – quantitative plating techniques-spread plate & pour plate methods.                          | 2 | Chalk & Talk<br>Dissection<br>Tools | Green Board<br>Microscope<br>Charts        |
| 16 | Turbidometric estimation of bacterial growth.  | 2 | Chalk & Talk<br>Dissection<br>Tools | Green Board<br>Microscope<br>Charts        |
| 17 | Effect of temperature and pH on bacterial growth   | 5 | Software<br>Internet with<br>Wifi   | Smart Board<br>Charts<br>Models            |

|              |   |           |                            |                              |
|--------------|---|-----------|----------------------------|------------------------------|
|              |   |           |                            | Laptops                      |
| 18           | Bacteriological examination of Raw and Pasteurized milk   | 4         | Discussion                 | Green Board                  |
| 19           | Degradation (Fermentation) of Starch by bacteria  | 1         | Chalk & Talk<br>Discussion | Preserved animals and slides |
| 20           | Testing the sensitivity of bacteria to the antibiotics  | 1         | Chalk & Talk<br>Discussion | Preserved animals and slides |
| 21           | Spotters: Laminar flow hood<br>a. Autoclave<br>b. Colony counter<br>c. Anerobic jar<br>d. Colony morphology –Identification<br>e. Millipore filter apparatus<br>Counting chamber Culture systems-<br>Continuous, batch and synchronous. Nif<br>gene cluster | 1         | Chalk & Talk<br>Discussion | Preserved animals and slides |
| <b>Total</b> |   | <b>60</b> |                            |                              |

## DEPARTMENT OF ZOOLOGY

Programme: M.Sc., Zoology, (Under CBCS and LOCF)

(For those students admitted during the Academic Year 2021 - 22 and after)

|  |                          |                         |
|--|--------------------------|-------------------------|
| PART – III : <b>Discipline Specific Elective</b> |                          | SEMESTER - I            |
| Course Title: <b>BIOINFORMATICS</b>              |                          |                         |
| Course Code: <b>31DS1A</b>                       | Hours per week: <b>6</b> | Credits: <b>5</b>       |
| CIA: <b>25 Marks</b>                             | ESE: <b>75 Marks</b>     | Total: <b>100 Marks</b> |

### Preamble

To enable the students to understand the basic aspects and functioning of computers and their packages, role of computers in the study of biology and understand the applications and need for Bioinformatics and their tools

### Course Outcomes (CO)

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

| No.  | Course Outcome   | Knowledge Level (according to Bloom's Taxonomy) |
|------|--|---|
| CO 1 | They can know the type of computer and their different applications  | K1 & K3   |
| CO 2 | Operate softwares to construct word process, work sheet and slide preparation and to overcome computer virus..   | K2 & K3   |
| CO 3 | Describe the content and properties of most important bioinformatics tools, data bases, perform text, sequence based searches and analyse them   | K1, K2 & K4                                     |
| CO 4 | Explain principles and execute, pair wise and multiple sequence alignment by dynamic programming.  | K1, K3 & K5                                     |
| CO 5 | Predict the primary, secondary, tertiary and quaternary structures of protein sequence. They can also design their template and predict the 3D structures of protein using homology modelling and make them energy minimisation and also validate them | K1, K3 & K5                                     |

**K1-Remembering K2-Understanding K3-Applying K4- Analyzing K5- Evaluating**

### Mapping of CO with PO

|       | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO6 | PO7 |
|-------|------|------|------|------|------|-----|-----|
| CLO 1 | 3    | 9    | -    | -    | -    | -   | 3   |
| CLO 2 | 3    | 9    | -    | -    | -    | -   | 9   |
| CLO 3 | 3    | 3    | -    | -    | -    | -   | 3   |
| CLO 4 | 3    | 3    | 3    | -    | -    | -   | 3   |
| CLO 5 | 9    | 9    | 3    | -    | 1    | -   | 9   |
|       | 21   | 35   | 6    |      | 1    |     | 27  |

### Mapping of CO with PSO

|       | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|-------|-------|-------|-------|-------|-------|
| CLO 1 | 3     | -     | 9     | 1     | 3     |
| CLO 2 | 3     | -     | 9     | 1     | 3     |
| CLO 3 | 3     | 3     | 9     | 1     | 3     |
| CLO 4 | 3     | 9     | 9     | 1     | 3     |
| CLO 5 | 3     | 9     | 9     | 3     | 1     |
|       | 15    | 21    | 45    | 7     | 13    |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

### Syllabus

|                   |   |                 |
|-------------------|---|-----------------|
| <b>UNIT-I:</b>    | <b>Introduction to computers:</b><br>a) History, generations and components of computers<br>b) Classifications of computer-main frame, mini, micro and super computer<br>c) Operating system-Windows, Microsoft office and components<br>d) Popular software packages- MS word, MS power point, MS Excel-statistical applications.  | <b>(18 Hrs)</b> |
| <b>UNIT-II:</b>   | <b>System software:</b><br>a) Internet- Modem- TCP/IP protocols -online services -commercial organization-Education, web browsers and portals-<br>b) Creation of web pages using HTML- web page<br>c) Electronic mail – Creation and management, data storage using email<br>d) Virus- Booting virus -EXE. virus and antivirus  | <b>(18 Hrs)</b> |
| <b>UNIT- III:</b> | <b>Databases:</b><br>a) Bioinformatics– Databases- classification- Data type, Maintainer status, data access, Data source, Data Design and Organisation-<br>b) NCBI –Structure, Tools and database, Sequence submission, Sequence retrieval<br>c) EMBL – Structure, Sequence submission, Sequence retrieval<br>d) DDBJ – Structure, Mass submission, Sequence retrieval.  | <b>(18 Hrs)</b> |
| <b>UNIT- IV:</b>  | <b>Sequence analysis:</b><br>a) Sequence alignment- Concept- Scoring matrices- PAM, BLOSUM<br>b) Sequence pairing – BLAST, Multiple sequence alignment<br>c) Methods of Gene prediction methods and difficulties<br>d) Molecular phylogeny – Mechanism- Phylogenetic markers, representation- Roots, Out, Distance scale, internal branch, CLADE, Horizontal branch, Cladogram, Dendrogram, Unrooted and rooted trees, Methods of phylogenetic analysis- Maximum like hood method, Distance method. | <b>(18 Hrs)</b> |
| <b>UNIT- V:</b>   | <b>Proteomics:</b><br>a) Protein structure and prediction - Confirmation parameters of secondary structures, Secondary structure types- Secondary structure prediction – their limitations.<br>b) Methods of protein modeling – Homology, Abnitio and Threading – Model refinement<br>c) Comparative modeling – Swiss model<br>d) Evaluation – Spdb`v and Ramachandran Plot. Internal evaluation, External evaluation of proteins   | <b>(18 Hrs)</b> |

#### Text Books

- Sanjay Saxena, 2007. A first course in Computers Based on Windows XP and office XP, Vikas Publishing House Pvt. Ltd. Nodia
- Zhumur Ghosh and Bibekanana Mallick, 2015. Bioinformatics Principle and application, Oxford University press.

#### Reference Books

- Curran B.G. Walker R.J. and Bhatia S.C. 2010. Bioinformatics, CBS Publishers & distributions Pvt Ltd, New Delhi
- Sundararajan S. and Balaji R. 2002. Introduction to Bioinformatics, Himalaya Publishing House, Mumbai
- Prakash, Lohar S. 2009. Bioinformatics, MJP Publishers, Chennai
- Sinha P.K. 2007. Computer Fundamentals 4<sup>th</sup> edition, BPB Publication
- Anand Solomon K. 2008. Molecular Modeling and Drug Designing, MJP Publishers, Chennai



**Pedagogy**

Chalk &amp; Talk, Group Discussion, PPT

**Teaching Aids**

Green Board, LCD Projector, Chart models, Interactive White Board

**Course Contents and Lecture Schedule**

| Module No.                                      | Topic  | No. of Lectures | Content Delivery Method       | Teaching Aids      |
|---|--|-----------------|-------------------------------|--------------------|
| <b>Unit -1 Bio-molecular chemistry (18 hrs)</b> |  |                 |                               |                    |
| 1.1   | Introduction to computers: History, generations and component of computers-  | 3               | Discussion                    | Smart Board        |
| 1.2   | Classifications of computer-main frame, mini, micro and super computer   | 5               | Chalk & Talk                  | Green Board        |
| 1.3   | Operating system-Windows, Microsoft office and components  | 5               | Chalk & Talk                  | Green Board        |
| 1.4   | Popular software packages- MS word, MS power point, MS Excel- statistical applications.  | 5               | Chalk & Talk                  | Green Board        |
| <b>Unit -2 System software (18 hrs)</b>         |  |                 |                               |                    |
| 2.1   | Internet- Modem- TCP/IP protocols -online services   | 4               | Lecture                       | Smart Board PPT    |
| 2.2   | commercial organization-Education, web browsers and portals  | 4               | Chalk & Talk                  | Green Board        |
| 2.3   | Creation of web pages using HTML- web page - Electronic mail – Creation and management   | 5               | Chalk & Talk, display models, | Green Board, Chart |
| 2.4   | data storage using email- Virus- Booting virus -EXE. virus and antivirus   | 5               | Chalk & Talk, PPT             | Green Board, LCD   |
| <b>Unit -3 Databases (18 hrs)</b>               |  |                 |                               |                    |
| 3.1   | : Bioinformatics\– Databases- classification- Data type  | 3               | Chalk & Talk                  | Green Board        |
| 3.2   | Maintainer status, data access, Data source  | 3               | Chalk & Talk                  | Green Board        |
| 3.3   | Data Design and Organisation- NCBI – Structure, Tools and database, Sequence submission  | 4               | Chalk & Talk                  | Green Board        |
| 3.4   | Sequence retrieval- EMBL – Structure, Sequence submission  | 4               | Chalk & Talk                  | Green Board        |
| 3.5   | Sequence retrieval- DDBJ – Structure, Mass submission, Sequence retrieval.   | 4               | PPT                           | LCD                |
| <b>Unit -4 Sequence analysis (18 hrs)</b>       |  |                 |                               |                    |
| 4.1   | : Sequence alignment- Concept- Scoring matrices- PAM, BLOSUM - Sequence pairing  | 3               | Discussion                    | Green Board        |
| 4.2   | BLAST, Multiple sequence alignment - Methods of Gene prediction methods and difficulties   | 5               | Chalk & Talk                  | Green Board        |
| 4.3   | Molecular phylogeny – Mechanism- Phylogenetic markers, representation- Roots, Out, Distance scale, internal branch, CLADE                        | 5               | Chalk & Talk                  | Green Board        |
| 4.4   | Horizontal branch, Cladogram, Dendrogram, Unrooted and rooted trees, Methods of phylogenetic analysis- Maximum like hood method, Distance method | 5               | Chalk & Talk                  | Green Board        |
| <b>Unit -5 Proteomics (18 hrs)</b>              |  |                 |                               |                    |
| 5.1   | : Protein structure and prediction -   | 5               | Lecture                       | Green              |

|     |  |               |              |             |
|-----|--|---------------|--------------|-------------|
|     | Confirmation parameters of secondary structures, Secondary structure types- Secondary structure prediction –Their limitations. |               |              | Board       |
| 5.2 | Methods of protein modeling – Homology, Abinto and Threading   | 5             | Chalk & Talk | Green Board |
| 5.3 | Model refinement<br>Comparative modeling – Swiss model<br>Evaluation – Spdb`v and Ramachandran Plot.<br>Internal evaluation,   | 5             | Chalk & Talk | Green Board |
| 5.4 | External evaluation of proteins  | 3             | Chalk & Talk | Green Board |
|     | <b>Total</b>   | <b>90 hrs</b> |              |             |

### E-Resources

<https://opentextbc.ca/computerstudies/chapter/classification-of-generations-of-computers/>

<https://www.slideshare.net/ZohaibAhmed40/microsoft-office-58554555>

<https://www.slideshare.net/sushruth645/internet-ppt-36201939>

<https://www.slideshare.net/KavisaGhosh/ncbi>

<https://www.slideshare.net/AjayChandra17/molecular-phylogenetics>

<https://www.slideshare.net/karamveer37/methods-for-protein-structure-prediction>

<https://www.slideshare.net/TeacherKrishna/ramachandran-plot-84698228>

## DEPARTMENT OF ZOOLOGY

Programme: M.Sc., Zoology, (Under CBCS and LOCF)

(For those students admitted during the Academic Year 2021 - 22 and after)

|  |                          |                         |
|--|--------------------------|-------------------------|
| PART – III : <b>Discipline Specific Elective</b> |                          | SEMESTER - I            |
| Course Title: <b>RESEARCH METHODOLOGY</b>        |                          |                         |
| Course Code: <b>31DS1B</b>                       | Hours per week: <b>6</b> | Credits: <b>5</b>       |
| CIA: <b>25 Marks</b>                             | ESE: <b>75 Marks</b>     | Total: <b>100 Marks</b> |

### Preamble

To enable the students to impart knowledge on fundamentals of basic research, principles of various methods and techniques for academic research in biology.

### Course Outcomes (CO)

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

| No.  | Course Outcome   | Knowledge Level (according to Bloom's Taxonomy) |
|------|--|---|
| CO 1 | identify, design and execute various biological experiments  | K1, K2  |
| CO 2 | know diverse research problem identification and get right methods to solve  | K1, K2, K3                                      |
| CO 3 | understand the working principles and applications of various analytical instruments   | K3, K4  |
| CO 4 | To utilize the various instruments and learnt techniques able to complete research work and prepare research report scientifically | K3, K4, K5                                      |
| CO 5 | spell and collect relevant literature from various sources and understand various ethics in research                               | K2, K3, K4, K5                                  |

K1-Remembering; K2-Understanding; K3-Applying; K4- Analysing; K5- Evaluating

### Mapping of CO with PO

|       | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO6 | PO7 |
|-------|------|------|------|------|------|-----|-----|
| CLO 1 | 3    | -    | 3    | -    | 1    | 3   | 3   |
| CLO 2 | 3    | -    | 3    | -    | 3    | 3   | 3   |
| CLO 3 | 9    | -    | 3    | -    | 3    | -   | 3   |
| CLO 4 | 3    | 3    | 3    | -    | 9    | -   | 9   |
| CLO 5 | 3    | 3    | 3    | -    | 9    | -   | 9   |
|       | 21   | 6    | 15   |      | 25   | 6   | 27  |

### Mapping of CO with PSO

|       | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|-------|-------|-------|-------|-------|-------|
| CLO 1 | 3     | -     | 3     | 3     | 1     |
| CLO 2 | 3     | -     | 3     | 3     | 1     |
| CLO 3 | 3     | 9     | 9     | 3     | 1     |
| CLO 4 | 3     | 9     | 9     | 3     | 1     |
| CLO 5 | 1     | -     | 1     | 9     | 1     |
|       | 13    | 18    | 25    | 21    | 5     |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

## Syllabus

- UNIT-I:** Objectives and significance of research, types of research- descriptive vs. analytical, applied vs fundamental, quantitative vs. qualitative, conceptual vs. empirical; literature review- various sources information; identification, defining and devising of research problem. Hypothesis- null and alternate hypothesis- hypothesis testing. **(18 Hrs)**
- UNIT-II:** Sampling design- Sampling methods- sample- sampling size and error, Types of sampling, random, systematic, stratified random and multi stage sampling. Methods of data collection, primary and secondary, questionnaire, interviews, observation, survey, case study, experimental, focus group discussion, rapid rural appraisal/assessment. Determining size of the sample- sample collection, handling and preservation. **(18 Hrs)**
- UNIT- III:** Principle, Mechanism and applications of: Compound, Phase contrast, Fluorescent, Electron (Transmission and Scanning) and Confocal, pH meter, Centrifuge, Lyophilizer and Micropipettes, Colorimeter, Spectrophotometer, AAS. Histological and histochemical staining of animal tissues and microbial staining. **(18 Hrs)**
- UNIT- IV:** Principle, Mechanism and applications of: Chromatographic techniques: paper, thin layer, column, gas and High Performance Liquid Chromatography, RT-PCR. Immunotechniques: agglutination and precipitation assays- immunoelectrophoresis- ELISA. **(18 Hrs)**
- UNIT- V:** Thesis writing- Introduction, Review of Literature, Methodology, Results-illustration and tables, Discussion, Bibliography, foot notes and proof correction, oral presentation- planning and preparation- use of visual aids- importance of scientific communication- publication of research articles- plagiarism- copyright-types of journal- citation index, impact factor, H index, i10 index, referencing software. **(18 Hrs)**

## Text Books

- Kothari CR, 2004. Research Methodology: Method and techniques. New Age International 418p
- Garg BL, Karadia, R, Agarwal, F., and Agarwal UK, 2002. An introduction to Research Methodology, RBSA Publishers.
- John W. Creswell and J. David Creswell, 2018. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches.

## Reference Books

- Boyer, RF 1993 Modern Experimental Biochemistry. The Benjamin Cummings Publication Company, INC, New York
- Chatwal, GR and Anand SK 2009. Instrumental Methods of chemical analysis, Himalaya Publishing House, New Delhi.
- Jeyaraman J, 1985. Lab Manual in Biochemistry. Wiley Eastern Ltd New Delhi
- Day, RA, 1992. How to write and publish a scientific paper, Cambridge University Press.

## Pedagogy

Chalk & Talk, Group Discussion, PPT

## Teaching Aids

Green Board, LCD Projector, Chart models, Interactive White Board

## Course Contents and Lecture Schedule

| Module No.                               | Topic   | No. of Lectures | Content Delivery Method   | Teaching Aids |
|--|---|-----------------|---------------------------|---------------|
| Unit -1                                  |   |                 |                           |               |
|  | Objectives and significance of research, types of research  | 6               | Discussion & Chalk & Talk | Green Board   |
|  | Survey of literature review from various sources  | 6               | Lecture                   | Smart board   |
|  | Hypothesis- null and alternate hypothesis- hypothesis testing.  | 6               | Chalk & Talk              | Green Board   |
| Unit -2                                  |   |                 |                           |               |
|  | Sampling design and Sampling methods  | 6               | Lecture                   | Green Board   |
|  | Methods of data collection  | 6               | Chalk & Talk              | Green Board   |
|  | Biological sample collection, handling and preservation.  | 6               | Chalk & Talk              | Green Board   |
| Unit -3                                  |   |                 |                           |               |
|  | Principle, Mechanism of various microscope and its applications   | 6               | Lecture                   | Smart board   |
|  | Principle, Mechanism and applications of various instruments Colorimeter, Spectrophotometer, AAS. Histological and histochemical staining of animal tissues and microbial staining. | 6               | Lecture                   | Smart board   |
|  | Principle, Mechanism and applications of Confocal, pH meter, Centrifuge, Lyophilizer and Micropipettes  | 6               | Lecture                   | Smart board   |
| Unit -4                                  |   |                 |                           |               |
|  | Principle, Mechanism and applications of Chromatographic techniques   | 6               | Discussion                | Smart board   |
|  | RT-PCR  | 3               | Lecture                   | Smart board   |
|  | Immunotechniques  | 9               | Lecture                   | Smart board   |
| Unit -5 Nucleic Acid Metabolism (12 hrs) |   |                 |                           |               |
|  | Methods of collections of Review of Literature  | 6               | Chalk & Talk              | Green Board   |
|  | Methods of report preparation and present scientifically  | 4               | Chalk & Talk              | Green Board   |
|  | Publication of research papers, ethics in publication   | 6               | Chalk & Talk              | Green Board   |
|  | plagiarism- copyright   | 6               | Chalk & Talk              | Green Board   |
|  | <b>Total</b>  | <b>90 hrs</b>   |                           |               |

## E-Resources

- Objectives and significance of research <https://www.flowmapp.com/blog/qa/research-design-purpose>
- Difference between Research objectives and Significance <https://www.youtube.com/watch?v=atleiRoBQ0I>
- Quantitative vs. qualitative English <https://www.youtube.com/watch?v=ET4c7hiRgbM>
- How To Choose Research Methodology <https://www.youtube.com/watch?v=hECPeKv5tPM>
- Hypothesis Testing Statistics Problems & Examples <https://www.youtube.com/watch?v=VK-rnA3-41c>
- Methods and tools of data collection [https://www.youtube.com/watch?v=yOU\\_s0xzc-Y](https://www.youtube.com/watch?v=yOU_s0xzc-Y)
- <https://www.youtube.com/watch?v=YglyYgmAeCw>
- handling and preservation in biology- <https://www.youtube.com/watch?v=vv74Nh2cw3I>
- Principle and Application of Transmission Electron Microscope [https://www.youtube.com/watch?v=VH6W\\_xqsyPI](https://www.youtube.com/watch?v=VH6W_xqsyPI)
- Mechanism and applications RT-PCR <https://www.youtube.com/watch?v=1vqNZ-H7Pq0>
- what is scientific writing <https://www.youtube.com/watch?v=Twc2S88zuGo>

## DEPARTMENT OF ZOOLOGY

Programme: M.Sc., Zoology, (Under CBCS and LOCF)

(For those students admitted during the Academic Year 2021 - 22 and after)

|                                 |                          |                         |
|---------------------------------|--------------------------|-------------------------|
| <b>PART – III : Core Course</b> |                          | <b>SEMESTER - II</b>    |
| Course Title: <b>IMMUNOLOGY</b> |                          |                         |
| Course Code: <b>31CT21</b>      | Hours per week: <b>6</b> | Credits: <b>4</b>       |
| CIA: <b>25 Marks</b>            | ESE: <b>75 Marks</b>     | Total: <b>100 Marks</b> |

### Preamble

To enable the students to understand the basic fundamentals of Immunology, know the components of Immune system and its mechanism, study the role of Immune system in relation to health and diseases and understand the chemistry of biomolecules like Carbohydrates, Proteins and Lipids and have a comprehensive account on the metabolic pathways /reactions in human.

### Course Outcomes (CO)

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

| No.  | Course Outcome   | Knowledge Level (according to Bloom's Taxonomy) |
|------|--|---|
| CO 1 | Learn the fundamentals of antigens, antibodies, and diversity of antibodies  | K1 & K2   |
| CO 2 | Acquire knowledge on the types of immune response (humoral and cell mediated) and hypersensitivity reactions                       | K1 & K3   |
| CO 3 | Differentiate the self and non-self immunity, organs transplantation, auto immune diseases, immunology of tumour and AIDS in human | K1, K2 & K5                                     |
| CO 4 | Understand the immune response to protozoan, bacterial and viral infections in human   | K2, K4 & K5                                     |
| CO 5 | Empower skill on Immunological techniques  | K1, K2 & K3                                     |

**K1-Remembering K2-Understanding K3-Applying K4- Analyzing K5- Evaluating**

### Mapping of CO with PO

|       | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
|-------|-------|-------|-------|-------|-------|-------|-------|
| CLO 1 | 3     | -     | -     | -     | -     | -     | 3     |
| CLO 2 | 9     | -     | 3     | 1     | 1     | -     | 3     |
| CLO 3 | 9     | -     | 9     | 3     | 9     | 3     | 9     |
| CLO 4 | 3     | -     | 9     | 3     | 3     | 9     | 3     |
| CLO 5 | 9     | -     | -     | -     | 1     | -     | 9     |
|       | 33    |       | 21    | 7     | 14    | 12    | 27    |

### Mapping of CO with PSO

|       | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|-------|-------|-------|-------|-------|-------|
| CLO 1 | 3     | 3     | 9     | 9     | -     |
| CLO 2 | 3     | 9     | 9     | 3     | -     |
| CLO 3 | 3     | 3     | 9     | 9     | 9     |
| CLO 4 | 3     | 3     | 3     | 9     | 3     |
| CLO 5 | 3     | 3     | 9     | 9     | 9     |
|       | 15    | 21    | 39    | 39    | 21    |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

### Syllabus

#### UNIT-I: Fundamentals of Immunology

(18 Hrs)

##### a) Antigen and its characters:

Definition- types- properties- role of biological system in immunogenicity- Adjuvants- epitopes-haptens

b) Immunoglobulin and their properties (Self study)

Basic structure- Isotype- allotype- idiotype- domains- constant and variable- IG classes- Sub classes- their properties and functions.

c) **Genetic basis of antibody diversity:**

Theory of germ line rearrangement- IG genes- light chain gene organization- heavy chain variable region diversity – heavy chain constant chain organization – production of diverse antibody

**UNIT-II: Immune Effector Mechanism (18 Hrs)**

a) Complement and its role: Complement components – classical and alternate complement pathways and consequence of complement activation

b) Humoral and cell mediated immunity:

i) Humoral immunity-primary and secondary immune responses, Ag dependent and Ag independent activation, affinity maturation – role of T<sub>H</sub> cells in B cell proliferation – class switching mechanism.

ii) Cell mediated immunity:- Role of T cell subsets- mechanism of lysis of cytotoxic cells.

c) Hyper sensitivity reactions:-

i) Ig E mediated hypersensitivity reactions ( type 1)

ii) Antibody mediated hypersensitivity reaction (Type II)

iii) Immune complex mediated hypersensitivity reaction (Type III)

iv) T cell mediated (DTH) hypersensitivity reaction (Type IV)

**UNIT- III: Immune System in Health (18 Hrs)**

a) Autoimmunity– principles– organ specific and systemic Autoimmune diseases- Treatment of autoimmune diseases.

b) Transplantation immunology:

Relationship of donor and recipient, HLA systems– principles of tolerance immunological basis of graft rejection. Role of immuno suppressive drugs, bone marrow and kidney transplantation

c) Tumour and AIDS immunology:

i. Tumour antigens – classification, immune response to tumours, surveillance, immuno therapy.

ii. AIDS epidemic – clinical and immunological consequence of HIV. Immuno deficiency – Phagocytic deficiency – Humoral deficiency- cell mediated deficiency (one example each) - SCID.

**UNIT- IV: Immune Response to Infectious Diseases (18 Hrs)**

a) Viral infection: Viral infection, and immunity. Viral strategies of immune evasion.

b) Bacterial infection:

i) Immune response to extra cellular and intra cellular.

ii) Bacteria defence mechanism-inflammation.

iii) Bacterial evasion of host defence mechanism.

iv) Diphtheria and tuberculosis infection and immunity.

c) Immune response against parasites:

i) Protozoan parasites-the effector function of NK cells during protozoan infection- *Plasmodium* and Trypanosomal infection and immunity.

ii) Immune response against Helminthic parasites-role of B cells in Helminth infection.

**UNIT- V: Immunotechniques (18 Hrs)**

a) Principles of precipitations- VDRL slide test.

b) Radioimmuno assay of Insulin.

c) ELISA Test

d) Immunodiffusion and Immunoelectrophoresis

**Text Books**

- Gangal S. and Sontakke, S. 2013 Text Book of Basic and Clinical Immunology, University Press (India) Pvt, Ltd, Hyderabad.

**Reference Books**



- Hannigan B.M., Moore, C.B.T. and Quinn, D.G. (2010). Immunology, Viva books, New Delhi
- Roitt, I. 1987, Essential Immunology, P.G. Publishing Pvt. LTd., New Delhi
- Kuby, T.1994. Immunology, P.G. Publishing Pvt., LTd., New Delhi
- Tizard I.R.1995. Immunology – An Introduction IV ED. Saunders College Publications, Philadelphia.

### Pedagogy

Chalk & Talk, Group Discussion, PPT

### Teaching Aids

Green Board, LCD Projector, Chart models, Interactive White Board

### Course Contents and Lecture Schedule

| Module No.   | Topic  | No. of Lectures | Content Delivery Method       | Teaching Aids      |
|--|--|-----------------|-------------------------------|--------------------|
| <b>Unit -1 Fundamentals of Immunology (18 hrs)</b> |  |                 |                               |                    |
| 1.1  | Antigen and its characters:<br>Definition- types- properties- role of biological system in immunogenicity- Adjuvants- epitopes-haptens   | 6               | Discussion                    | Smart Board<br>PPT |
| 1.2  | Immunoglobulin and their properties (Self study)<br>Basic structure- Isotype- allotype- idiotype- domains- constant and variable- IG classes- Sub classes- their properties and functions  | 6               | Chalk & Talk                  | Green Board        |
| 1.3  | Genetic basis of antibody diversity:<br>Theory of germ line rearrangement- IG genes- light chain gene organization- heavy chain variable region diversity – heavy chain constant chain organization – production of diverse antibody               | 6               | Chalk & Talk                  | Green Board        |
| <b>Unit -2 Immune Effector Mechanism (18 hrs)</b>  |  |                 |                               |                    |
| 2.1  | Complement and its role: Complement components – classical and alternate complement pathways and consequence of complement activation  | 4               | Lecture                       | Smart Board<br>PPT |
| 2.2  | Humoral and cell mediated immunity:<br>Humoral immunity-primary and secondary immune responses, Ag dependent and Ag independent activation, affinity maturation – role of T <sub>H</sub> cells in B cell proliferation – class switching mechanism | 4               | Chalk & Talk                  | Green Board        |
| 2.3  | Cell mediated immunity:- Role of T cell subsets- mechanism of lysis of cytotoxic cells   | 3               | Chalk & Talk, display models, | Green Board, Chart |
| 2.4  | Hyper sensitivity reactions:-<br>Ig E mediated hypersensitivity reactions ( type 1)<br>Antibody mediated hypersensitivity reaction (Type II)   | 4               | Chalk & Talk, PPT             | Green Board, LCD   |
| 2.5  | Immune complex mediated hypersensitivity reaction (Type III)<br>T cell mediated (DTH) hypersensitivity reaction (Type IV)  | 3               | Chalk & Talk, PPT             | Green Board, LCD   |

| Unit -3 Immune System in Health (18 hrs)                |   |               |              |                 |
|---|---|---------------|--------------|-----------------|
| 3.1   | Autoimmunity– principles– organ specific and systemic Autoimmune diseases- Treatment of autoimmune diseases.  | 3             | Chalk & Talk | Green Board     |
| 3.2   | Transplantation immunology:<br>Relationship of donor and recipient, HLA systems– principles of tolerance immunological basis of graft rejection                               | 4             | Chalk & Talk | Green Board     |
| 3.3   | Role of immuno suppressive drugs, bone marrow and kidney transplantation  | 3             | Chalk & Talk | Green Board     |
| 3.4   | Tumour and AIDS immunology:<br>Tumour antigens – classification, immune response to tumours, surveillance, immuno therapy.  | 4             | Chalk & Talk | Green Board     |
| 3.5   | AIDS epidemic – clinical and immunological consequence of HIV.  | 2             | PPT          | LCD             |
| 3.6   | Immuno deficiency – Phagocytic deficiency – Humoral deficiency- cell mediated deficiency (one example each) - SCID.   | 2             | Chalk & Talk | Green Board     |
| Unit -4 Immune Response to Infectious Diseases (18 hrs) |   |               |              |                 |
| 4.1   | a) Viral infection: Viral infection, and immunity. Viral strategies of immune evasion.<br>b) Bacterial infection:<br>i) Immune response to extra cellular and intra cellular. | 4             | Discussion   | Smart Board PPT |
| 4.2   | Bacteria defence mechanism-inflammation   | 3             | Chalk & Talk | Green Board     |
| 4.3   | Bacterial evasion of host defence mechanism   | 2             | Chalk & Talk | Green Board     |
| 4.4   | Diphtheria and tuberculosis infection and immunity.   | 3             | Chalk & Talk | Green Board     |
| 4.5   | Protozoan parasites-the effector function of NK cells during protozoan infection- <i>Plasmodium</i> and Trypanosomal infection and immunity.                                  | 3             | Lecture      | Smart Board PPT |
| 4.7   | Immune response against Helminthic parasites- role of B cells in Helminth infection   | 3             | Chalk & Talk | Green Board     |
| Unit -5 Immunotechniques (18 hrs)                       |   |               |              |                 |
| 5.1   | Principles of precipitations- VDRL slide test.  | 4             | Lecture      |                 |
| 5.2   | Radioimmuno assay of Insulin  | 5             | Chalk & Talk | Green Board     |
| 5.3   | ELISA Test  | 5             | Chalk & Talk | Green Board     |
| 5.4   | Immunodiffusion and Immunoelectrophoresis   | 4             | Chalk & Talk | Green Board     |
| <b>Total</b>  |   | <b>90 hrs</b> |              |                 |

## E-Resources

UNIT – Ia) Antigens and their properties

<https://microbiologyinfo.com/antigen-properties-types-and-determinants-of-antigenicity/>

<https://www.biologydiscussion.com/antigens/define-antigens-with-diagram-immunology/56019>

b) Immunoglobulins and their properties

<https://www.labpedia.net/elementary-immunology/chapter-5-immunoglobulins-and-their-properties/>

<https://microbenotes.com/antibody/>

c) Genetic basis of antibody diversity

<http://www.tusculum.edu/faculty/home/ivanlare/html/genetics/antibodies-master.html>

<https://www.slideshare.net/rekhaswarrier/genetic-basis-of-antibody-diversity>

UNIT – II a) Complement system

<https://www.immunology.org/public-information/bitesized-immunology/systems-and-processes/complement-system>

<https://www.slideshare.net/SantoshYadav225/complement-system-65834753>

b) Humoral and cell mediated immunity

<https://www.slideshare.net/doctorrao/humoral-immunity>

<https://www.slideshare.net/prithvi3/cell-mediated-humoral-immunity>

C) Hypersensitivity reactions

<https://www.lecturio.com/magazine/hypersensitivity-and-its-types/>

<https://www.youtube.com/watch?v=2HPWIgzeRCs>

UNIT- III a) Autoimmunity

[https://www.kau.edu.sa/Files/0001735/Files/20287\\_LECTURE\\_7\\_AUTOIMMUNITY\\_AND\\_AUTOIMMUNE\\_DISEASE\\_Part1.pdf](https://www.kau.edu.sa/Files/0001735/Files/20287_LECTURE_7_AUTOIMMUNITY_AND_AUTOIMMUNE_DISEASE_Part1.pdf)

b) Transplantation immunology

<https://www.slideshare.net/doctorrao/transplantation-immunology-30176051>

<https://www.slideshare.net/joshirinkesh/transplantation-immunology-27145748>

c) Tumour and AIDS immunology

<https://www.slideshare.net/SwathiPrabakar/tumor-antigen>

<https://www.slideshare.net/qussayabbas/immune-response-against-tumors>

UNIT- IV a) Viral infection

<https://www.immunology.org/public-information/bitesized-immunology/pathogens-and-disease/immune-responses-viruses>

<https://www.lehigh.edu/~jas0/V09.html>

b) Bacterial infection

<https://www.slideshare.net/fadelmuhammadgarishah/immunity-to-microbes>

<https://www.slideshare.net/muradkhanmb/immunity-to-microbes-60120218>

c) Immune response against parasites

<https://www.slideshare.net/prkppt/communicable-disease-85471063>

<https://www.slideshare.net/HossamGhoneim3/immunology-of-parasitic-diseases-75231706>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4956549/>

UNIT- V a) Principles of precipitations - VDRL slide test

<https://www.slideshare.net/harshayaramati/lab-diagnosis-of-syphilis>

<https://microbenotes.com/venereal-disease-research-laboratory-vdrl-test/>

b) Radioimmunoassay of Insulin

<https://www.slideshare.net/justinsolin/radioimmunoassay-56112157>

<https://slideplayer.com/slide/10929037/>

c) ELISA Test

d) Immunodiffusion and Immuno-electrophoresis

<https://www.slideshare.net/suniu/immunodiffusion-principles-and-application>

<https://www.slideshare.net/vivekaiden/ouchterlony-double-diffusion-and-radial-immunodiffusion>

## DEPARTMENT OF ZOOLOGY

Programme: M.Sc., Zoology, (Under CBCS and LOCF)

(For those students admitted during the Academic Year 2021-22 and after)

|                                     |                            |                               |
|-------------------------------------|----------------------------|-------------------------------|
| PART – III : Core Course            |                            | SEMESTER - II                 |
| Course Title : <b>BIostatistics</b> |                            |                               |
| Course Code: <b>31CT22</b>          | Hours per week: <b>6</b>   | Credits: <b>4</b>             |
| CIA Marks: <b>25 Marks</b>          | ESE Marks: <b>75 Marks</b> | Total Marks: <b>100 Marks</b> |

### Preamble

To enable the students to understand the importance of statistics in biology and study the role of statistics in demography.

### Course Outcomes (CO)

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

| No.  | Course Outcome  | Knowledge Level (according to Bloom's Taxonomy) |
|------|---|---|
| CO 1 | Acquire knowledge on types, classification, tabulation and presentation of data and collection methods. Frequency distribution. Measures of central tendency, Chi-square analysis, probability distributions. | K1 & K2   |
| CO 2 | Understand the sampling distribution and sampling methods, students- <i>t</i> test and hypothesis testing procedure.  | K1, K2 & K3                                     |
| CO 3 | Differentiate and apply correlation and regression analysis in agriculture, medical, environment and research.  | K3, K4 & K5                                     |
| CO 4 | Compare the means of more than two samples (between and within) by analysis of variance.  | K3, K4 & K5                                     |
| CO 5 | Understand the parameters of vital statistics: natality, mortality, fertility, construction of life table and growth curve in human population.   | K2, K3, K4 & K5                                 |

**K1-Remembering K2-Understanding K3-Applying K4- Analyzing K5- Evaluating**

### Mapping of CO with PO

|       | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO6 | PLO7 |
|-------|-------|-------|-------|-------|-------|------|------|
| CLO 1 | 9     | 3     | 3     | -     | 3     | -    | 9    |
| CLO 2 | 3     | 3     | -     | -     | -     | -    | 3    |
| CLO 3 | 9     | 3     | 3     | -     | -     | 1    | 9    |
| CLO 4 | 3     | 1     | 9     | -     | -     | -    | 3    |
| CLO 5 | 3     | 1     | 9     | 3     | 9     | 3    | 3    |
|       | 27    | 11    | 24    | 3     | 12    | 4    | 27   |

### Mapping of CO with PSO

|       | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|-------|-------|-------|-------|-------|-------|
| CLO 1 | 1     | -     | 9     | -     | 3     |
| CLO 2 | 1     | -     | 9     | -     | 3     |
| CLO 3 | 1     | -     | 9     | 3     | 3     |
| CLO 4 | 1     | -     | 9     | -     | -     |
| CLO 5 | 3     | -     | 9     | 9     | -     |
|       | 7     |       | 45    | 12    | 9     |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

### Syllabus

|                   |   |                 |
|-------------------|---|-----------------|
| <b>UNIT-I:</b>    | <b>Introduction to Biostatistics, Chi square and Probability Distributions</b><br>a) Data-Collection, tabulation, classification, presentation and frequency distribution. Calculation of mean, median, mode, variance and standard deviation.<br>b) Chi-Square analysis-degrees of freedom-Goodness of fit, calculation of chi-square value for genetic experiments and 2X2 contingency table.<br>c) Probability -properties-types-theorems-Probability distribution-normal, binomial and Poisson – characteristics-formulae- skewness and kurtosis, SPSS. | <b>(15 Hrs)</b> |
| <b>UNIT-II:</b>   | <b>Sampling statistics and ‘t’ distribution</b><br>a) Sampling-characters-sample size-types<br>b) Sampling distribution-comparison of means (samples and population) – Calculation of Student’s ‘t’ test-paired and unpaired data.<br>c) Hypothesis test procedure- Null and alternate hypotheses- Standard error, confidence limits.   | <b>(15 Hrs)</b> |
| <b>UNIT- III:</b> | <b>Correlation and Regression</b><br>a) Correlation - Calculation of Karl Pearson’s correlation coefficient and rank correlation-applications.<br>b) Scatter diagram-linear regression-plotting of regression lines ‘y on x’ and ‘x on y’.<br>c) Regression coefficient-testing the significances of regression.  | <b>(15 Hrs)</b> |
| <b>UNIT- IV:</b>  | <b>F- test and analysis of variance</b><br>a) F – distribution - definition and applications<br>b) One way classification - total variation - variation with treatments, Variation between treatments, distribution of variations- Calculation.<br>c) Two-way classification-variation of 2 factors experiment.   | <b>(15 Hrs)</b> |
| <b>UNIT- V:</b>   | <b>Vital Statistics and Demography</b><br>a) Introduction - uses of vital statistics, basic formulae, mortality and fertility rates.<br>b) Construction of a life table, structure and applications<br>c) Demographic characteristics of India.   | <b>(12 Hrs)</b> |

#### Text Books

- Gurumani, N. 2004. Biostatistics, M.J.Publishers, Chennai.

#### Reference Books

- Khan I.A.and Khanum A.1994. Fundamentals of Biostatistics, , Ukaaz publication Hyderabad.
- Zar. H.1984Biostatistics Analysis 2<sup>nd</sup> edition, Prentice-Hall International, In New Jersey.
- Mahajan B.K. 1984. Methods in Biostatistics, Lmt. Indumahajan Publication .4<sup>th</sup> edition.
- Misra B.M. & Misra, K.M. 1983. Introductory Practical biostatistics. Naya Prakash Calcutta.
- Finney D.J. 1980. Basic statistics for Biologists.. Chapman& Halt. London, science paperback.
- Pillai R.S.N and Bagavathy V. 2003. Practical statistics, S.Chand & Co.,New Delhi

#### Pedagogy

- Chalk & Talk, Group Discussion, PPT

#### Teaching Aids

- Green Board, LCD Projector, Chart models, Interactive White Board

#### Course Contents and Lecture Schedule

| Module No. | Topic   | No. of Lectures | Content Delivery Method | Teaching Aids      |
|------------|---|-----------------|-------------------------|--------------------|
| Unit -1    | <b>Introduction to Biostatistics, Chi square and Probability Distributions (18 hrs)</b>   |                 |                         |                    |
| 1.1        | Data-Collection, tabulation, classification, presentation and frequency distribution. Calculation of mean, median, mode, variance | 6               | Discussion              | Green Board Survey |

|  |  |               |                               |                    |
|--|--|---------------|-------------------------------|--------------------|
|  | and standard deviation.  |               |                               | charts             |
| 1.2  | Chi-Square analysis-degrees of freedom-Goodness of fit, calculation of chi-square value for genetic experiments and 2X2 contingency table.     | 6             | Chalk & Talk                  | Green Board        |
| 1.3  | Probability -properties-types-theorems-Probability distribution-normal, binomial and Poisson – characteristics-formulae- skewness and kurtosis | 6             | Chalk & Talk                  | Green Board        |
| <b>Unit -2 Sampling statistics and 't' distribution (18 hrs)</b> |  |               |                               |                    |
| 2.1  | Sampling-characters-sample size-types  | 6             | Lecture                       |                    |
| 2.2  | Sampling distribution-comparison of means (samples and population) – Calculation of Student's 't' test-paired and unpaired data                | 6             | Chalk & Talk                  | Green Board        |
| 2.3  | Hypothesis test procedure- Null and alternate hypotheses- Standard error, confidence limits  | 6             | Chalk & Talk, display models, | Green Board, Chart |
| <b>Unit -3 Correlation and Regression (18 hrs)</b>               |  |               |                               |                    |
| 3.1  | Correlation- Calculation of Karl Pearson's correlation coefficient and rank correlation-applications   | 6             | Chalk & Talk                  | Green Board        |
| 3.2  | Scatter diagram-linear regression-plotting of regression lines 'y on x' and 'x on y'.  | 6             | Chalk & Talk                  | Green Board        |
| 3.3  | Regression coefficient-testing the significances of regression   | 6             | Chalk & Talk                  | Green Board        |
| <b>Unit -4 F- test and analysis of variance (18 hrs)</b>         |  |               |                               |                    |
| 4.1  | F-distribution- definition and applications  | 6             | Discussion                    |                    |
| 4.2  | One way classification-total variation-variation with treatments, Variation between treatments, distribution of variations- Calculation        | 6             | Chalk & Talk                  | Green Board        |
| 4.3  | Two-way classification-variation of 2 factors experiment   | 6             | Chalk & Talk                  | Green Board        |
| <b>Unit -5 Vital Statistics and Demography (18 hrs)</b>          |  |               |                               |                    |
| 5.1  | Introduction-uses of vital statistics, basic formulae, mortality and fertility rates.  | 6             | Lecture                       |                    |
| 5.2  | Construction of a life table, structure and applications   | 6             | Chalk & Talk                  | Green Board        |
| 5.3  | Demographic characteristics of India   | 6             | Chalk & Talk                  | Green Board        |
| <b>Total</b>   |  | <b>90 hrs</b> |                               |                    |

### E-Resources

<https://www.slideshare.net/drnareshgill/biostatstics-type-and-presentation-of-data>  
[https://www.slideshare.net/CasperWendy/measures-of-central-tendency-mean-median-mode?next\\_slideshow=1](https://www.slideshare.net/CasperWendy/measures-of-central-tendency-mean-median-mode?next_slideshow=1)  
<https://www.slideshare.net/abulibya/sampling-methods-59807094>  
<https://www.slideshare.net/RamKumarshah/correlation-and-regression-56561989>  
<https://www.slideshare.net/SadhanaSingh28/analysis-of-variance-anova-78374406>  
<https://slideplayer.com/slide/4906485/> (Vital Statistics and Demography)

## DEPARTMENT OF ZOOLOGY

Programme: M.Sc., Zoology, (Under CBCS and LOCF)

(For those students admitted during the Academic Year 2021 - 22 and after)

|   |                            |                               |
|---|----------------------------|-------------------------------|
| <b>PART – III : Core Course</b>           |                            | <b>SEMESTER - II</b>          |
| <b>Course Title: DEVELOPMENTALBIOLOGY</b> |                            |                               |
| <b>Course Code: 31CT23</b>                | <b>Hours per week: 6</b>   | <b>Credits: 4</b>             |
| <b>CIA Marks: 25 Marks</b>                | <b>ESE Marks: 75 Marks</b> | <b>Total Marks: 100 Marks</b> |

### Preamble

To enable the students to reveal basic aspects of animal and human development, introduction of experimental embryology and its importance and imparting knowledge on various aspects of embryonic development

### Course Outcomes (CO)

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

| No.  | Course Outcome   | Knowledge Level (according to Bloom's Taxonomy) |
|------|--|---|
| CO 1 | Acquire knowledge on spermatogenesis, oogenesis, fertilization, egg activation and parthenogenesis.                          | K1 & K2   |
| CO 2 | Understand the reproductive cycle, menstruation, ovulation, embryo development, extra embryonic membrane, placenta in human. | K1 & K2   |
| CO 3 | Distinguish the organizer concept, gradient theory and nuclear transplantation based on experiments.                         | K3, K4 & K5                                     |
| CO 4 | Differentiate the molecular aspects of cell differentiation, chemo differentiation, stem cells and gene action.              | K1, K3, K4                                      |
| CO 5 | Have knowledge on metamorphosis and regeneration in amphibians   | K1, K2, K5                                      |

**K1-Remembering K2-Understanding K3-Applying K4- Analyzing K5- Evaluating**

### Mapping of CO with PO

|       | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO6 | PLO7 |
|-------|-------|-------|-------|-------|-------|------|------|
| CLO 1 | 3     | -     | 3     | 3     | -     | 3    | 3    |
| CLO 2 | 9     | -     | 3     | 3     | -     | 3    | 3    |
| CLO 3 | 3     | -     | 3     | -     | 3     | 1    | 1    |
| CLO 4 | 9     | -     | 3     | 1     | 3     | -    | 9    |
| CLO 5 | 3     | -     | 1     | -     | -     | 3    | 1    |
|       | 27    |       | 13    | 7     | 6     | 9    | 17   |

### Mapping of CO with PSO

|       | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|-------|-------|-------|-------|-------|-------|
| CLO 1 | 3     | 3     | -     | 9     | -     |
| CLO 2 | 3     | 3     | 1     | 9     | 3     |
| CLO 3 | 1     | 3     | 1     | 9     | 1     |
| CLO 4 | 3     | 1     | 1     | 9     | 3     |
| CLO 5 | 1     | 1     | 1     | 3     | -     |
|       | 11    | 11    | 4     | 39    | 7     |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

### Syllabus

|                |  |                 |
|----------------|--|-----------------|
| <b>UNIT-I:</b> | <b>Gametogenesis and fertilization</b><br>Spermatogenesis-oogenesis- Spermatozoon-egg types - fertilization -Molecular basis of egg activation, Parthenogenesis. | <b>(18 Hrs)</b> |
|----------------|--|-----------------|

|                   |  |                 |
|-------------------|--|-----------------|
| <b>UNIT-II:</b>   | <b>Early development of human embryo</b><br>Reproductive cycle-menstruous-ovulation-cleavage,gastrulation and peculiar feature of human development-extra embryonic membranes and placenta formation-teratogenesis and Malignancy  | <b>(18 Hrs)</b> |
| <b>UNIT- III:</b> | <b>Experimental embryology</b><br>Organizer- Embryonic inductions and competence-types of induction-vertebrate lens neural induction-mechanism-competence and its molecular biology-Gradient theory-Nuclear transplantation  | <b>(18 Hrs)</b> |
| <b>UNIT- IV:</b>  | <b>Cell differentiation.</b><br>Types and characteristics of differentiation-chemical basis-role of cytoplasm on differentiation-molecular biology of differentiation-tissue maintenance and replacement-stem cells and its studies. Gene action and Hormonal control in development             | <b>(18 Hrs)</b> |
| <b>UNIT- V:</b>   | <b>Metamorphosis and regeneration</b><br>Morphological, physiological and biochemical changes during amphibian metamorphosis-hormonal control of amphibian metamorphosis- Regeneration mechanism-Regeneration in amphibia- Wound healing- Blastema formation-Dedifferentiation and morphogenesis | <b>(18 Hrs)</b> |

### Text Books

- Balinsky,B.I.and Fabian 2012, An introduction to embryology. Cengage Learning India Pvt, New Delhi.
- Inderbir Singh & Pal G.P. 2013, Human Embryology, 9 th edition MacMillan India. Ltd. Chennai.

### Reference Books

- Subramanian M.A 2012, Developmental Biology. MJP Publishers, Chennai
- Berril, N.J.1976- Development. Tata Mc.Graw. Hill .Pub.Co.Ltd.
- Scott F. Gilbert 1988. Developmental biology, Sinauer Associates and Pub. Massachutes.
- Verma, P. S and Agarw al, V.K. 2005, Chordate Embryology, S.Chand & Co, New Delhi.
- Jain P.C. 2007. Elements of developmental biology. Vishal Publication Jalandhar- Delhi

### Pedagogy

- Chalk & Talk, Group Discussion, PPT

### Teaching Aids

- Green Board, LCD Projector, Chart models, Interactive White Board

### Course Contents and Lecture Schedule

| Module No.  | Topic   | No. of Lectures | Content Delivery Method       | Teaching Aids      |
|---|---|-----------------|-------------------------------|--------------------|
| <b>Unit -1 Gametogenesis and fertilization (18 hrs)</b>   |   |                 |                               |                    |
| 1.1   | Spermatogenesis-oogenesis-  | 6               | Discussion                    | Green Board        |
| 1.2   | Spermatozoon-egg types - fertilization                            | 6               | Chalk & Talk                  | Green Board        |
| 1.3   | Molecular basis of egg activation, Parthenogenesis                | 6               | Chalk & Talk                  | Green Board        |
| <b>Unit -2 Early development of human embryo (18 hrs)</b> |   |                 |                               |                    |
| 2.1   | Reproductive cycle-menstruous-ovulation                           | 4               | Lecture                       |                    |
| 2.2   | cleavage,gastrulation   | 4               | Chalk & Talk                  | Green Board        |
| 2.3   | peculiar feature of human development-extra embryonic membranes   | 5               | Chalk & Talk, display models, | Green Board, Chart |
| 2.4   | placenta formation-teratogenesis and Malignancy                   | 5               | Chalk & Talk, PPT             | Green Board, LCD   |
| <b>Unit -3 Experimental embryology (18 hrs)</b>           |   |                 |                               |                    |
| 3.1   | Organizer- Embryonic inductions and competence-types of induction | 6               | Chalk & Talk                  | Green Board        |



|  |  |               |              |             |
|--|--|---------------|--------------|-------------|
| 3.2  | vertebrate lens neural induction-mechanism-competence and its molecular biology                      | 6             | Chalk & Talk | Green Board |
| 3.3  | Gradient theory-Nuclear transplantation  | 6             | Chalk & Talk | Green Board |
| <b>Unit -4 Cell differentiation (18 hrs)</b>           |  |               |              |             |
| 4.1  | Types and characteristics of differentiation-chemical basis-role of cytoplasm on differentiation- -. | 4             | Discussion   | Green Board |
| 4.2  | molecular biology of differentiation   | 4             | Chalk & Talk | Green Board |
| 4.3  | tissue maintenance and replacement-stem cells and its studies  | 5             | Chalk & Talk | Green Board |
| 4.4  | Gene action and Hormonal control in development  | 5             | Chalk & Talk | Green Board |
| <b>Unit -5 Metamorphosis and regeneration (18 hrs)</b> |  |               |              |             |
| 5.1  | Morphological, physiological and biochemical changes during amphibian metamorphosis                  | 4             | Lecture      | Green Board |
| 5.2  | hormonal control of amphibian metamorphosis  | 4             | Chalk & Talk | Green Board |
| 5.3  | Regeneration mechanism-Regeneration in amphibia  | 5             | Chalk & Talk | Green Board |
| 5.4  | Wound healing- Blastema formation-Dedifferentiation and morphogenesis                                | 5             | Chalk & Talk | Green Board |
| <b>Total</b>   |  | <b>90 hrs</b> |              |             |

### E-Resources

<https://youtu.be/aTfXaqN24Bc>

<https://www.slideshare.net/16011996/spermatogenesis-dan-oogenesis-40242421>

<https://youtu.be/usEIVynA0Ck>

<https://www.slideshare.net/StreetRacer3/mechanism-of-natural-competence-by-jaimin-maheta>

<https://www.slideshare.net/selvarajselva1/developmental-biology-232262057>

<https://www.slideshare.net/varunsurya92/epithelial-tumor-markers>

<https://youtu.be/Fu7t3rjW7yQ>

<https://www.slideshare.net/drashutoshtiwari/stem-cell-therapy-36963348>

<https://www.slideshare.net/sanjaysingh1256/regeneration-sat>

<https://youtu.be/abX0a4I23vE>

## DEPARTMENT OF ZOOLOGY

Programme: M.Sc., Zoology, (Under CBCS and LOCF)

(For those students admitted during the Academic Year 2021 - 22 and after)

|                              |                   |                  |
|------------------------------|-------------------|------------------|
| PART – III : Core Practical  |                   | SEMESTER - II    |
| Course Title: PRACTICAL - II |                   |                  |
| Course Code: 31CP24          | Hours per week: 6 | Credits: 3       |
| CIA: 40 Marks                | ESE: 60 Marks     | Total: 100 Marks |

### Preamble

To enable the students to observe, analyse, test the immunological organ and cells through immunotechniques, to apply the standards of calculations for evaluating the biological data and to identify, mount the embryonic cells and their developmental changes.

### Course Outcomes (CO)

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

| No.  | Course Outcome   | Knowledge Level (according to Bloom's Taxonomy) |
|------|--|---|
| CO 1 | Analyse the cellular organs, cell types of immuno organs   | K1, K2 & K5                                     |
| CO 2 | Evaluate the structure, analyse and reactivity of immuno organs through immunotechniques.                                | K2, K4  |
| CO 3 | Estimate the measures of central tendency and dispersion of the biological data  | K3 & K5   |
| CO 4 | Assess the correlation, its deviation and chances of the biological data   | K2, K4 & K5                                     |
| CO 5 | Trace the developing stages and its accessories structures of chick, developmental strategies of the amphibia and human. | K2, K4 & K5                                     |

K1-Remembering K2-Understanding K3-Appling K4- Analyzing K5- Evaluating

### Mapping of CO with PO

|       | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO6 | PLO7 |
|-------|-------|-------|-------|-------|-------|------|------|
| CLO 1 | 9     | -     | 3     | 3     | 3     | 1    | 3    |
| CLO 2 | 9     | -     | 3     | 3     | 3     | 1    | 3    |
| CLO 3 | 3     | -     | 3     | -     | 1     | 1    | 3    |
| CLO 4 | 3     | -     | 3     | -     | 1     | 1    | 3    |
| CLO 5 | 9     | -     | 1     | -     | 1     | 1    | 3    |
|       | 24    | -     | 13    | 6     | 9     | 5    | 15   |

### Mapping of CO with PSO

|       | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|-------|-------|-------|-------|-------|-------|
| CLO 1 | 1     | 3     | 1     | 9     | -     |
| CLO 2 | 1     | 9     | 9     | 3     | -     |
| CLO 3 | 1     | 3     | 9     | -     | -     |
| CLO 4 | -     | 1     | 9     | 3     | -     |
| CLO 5 | 3     | 1     | 1     | 3     | -     |
|       | 6     | 17    | 29    | 18    | -     |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

### Syllabus

#### IMMUNOLOGY

(12 Hrs)

1. Dissection in chick to show the lymphoid organs.
2. Differential count of Human WBC.
3. Counting of total RBC using haemocytometer.
4. Techniques of preparation of cellular, particulate, soluble Ags and emulsified

- Fruend's adjuvant.
- Injection schedule in rabbit to induce antibody.
  - Bleeding technique in rabbit and preparation of anti serum.
  - Ouchterlony double immune diffusion and Mancini single radial immune diffusion.
  - Haemagglutination titration assay: Commercial kits use-ELISA-HIV/Hepatitis, Blood grouping.
  - Immuno electrophoresis.

#### Spotters:

- Lymphoid organs.
- Primary and secondary immune response curves.
- Latex test.
- Blood group anti serum.
- Anaphylatic reactions.
- Arthus reaction.
- Tuberculin types hypersensitivity.
- Contact hypersensitivity.
- Hashimoto's thyroiditis.

#### BIOSTATISTICS

- Collection of data and construction of frequency tables.
- Calculation of mean, median, mode.
- Calculation of standard deviation and variance.
- Comparison of means of two samples by student's "t" test.
- The correlation of measurements (e.g length and weight of fish; no.of seeds and seed pod length).
- Regression analysis.
- Probability distribution (Normal, Binomial, Poisson and skewed 2.distribution).
- Chi square analysis (genetic experiment and 2X2 contingency table).
- Analysis of variance.

#### DEVELOPMENTAL BIOLOGY

- Observation of chick embryos (24 Hrs, 48 Hrs 72 Hrs and 96 Hrs)
- Temporary mounting of chick blastoderm.
- Effect of thyroxin on amphibian metamorphosis.
- Regeneration in frog tadpoles.

#### Spotters

- Extraembryonic membranes (Human)
- Xenopus laevis*

#### Text Books

- Balinsky, B.I. and Fabian 2012, An introduction to embryology. Cengage Learning India Pvt, New Delhi.
- Inderbir Singh & Pal G.P. 2013, Human Embryology, 9 th edition MacMillan India. Ltd. Chennai.

#### Reference Books

- Subramanian M.A 2012, Developmental Biology. MJP Publishers, Chennai
- Berril, N.J. 1976- Development. Tata Mc.Graw. Hill .Pub.Co.Ltd.
- Scott F. Gilbert 1988. Developmental biology, Sinauer Associates and Pub. Massachutes.
- Verma, P. S and Agarwal, V.K. 2005, Chordate Embryology, S.Chand & Co, New Delhi.
- Jain P.C. 2007. Elements of developmental biology. Vishal Publication Jalandhar- Delhi

#### Pedagogy

Chalk & Talk, Group Discussion, PPT

#### Teaching Aids

Green Board, LCD Projector, Chart models, Interactive White Board

#### Course Contents and Lecture Schedule

| Module No. | Topic | No. of Practicals | Content Delivery | Teaching Aids |
|------------|-------|-------------------|------------------|---------------|
|------------|-------|-------------------|------------------|---------------|

|    |   |   | Method                              |  |
|----|---|---|-------------------------------------|--|
| 1  | <b>Immunology</b><br>Dissection in chick to show the lymphoid organs.   | 2 | Chalk & Talk<br>Dissection<br>Tools | Green Board<br>Charts                      |
| 2  | Differential count of Human WBC   | 2 | Chalk & Talk<br>Dissection<br>Tools | Green Board<br>Microscope<br>Charts        |
| 3  | Counting of total RBC using haemocytometer  | 2 | Chalk & Talk<br>Dissection<br>Tools | Green Board<br>Microscope<br>Charts        |
| 4  | Techniques of preparation of cellular, particulate, soluble Ags and emulsified Freund's adjuvant  | 2 | Chalk & Talk<br>Dissection<br>Tools | Green Board<br>Microscope<br>Charts        |
| 5  | Injection schedule in rabbit to induce antibody   | 2 | Chalk & Talk<br>Dissection<br>Tools | Green Board<br>Microscope<br>Charts        |
| 6  | Bleeding technique in rabbit and preparation of anti serum  | 4 | Software<br>Internet with<br>Wifi   | Smart Board<br>Charts<br>Models<br>Laptops |
| 7  | Ouchterlony double immune diffusion and Mancini single radial immune diffusion  | 1 | Discussion                          | Green Board                                |
| 8  | Haemoagglutination titration assay:<br>Commercial kits use-ELISA-HIV/Hepatitis,<br>Blood grouping   | 1 | Discussion                          | Green Board                                |
| 9  | Immuno electrophoresis  | 1 | Chalk & Talk<br>Discussion          | Preserved<br>animalcules<br>and slides     |
| 10 | <b>Spotters:</b><br>1. Lymphoid organs.<br>2. Primary and secondary immune response curves.<br>3. Latex test.<br>4. Blood group anti serum.<br>5. Anaphylatic reactions.<br>6. Arthus reaction.<br>7. Tuberculin types hypersensitivity.<br>8. Contact hypersensitivity.<br>9. Hashimoto's thyroiditis. | 1 | Chalk & Talk<br>Discussion          | Preserved<br>animalcules<br>and slides     |
| 11 | <b>Biostatistics</b><br>Collection of data and construction of frequency tables.  | 1 | Chalk & Talk<br>Discussion          | Preserved<br>animals and<br>slides         |
| 12 | Calculation of mean, median, mode.  | 1 | Chalk & Talk<br>Discussion          | Preserved<br>animals and<br>slides         |
| 13 | Calculation of standard deviation and variance  | 1 | Chalk & Talk<br>Discussion          | Preserved<br>animals and<br>slides         |
| 14 | Comparison of means of two samples by student's "t" test  | 4 | Discussion<br>PPT<br>Photographs    | Live farms and<br>demonstration            |
| 15 | The correlation of measurements (e.g length and weight of fish; no. of seeds and seed   | 2 | Chalk & Talk<br>Dissection          | Green Board<br>Microscope                  |

|    | pod length).  |           | Tools                               | Charts                                     |
|----|---|-----------|-------------------------------------|--|
| 16 | Regression analysis   | 2         | Chalk & Talk<br>Dissection<br>Tools | Green Board<br>Microscope<br>Charts        |
| 17 | Probability distribution (Normal, Binomial, Poisson and skewed 2.distribution).   | 5         | Software<br>Internet with<br>Wifi   | Smart Board<br>Charts<br>Models<br>Laptops |
| 18 | Chi square analysis (genetic experiment and 2X2 contingency table).   | 4         | Discussion                          | Green Board                                |
| 19 | Analysis of variance  | 1         | Chalk & Talk<br>Discussion          | Preserved<br>animals and<br>slides         |
| 20 | <b>Developmental Biology</b><br>1. Observation of chick embryos (24 Hrs, 48 Hrs 72 Hrs and 96 Hrs)                          | 1         | Chalk & Talk<br>Discussion          | Preserved<br>animals and<br>slides         |
| 21 | Temporary mounting of chick blastoderm  | 1         | Chalk & Talk<br>Discussion          | Preserved<br>animals and<br>slides         |
| 22 | Effect of thyroxin on amphibian metamorphosis   | 1         | Chalk & Talk<br>Discussion          | Preserved<br>animals and<br>slides         |
| 23 | Regeneration in frog tadpoles   | 3         | Chalk & Talk<br>Discussion          | Preserved<br>animals and<br>slides         |
| 24 | Spotters<br>1. Extraembryonic membranes (Human)<br>2. Xenopus laevis  |           |                                     |  |
|    | <b>Evolution</b><br>1. Experiment to demonstrate the Natural selection in large population                                  |           |                                     |  |
|    | Experiment to demonstrate Genetic drift in small population   |           |                                     |  |
|    | Study of Darwinian fitness  |           |                                     |  |
|    | Experiment to estimate the proportion of homozygous and heterozygous allele in a population (a case study with human trait) |           |                                     |  |
|    | Spotters<br>1. Darwin's finches<br>2. Industrial melanism<br>3. Human evolution (causes)                                    |           |                                     |  |
|    | <b>Total</b>  | <b>60</b> |                                     |  |

**DEPARTMENT OF ZOOLOGY**

Programme: M.Sc., Zoology, (Under CBCS and LOCF)

(For those students admitted during the Academic Year 2021 - 22 and after)

|  |                          |                         |
|--|--------------------------|-------------------------|
| <b>PART – III : Discipline Specific Elective</b> |                          | <b>SEMESTER - II</b>    |
| <b>Course Title: EVOLUTION</b>                   |                          |                         |
| <b>Course Code: 31DS2A</b>                       | <b>Hours per week: 6</b> | <b>Credits: 5</b>       |
| <b>CIA: 25 Marks</b>                             | <b>ESE: 75 Marks</b>     | <b>Total: 100 Marks</b> |

**Preamble**

To enable the students to impart knowledge of origin of life and to trace human evolution, introduction of evolutionary theories & their significances and make them to understand species concept and distribution of animals

**Course Outcomes (CO)**

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

| No.         | Course Outcome  | Knowledge Level (according to Bloom's Taxonomy) |
|-------------|---|---|
| <b>CO 1</b> | Study the modern concepts of natural selection                                    | K1, K2  |
| <b>CO 2</b> | Imparting knowledge on molecular evolution from amino acid-protein –DNA phylogeny | K1, K2, K3                                      |
| <b>CO 3</b> | Understand species concept and distribution of animals                            | K2, K5  |
| <b>CO 4</b> | Trace the origin of higher taxa and its deviation                                 | K2, K3, K4, K5                                  |
| <b>CO 5</b> | Understand fossil history of early man, biological and cultural evolution of man  | K2, K3, K4, K5                                  |

**K1-Remembering K2-Understanding K3-Applying K4- Analyzing K5- Evaluating**

**Mapping of CO with PO**

|              | <b>PLO 1</b> | <b>PLO 2</b> | <b>PLO 3</b> | <b>PLO 4</b> | <b>PLO 5</b> | <b>PLO6</b> | <b>PLO7</b> |
|--------------|--------------|--------------|--------------|--------------|--------------|-------------|-------------|
| <b>CLO 1</b> | 3            | -            | 3            | -            | -            | 9           | 3           |
| <b>CLO 2</b> | 9            | 3            | 3            | -            | 1            | 3           | 3           |
| <b>CLO 3</b> | 3            | -            | 1            | -            | 1            | 9           | 3           |
| <b>CLO 4</b> | 3            | -            | 3            | -            | 3            | 3           | 3           |
| <b>CLO 5</b> | 9            | -            | 3            | -            | 3            | 3           | 3           |
|              | 27           | 3            | 13           | -            | 8            | 27          | 15          |

**Mapping of CO with PSO**

|              | <b>PSO 1</b> | <b>PSO 2</b> | <b>PSO 3</b> | <b>PSO 4</b> | <b>PSO 5</b> |
|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>CLO 1</b> | -            | 9            | -            | 1            | -            |
| <b>CLO 2</b> | -            | 2            | 9            | 1            | -            |
| <b>CLO 3</b> | -            | 9            | 3            | -            | -            |
| <b>CLO 4</b> | 9            | 3            | 3            | -            | -            |
| <b>CLO 5</b> | 3            | 9            | 1            | 1            | -            |
|              | 12           | 32           | 16           | 3            | -            |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

**Syllabus**

- UNIT-I: Modern concepts of Natural Selection (18 Hrs)**  
 Darwinian principles- Modern understanding of natural selection- Modes and types of selection. Darwinian fitness- genetic drift and natural selection.
- UNIT-II: Molecular evolution (18 Hrs)**  
 Amino acid sequences of proteins-Amino acid substitution-protein

evolution. Electrophoretic analysis of genetic variation - DNA phylogeny-neutrality theory of protein evolution- molecular clock of evolution

**UNIT- III: Speciation (18 Hrs)**

Nature of Speciation- Modes of speciation- allopatric, sympatric, Parapatric and Quantum speciation- Types of isolating mechanism- Pre zygotic and post zygotic

**UNIT- IV: Origin of higher taxa (18 Hrs)**

Simpson's definition of higher taxa-Mechanism- polyploidy - Deviation -Allometry --Neotony- Preadaptation. And post adaptation - Modes of Origin of higher taxa:Mosaic mode-connecting links between vertebrates-Quantum evolution -Simpson's adaptive grid-Rates of evolution: Horotely-Bradytely-Tachytely-Gradualism Vs Punctuated equilibrium-Extinction and its causes

**UNIT- V: Human evolution (18 Hrs)**

Fossil history of early man- Australopithecines-*Homo habilis* - *Homo erectus* - Neanderthal man, - Fossil sites, Dating of fossils, Cultural evolution -Stone tool culture - Language -self-awareness and death awareness - Biological evolution of man. Selfish gene - Altruism - Kin selection, Modern cultural evolution and ancient - evidences to Moganjatharo through keeladi.

#### Text Books

- Hall B.K and B. Hallgrimsson 2014 Strickberger's Evolution, Jones and Bartlett India Pvt Ltd, New Delhi.

#### Reference Books

- VeerBala Rastogi, 2005. Organic Evolution, Kedarnath Ramnath P
- P.A.Moody, 1995. Introduction to evolution, Kalyani Pub, New Delhi.
- Dobzhansky, Th., Ayala, F. J., Stebbins, G. Ledyard & Valentine, J. W., 1977. Evolution W. H. Freeman and Company, San Francisco
- Chattopadhyay, 2002. Life -Origin, Evolution and adaptation, Books and Allied P Ltd, Kolkata.

#### • Pedagogy

- Chalk & Talk, Group Discussion, PPT
- 

#### • Teaching Aids

- Green Board, LCD Projector, Chart models, Interactive White Board
- 

#### • Course Contents and Lecture Schedule

| Module No.   | Topic   | No. of Lectures | Content Delivery Method | Teaching Aids |
|--|---|-----------------|-------------------------|---------------|
| <b>Unit -1 Modern concepts of Natural Selection (15 hrs)</b> |   |                 |                         |               |
| 1.1  | Darwinian principles- Modern understanding of natural selection               | 6               | Discussion              | Smart board   |
| 1.2  | Modes and types of selection.   | 6               | Chalk & Talk            | Green Board   |
| 1.3  | Darwinian fitness- genetic drift and natural selection                        | 6               | Chalk & Talk            | Green Board   |
| <b>Unit -2 Molecular evolution (15 hrs)</b>                  |   |                 |                         |               |
| 2.1  | Amino acid sequences of proteins-Amino acid substitution-protein evolution. - | 6               | Lecture                 | Smart board   |
| 2.2  | Electrophoretic analysis of genetic variation                                 | 6               | Chalk & Talk            | Green Board   |
| 2.3  | DNA phylogeny-neutrality theory of protein                                    | 6               | Chalk & Talk,           | Green         |

|   |  |               |                 |              |
|---|--|---------------|-----------------|--------------|
|   | evolution- molecular clock of evolution  |               | display models, | Board, Chart |
| <b>Unit -3 Speciation (15 hrs)</b>            |  |               |                 |              |
| 3.1   | Nature of Speciation- Modes of speciation- allopatric, sympatric, -  | 6             | Chalk & Talk    | Green Board  |
| 3.2   | Parapatric and Quantum speciation- Types of isolating mechanism  | 6             | Chalk & Talk    | Green Board  |
| 3.3   | Pre zygotic and post zygotic   | 6             | Chalk & Talk    | Green Board  |
| <b>Unit -4 Origin of higher taxa (15 hrs)</b> |  |               |                 |              |
| 4.1   | Simpson's definition of higher taxa- Mechanism- polyploidy – Deviation – Allometry --  | 6             | Discussion      | Smart board  |
| 4.2   | Neotony- Preadaptation. And post adaptation - Modes of Origin of higher taxa: Mosaic mode- connecting links between vertebrates-                             | 6             | Chalk & Talk    | Green Board  |
| 4.3   | Quantum evolution -Simpson's adaptive grid- Rates of evolution: Horotely-Bradytely- Tachytely-Gradualism Vs Punctuated equilibrium-Extinction and its causes | 6             | Chalk & Talk    | Green Board  |
| <b>Unit -5 (12 hrs)</b>                       |  |               |                 |              |
| 5.1   | Fossil history of early man- Australopithecines- <i>Homo habilis</i> –   | 2             | Lecture         |              |
| 5.2   | <i>Homo erectus</i> – Neanderthal man, – Fossil sites, Dating of fossils,  | 4             | Chalk & Talk    | Green Board  |
| 5.3   | Cultural evolution –Stone tool culture – Language –self-awareness and death awareness  | 4             | Chalk & Talk    | Green Board  |
| 5.4   | Biological evolution of man. Selfish gene – Altruism – Kin selection,  | 4             | Chalk & Talk    | Green Board  |
| 5.5   | Modern cultural evolution and ancient – evidences to Moganjatharo through keeladi.   | 4             | Chalk & Talk    | Green Board  |
| <b>Total</b>                                  |  | <b>90 hrs</b> |                 |              |

## E-Resources

[https://bio.libretexts.org/Bookshelves/Introductory and General Biology/Book%3A General Biology \(Boundless\)/19%3A The Evolution of Populations/19.3%3A Adaptive Evolution/19.3B%3A Stabilizing Directional and Diversifying Selection](https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(Boundless)/19%3A_The_Evolution_of_Populations/19.3%3A_Adaptive_Evolution/19.3B%3A_Stabilizing_Directional_and_Diversifying_Selection)  
<https://www.youtube.com/watch?v=jg-S2Q9iaCY>  
<https://plato.stanford.edu/entries/natural-selection/>  
<https://www.livescience.com/474-controversy-evolution-works.html>  
<https://www.khanacademy.org/science/ap-biology/natural-selection/population-genetics/v/genetic-drift-bottleneck-effect-and-founder-effect>  
<https://www.youtube.com/watch?v=iN-o3o6MCHA>  
<https://www.youtube.com/watch?v=vB4Oq49iNwQ>  
<https://www.youtube.com/watch?v=FAeJJNq9jHI>  
<https://users.ox.ac.uk/~tskemp/pdfs/az2007.pdf>  
<https://people.uwec.edu/jolhm/eh4/extinction/causeslink.html>  
<https://www.slideshare.net/adityakuroodi/the-evolution-of-kin-selection>  
<https://humanorigins.si.edu/education/introduction-human-evolution>



**DEPARTMENT OF ZOOLOGY**

Programme: M.Sc., Zoology, (CBCS and LOCF)

(For those students admitted during the Academic Year 2021-22 and after)

|   |                            |                               |
|---|----------------------------|-------------------------------|
| PART-III: <b>Discipline Specific Elective</b> |                            | <b>SEMESTER-IV</b>            |
| Course Title: <b>ENDOCRINOLOGY</b>            |                            |                               |
| Course Code: <b>31DS2B</b>                    | Hours per week: <b>6</b>   | Credits: <b>5</b>             |
| CIA Marks: <b>25 Marks</b>                    | ESE Marks: <b>75 Marks</b> | Total Marks: <b>100 Marks</b> |

**Preamble**

If focus on the structure anatomy and molecular biology physiology about their related about both diseases vertebrate and invertebrate endocrinology systems.

**Course Outcomes (CO)**

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

| No.        | Course Outcome  | Knowledge Level (according to Bloom's Taxonomy) |
|------------|---|---|
| <b>CO1</b> | The student is able to obtain knowledge on various endowed organs and their anatomy of both invertebrates and chordates.              | K1, K2, K3, K4 & K5                             |
| <b>CO2</b> | They are able to understand their physiology biochemistry and molecular structure.  | K1, K2, K3, K4 & K5                             |
| <b>CO3</b> | They are able to analyse the actions on various organs and their impotence's on induction and cell signaling.                         | K1, K2, K3, K4 & K5                             |
| <b>CO4</b> | They are able to there the outcomes, both negative and positive feedbacks of the organs by the hormones.                              | K1, K2, K3, K4 & K5                             |
| <b>CO5</b> | They are also able to critically evaluate, integrate in multiple endocrine system for betterment of well functioning of the organism. | K1, K2, K3, K4 & K5                             |

Note: K1-Remembering; K2-Understanding; K3-Appling; K4-Analysing; K5-Evaluating

**Mapping of CO with PO**

|              | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
|--------------|-------|-------|-------|-------|-------|-------|-------|
| <b>CLO 1</b> | 3     | -     | -     | -     | -     | -     | 3     |
| <b>CLO 2</b> | 3     | -     | 1     | -     | -     | 3     | 1     |
| <b>CLO 3</b> | 9     | -     | 1     | -     | -     | 3     | 9     |
| <b>CLO 4</b> | 9     | -     | 3     | 3     | 3     | 3     | 3     |
| <b>CLO 5</b> | 9     | -     | 3     | 3     | 3     | 3     | 3     |
|              | 33    |       | 8     | 6     | 6     | 12    | 19    |

**Mapping of CO with PSO**

|              | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|--------------|-------|-------|-------|-------|-------|
| <b>CLO 1</b> | 3     | 9     | 3     | 3     | 1     |
| <b>CLO 2</b> | 3     | 9     | 3     | 3     | 1     |
| <b>CLO 3</b> | 3     | 9     | 3     | 3     | 1     |
| <b>CLO 4</b> | 3     | 3     | 9     | 1     | -     |
| <b>CLO 5</b> | 1     | 9     | 1     | 9     | 1     |
|              | 13    | 39    | 19    | 19    | 4     |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

## Syllabus

|          |   |         |
|----------|---|---------|
| UNIT-I   | Introduction to endocrinology – endocrine terminologies – invertebrate hormones – phylum – vertebrate, annelid, mollusc, Arthropoda – Hormones of moulting, diapauses, reproduction, osmoregulation, Colorchages – structure and organization of brain of insects.                      | (18Hrs) |
| UNIT-II  | Introduction to vertebrate endocrine system – Endocrine glands and their hormones – Anatomy and hormones and disorders of the pituitary – Neurohypophyseal hormones – endocrine hypothalamus – parietal gland development and morphology.   | (18Hrs) |
| UNIT-III | Neurohormones – Endorphins physiological role and mechanism of action – structure and function of hypothalamus – growth hormones and its disorders – mechanism of hormones actions, messengers and receptors.   | (18Hrs) |
| UNIT-IV  | Regulation of metabolism and other physiological role of the thyroid hormones – hypothyroidism – gastrointestinal hormones: role and mechanism of action – pancreatic hormones: role and its diseases – synthesis and physiological role of adrenal steroid hormones and its disorders. | (18Hrs) |
| UNIT-V   | Male reproductive hormones and its disorders – physiology of female reproductive hormones, syndromes – Hormones role on pregnancy, parturition and lacerations – Hormonal control of calcium homeostasis  | (18Hrs) |

### Text Books

- Lavin Norman (2018) Manual of Endocrinology and Metabolism, Wolters Kluwer India Pvt. Ltd.

### Reference Books

- S.Melmed, R.Koenig, C.Rosen, R. Auchus, A. Goldfine (2019) Williams Textbook of Endocrinology. ISBN: 9780323555968.
- M.E. Hadley and J. Levine (2006) Endocrinology. Pearson Prentice Hall. ISBN 0131876066.
- Michael McDermott (2019) Endocrine Secrets. ISBN: 9780323624282.
- John Laycock and Karim Meeran (2012) Integrated Endocrinology. ISBN:9780470688137.
- Patricia E. Molina (2018) Endocrine Physiology. ISBN: 9781260019353.
- David G. Gardner and Dolores M. Shoback (2018) Greenspan's Basic and Clinical Endocrinology. ISBN 978-1-259-58928-7.

### Pedagogy

Chalk&Talk, Group Discussion, PPT

### TeachingAids

Green Board, LCD Projector, Chart models, Interactive White Board

### Course Contents and Lecture Schedule

| Module No.      | Topic   | No. of Lectures | Content Delivery Method | Teaching Aids |
|-----------------|---|-----------------|-------------------------|---------------|
| Unit-1 (18 hrs) |   |                 |                         |               |
| 1.1             | Introduction to endocrinology – endocrine terminologies – | 4               | Discussion              | Green Board   |

|                         |   |              |             |              |
|-------------------------|---|--------------|-------------|--------------|
|                         | invertebrate hormones –   |              |             |              |
| 1.2                     | phylum – venerate, annelid, mollusc, Arthropoda                                   | 5            | Chalk&Talk  | Green Board  |
| 1.3                     | Hormones of moulting, diapauses, reproduction, osmoregulation, Colorchages        | 5            | Chalk&Talk  | Green Board  |
| 1.4                     | Structure and organization of brain of insects.                                   | 4            | Chalk&Talk  | Green Board  |
| <b>Unit-2 (18 hrs)</b>  |   |              |             |              |
| 2.1                     | Introduction to vertebrate endocrine system – Endocrine glands and their hormones | 4            | Lecture     | Green Board  |
| 2.2                     | Anatomy and hormones and disorders of the pituitary                               | 4            | Chalk&Talk  | Green Board  |
| 2.3                     | Nero hypo physical hormones – endocrine hypothalamus –.                           | 5            | Chalk&Talk, | Green Board, |
| 2.4                     | parietal gland development and morphology   | 5            | Chalk&Talk, | Green Board, |
| <b>Unit-3 (18 hrs)</b>  |   |              |             |              |
| 3.1                     | Nero hormones – Endorphins physiological role and mechanize of action             | 4            | Chalk&Talk  | Green Board  |
| 3.2                     | structure and function of hypothalamus  | 4            | Chalk&Talk  | Green Board  |
| 3.3                     | growth hormones and its disorders   | 5            | Chalk&Talk  | Green Board  |
| 3.4                     | mechanism of hormones actions, messengers and receptors                           | 5            | Chalk&Talk  | Green Board  |
| <b>Unit-4 (18 hrs)</b>  |   |              |             |              |
| 4.1                     | Requesting of metabolism and other physiological role of the thyroid hormones     | 4            | Discussion  | Smart Board  |
| 4.2                     | hypothyroidism – gastrointestinal hormones: role and mechanism of action          | 4            | Chalk&Talk  | Green Board  |
| 4.3                     | pancreatic hormones: role and its diseases  | 5            | Chalk&Talk  | Green Board  |
| 4.4                     | synthesis and physiological role of adrenal steroid hormones and its disorders.   | 5            | Chalk&Talk  | Green Board  |
| <b>Unit -5 (18 hrs)</b> |   |              |             |              |
| 5.1                     | Male reproductive hormones and its disorders                                      | 4            | Lecture     | Green Board  |
| 5.2                     | physiology of female reproductive hormones, syndromes                             | 4            | Chalk&Talk  | Green Board  |
| 5.3                     | Hormones role on pregnancy, parturition and lacerations                           | 6            | Chalk&Talk  | Green Board  |
| 5.4                     | Hormonal control of calcium homeostasis   | 4            | Chalk&Talk  | Green Board  |
|                         | <b>Total</b>  | <b>90hrs</b> |             |              |

### E-Resources

<https://youtu.be/YcPicFL5Jnw>

<https://youtu.be/or8AWfWJmiE>

<https://youtu.be/hn6YDo39tx4>

<https://www.gblions.org/site/handlers/filedownload.ashx?moduleinstanceid=373&dataid=399&FileName=Endocrine%20Systemn ew.ppt>

## DEPARTMENT OF ZOOLOGY

Programme: M.Sc., Zoology, (Under CBCS and LOCF)

(For those students admitted during the Academic Year 2021 - 22 and after)

|                               |                            |                               |
|-------------------------------|----------------------------|-------------------------------|
| PART – III : Core Course      |                            | SEMESTER - III                |
| Course Title: <b>GENETICS</b> |                            |                               |
| Course Code: <b>31CT31</b>    | Hours per week: <b>6</b>   | Credits: <b>4</b>             |
| CIA Marks: <b>25 Marks</b>    | ESE Marks: <b>75 Marks</b> | Total Marks: <b>100 Marks</b> |

### Preamble

To enable the students to understand the modern concepts of genes, gene transfer techniques, gene modifications, DNA repair mechanism and application genetics in human welfare.

### Course Outcomes (CO)

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

| No.  | Course Outcome   | Knowledge Level (according to Bloom's Taxonomy) |
|------|--|---|
| CO 1 | Acquire knowledge on gene concepts and animal heredity   | K1, K2 & K5                                     |
| CO 2 | Impart knowledge on organisational genetics of bacteria and gene transfer methods.             | K2, K4  |
| CO 3 | Develop knowledge on genetic organisation, multiplication and replication of virus.            | K3 & K5   |
| CO 4 | Trace the various gene mutation, repair mechanisms and various types of recombination.         | K2, K4 & K5                                     |
| CO 5 | Understand the molecular basis of human cancer and apply the techniques to improve human race. | K2, K4 & K5                                     |

**K1-Remembering K2-Understanding K3-Applying K4- Analyzing K5- Evaluating**

### Mapping of CO with PO

|       | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO6 | PLO7 |
|-------|-------|-------|-------|-------|-------|------|------|
| CLO 1 | 3     | -     | -     | -     | 1     | 3    | 3    |
| CLO 2 | 3     | -     | 3     | 1     | -     | 3    | 3    |
| CLO 3 | 3     | -     | 3     | 1     | -     | 3    | 3    |
| CLO 4 | 3     | -     | 3     | 1     | -     | 3    | 9    |
| CLO 5 | 3     | -     | -     | 3     | 3     | 3    | 9    |
|       | 15    |       | 9     | 6     | 4     | 15   | 27   |

### Mapping of CO with PSO

|       | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|-------|-------|-------|-------|-------|-------|
| CLO 1 | -     | 9     | -     | 1     | -     |
| CLO 2 | -     | 3     | -     | 1     | -     |
| CLO 3 | -     | 9     | 3     | 3     | -     |
| CLO 4 | -     | 3     | -     | 9     | -     |
| CLO 5 | -     | 9     | -     | 9     | -     |
|       |       | 33    | 3     | 23    |       |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

### Syllabus

- UNIT-I: Gene concept and molecular basis of heredity (18 Hrs)**
- Classical gene concept – Mendelian concept –Deviation of Mendelian concept - Chromosomal map
  - Modern gene concept –Fine structure of gene-Cistron– Recon– Muton.
  - Gene isolation and restriction mapping

- UNIT-II: Microbial genetics (18 Hrs)**
- Essential genetics of haploid organisms and gene transfer mechanism- Genetic notation, Conventions and Terminology.
  - Plasmids-types-detection –isolation – replication –transfer and uses.
  - Bacterial transformation – discovery-detection –competence-molecular mechanism. Bacterial conjugation –insertion of “F” into the *E coli* chromosome –Hfr transfer, genetic Recombination of F plasmids, mechanism of chromosomal transfer.
- UNIT- III: Viral genetics (18 Hrs)**
- Genetic organisation of viruses.
  - Transduction – DNA transfer- specialized and generalized transduction.
  - Bacteriophage - lambda phage-lambda DNA and its genetic structure – lytic and lysogenic cycle-early and late genes-DNA replication-concatamer - assembly and lysis of cell, Transposable elements – mechanism and type study - retroposan.
- UNIT- IV: Mutation, DNA repair and recombination (18 Hrs)**
- Mutation-types –molecular mechanism –deletion – addition –substitution-spontaneous mutation –mutation rates-origin of spontaneous mutation- tautomeric and frame shift mutation- suppressor mutation.
  - DNA repair– photoreactivation, excision repair, mismatch repairs, SOS repair.
  - Genetic recombination –breakage and reunion-heteroduplex DNA –simple and double stranded breaks- isolation and recombination Intermediates- Inter allelic recombination- specialised recombination at specific sites.
- UNIT- V: Human Genetics (18 Hrs)**
- Pedigree analysis – similarity among the relationship – Afro-Asian human relationship, congenital malformations, diagnosis and genetic counseling. Genetic basis of human cancer, detection of oncogenes, cellular function of oncoproteins and diagnosis.
  - Human genome project and its implications
  - Eugenics, Euthenics and Euphenics – types and applications.

#### Text Books

- Gardner. A & Davies. T, 2010. Human Genetics, Viva Books, New Delhi.
- Graig N.L., Cohen-Fix.O, Green R., Greider, C.W., Storz, G., Wolgerger.W. 2010. Molecular Biology- Principles of Genome Functioning, Oxford University Press

#### Reference Books

- David Friefelder 1990. Microbial genetics Narosa Pub. House, New Delhi.
- Hartl and Jones 1998. Genetics–Principles and analysis Jones and Bart latt , Pub.
- Watson J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A., and Weiner, A.M. 1987. Molecular biology of Gene I & II
- Suzuki, D.T., Griffiths, A.J.F., Miller, J.H., Lewontin, R.C., 1986. An introduction to genetics analysis W. H. Freeman and Co. New York.
- Cossman. J 1990. Molecular genetics in cancer diagnosis Elsevier, New York.
- Brown, T.A. 2006. Genomes by Garland science New York.
- The Journey of Man, Author: Dr. Pitchappan, Madurai Kamaraj University, Madurai.

#### Pedagogy

Chalk & Talk, Group Discussion, PPT

#### Teaching Aids

Green Board, LCD Projector, Chart models, Interactive White Board

## Course Contents and Lecture Schedule

| Module No.   | Topic   | No. of Lectures | Content Delivery Method         | Teaching Aids         |
|--|---|-----------------|---------------------------------|-----------------------|
| <b>Unit -1 Gene concept and molecular basis of heredity (18 hrs)</b> |   |                 |                                 |                       |
| 1.1  | Classical gene concept, Mendelian concept   | 1               | Discussion                      | Green Board<br>Charts |
| 1.2  | Deviation of Mendelian concept  | 3               | Chalk & Talk                    | Green Board           |
| 1.3  | Chromosomal map   | 3               | Chalk & Talk                    | Green Board           |
| 1.4  | Modern gene concept –Fine structure of gene-cistron   | 3               | Chalk & Talk                    | Green Board           |
| 1.5  | Recon– Muton  | 2               | Chalk & Talk                    | Green Board           |
| 1.6  | Gene isolation  | 3               | Chalk & Talk                    | Green Board           |
| 1.7  | Restriction mapping   | 3               | Chalk & Talk,<br>PPT            | Green Board,<br>LCD   |
| <b>Unit -2 Microbial genetics (18 hrs)</b>                           |   |                 |                                 |                       |
| 2.1  | Essential genetics of haploid organisms and gene transfer mechanism                                   | 1               | Lecture                         |                       |
| 2.2  | Genetic notation, Conventions and Terminology   | 1               | Chalk & Talk                    | Green Board           |
| 2.3  | Plasmids-types  | 5               | Chalk & Talk,<br>display models | Green Board,<br>Chart |
| 2.4  | Detection –isolation – replication –transfer and uses   | 3               | Chalk & Talk,<br>PPT            | Green Board,<br>LCD   |
| 2.5  | Bacterial transformation – discovery  | 1               | Chalk & Talk,<br>PPT            | Green Board,<br>LCD   |
| 2.6  | Detection –competence-molecular mechanism. Bacterial conjugation                                      | 1               | Chalk & Talk,<br>PPT            | Green Board,<br>LCD   |
| 2.7  | Insertion of “f” into the <i>E coli</i> chromosome – Hfr transfer                                     | 2               | Chalk & Talk                    | Green Board           |
| 2.8  | Genetic recombination of F plasmids   | 1               | Chalk & Talk,<br>PPT            | Green Board,<br>LCD   |
| 2.9  | Mechanism of chromosomal transfer   | 3               | Chalk & Talk                    | Green Board           |
| <b>Unit -3 Viral genetics (18 hrs)</b>                               |   |                 |                                 |                       |
| 3.1  | Genetic organisation of viruses   | 3               | Chalk & Talk                    | Green Board           |
| 3.2  | Transduction – DNA transfer   | 2               | Chalk & Talk                    | Green Board           |
| 3.3  | Specialized and generalized transduction  | 2               | Chalk & Talk                    | Green Board           |
| 3.4  | Bacteriophage - lambda phage-lambda DNA and its genetic structure                                     | 3               | Chalk & Talk                    | Green Board           |
| 3.5  | Lytic life cycle-early and late genes   | 2               | PPT                             | LCD                   |
| 3.6  | DNA replication-concatamer  | 3               | Chalk & Talk                    | Green Board           |
| 3.7  | Assembly and lysis of cell  | 3               | Chalk & Talk                    | Green Board           |
| 3.8  | Transposable elements.  | 2               | Chalk & Talk                    | Green Board           |
| <b>Unit -4 Mutation, DNA repair and recombination (18 hrs)</b>       |   |                 |                                 |                       |
| 4.1  | Mutation-types –molecular mechanism   | 1               | Discussion                      | Smart Board           |
| 4.2  | Deletion – addition –substitution-spontaneous mutation  | 3               | Chalk & Talk                    | Green Board           |
| 4.3  | Mutation rates-origin of spontaneous mutation-tautomeric and frame shift mutation-suppressor mutation | 3               | Chalk & Talk                    | Green Board           |

|  |  |               |                     |                    |
|--|--|---------------|---------------------|--------------------|
| 4.4                                    | DNA repair– photoreactivation, excision repair, mismatch repairs, SOS repair                                       | 3             | Chalk & Talk        | Green Board        |
| 4.5                                    | Genetic recombination –breakage and reunion-heteroduplex DNA –simple and double stranded breaks                    | 4             | Lecture<br>PPT, LCD | PPT                |
| 4.7                                    | Isolation and recombination intermediates-Inter allelic recombination- specialised recombination at specific sites | 4             | Chalk & Talk        | Green Board        |
| <b>Unit -5 Human Genetics (18 hrs)</b> |  |               |                     |                    |
| 5.1                                    | Pedigree analysis - similarity among the relationship – Afro-Asian human relationship                              | 1             | Lecture             | Green Board        |
| 5.2                                    | Congenital malformations, diagnosis and genetic counselling  | 4             | Chalk & Talk        | Green Board        |
| 5.3                                    | Genetic basis of human cancer, detection of oncogenes, cellular function of oncoproteins and diagnosis             | 6             | Chalk & Talk<br>PPT | Green Board<br>PPT |
| 5.4                                    | The Human genome project and its implications  | 3             | Chalk & Talk        | Green Board        |
| 5.5                                    | Eugenics, eugenics and eugenics.   | 4             | Chalk & Talk        | Green Board        |
| <b>Total</b>                           |  | <b>90 hrs</b> |                     |                    |

## E-Resources

### UNIT-I

#### a) Classical gene concept – Mendelian concept

<https://www.slideshare.net/tas11244/mendelian-genetics-8528013>

<https://www.slideshare.net/cgales/classical-genetics>

<https://www.scribd.com/presentation/436061299/Classical-Mendelian-Genetics-ppt-pptx>

#### Deviation from Mendelian concept

<https://slideplayer.com/slide/10947189/>

[https://www.powershow.com/view1/1cb795-](https://www.powershow.com/view1/1cb795-ZDc1Z/Deviations+from+Mendelian+Ratios+powerpoint+ppt+presentation)

[ZDc1Z/Deviations from Mendelian Ratios powerpoint ppt presentation](https://www.powershow.com/view1/1cb795-ZDc1Z/Deviations+from+Mendelian+Ratios+powerpoint+ppt+presentation)

<https://www.slideserve.com/oral/chapter-4-genetic-inheritance-4-2-deviations-from-the-mendelian-inheritance>

<https://www.stcharles.k12.la.us/site/handlers/filedownload.ashx?moduleinstanceid=8999&dataid=27146&FileName=Chapter%2014.pptx>

<http://www.jnkvv.org/PDF/13042020131838Post%20Mendelian%20concept.pdf>

#### Chromosome map

<https://www.slideshare.net/zeeshanahmed121121/gene-mapping-ppt-81617490>

<https://www.slideshare.net/PrashantTripathi59/gene-mapping-ppt>

#### b. Modern gene concept

<https://www.slideshare.net/Sayali28/fine-structure-of-gene-57949681>

<https://www.slideshare.net/kayeenvadakkan/gene-structure>

[http://www.ru.ac.bd/zoology/wp-content/uploads/sites/51/2016/11/Gene-and-Fine-structure-of-gene\\_Fazlul.pptx](http://www.ru.ac.bd/zoology/wp-content/uploads/sites/51/2016/11/Gene-and-Fine-structure-of-gene_Fazlul.pptx)

<https://www.slideshare.net/devendrakumar77964/concept-of-gene>

<https://www.slideshare.net/GauravRajSinhVaghela/ultra-fine-structure-of-gene>

[http://www.macollege.in/app/webroot/uploads/department\\_materials/doc\\_481.pdf](http://www.macollege.in/app/webroot/uploads/department_materials/doc_481.pdf)

<https://www.chegg.com/homework-help/definitions/cistron-recon-and-muton-14>

#### c. Gene isolation and restriction mapping

<https://www.slideshare.net/AfraFathima5/restriction-mapping-169291887>

<https://www.slideshare.net/bdrabby/restriction-mapping-of-bacterial-dna>

<https://www.youtube.com/watch?v=GWe6o8yWM5I>

### UNIT-II Microbial genetics

<https://www.uwyo.edu/molecbio/courses/molb-3000/files/13/13-miller-chap-5a-lecture.ppt>

<https://www.uwyo.edu/molecbio/courses/molb-3000/files/13/13-miller-chap-5a-lecture.ppt>

<https://www.slideshare.net/enamifat/final-ppt-of-terminology>  
<https://www.slideshare.net/samiurrehman/ genetics-ppt-8948503>  
<https://www.easybiologyclass.com/introduction-to-genetics-glossary-of-genetics-terminologies-short-notes-with-ppt/>  
<https://www.slideshare.net/Dilippandya/plasmid>  
<https://www.slideshare.net/SijoA/plasmids-and-types>  
<https://www.slideshare.net/SijoA/plasmids-and-types>  
<https://sjctni.edu/Department/bt/eLecture/Plasmids.ppt>  
<https://www.slideshare.net/kabernath123/plasmid-85751383>  
[https://uomustansiriyah.edu.iq/media/lectures/6/6\\_2017\\_12\\_18!06\\_38\\_18\\_PM.pptx](https://uomustansiriyah.edu.iq/media/lectures/6/6_2017_12_18!06_38_18_PM.pptx)  
<https://www.slideshare.net/SyarifHamdani/plasmid-isolation>  
<https://www.slideshare.net/indranilchatterjee19/plasmid-isolation-150380458>  
<https://www.slideshare.net/neeru02/plasmid-replication-methods-types>  
<https://www.biologydiscussion.com/plasmids/plasmids-definition-types-and-replication-microbiology/54754>  
<https://www.slideshare.net/kabernath123/plasmid-85751383>  
<https://capricorn.bc.edu/bi204/wp-content/uploads/2015/08/10-Plasmids.pptx>  
[https://www.slideshare.net/Mona\\_Alburikan/transformation-in-bacteria](https://www.slideshare.net/Mona_Alburikan/transformation-in-bacteria)  
<https://www.slideshare.net/rbanthia2/bacterial-conjugation>  
<https://www.slideshare.net/megansuara/conjugation-microbiology>  
<https://www.slideshare.net/AmoIPawar71/bacterial-conjugation-72987121>  
<https://www.slideshare.net/rbanthia2/bacterial-conjugation>  
<https://www.slideshare.net/ChandraniGoswami1/gene-transfer-79286243>  
<http://web.pdx.edu/~justc/courses/IntroGenetics/Ch7BacterialGenetics.ppt>

### **UNIT- III: Viral genetics**

<https://www.slideshare.net/asifkanth786/general-organization-and-characteristics-of-virus>  
[https://www.ptbeach.com/cms/lib/NJ01000839/Centricity/Domain/113/ap%20biology%20ppts/CPB718\\_LEC\\_GeneticsOfBacteria\\_Viruses.ppt](https://www.ptbeach.com/cms/lib/NJ01000839/Centricity/Domain/113/ap%20biology%20ppts/CPB718_LEC_GeneticsOfBacteria_Viruses.ppt)  
<https://www.austincc.edu/cbeaman/micro%20ppt/Chapter%206%20ppt.ppt>  
<https://www.slideshare.net/vivekaiden/generalized-specialized-transduction-transformation-and-conjugation>  
<https://www.slideshare.net/SurajGabale/transduction-80440116>  
<https://slideplayer.com/slide/13016833/>  
<https://www.slideshare.net/minhazahmed21/lamda-phage-28762554>  
<https://www.slideshare.net/MisSsiDD/bacteriophage-44694369>  
<https://www.slideshare.net/suganyakunju/bacteriophages-71259201>  
<https://www.slideshare.net/AmithReddy2/phage-strategies>  
<https://www.youtube.com/watch?v=WCLCBt3f6rM>  
<https://www.youtube.com/watch?v=NNfize9Gcm4>  
<https://www.slideshare.net/MMASSY/bacterial-phage-3>  
<https://www.slideshare.net/vivekaiden/transposones>  
<https://www.slideshare.net/zeeshanahmed121121/transposons-ppt>

### **UNIT- IV: Mutation, DNA repair and recombination**

<https://www.slideshare.net/AchyutBora/molecular-mechanism-of-mutation>  
<https://www.slideshare.net/gauravraja4/gene-mutation-all-type-of-mutation>  
<http://www.uky.edu/~tphillip/Chapter14.ppt>  
<http://www.wfisd.net/cms/lib/TX01000557/Centricity/Domain/2039/Mutations.ppt>  
<http://public.gettysburg.edu/~hiraizum/bio211s14/0219.ppt>  
[https://www.gcsnc.com/cms/lib/NC01910393/Centricity/Domain/4648/Mutations\\_Powerpoint.ppt](https://www.gcsnc.com/cms/lib/NC01910393/Centricity/Domain/4648/Mutations_Powerpoint.ppt)  
<https://www.uwo.edu/molecbio/courses/molb-3000/files/13/13-miller-chap-5a-lecture.ppt>  
<https://www.slideshare.net/RIZWANABBAS3/dna-repairing>  
<https://www.slideshare.net/RajeshChaudhary10/dna-repair-mechanism-61348400>  
<https://www.slideshare.net/pravee14/dna-repair-61633570>  
<https://www.slideshare.net/najmhemato/dna-repair>  
[http://www.bx.psu.edu/~ross/BMB400/Presentations/2\\_6\\_repair\\_2002.ppt](http://www.bx.psu.edu/~ross/BMB400/Presentations/2_6_repair_2002.ppt)  
<https://www.slideshare.net/bijayauprety/genetic-recombination-41216267>  
<https://www.slideshare.net/DeeshmaKp/6-genetic-recombination-in-prokaryotes>



[http://www.bx.psu.edu/~ross/BMB400/Presentations/2\\_7\\_rexn\\_genetics\\_models.ppt](http://www.bx.psu.edu/~ross/BMB400/Presentations/2_7_rexn_genetics_models.ppt)

## **UNIT- V: Human Genetics**

<https://www.slideshare.net/Manyamkanakavalli/pedigree-analysis-53508509>

<https://www.slideshare.net/MsAllenBio/pedigree-analysis>

<https://www.slideshare.net/smaxy/congenital-anomalies-66287198>

<https://www.slideshare.net/smaxy/congenital-anomalies-66287198>

<https://www.slideshare.net/drms hassan/cancer-genetics-43857313>

<https://www.slideshare.net/mpattani/the-genetics-of-cancer>

<https://www.uwyo.edu/molecbio/courses/molb-3000/files/13/13-chap-24-lecture.ppt>

<https://www.slideshare.net/vinithasekar/human-genome-project-72272927>

<http://www.pitt.edu/~super4/38011-39001/38781.ppt>

<http://www.bibalex.org/supercourse/supercoursePPT/19011-20001/19301.ppt>

<https://www.slideshare.net/DrDineshCSharma/eugenics-euthenics-euphenics>

[https://www.brainkart.com/article/Eugenics,-Euphenics-and-Euthenics\\_38050/](https://www.brainkart.com/article/Eugenics,-Euphenics-and-Euthenics_38050/)

## DEPARTMENT OF ZOOLOGY

Programme: M.Sc., Zoology, (Under CBCS and LOCF)

(For those students admitted during the Academic Year 2021 - 22 and after)

|                                 |                          |                         |
|---------------------------------|--------------------------|-------------------------|
| PART – III : Core Course        |                          | SEMESTER - III          |
| Course Title: <b>PHYSIOLOGY</b> |                          |                         |
| Course Code: <b>31CT32</b>      | Hours per week: <b>6</b> | Credits: <b>4</b>       |
| CIA: <b>25 Marks</b>            | ESE: <b>75 Marks</b>     | Total: <b>100 Marks</b> |

### Preamble

To enable the students to acquire knowledge on physiology of organisms with reference to respiratory, circulatory, excretory systems and receptors.

### Course Outcomes (CO)

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

| No.  | Course Outcome   | Knowledge Level (according to Bloom's Taxonomy) |
|------|--|---|
| CO 1 | Acquire knowledge on structure, physiology and mechanism of respiratory system.          | K1, K2 & K5                                     |
| CO 2 | Trace the knowledge on physiology of receptors and biophysical implications.             | K2, K4  |
| CO 3 | Gain the knowledge on the functions and regulations of respiratory, circulatory systems. | K3 & K5   |
| CO 4 | Explore the organisation of nervous system, their functions and behaviour.               | K2, K4 & K5                                     |
| CO 5 | Acquire knowledge on blood components and its physiology                                 | K2, K4 & K5                                     |

**K1-Remembering K2-Understanding K3-Applying K4- Analyzing K5- Evaluating**

### Mapping of CO with PO

|       | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO6 | PLO7 |
|-------|-------|-------|-------|-------|-------|------|------|
| CLO 1 | 9     | -     | -     | -     | -     | 3    | 3    |
| CLO 2 | 3     | -     | 3     | 3     | -     | 3    | 3    |
| CLO 3 | 9     | -     | 3     | 3     | -     | 3    | 3    |
| CLO 4 | 9     | -     | 3     | 3     | -     | 3    | 3    |
| CLO 5 | 9     | -     | 3     | 3     | -     | 3    | 3    |
|       | 39    |       | 12    | 12    |       | 15   | 15   |

### Mapping of CO with PSO

|       | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|-------|-------|-------|-------|-------|-------|
| CLO 1 | 3     | 3     | 3     | 9     | -     |
| CLO 2 | 3     | 3     | 3     | 9     | -     |
| CLO 3 | 3     | 3     | 3     | 9     | -     |
| CLO 4 | -     | 3     | -     | 9     | -     |
| CLO 5 | 3     | 3     | -     | 1     | 3     |
|       | 12    | 15    | 9     | 37    | 3     |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

### Syllabus

**UNIT-I: Respiration, Ionic & Osmotic balance and Endocrine Regulation of Reproduction (18 Hrs)**

- The exchange of gases-respiratory organs and their ventilation – transport of gases
- Metabolic and respiratory responses –rate of metabolism – oxygen as limiting factor in the environment – effects of hydrostatic pressure –

buoyancy.

- c. Osmotic and ionic regulation - maintaining water and electrolyte balance – hormones and the regulation of water and electrolytes
- d. Endocrine regulation of reproduction - invertebrate hormones of reproduction - vertebrate controls.

**UNIT – II: Light, Bioelectricity & Physiology of therapies (18 Hrs)**

- a. Photo biology (Vision and Bioluminescence)
- b. Physics and physiology of receptors
- c. Bioelectricity and Neuro biophysics
- d. Physiology of heat therapy, physiotherapy, phototherapy, magnetotherapy and megavoltage therapy.

**UNIT-III Effector Organs, Counter Current Exchange & Circulation (18 Hrs)**

- a. Mechanics of Muscle and animal movements
- b. Mechanics of pulmonary ventilation and counter current mechanism
- c. Haemodynamics and cardiac cycle.

**UNIT- IV: Nervous Integration (18 Hrs)**

- a. Neuron to brain; Reflex to planned action.
- b. Properties of inter neuron.
- c. Organization of Nervous system.
- d. Physiology of behaviour

**UNIT- V: Circulation of Body Fluids (18 Hrs)**

- a. The body fluids.
- b. Circulation of Blood.
- c. Vascular pump and Cardiac rhythms.
- d. Blood flow and blood pressure

#### Text Books

- William S. Hoar. 2004. General and comparative physiology Prentice-Hall Publication
- R.C.Dalela Verma and S.R. Verma. 1995. Animal Physiology and Related Biochemistry Jaiprakash Nath & Co,

#### Reference Books

- Marieb E.N. 2006. Human Anatomy and Physiology, Pearson Edu.
- Prosser C.L and Brown F. A. 1962. Comparative animal physiology, W.B. Saunders Company Ltd. London.

#### • Pedagogy

- Chalk & Talk, Group Discussion, PPT

#### • Teaching Aids

- Green Board, LCD Projector, Chart models, Interactive White Board

#### • Course Contents and Lecture Schedule

| Module No.       | Topic   | No. of Lectures | Content Delivery Method | Teaching Aids      |
|------------------|---|-----------------|-------------------------|--------------------|
| Unit -1 (18 hrs) |   |                 |                         |                    |
| 1.1              | The exchange of gases   | 1               | Discussion              | Green Board Charts |
| 1.2              | Respiratory organs and their ventilation transport of gases   | 3               | Chalk & Talk            | Green Board        |
| 1.3              | Metabolic and respiratory responses   | 3               | Chalk & Talk            | Green Board        |
| 1.4              | Rate of metabolism – oxygen as limiting factor in the environment, effects of hydrostatic pressure – buoyancy | 2               | Chalk & Talk            | Green Board        |
| 1.5              | Osmotic and ionic regulation - maintaining water and electrolyte balance                                      | 3               | Chalk & Talk            | Green Board        |
| 1.6              | Hormones and the regulation of water and electrolytes   | 3               | Chalk & Talk            | Green Board        |

|                         |   |               |                                 |                       |
|-------------------------|---|---------------|---------------------------------|-----------------------|
| 1.7                     | Endocrine regulation of reproduction -<br>invertebrate hormones of reproduction -<br>vertebrate controls. | 3             | Chalk & Talk,<br>PPT            | Green<br>Board, LCD   |
| <b>Unit -2 (18 hrs)</b> |   |               |                                 |                       |
| 2.1                     | Photobiology - Vision   | 3             | Lecture                         |                       |
| 2.2                     | Bioluminescence   | 1             | Chalk & Talk                    | Green Board           |
| 2.3                     | Physics and physiology of receptors   | 3             | Chalk & Talk,<br>display models | Green<br>Board, Chart |
| 2.4                     | Bioelectricity and Neurobiophysics  | 3             | Chalk & Talk,<br>PPT            | Green<br>Board, LCD   |
| 2.5                     | Physiology of heat therapy  | 1             | Chalk & Talk,<br>PPT            | Green<br>Board, LCD   |
| 2.6                     | Physio-therapy  | 1             | Chalk & Talk,<br>PPT            | Green<br>Board, LCD   |
| 2.7                     | Photo-therapy   | 2             | Chalk & Talk                    | Green Board           |
| 2.8                     | Magneto-therapy   | 2             | Chalk & Talk,<br>PPT            | Green<br>Board, LCD   |
| 2.9                     | Mega voltage therapy  | 2             | Chalk & Talk                    | Green Board           |
| <b>Unit -3 (18 hrs)</b> |   |               |                                 |                       |
| 3.1                     | Mechanics of muscle and animal movements  | 3             | Chalk & Talk                    | Green Board           |
| 3.2                     | Mechanics of pulmonary ventilation  | 4             | Chalk & Talk                    | Green Board           |
| 3.3                     | Counter current mechanism   | 4             | Chalk & Talk                    | Green Board           |
| 3.4                     | Haemodynamics   | 4             | Chalk & Talk                    | Green Board           |
| 3.5                     | Cardiac cycle   | 3             | PPT                             | LCD                   |
| <b>Unit -4 (18 hrs)</b> |   |               |                                 |                       |
| 4.1                     | Neuron to brain   | 3             | Discussion                      | Smart<br>Board        |
| 4.2                     | Reflex to planned action  | 4             | Chalk & Talk                    | Green Board           |
| 4.3                     | Properties of inter neuron  | 3             | Chalk & Talk                    | Green Board           |
| 4.4                     | Organization of Nervous system  | 4             | Chalk & Talk                    | Green Board           |
| 4.5                     | Physiology of behaviour   | 4             | Lecture                         |                       |
| <b>Unit -5 (18 hrs)</b> |   |               |                                 |                       |
| 5.1                     | The body fluids   | 3             | Lecture                         | Green<br>Board        |
| 5.2                     | Circulation of Blood  | 5             | Chalk & Talk                    | Green Board           |
| 5.3                     | Vascular pump and cardiac rhythms   | 5             | Chalk & Talk                    | Green Board           |
| 5.4                     | Blood flow and blood pressure   | 5             | Chalk & Talk                    | Green Board           |
| <b>Total</b>            |   | <b>90 hrs</b> |                                 |                       |

### E-Resources

<https://www.slideshare.net/LubnaAbuAlRub/gas-exchange-51235082>

<https://www.slideshare.net/PrakashYadav3/introduction-to-endocrine-physiology-mbbs-bds-2nd-yr>

<https://youtu.be/gHOJQmYFW1A>

<https://youtu.be/sBZcQ6ISbpU>

<https://www.slideshare.net/rajud521/mechanism-of-muscle-contractionneural-control>

<https://youtu.be/xamYVINf5Zo>

<https://www.slideshare.net/drhimanshuj/anatomy-and-physiology-of-central-nervous-system-83788041>

<https://www.slideshare.net/BarathiParu/heart-blood-circulation-and-function-of-cardiac-muscles>

<https://youtu.be/KUtwNtWEg8s>

[https://youtu.be/\\_M6pxzax72A](https://youtu.be/_M6pxzax72A)

## DEPARTMENT OF ZOOLOGY

Programme: M.Sc., Zoology, (Under CBCS and LOCF)

(For those students admitted during the Academic Year 2021 - 22 and after)

|  |                          |                         |
|--|--------------------------|-------------------------|
| PART – III : Core Course                         |                          | SEMESTER - III          |
| Course Title: <b>PRINCIPLES OF BIOTECHNOLOGY</b> |                          |                         |
| Course Code: <b>31CT33</b>                       | Hours per week: <b>6</b> | Credits: <b>4</b>       |
| CIA: <b>25 Marks</b>                             | ESE: <b>75 Marks</b>     | Total: <b>100 Marks</b> |

### Preamble

To enable the students to understand the use of molecular tools, techniques and methodology to manipulate the organisms taking consideration of IPR, ethical and safety measures.

### Course Outcomes (CO)

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

| No.  | Course Outcome   | Knowledge Level (according to Bloom's Taxonomy) |
|------|--|---|
| CO 1 | Inculcate knowledge on scenario, safety and social ethical issues on biotechnology and also methods of obtaining patent. | K1, K2 & K5                                     |
| CO 2 | Enable the students to gain the knowledge on various types and actions of molecular enzymes and markers.                 | K2, K4  |
| CO 3 | Understand the cloning and expression vector types and their role in gene therapy  | K3 & K5   |
| CO 4 | Explore the techniques of sequencing and identification of DNA, RNA and proteins and their applications                  | K2, K4 & K5                                     |
| CO 5 | Trace the skills of gene transfer, construction of clones, genomic libraries and their screening strategies.             | K2, K4 & K5                                     |

K1-Remembering K2-Understanding K3-Applying K4- Analyzing K5- Evaluating

### Mapping of CO with PO

|       | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO6 | PLO7 |
|-------|-------|-------|-------|-------|-------|------|------|
| CLO 1 | 3     | -     | 3     | -     | 9     | 3    | 9    |
| CLO 2 | 9     | -     | 3     | 3     | 3     | 3    | 9    |
| CLO 3 | 9     | -     | 3     | 3     | 3     | 3    | 9    |
| CLO 4 | 9     | -     | 3     | 3     | 3     | 3    | 9    |
| CLO 5 | 9     | -     | 3     | 3     | 9     | 3    | 9    |
|       | 39    | -     | 15    | 12    | 27    | 15   | 45   |

### Mapping of CO with PSO

|       | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|-------|-------|-------|-------|-------|-------|
| CLO 1 | -     | -     | 9     | 3     | -     |
| CLO 2 | -     | -     | 9     | 9     | 3     |
| CLO 3 | -     | -     | 9     | 9     | 1     |
| CLO 4 | -     | 9     | 9     | 9     | -     |
| CLO 5 | -     | 3     | 9     | 9     | -     |
|       |       | 12    | 45    | 39    | 4     |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

### Syllabus

**UNIT-I: Principles of Biotechnology (18 Hrs)**  
Present status and scope of biotechnology - current scenario of Indian Biotechnology  
Biosafety- Guidelines for DNA research activity.  
Patents and IPR (Proprietary and patent rights) - WTO-GATT & TRIPS

- Bioethics - Social and Ethical issues- risk management.

- UNIT-II: Molecular Tools– I (18 Hrs)**  
 Restriction endonucleases: types and mode of action  
 Nucleases: exo- and endo-nucleases (DNAses, RNAses)  
 DNA-ligases and DNA modifying enzymes.  
 DNA and RNA markers
- UNIT- III: Molecular Tools -II (18 Hrs)**  
 Cloning and expression vectors: Plasmids, Cosmids, Artificial chromosomes, Shuttle vectors and Phagemids  
 Ti and Ri plasmids: General features and mechanism of DNA transfer,  
 Vectors in human gene therapy (viral and non viral vectors)  
 Identification of Recombinant DNA (Direct and indirect methods)
- UNIT- IV: Techniques (18 Hrs)**  
 Restriction mapping of DNA fragments  
 Nucleic acid blotting techniques: Southern, Northern, Dot and Western blotting  
 DNA sequencing: principles and methods  
 Polymerase chain reaction: Principle and applications / Micro array
- UNIT- V: Gene Cloning and Gene Libraries (18 Hrs)**  
 Methods of gene transfer:  
 cDNA synthesis and genomic libraries  
 Gene cloning strategies  
 Screening strategies: Screening by DNA hybridization and colony hybridization

#### Text Books

- Biotechnology, Satyanarayana, 2010, Books and Allied Pvt Ltd, Kolkata
- Principles of Biotechnology, A.J. Nair, 2007, Lakshmi Publications Pvt Ltd, Bangalore.

#### Reference Books

- H. K. Das 2007. Text Books of Biotechnology, Wiley Precise text books.
- Channarayappa, 2006. Molecular Biotechnology Principles and practices University Press.
- Satyanarayana, U. 2008. Biotechnology, Books and Allied, Kolkata

#### • Pedagogy

- Chalk & Talk, Group Discussion, PPT

#### • Teaching Aids

- Green Board, LCD Projector, Chart models, Interactive White Board

#### • Course Contents and Lecture Schedule

| Module No.                          | Topic  | No. of Lectures | Content Delivery Method | Teaching Aids      |
|-------------------------------------|--|-----------------|-------------------------|--------------------|
| Unit -1 Principles of Biotechnology |  | (18 hrs)        |                         |                    |
| 1.1                                 | Present status and scope of biotechnology              | 1               | Discussion              | Green Board Charts |
| 1.2                                 | Current scenario of Indian Biotechnology               | 3               | Chalk & Talk            | Green Board        |
| 1.3                                 | Biosafety  | 3               | Chalk & Talk            | Green Board        |
| 1.4                                 | Guidelines for DNA research activity                   | 3               | Chalk & Talk            | Green Board        |
| 1.5                                 | Patents and IPR (Proprietary and patent rights)        | 2               | Chalk & Talk            | Green Board        |
| 1.6                                 | WTO-GATT & TRIPS                                       | 3               | Chalk & Talk            | Green Board        |
| 1.7                                 | Bioethics - Social and Ethical issues- risk management | 3               | Chalk & Talk, PPT       | Green Board, LCD   |
| Unit -2 Molecular Tools– I          |  | (18 hrs)        |                         |                    |

|   |   |               |                              |                    |
|---|---|---------------|------------------------------|--------------------|
| 2.1   | Restriction endonucleases: types and mode of action                 | 5             | Lecture                      | Green Board PPT    |
| 2.2   | Nucleases: exo- and endo-nucleases (DNAses, RNAses)                 | 5             | Chalk & Talk PPT             | Green Board        |
| 2.3   | DNA-ligases and DNA modifying enzymes                               | 5             | Chalk & Talk, display models | Green Board, Chart |
| 2.4   | DNA and RNA markers   | 3             | Chalk & Talk, PPT            | Green Board, LCD   |
| <b>Unit -3 Molecular Tools -II (18 hrs)</b>             |   |               |                              |                    |
| 3.1   | Cloning and expression vectors                                      | 3             | Chalk & Talk                 | Green Board        |
| 3.2   | Plasmids, Cosmids, Artificial chromosomes                           | 3             | Chalk & Talk                 | Green Board Chart  |
| 3.3   | Shuttle vectors and Phagemids                                       | 3             | Chalk & Talk                 | Green Board Chart  |
| 3.4   | Ti and Ri plasmids: General features and mechanism of DNA transfer  | 3             | Chalk & Talk                 | Green Board        |
| 3.5   | Vectors in human gene therapy (viral and non-viral vectors)         | 3             | PPT                          | LCD                |
| 3.6   | Identification of Recombinant DNA (Direct and indirect methods)     | 3             | Chalk & Talk                 | Green Board        |
| <b>Unit -4 Techniques (18 hrs)</b>                      |   |               |                              |                    |
| 4.1   | Restriction mapping of DNA fragments                                | 2             | Discussion                   | Smart Board        |
| 4.2   | Nucleic acid blotting techniques: Southern                          | 4             | Chalk & Talk LCD             | Green Board PPT    |
| 4.3   | Northern, Dot and Western blotting                                  | 4             | Chalk & Talk LCD             | Green Board PPT    |
| 4.4   | DNA sequencing: principles and methods                              | 4             | Chalk & Talk LCD             | Green Board PPT    |
| 4.5   | Polymerase chain reaction: Principle and applications / Micro array | 4             | Lecture LCD                  | Green Board PPT    |
| <b>Unit -5 Gene Cloning and Gene Libraries (18 hrs)</b> |   |               |                              |                    |
| 5.1   | Methods of gene transfer: cDNA synthesis and genomic libraries      | 4             | Lecture                      | Green Board        |
| 5.2   | Gene cloning strategies   | 4             | Chalk & Talk                 | Green Board        |
| 5.3   | Screening strategies: Screening by DNA                              | 5             | Chalk & Talk                 | Green Board        |
| 5.4   | hybridization and colony hybridization                              | 5             | Chalk & Talk                 | Green Board        |
| <b>Total</b>  |   | <b>90 hrs</b> |                              |                    |

### E-Resources

- <https://www.biologydiscussion.com/biotechnology/biotechnology-introduction-scope-and-applications-of-biotechnology/11608>
- <https://www.slideshare.net/Brainleague/patents-and-biotechnology-a-presentation-by-dr-kalyan-kankanala-bananaip>
- <https://www.slideshare.net/ranjeetsingh09/patenting-biotechnology-inventions>
- [https://sfvideo.blob.core.windows.net/sitefinity/docs/default-source/biotech-basics/restriction-endonucleases.pdf?sfvrsn=1e563407\\_4](https://sfvideo.blob.core.windows.net/sitefinity/docs/default-source/biotech-basics/restriction-endonucleases.pdf?sfvrsn=1e563407_4)
- <https://www.biologydiscussion.com/dna/dna-markers/dna-markers-definition-properties-and-applications/37972>
- [https://www.youtube.com/watch?v=dGxLy\\_fLcUU](https://www.youtube.com/watch?v=dGxLy_fLcUU)
- [https://www.mlsu.ac.in/econtents/209\\_DNA%20Transfer%20Methods.pdf](https://www.mlsu.ac.in/econtents/209_DNA%20Transfer%20Methods.pdf)

[https://www.powershow.com/viewfl/462ebd-OGRjY/Chapter 5 Screening and Identification of Recombinant Clones powerpoint ppt presentation](https://www.powershow.com/viewfl/462ebd-OGRjY/Chapter_5_Screening_and_Identification_of_Recombinant_Clones_powerpoint_ppt_presentation)  
<https://www.youtube.com/watch?v=G0Jor-8lwAs>  
<https://international.neb.com/applications/dna-amplification-pcr-and-qpcr/rt-pcr-and-cdna-synthesis/cdna-synthesis>



## DEPARTMENT OF ZOOLOGY

Programme: M.Sc., Zoology, (Under CBCS and LOCF)

(For those students admitted during the Academic Year 2021 - 22 and after)

|                               |                   |                  |
|-------------------------------|-------------------|------------------|
| PART – III : Core Practical   |                   | SEMESTER - III   |
| Course Title: PRACTICAL - III |                   |                  |
| Course Code: 31CP34           | Hours per week: 6 | Credits: 3       |
| CIA: 40 Marks                 | ESE: 60 Marks     | Total: 100 Marks |

### Preamble

To enable the students to identify blood groups and its sensitivity, gene isolation, transfer and repair mechanisms, observe identity, transfer, regulations and tests of organ structures, receptors, biomedical instruments and their techniques.

### Course Outcomes (CO)

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

| No.  | Course Outcome   | Knowledge Level (according to Bloom's Taxonomy) |
|------|--|---|
| CO 1 | Identify and demonstrate blood groups, DNA extraction and antibiotic sensitivity test in <i>E.coli</i> .                                 | K1, K2 & K5                                     |
| CO 2 | Observe the human genome project through internet, analyse genome isolation and repair, culture and genetic modification in fruit flies. | K2, K4  |
| CO 3 | Understand the physiological mechanisms and testing of ionic regulations and observe crystals in blood and urine.                        | K3 & K5   |
| CO 4 | Understand principle, structure, working mechanism of biomedical instruments and to observe structure and function of receptors.         | K2, K4 & K5                                     |
| CO 5 | To trace the isolation, identification and application of genetic materials.   | K2, K4 & K5                                     |

K1-Remembering K2-Understanding K3-Applying K4- Analyzing K5- Evaluating

### Mapping of CO with PO

|       | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
|-------|-------|-------|-------|-------|-------|-------|-------|
| CLO 1 | 3     | -     | 3     | -     | 3     | 3     | 3     |
| CLO 2 | 3     | 3     | 3     | 3     | 3     | 3     | 3     |
| CLO 3 | 3     | -     | 3     | 3     | 3     | 3     | 3     |
| CLO 4 | 3     | -     | 1     | -     | 1     | 3     | 9     |
| CLO 5 | 3     | -     | 3     | -     | 3     | 3     | 9     |
|       | 15    | 3     | 13    | 6     | 13    | 15    | 24    |

### Mapping of CO with PSO

|       | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|-------|-------|-------|-------|-------|-------|
| CLO 1 | 3     | 3     | 3     | 9     | 3     |
| CLO 2 | 3     | 3     | 9     | 3     | 3     |
| CLO 3 | 3     | 9     | 9     | 3     | 1     |
| CLO 4 | 3     | 3     | 9     | 3     | 1     |
| CLO 5 | 3     | 9     | 9     | 3     | 1     |
|       | 15    | 27    | 39    | 21    | 9     |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

### Syllabus

#### GENETICS

2hrs/week

(12 Hrs)

1. Genes in population- A survey of blood group alleles in a population.
2. DNA extraction (demonstration).
3. Antibiotic sensitivity test in *E.coli*. (demonstration).

4. Observation of Human Genome project through internet
5. Culture of *Drosophila* and observation of variations

**Spotters:**

- a. Griffith experiment on recombination
- b. Frame shift mutation
- c. Photo reactivation
- d. Excision repair
- e. Molecular mechanism of recombination
- f. Bacterial conjugation
- g. Transduction
- h. Transposons
- i. Structure of lambda phage DNA
- j. Microarray
- k. PCR
- l. RFLP

**PHYSIOLOGY**

2hrs/week

1. Crystal studies in blood & urine (any 3 of the following)
  - A) Haemin B) Uric/Urate C) Osazone D) Calcium oxalate E) Leucine/Tyrosine
2. Osmoregulation in earth worm
3. Thermo regulation / water loss analysis in Frog/Slug/Earthworm.
4. Effects of UV/IR radiations on earthworm or silkworm or slug or frog
5. Volumetric analysis of pulmonary ventilation.
6. Study of colour blindness.
7. Study of hearing tests.
8. Observation of circulation in wings of insects.
9. Study of architecture and functional importance (spotter)
  - a) Photoreceptor b) Phono receptor c) Tango receptor d) Olfactory receptor
  - e) Thermo receptor f) Proprioceptor g) Chemo receptor h) Buccal receptor
  - i) Mechano receptor j) Thigmo receptor
- 10 Visit to a hospital laboratory for the observation of ECG, EMG, EEG, ERG, EOG, SCAN, LASER and Auto analyser

**PRINCIPLES of BIOTECHNOLOGY**

(2hrs/week)

1. Isolation of *E. coli* plasmids (cloning vector) (demonstration only)
2. Isolation of chromosomal DNA from Streptococcus (demonstration only)
3. Demonstration of Immobilisation technique (any one enzyme and measurement of its activity)
4. Techniques
  - a) Typical cloning b) Callus culture c) Hybridization d) Blotting techniques
5. Instruments
  - a) PCR b) Electrophoresis c) UV-Transilluminator

**Pedagogy**

Chalk & Talk, Group Discussion, PPT, Industrial Visit

**Teaching Aids**

Green Board, LCD Projector, Chart models, Interactive White Board

**Course Contents and Lecture Schedule**

| Module No. | Topic  | No. of Practicals | Content Delivery Method             | Teaching Aids             |
|------------|--|-------------------|-------------------------------------|---------------------------|
| 1          | <b>GENETICS</b><br>Genes in population- A survey of blood group alleles in a population. | 2                 | Chalk & Talk<br>Dissection<br>Tools | Green Board<br>Charts     |
| 2          | DNA extraction (demonstration).  | 2                 | Chalk & Talk<br>Dissection          | Green Board<br>Microscope |

|    |   |   | Tools   | Charts  |
|----|---|---|---|---|
| 3  | Antibiotic sensitivity test in <i>E.coli</i> . (demonstration).   | 2 | Chalk & Talk<br>Dissection<br>Tools                           | Green Board<br>Microscope<br>Charts                     |
| 4  | Observation of Human Genome project through internet  | 2 | Chalk & Talk<br>Dissection<br>Tools                           | Green Board<br>Microscope<br>Charts                     |
| 5  | Culture of <i>Drosophila</i> and observation of variations  | 2 | Chalk & Talk<br>Dissection<br>Tools                           | Green Board<br>Microscope<br>Charts                     |
| 6  | <b>Spotters:</b><br>Griffith experiment on recombination<br>Frame shift mutation<br>Photo reactivation<br>Excision repair<br>Molecular mechanism of recombination<br>Bacterial conjugation<br>Transduction<br>Transposons<br>Structure of lambda phage DNA<br>Microarray<br>PCR<br>RFLP | 4 | Software<br>Internet with<br>Wifi<br>and Printed<br>materials | Smart Board<br>Charts<br>Models<br>Laptops and<br>books |
| 7  | <b>Physiology</b><br>Crystal studies in blood & urine (any 3 of the following)<br>A) Haemin B) Uric/Urate C) Osazone D) Calcium oxalate E) Leucine/Tyrosine   | 1 | Discussion  | Green Board   |
| 8  | Osmoregulation in earth worm  | 1 | Discussion  | Green Board   |
| 9  | Thermo regulation / water loss analysis in Frog/Slug/Earthworm  | 1 | Chalk & Talk<br>Discussion                                    | Preserved<br>animalcules<br>and slides                  |
| 10 | Effects of UV/IR radiations on earthworm or silkworm or slug or frog  | 1 | Chalk & Talk<br>Discussion                                    | Preserved<br>animalcules<br>and slides                  |
| 11 | Demonstration of photosynthesis   | 1 | Chalk & Talk<br>Discussion                                    | Preserved<br>animals and<br>slides                      |
| 12 | Demonstration of Plasmolysis  | 1 | Chalk & Talk<br>Discussion                                    | Preserved<br>animals and<br>slides                      |
| 13 | Volumetric analysis of pulmonary ventilation.   | 1 | Chalk & Talk<br>Discussion                                    | Preserved<br>animals and<br>slides                      |
| 14 | Study of vision tests.  | 4 | Discussion<br>PPT<br>Photographs                              | Live farms and<br>demonstration                         |
| 15 | Study of hearing tests.   | 2 | Chalk & Talk<br>Dissection<br>Tools                           | Green Board<br>Microscope<br>Charts                     |
| 16 | Observation of circulation in wings of insects.   | 2 | Chalk & Talk<br>Dissection<br>Tools                           | Green Board<br>Microscope<br>Charts                     |
| 17 | 11. Study of architecture and functional  | 5 | Software  | Smart Board   |

|    |   |           |                    |                             |
|----|---|-----------|--------------------|-----------------------------|
|    | importance (spotter)<br>a) Photoreceptor    b) Phono receptor<br>c) Tango receptor    d) Olfactory receptor<br>e) Thermo receptor    f) Proprioceptor<br>g) Chemo receptor    h) Buccal receptor<br>i) Mechano receptor    j) Thigmo receptor |           | Internet with Wifi | Charts<br>Models<br>Laptops |
| 18 | 12) Visit to a hospital laboratory for the observation of<br>ECG, EMG, EEG, ERG, EOG, SCAN, LASER and Auto analyser   | 4         | Discussion         | Green Board                 |
| 19 | <b>Principles of Biotechnology</b><br>Isolation of <i>E .coli</i> plasmids (cloning vector) (demonstration only)  | 4         | Chalk & Talk       | Green Board                 |
| 20 | Isolation of chromosomal DNA from <i>Streptococcus</i> (demonstration only)   | 4         | Chalk & Talk       | Green Board                 |
| 21 | Demonstration of Immobilisation technique (any one enzyme and measurement of its activity)  | 4         | Chalk & Talk       | Green Board                 |
| 22 | Techniques a) Typical cloning b) Callus culture c) Hybridization d) Blotting techniques   | 4         | Chalk & Talk       | Green Board                 |
| 23 | Instruments a) PCR b) Electrophoresis c) UV-Illuminator   | 4         | Discussion         | Green Board                 |
|    | <b>Total</b>  | <b>60</b> |                    |                             |

## DEPARTMENT OF ZOOLOGY

Programme: M.Sc., Zoology, (Under CBCS and LOCF)

(For those students admitted during the Academic Year 2021 - 22 and after)

|                                      |                   |                  |
|--------------------------------------|-------------------|------------------|
| PART – III : Generic Elective Course |                   | SEMESTER - III   |
| Course Title: ECONOMIC ZOOLOGY       |                   |                  |
| Course Code: 31GE31                  | Hours per week: 6 | Credits: 5       |
| CIA: 25 Marks                        | ESE: 75 Marks     | Total: 100 Marks |

### Preamble

Students are enabled to entrepreneurial practices through various animal culture techniques of vermiculture, apiculture, sericulture, Pisciculture and dairy farming.

### Course Outcomes (CO)

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

| No.  | Course Outcome  | Knowledge Level (according to Bloom's Taxonomy) |
|------|---|---|
| CO 1 | Acquire knowledge on characteristics, biology, process and applications of earthworms in organic farming.                             | K1, K2 & K5                                     |
| CO 2 | Understand the knowledge on races of honey bee, bionomics, bee keeping methods, diseases and its products and economic importance.    | K2, K4  |
| CO 3 | Impart knowledge on moriculture, types and biology of silkworm, rearing methods and diseases.   | K3 & K5   |
| CO 4 | Obtain knowledge on biology, characteristics and disease of Indian major carps, Ornamental fishes and artificial spawning techniques. | K2, K4 & K5                                     |
| CO 5 | Trace the deeper knowledge on characteristics, feeding and breeding methods of dairy.   | K2, K4 & K5                                     |

K1-Remembering K2-Understanding K3-Applying K4- Analyzing K5- Evaluating

### Mapping of CO with PO

|       | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
|-------|-------|-------|-------|-------|-------|-------|-------|
| CLO 1 | 3     | -     | 3     | 3     | 3     | 3     | 3     |
| CLO 2 | 3     | -     | 3     | 3     | 3     | 3     | 3     |
| CLO 3 | 3     | -     | 3     | 3     | 3     | 3     | 3     |
| CLO 4 | 3     | -     | 3     | 3     | 3     | 3     | 3     |
| CLO 5 | 3     | -     | 3     | 3     | 3     | 3     | 3     |
|       | 15    |       | 15    | 15    | 15    | 15    | 15    |

### Mapping of CO with PSO

|       | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|-------|-------|-------|-------|-------|-------|
| CLO 1 | 3     | 1     | -     | 3     | 9     |
| CLO 2 | 1     | -     | 3     | 9     | 9     |
| CLO 3 | 1     | -     | 3     | 9     | 9     |
| CLO 4 | 1     | -     | 3     | 9     | 9     |
| CLO 5 | 1     | -     | 3     | 9     | 9     |
|       | 7     | 1     | 12    | 39    | 45    |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

### Syllabus

|                |  |                 |
|----------------|--|-----------------|
| <b>UNIT-I:</b> | <b>Vermiculture</b><br>Vermiculture – Introduction – General morphology of earthworm – biology of <i>Eisenia foetida</i> – Process of vermicomposting ( bedding, layering and watering) – harvesting – vermicast – vermish – Role of | <b>(15 Hrs)</b> |
|----------------|--|-----------------|

|                   |   |                 |
|-------------------|---|-----------------|
|                   | vermitechnology in organic farming  |                 |
| <b>UNIT-II:</b>   | <b>Apiculture</b><br>Apiculture - Honey bee – Species of honey bees – life cycle – methods of bee keeping – bee enemies - Nutritive and medicinal value of honey and economic importance of bee wax – bee venom   | <b>(12 Hrs)</b> |
| <b>UNIT- III:</b> | <b>Sericulture</b><br>Sericulture - Scope of sericulture - Moriculture – morphology of mulberry plant – methods of propagation – classification of silkworm – mulberry and non-mulberry – life cycle of <i>Bombyx mori</i> – rearing of silkworms – diseases and control measures (Grasserie, Muscardine, Flacherie and Pebrine)  | <b>(15 Hrs)</b> |
| <b>UNIT- IV:</b>  | <b>Pisciculture</b><br>Scope of Pisciculture - Characteristics of culturable fishes - Biology of Indian Major Carps – Induced spawning technique – Ornamental fish culture – Introduction – common ornamental fishes ( Gold fish, blackmolly and guppy) – construction of fish tank – water quality management – diseases and control measures (white spot and gill rot)          | <b>(15 Hrs)</b> |
| <b>UNIT- V:</b>   | <b>Dairy Farming</b><br>Dairy farming – Scope - common cattle breeds – Jersey, Holstein Friesian, Murrah, Surti, Jamunapari and Malabari – management of a model dairy farm – artificial insemination – diseases and control measures (Foot and Mouth Disease and Mastitis) – Nutritive value of milk – milk products – milk powder, curd, buttermilk, ghee, cheese and ice cream | <b>(15 Hrs)</b> |

#### Text Books

- Arumugam , N, 2017. Applied Zoology, Saras Publications, Nagercoil
- Seetha Lekshmy, M and Santhi, R 2014, Vermitechnology, Saras Publications, Nagercoil

#### Reference Books

- Shukla and Upadhyay 2015. Economic zoology, Rastogi publications, Meerut
- G.Ganga and J. Sulochana Chetty 2006. An introduction to Sericulture– Oxford and IBH Pub. Co. Pvt.Ltd, New Delhi
- G.C.Banerjee, 2012. A Text Book of Animal Husbandary, Oxford & IBH Publishing Co. Pvt.Ltd, New Delhi
- V.G.Jhingram 1983. Fish and Fisheries of India, Hindustan Publishing Corporation (India) New Delhi.

#### Pedagogy

- Chalk & Talk, Group Discussion, PPT

#### Teaching Aids

- Green Board, LCD Projector, Chart models, Interactive White Board

#### Course Contents and Lecture Schedule

| Module No.              | Topic   | No. of Lectures | Content Delivery Method | Teaching Aids      |
|-------------------------|---|-----------------|-------------------------|--------------------|
| Unit -1 Vermitechnology |   | (15 hrs)        |                         |                    |
| 1.1                     | Introduction- General morphology of earthworm                             | 3               | Discussion              | Green Board Charts |
| 1.2                     | biology of <i>Eisenia foetida</i>   | 3               | Chalk & Talk            | Green Board        |
| 1.3                     | Process of vermicomposting ( bedding, layering and watering) – harvesting | 3               | Chalk & Talk            | Green Board        |
| 1.4                     | Vermicast and Vermiwash   | 3               | Chalk & Talk            | Green Board        |
| 1.5                     | Role of vermitechnology in organic farming                                | 3               | Chalk & Talk            | Green Board        |

| Unit -2 Apiculture (12 hrs)    |  |               |                              |                    |
|--------------------------------|--|---------------|------------------------------|--------------------|
| 2.1                            | Apiculture - Honey bee – Species of honey bees   | 3             | Lecture                      |                    |
| 2.2                            | life cycle of bees   | 2             | Chalk & Talk                 | Green Board        |
| 2.3                            | Methods of bee keeping and bee enemies   | 3             | Chalk & Talk, display models | Green Board, Chart |
| 2.4                            | Nutritive and medicinal value of honey   | 2             | Chalk & Talk, PPT            | Green Board, LCD   |
| 2.5                            | Economic importance of bee wax and bee venom   | 2             | Chalk & Talk, PPT            | Green Board, LCD   |
| Unit -3 Sericulture (15 hrs)   |  |               |                              |                    |
| 3.1                            | Sericulture - Scope of sericulture   | 2             | Chalk & Talk                 | Green Board        |
| 3.2                            | Moriculture – morphology of mulberry plant – methods of propagation  | 3             | Chalk & Talk                 | Green Board        |
| 3.3                            | Classification of silkworm – mulberry and non-mulberry   | 3             | Chalk & Talk                 | Green Board        |
| 3.4                            | Life cycle of <i>Bombyx mori</i> – rearing of silkworms  | 4             | Chalk & Talk                 | Green Board        |
| 3.5                            | Diseases and control measures (Grasserie, Muscardine, Flacherie and Pebrine)                                     | 3             | PPT                          | LCD                |
| Unit -4 Pisciculture (15 hrs)  |  |               |                              |                    |
| 4.1                            | Scope of Pisciculture - Characteristics of culturable fishes   | 2             | Discussion                   | Smart Board        |
| 4.2                            | Biology of Indian Major Carps – Induced spawning technique   | 4             | Chalk & Talk                 | Green Board        |
| 4.3                            | Ornamental fish culture – Introduction – common ornamental fishes ( Gold fish, blackmolly and guppy)             | 3             | Chalk & Talk                 | Green Board        |
| 4.4                            | Construction of fish tank – water quality management   | 3             | Chalk & Talk                 | Green Board        |
| 4.5                            | Diseases and control measures (white spot and gill rot)  | 3             | Chalk & Talk                 | Green Board        |
| Unit -5 Dairy farming (15 hrs) |  |               |                              |                    |
| 5.1                            | Dairy farming – Scope - common cattle breeds – Jersey, Holstein Friesian, Murrah, Surti, Jamunapari and Malabari | 3             | Lecture                      | Green Board        |
| 5.2                            | Management of a model dairy farm – artificial insemination   | 3             | Chalk & Talk                 | Green Board        |
| 5.3                            | Diseases and control measures (Foot and Mouth Disease and Mastitis)  | 3             | Chalk & Talk                 | Green Board        |
| 5.4                            | Nutritive value of milk  | 3             | Chalk & Talk                 | Green Board        |
| 5.5                            | Milk products – milk powder, curd, buttermilk, ghee, cheese and ice cream  | 3             | Chalk & Talk                 | Green Board        |
| <b>Total</b>                   |  | <b>72 hrs</b> |                              |                    |

### E-Resources

<https://www.slideshare.net/sudharajput/vermicomposting-47669414>

<https://www.slideshare.net/safeermanhas/apiculture-95442492>

<https://www.studyandscore.com/studymaterial-detail/apiculture-introduction-bee-colony-and-bee-dance>

<https://www.youtube.com/watch?v=9LpDTMkyblo> (Life cycle of Silkworm)

[https://www.shcollege.ac.in/wp-content/uploads/NAAC\\_Documents\\_IV\\_Cycle/Criterion-II/2.3.2/ppt/Ms\\_LeenaRaphael\\_Inducedbreeding.pdf](https://www.shcollege.ac.in/wp-content/uploads/NAAC_Documents_IV_Cycle/Criterion-II/2.3.2/ppt/Ms_LeenaRaphael_Inducedbreeding.pdf)

## DEPARTMENT OF ZOOLOGY

Programme: M.Sc., Zoology, (Under CBCS and LOCF)

(For those students admitted during the Academic Year 2021 - 22 and after)

|  |                          |                         |
|--|--------------------------|-------------------------|
| PART – III : Core Course                   |                          | SEMESTER - IV           |
| Course Title: <b>APPLIED BIOTECHNOLOGY</b> |                          |                         |
| Course Code: <b>31CT41</b>                 | Hours per week: <b>6</b> | Credits: <b>5</b>       |
| CIA: <b>25 Marks</b>                       | ESE: <b>75 Marks</b>     | Total: <b>100 Marks</b> |

### Preamble

To explore the knowledge on biotechnology in human, animal, plant and nanoscience technology. Create awareness, conservation and remedial management of environment.

### Course Outcomes (CO)

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

| No.  | Course Outcome   | Knowledge Level (according to Bloom's Taxonomy) |
|------|--|---|
| CO 1 | Enhance knowledge on molecular biotechnological approaches and biomaterials in human diseases, diagnosis, therapy and treatment. | K1, K2 & K5                                     |
| CO 2 | Develop knowledge on animal reproduction, alternative techniques including stem cells and cloning.                               | K2, K4  |
| CO 3 | Acquire cloning knowledge on the applications of plant tissue culture, GM food, bio insecticides and bio fertilizers.            | K3 & K5   |
| CO 4 | Trace the properties, characteristics, synthesis and applications of Nano particles.   | K2, K4 & K5                                     |
| CO 5 | Create application knowledge on waste management, remediation techniques and bioenergy productions.                              | K2, K4 & K5                                     |

**K1-Remembering K2-Understanding K3-Applying K4- Analyzing K5- Evaluating**

### Mapping of CO with PO

|       | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO6 | PLO7 |
|-------|-------|-------|-------|-------|-------|------|------|
| CLO 1 | 9     | -     | 3     | 3     | 3     | 3    | 9    |
| CLO 2 | 9     | -     | 3     | 1     | 9     | 3    | 3    |
| CLO 3 | 3     | -     | 3     | 3     | 9     | 9    | 9    |
| CLO 4 | 9     | -     | 3     | 3     | 3     | 3    | 9    |
| CLO 5 | 9     | -     | 3     | 3     | 3     | 9    | 3    |
|       | 39    |       | 15    | 13    | 27    | 27   | 35   |

### Mapping of CO with PSO

|       | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|-------|-------|-------|-------|-------|-------|
| CLO 1 | -     | 3     | 9     | 9     | -     |
| CLO 2 | 1     | 9     | 9     | 3     | 3     |
| CLO 3 | 1     | 9     | 9     | 3     | 9     |
| CLO 4 | -     | 1     | 9     | 9     | 3     |
| CLO 5 | -     | -     | 3     | 9     | 9     |
|       | 2     | 22    | 39    | 33    | 24    |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

### Syllabus

#### UNIT-I: Human / Medical Biotechnology

(18 Hrs)

Molecular Medicine- Molecular analysis of human diseases

Gene therapy, molecular diagnostics- monoclonal antibodies production and its application- vaccines.

Tissue engineering- Types of biomaterials and their applications



Advances in drug targeting and therapy-virulence factors as drug targets

**UNIT-II: Animal Biotechnology (18 Hrs)**

Manipulation of reproduction in animals - Artificial Insemination, Embryo transfer, *In vitro* fertilization. Embryo cloning.

Transgenic methods - Retro viral vector- Microinjection- Electroporation

Engineered embryonic stem cells

Cloning by nuclear transfer- Somatic cell nuclear transfer (SCNT)- YAC- transgenesis

**UNIT- III: Plant Biotechnology (18 Hrs)**

Techniques of plant cell and tissue culture and their application

Genetic engineering in plants, germplasm storage and GM food

Bioinsecticides – *Bacillus thuringiensis* - Types and applications

Biofertilizers - Azolla and Vesicular Arbuscular Mycorrhiza - Types and applications

**UNIT- IV: Nanobiotechnology (18 Hrs)**

Scope - Properties of nanoparticles

Strategies for nanoparticle synthesis (Physical, Chemical and Biological)

Characteristics of nanoparticles

Applications of nanobiotechnology in medicine – drug designing

**UNIT- V: Environmental Biotechnology (18 Hrs)**

Sewage and waste: Principles of conventional and modern treatment methods

Solid waste management

Bioremediation technologies: Principles involved in bioconversion, biotransformation, biodegradation, biodeterioration, biorecovery, biomining, bioleaching and oil recovery.

Bioenergy: Bioenergy Park, Biodiesel and Biogas production

**Text Books**

- Satyanarayana, 2010. Biotechnology, Books and Allied Pvt Ltd, Kolkata
- A.J. Nair, 2007. Principles of Biotechnology, Lakshmi Publications Pvt Ltd, Bangalore

**Reference Books**

- Mohan P. Arora, 2003. Biotechnology, Himalaya publishing house.
- Ratledge C. and Kristiansen B. 2001. Basic Biotechnology, Cambridge University.
- Barnum S.R.2003. Biotechnology an Introduction, Thomson Books / cole- Australia.
- D. Bourgaize 2003. Biotechnology, Pearson education Singapore

**Pedagogy**

- Chalk & Talk, Group Discussion, PPT

**Teaching Aids**

- Green Board, LCD Projector, Chart models, Interactive White Board

**Course Contents and Lecture Schedule**

| Module No.                  | Topic   | No. of Lectures | Content Delivery Method | Teaching Aids      |
|-----------------------------|---|-----------------|-------------------------|--------------------|
| Unit -1 Human Biotechnology |   | (18 hrs)        |                         |                    |
| 1.1                         | Molecular Medicine- Molecular analysis of human diseases                                  | 3               | Discussion              | Green Board Charts |
| 1.2                         | Gene therapy, molecular diagnostics- monoclonal antibodies production and its application | 5               | Chalk & Talk            | Green Board        |
| 1.3                         | Tissue engineering- Types of biomaterials and their applications                          | 5               | Chalk & Talk            | Green Board        |

|   |  |               |                              |                    |
|---|--|---------------|------------------------------|--------------------|
| 1.4   | Advances in drug targeting and therapy- virulence factors as drug targets - vaccines                 | 5             | Chalk & Talk                 | Green Board        |
| <b>Unit -2 Animal Biotechnology (18 hrs)</b>        |  |               |                              |                    |
| 2.1   | Manipulation of reproduction in animals - Artificial Insemination                                    | 3             | Lecture                      |                    |
| 2.2   | Embryo transfer, <i>In vitro</i> fertilization. Embryo cloning                                       | 5             | Chalk & Talk                 | Green Board        |
| 2.3   | Transgenic methods - Retro viral vector- Microinjection- Electroporation                             | 5             | Chalk & Talk, display models | Green Board, Chart |
| 2.4   | Engineered embryonic stem cells Cloning by nuclear transfer- YAC-transgenesis                        | 5             | Chalk & Talk, PPT            | Green Board, LCD   |
| <b>Unit -3 Plant Biotechnology (18 hrs)</b>         |  |               |                              |                    |
| 3.1   | Techniques of plant cell and tissue culture and their application                                    | 3             | Chalk & Talk                 | Green Board        |
| 3.2   | Genetic engineering in plants, germplasm storage and GM food   | 5             | Chalk & Talk                 | Green Board        |
| 3.3   | Bioinsecticides – Types and applications   | 5             | Chalk & Talk                 | Green Board        |
| 3.4   | Biofertilizers - Types and applications  | 5             | Chalk & Talk                 | Green Board        |
| <b>Unit -4 Nanobiotechnology (18 hrs)</b>           |  |               |                              |                    |
| 4.1   | Scope - Properties of nanoparticles  | 3             | Discussion                   | Smart Board        |
| 4.2   | Strategies for nanoparticle synthesis (Physical, Chemical and Biological)                            | 5             | Chalk & Talk                 | Green Board        |
| 4.3   | Characteristics of nanoparticles   | 5             | Chalk & Talk                 | Green Board        |
| 4.4   | Applications of nanobiotechnology in medicine – drug designing                                       | 5             | Chalk & Talk                 | Green Board        |
| <b>Unit -5 Environmental Biotechnology (18 hrs)</b> |  |               |                              |                    |
| 5.1   | Sewage and waste: Principles of conventional and modern treatment methods                            | 2             | Lecture                      | Green Board        |
| 5.2   | Solid waste management   | 4             | Chalk & Talk                 | Green Board        |
| 5.3   | Bioremediation technologies: Principles involved in bioconversion, biotransformation, biodegradation | 4             | Chalk & Talk                 | Green Board        |
| 5.4   | Biodeterioration, biorecovery, biomining, leaching and oil recovery                                  | 4             | Chalk & Talk                 | Green Board        |
| 5.5   | Bioenergy: Bioenergy Park, Biodiesel and Biogas production   | 4             | Chalk & Talk                 | Green Board        |
| <b>Total</b>  |  | <b>90 hrs</b> |                              |                    |

### E-Resources

<https://www.slideshare.net/NotiManusha/monoclonal-antibodies-142624850>

<https://www.slideshare.net/SaumyaPandey7/characteristics-of-the-biomaterials-for-tissue-engineering-application>

<https://www.slideshare.net/KaraboHopeMdaka/humanreproductionsacha-130722032329phpapp01140307035250phpapp02-111504258>

<https://youtu.be/KZOW-BsIcdU>

<https://www.slideshare.net/selvarajselva1/plant-tissue-culture-techniques-232261528>

<https://www.slideshare.net/NiharikaSrivastava22/biofertilizers-74669497>

<https://www.slideshare.net/RameshPandi4/applications-of-nanobiotechnology-in-medicine>

<https://www.slideshare.net/RameshPandi4/production-of-biogas>

<https://youtu.be/eIXyQVmuBDs>

<https://www.slideshare.net/Haddies/solid-waste-management-55730939>

## DEPARTMENT OF ZOOLOGY

Programme: M.Sc., Zoology, (Under CBCS and LOCF)

(For those students admitted during the Academic Year 2021 - 22 and after)

|                                     |                   |                  |
|-------------------------------------|-------------------|------------------|
| PART – III : Core Course            |                   | SEMESTER - IV    |
| Course Title: ENVIRONMENTAL BIOLOGY |                   |                  |
| Course Code: 31CT42                 | Hours per week: 6 | Credits: 5       |
| CIA: 25 Marks                       | ESE: 75 Marks     | Total: 100 Marks |

### Preamble

Enable the students to enhance knowledge on environmental organisation, resources, repercussion, reclamations and improvement. To make awareness on role and responsibilities of government, national and international bodies.

### Course Outcomes (CO)

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

| No.  | Course Outcome   | Knowledge Level (according to Bloom's Taxonomy) |
|------|--|---|
| CO 1 | Acquire knowledge on concepts and dynamics of ecosystem, biodiversity and its conservation methods.                          | K1, K2 & K5                                     |
| CO 2 | Impart knowledge on origin and status of natural resources, conservations, deterioration effects and its alternate remedies. | K2, K4  |
| CO 3 | Enhance the knowledge on toxicants, effects, radioactive materials, nuclear reactors, its hazards and remedies.              | K3 & K5   |
| CO 4 | Explore the concepts of dwelling structures, characteristics of human in rural, urban, slum and in space.                    | K2, K4 & K5                                     |
| CO 5 | Understanding concision on environment through education programmes, laws, national and international bodies.                | K2, K4 & K5                                     |

K1-Remembering K2-Understanding K3-Applying K4- Analyzing K5- Evaluating

### Mapping of CO with PO

|       | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO6 | PLO7 |
|-------|-------|-------|-------|-------|-------|------|------|
| CLO 1 | 3     | -     | 3     | 3     | 3     | 9    | 9    |
| CLO 2 | 3     | -     | 3     | 3     | 3     | 9    | 9    |
| CLO 3 | 9     | -     | 3     | 3     | 3     | 9    | 9    |
| CLO 4 | 9     | -     | 3     | 3     | 3     | 3    | 3    |
| CLO 5 | 9     | 3     | 3     | 3     | 3     | 3    | 3    |
|       | 33    | 3     | 15    | 15    | 15    | 33   | 33   |

### Mapping of CO with PSO

|       | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|-------|-------|-------|-------|-------|-------|
| CLO 1 | 9     | -     | 1     | 9     | 1     |
| CLO 2 | 1     | 3     | 3     | 9     | -     |
| CLO 3 | 1     | 3     | 3     | 9     | 1     |
| CLO 4 | 3     | 1     | -     | 9     | 3     |
| CLO 5 | 3     | -     | -     | 9     | 3     |
|       | 17    | 7     | 7     | 45    | 8     |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

### Syllabus

UNIT-I: Ecosystem and Bio-geochemical Cycles (18 Hrs)

**Concept and dynamics of Ecosystem.** Components and process of Ecosystem – Food chain – food web - trophic levels – Energy flow - Productivity-Ecological energetics– Trophic structure and ecological pyramids.  
Biogeo chemical cycles and Limiting factors – Principles and

concepts– Leibigs law and Shelfords law of maximum

### **Community and Biodiversity**

Biotic community – Concept – structure and composition- community and stability- concept of ecological niche - Ecological succession.

Biodiversity- measures of diversity- species richness- Evenness - Endangered species – Bioindicators and their role in Environmental monitoring – Remote sensing.

Biodiversity conservation –Methods of conservation - (*in situ* and *ex-situ*) - germplasm conservation –Economic evaluation of Biodiversity – Intellectual property rights - Documentation of Biodiversity

#### **UNIT-II: Economic Ecology and Field Biology (18 Hrs)**

Basic facts of conservation of natural resources- Natural resources – Impact of civilization on sustainable development – Soil erosion and soil conservation – Water resources- Conservation – Rain water Harvesting – Forest conservation .

Monsoon – its origin – Kinds – Its impact on Indian peninsula.

Non-conventional energy resources.

#### **UNIT- III: Environment toxicology and Radiation Ecology (18 Hrs)**

Basic concepts of toxicology – Sources of toxicants (air, water, soil – Brief account) Toxicological testing methods- Toxicants of public health hazard- xenobiotics

Radiation ecology and environment:-

Radioactivity- Nuclear radiations- Half-life period-  $E=mc^2$  – Safety hazards of the nuclear power plants – Radioactive fallout problems – Disposal of radioactive wastes- Biological effects of nuclear radiations.

#### **UNIT- IV: Demography and Urban ecology (18 Hrs)**

History of human population growth- Population explosion – social impacts and ecological implications- Population control .

Urban ecology – History and development of urbanization Formation of urban areas- central business district – satellite towns – Impact of transport systems on urban environment – Housing – Slums its nature- Characteristics and problems on urban environment – drainage and storm water drainage.

Space ecology – Life supporting system.

#### **UNIT- V: Environmental Education and Organization (18 Hrs)**

Goals, objectives and principles of environmental education – Environmental education programmes-Environmental education in India –Environmental laws – role of pollution control board. An account of Natural calamities (Flood, earth quake, forest fire, volcanoes, cyclones and tsunami)

International bodies- Man and Biosphere Programmes (MAB) – Paris submit - National organization – Department of environment , forest and wild life – A list of important of Environmental agencies

### **Text Books**

- Eugene P.Odum 1971. Fundamentals of ecology wb. Saunders Co.

### **Reference Books**

- Jonathan Turk and Amas Turk. 1988. Environmental science, Saunder's college publishing, Philadelphia.
- Trivedi P.R. and Gurdeep Raj 1992. Encyclopaedia of Environmental sciences, Vol. 1 to Vol. 25 Akeshdeep publishing house New Delhi.
- Micheal Begon 1996. Ecology, Blackwell science, Oxford.
- Gupta P.K and D.K Salunka 1985. Modern Toxicology, Vol. 1 to 3 - Metropolitan book co. New Delhi.
- Robert Leo Smith 1990. Ecology and field biology- Harper Collins. Pub New York.

- **Pedagogy**
- Chalk & Talk, Group Discussion, PPT
- **Teaching Aids**
- Green Board, LCD Projector, Chart models, Interactive White Board
- **Course Contents and Lecture Schedule**

| Module No.              | Topic   | No. of Lectures | Content Delivery Method         | Teaching Aids         |
|-------------------------|---|-----------------|---------------------------------|-----------------------|
| <b>Unit -1 (18 hrs)</b> |   |                 |                                 |                       |
| 1.1                     | <b>Ecosystem and Bio-geochemical cycles</b><br><b>Concept and dynamics of Ecosystem</b>   | 1               | Discussion                      | Green Board<br>Charts |
| 1.2                     | Components and process of Ecosystem – Food chain – food web - trophic levels – Energy flow - Productivity-Ecological energetics– Trophic structure and ecological pyramids. | 3               | Chalk & Talk                    | Green Board           |
| 1.3                     | Biogeochemical cycles and Limiting factors – Principles and concepts– Leibigs law and Shelford's law of maximum   | 3               | Chalk & Talk                    | Green Board           |
| 1.4                     | <b>Community and Biodiversity</b><br>Biotic community – Concept – structure and composition- community and stability- concept of ecological niche - Ecological succession   | 3               | Chalk & Talk                    | Green Board           |
| 1.5                     | Biodiversity- measures of diversity- species richness- Evenness - Endangered species – Bioindicators and their role in Environmental monitoring – Remote sensing            | 2               | Chalk & Talk                    | Green Board           |
| 1.6                     | Biodiversity conservation –Methods of conservation - (in situ and ex-situ) - germplasm conservation   | 3               | Chalk & Talk                    | Green Board           |
| 1.7                     | Economic evaluation of biodiversity – Intellectual property rights - documentation of Biodiversity  | 3               | Chalk & Talk,<br>PPT            | Green Board,<br>LCD   |
| <b>Unit -2 (18 hrs)</b> |   |                 |                                 |                       |
| 2.1                     | <b>Economic ecology and Field biology</b><br>Basic facts of conservation of natural resources- Natural resources  | 3               | Lecture                         |                       |
| 2.2                     | Impact of civilization on sustainable development – Soil erosion and soil conservation  | 3               | Chalk & Talk                    | Green Board           |
| 2.3                     | Water resources- Conservation – Rain water harvesting   | 3               | Chalk & Talk,<br>display models | Green Board,<br>Chart |
| 2.4                     | Forest conservation   | 3               | Chalk & Talk,<br>PPT            | Green Board,<br>LCD   |
| 2.5                     | Monsoon – its origin – Kinds – Its impact on Indian peninsula   | 3               | Chalk & Talk,<br>PPT            | Green Board,<br>LCD   |
| 2.6                     | Non-conventional energy resources   | 3               | Chalk & Talk,<br>PPT            | Green Board,<br>LCD   |
| <b>Unit -3 (18 hrs)</b> |   |                 |                                 |                       |
| 3.1                     | <b>Environment toxicology and Radiation ecology</b><br>Basic concepts of toxicology – Sources of toxicants (air, water, soil – Brief account)                               | 4               | Chalk & Talk                    | Green Board           |
| 3.2                     | Toxicological testing methods- Toxicants of   | 5               | Chalk & Talk                    | Green Board           |

|                         |  |               |              |             |
|-------------------------|--|---------------|--------------|-------------|
|                         | public health hazard- xenobiotics  |               |              |             |
| 3.3                     | Radiation ecology and environment:-<br>Radioactivity- Nuclear radiations- Half life<br>period- $E=mc^2$  | 3             | Chalk & Talk | Green Board |
| 3.4                     | Safety hazards of the nuclear power plants –<br>Radioactive fallout problems   | 3             | Chalk & Talk | Green Board |
| 3.5                     | Disposal of radioactive wastes- Biological<br>effects of nuclear radiations  | 3             | PPT          | LCD         |
| <b>Unit -4 (18 hrs)</b> |  |               |              |             |
| 4.1                     | <b>Demography and Urban ecology</b><br>Population ecology of man- History of human<br>population growth- Population explosion –<br>social impacts and ecological implications-<br>Population control | 5             | Discussion   | Smart Board |
| 4.2                     | Urban ecology – History and development of<br>urbanization - Formation of urban areas-<br>central business district – satellite towns  | 5             | Chalk & Talk | Green Board |
| 4.3                     | Impact of transport systems on urban<br>environment – Housing – Slums its nature-<br>Characteristics and problems on urban<br>environment – drainage and storm water<br>drainage                     | 5             | Chalk & Talk | Green Board |
| 4.4                     | Space ecology – Life supporting system   | 3             | Chalk & Talk | Green Board |
| <b>Unit -5 (18 hrs)</b> |  |               |              |             |
| 5.1                     | <b>Environmental education and Organization</b><br>Goals, objectives and principles of<br>environmental education – Environmental<br>education programmes-Environmental<br>education in India        | 5             | Lecture      | Green Board |
| 5.2                     | Environmental laws – role of pollution control<br>board. An account of Natural calamities<br>(Flood, earth quake, forest fire, volcanoes,<br>cyclones and tsunami)                                   | 5             | Chalk & Talk | Green Board |
| 5.3                     | International bodies- Man and Biosphere<br>Programmes (MAB) – Paris submit   | 5             | Chalk & Talk | Green Board |
| 5.4                     | National organization – Department of<br>environment , forest and wild life – A list of<br>important of Environmental agencies   | 3             | Chalk & Talk | Green Board |
| <b>Total</b>            |  | <b>90 hrs</b> |              |             |

### E-Resources

<https://www.slideshare.net/GianneErikaGuias/8122418481-environmental-science>

<https://www.slideshare.net/UnbeatableGamer/indian-resource-conservation>

<https://www.slideshare.net/saxenaankit2010/renewable-energy-resources-ncernonconventional-energy-resources>

<https://youtu.be/jSSou9wgBDY>

<https://www.slideshare.net/nagarajdeshaboina1/ugc-locfbotany-drdnr>

<https://www.slideshare.net/mudraabhagat/man-natural-environment>

<https://youtu.be/D4NvywWxcqW>

<https://www.civildaily.com/international-organizations-related-to-environment-conservation>

<https://youtu.be/z0K5pNvnW0>

<https://www.slideshare.net/Vijirayar/environmental-education-ppt-56247070>

## DEPARTMENT OF ZOOLOGY

Programme: M.Sc., Zoology, (Under CBCS and LOCF)

(For those students admitted during the Academic Year 2021 - 22 and after)

|                                     |                          |                         |
|-------------------------------------|--------------------------|-------------------------|
| <b>PART – III : Core Practical</b>  |                          | <b>SEMESTER - IV</b>    |
| <b>Course Title: PRACTICAL - IV</b> |                          |                         |
| <b>Course Code: 31CP44</b>          | <b>Hours per week: 6</b> | <b>Credits: 3</b>       |
| <b>CIA: 40 Marks</b>                | <b>ESE: 60 Marks</b>     | <b>Total: 100 Marks</b> |

### Preamble

Applications of biotechnological methods in entrepreneurial and remedial activities, evaluate environmental parameters and standards, understand the working principles and their outcomes of biofarming technology.

### Course Outcomes (CO)

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

| No.         | Course Outcome   | Knowledge Level (according to Bloom's Taxonomy) |
|-------------|--|---|
| <b>CO 1</b> | Acquire knowledge on bioconversion methods, strategies, products and their importance.   | K1, K2 & K5                                     |
| <b>CO 2</b> | Evaluate structure, quantity, quality of essential biotic and non-biotic parameters in aquatic ecosystems.                                 | K2, K4  |
| <b>CO 3</b> | Estimate and observe quality of essential standards of tolerance of toxic chemicals, density, size and indicators in an ecological region. | K3 & K5   |
| <b>CO 4</b> | Handling, feeding, rearing, testing and maintenance of sericulture, vermiculture and their products.                                       | K2, K4 & K5                                     |
| <b>CO 5</b> | Enhance entrepreneurial knowledge on observation, identification and analysis of honey bees, poultry and fishes.                           | K2, K4 & K5                                     |

**K1-Remembering K2-Understanding K3-Appling K4- Analyzing K5- Evaluating**

### Mapping of CO with PO

|              | <b>PLO 1</b> | <b>PLO 2</b> | <b>PLO 3</b> | <b>PLO 4</b> | <b>PLO 5</b> | <b>PLO6</b> | <b>PLO7</b> |
|--------------|--------------|--------------|--------------|--------------|--------------|-------------|-------------|
| <b>CLO 1</b> | 3            | -            | 3            | 3            | 3            | 3           | 3           |
| <b>CLO 2</b> | 3            | -            | 3            | 3            | 3            | 3           | 3           |
| <b>CLO 3</b> | 9            | -            | 3            | 3            | 3            | 3           | 9           |
| <b>CLO 4</b> | 3            | -            | 3            | 3            | 3            | 3           | 9           |
| <b>CLO 5</b> | 3            | -            | 3            | 3            | 3            | 3           | 9           |
|              | 21           |              | 15           | 15           | 15           | 15          | 33          |

### Mapping of CO with PSO

|              | <b>PSO 1</b> | <b>PSO 2</b> | <b>PSO 3</b> | <b>PSO 4</b> | <b>PSO 5</b> |
|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>CLO 1</b> | 1            | 3            | -            | 1            | 1            |
| <b>CLO 2</b> | 3            | -            | 3            | 1            | 1            |
| <b>CLO 3</b> | 1            | 3            | 3            | 9            | 1            |
| <b>CLO 4</b> | 9            | 1            | 3            | 9            | 9            |
| <b>CLO 5</b> | 9            | 1            | 3            | 9            | 9            |
|              | 23           | 8            | 12           | 29           | 21           |

Note: 8

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

### Syllabus

#### Practical-1 APPLIED BIOTECHNOLOGY

- |   |                                  |
|---|----------------------------------|
| <ol style="list-style-type: none"> <li>1. Installation, operation and maintenance of Bio-gas Plant (visit to biogas Plant)</li> <li>2. Models a) Typical fermenter b) Culture systems – Batch and continuous culture<br/>Trickling filter</li> <li>3. Substrates utilization - a) Starch b) Agricultural waste</li> </ol> | <p><b>(12 Hrs)</b></p> <p>c)</p> |
|---|----------------------------------|

4. Commercially important bio-products a) amino acid b) Lactic acid c) Citric acid d) Ethanol e) Enzyme f) Antibiotics g) Vitamins h) Hormones i) Vaccines
5. Study of composting strategies and Vermicomposting methods

### **Practical- 2 ENVIRONMENTAL BIOLOGY**

1. Study of morphometry of a Fresh water Pond.
2. Estimation of Primary Productivity in a pond using Dark and Light bottle method.
3. Estimation of Calcium and Magnesium in Water Samples.
4. Estimation of Nitrates and Phosphates in Water samples.
5. Qualitative and quantitative Estimation of Plankton in a pond.
6. BOD- Estimation.
7. Estimation of tolerance limits of Pesticides on an organism.
8. Study of Population density in grassland using quadrat method.
9. Observation of Pollution indicator organisms
10. Estimation of Population size in an Imaginary Pond.

### **Practical-3 BIOFARMING TECHNOLOGY**

#### **➤ Practical, demonstration and field visit**

1. Maintenance of mulberry farm – study on the biology of mulberry plant – pests (any five) – Chawki leaves (Tender leaves).
2. Morphology of silkworms – male and female identification in the larva, pupa and adult stages.
3. Rearing of silkworm from disease free laying – harvesting of cocoons
4. Morphology of Earthworm – segmentations – pores – ecotypes
5. Visit to Vermicomposting unit – observation for precomposting – composting
6. Observation of vermicast – Qualitative analysis of vermicast
7. Preparation of vermiwash - Qualitative analysis of vermiwash
8. Study on the identification of Honey bees
9. Study of structure of bee hive - parts
10. Study on the identification of poultry breeds
11. Study on the identification of any three edible fishes (Morphology)
12. Study on the identification of any three ornamental fishes (Morphology)

### **Pedagogy**

Chalk & Talk, Group Discussion, PPT

### **Teaching Aids**

Green Board, LCD Projector, Chart models, Interactive White Board

### **Course Contents and Lecture Schedule**

| Module No. | Topic   | No. of Practicals | Content Delivery Method           | Teaching Aids                       |
|------------|---|-------------------|-----------------------------------|-------------------------------------|
| 1          | <b>Advanced Biotechnology</b><br>Installation, operation and maintenance of Bio-gas Plant (visit to biogas Plant) | 2                 | Chalk & Talk<br>Field visit       | Green Board<br>Charts               |
| 2          | Models a) Typical fermenter b) Culture systems – Batch and continuous culture c) Trickling filter                 | 2                 | Chalk & Talk                      | Green Board<br>Microscope<br>Charts |
| 3          | Substrates a) Starch b) Agricultural waste c) Energy crops  | 2                 | Chalk & Talk                      | Green Board<br>Microscope<br>Charts |
| 4          | Commercially important bio-products<br>a) amino acid b) Lactic acid c) Citric acid                                | 2                 | Chalk & Talk                      | Green Board<br>Microscope<br>Charts |
| 5          | d) Ethanol e) Enzyme f) Antibiotics g) Vitamins h) Hormones i) Vaccines   | 2                 | Chalk & Talk                      | Green Board<br>Microscope<br>Charts |
| 6          | Composting strategies and Vermicomposting methods   | 4                 | Software<br>Internet with<br>Wifi | Smart Board<br>Charts<br>Models     |



|    |  |   |                                     |  |
|----|--|---|-------------------------------------|--|
|    |  |   |                                     | Laptops                                    |
| 7  | <b>Environmental Biology</b><br>Morphometry of a Fresh water Pond.   | 1 | Discussion                          | Green Board                                |
| 8  | Estimation of Primary Productivity in a pond using Dark and Light bottle method.   | 1 | Discussion                          | Green Board                                |
| 9  | Estimation of Calcium and Magnesium in Water Samples.  | 1 | Chalk & Talk<br>Discussion          | Preserved animalcules and slides           |
| 10 | Estimation of Nitrates and Phosphates in Water samples.  | 1 | Chalk & Talk<br>Discussion          | Preserved animalcules and slides           |
| 11 | Qualitative and quantitative Estimation of Planktons in a pond.  | 1 | Chalk & Talk<br>Discussion          | Preserved animals and slides               |
| 12 | BOD- Estimation.   | 1 | Chalk & Talk<br>Discussion          | Preserved animals and slides               |
| 13 | Estimation of tolerance limits of Pesticides on an organism.   | 1 | Chalk & Talk<br>Discussion          | Preserved animals and slides               |
| 14 | Study of Population density in grassland using quadrat method.   | 4 | Discussion<br>PPT<br>Photographs    | Live farms and demonstration               |
| 15 | Observation of Pollution indicator organisms   | 2 | Chalk & Talk<br>Dissection<br>Tools | Green Board<br>Microscope<br>Charts        |
| 16 | Estimation of Population size in an Imaginary Pond.  | 2 | Chalk & Talk<br>Dissection<br>Tools | Green Board<br>Microscope<br>Charts        |
| 17 | <b>Biofarming Technology</b><br>Maintenance of mulberry farm – study on the biology of mulberry plant – pests (any five) – Chawki leaves | 5 | Software<br>Internet with<br>Wifi   | Smart Board<br>Charts<br>Models<br>Laptops |
| 18 | Morphology of silkworms – male and female identification in the larva, pupa and adult stages   | 4 | Discussion                          | Green Board                                |
| 19 | Rearing of silkworm from disease free laying – harvesting of cocoons   | 1 | Chalk & Talk<br>Discussion          | Preserved animals and slides               |
| 20 | Morphology of Earthworm – segmentations – pores – ecotypes   | 1 | Chalk & Talk<br>Discussion          | Preserved animals and slides               |
| 21 | Visit to Vermicomposting unit – observation for precomposting – composting   | 1 | Chalk & Talk<br>Discussion          | Preserved animals and slides               |
| 22 | Observation of vermicast – Qualitative analysis of vermicast   | 1 | Chalk & Talk<br>Discussion          | Preserved animals and slides               |
| 23 | Preparation of vermiwash - Qualitative analysis of vermiwash   | 3 | Chalk & Talk<br>Discussion          | Preserved animals and slides               |
| 24 | Identification of Honey bees   | 1 | Chalk & Talk<br>Discussion          | Preserved animals and slides               |
| 25 | Structure of bee hive - parts  | 1 | Chalk & Talk<br>Discussion          | Preserved animals and                      |

|              |  |           |                            |                                    |
|--------------|--|-----------|----------------------------|------------------------------------|
|              |  |           |                            | slides                             |
| 26           | Identification of poultry breeds                             | 1         | Chalk & Talk<br>Discussion | Preserved<br>animals and<br>slides |
| 27           | Identification of any three edible fishes<br>(Morphology)    | 1         | Chalk & Talk<br>Discussion | Preserved<br>animals and<br>slides |
| 28           | Identification of any three ornamental<br>fishes(Morphology) | 1         | Chalk & Talk<br>Discussion | Preserved<br>animals and<br>slides |
| <b>Total</b> |  | <b>60</b> |                            |                                    |

## DEPARTMENT OF ZOOLOGY

Programme: M.Sc., Zoology, (Under CBCS and LOCF)

(For those students admitted during the Academic Year 2021 - 22 and after)

|  |                          |                         |
|--|--------------------------|-------------------------|
| PART – III : <b>Discipline Specific Elective</b> |                          | SEMESTER - IV           |
| Course Title: <b>BIO-FARMING TECHNOLOGY</b>      |                          |                         |
| Course Code: <b>31DS4A</b>                       | Hours per week: <b>6</b> | Credits: <b>5</b>       |
| CIA: <b>25 Marks</b>                             | ESE: <b>75 Marks</b>     | Total: <b>100 Marks</b> |

### Preamble

Students are enabled to entrepreneurial practices through various animal culture techniques of vermiculture, apiculture, sericulture, Pisciculture, dairy farming and poultry.

### Course Outcomes (CO)

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

| No.  | Course Outcome  | Knowledge Level (according to Bloom's Taxonomy) |
|------|---|---|
| CO 1 | Acquire knowledge on characteristics, biology, culture methods and applications of earthworms in organic farming.                     | K1, K2 & K5                                     |
| CO 2 | Understand the knowledge on races of honey bee, bionomics, bee keeping methods, diseases and its products and economic importance.    | K2, K4  |
| CO 3 | Impart knowledge on moriculture, types and biology of silkworm, rearing methods, diseases, grainage and silk technology.              | K3 & K5   |
| CO 4 | Obtain knowledge on biology, characteristics and disease of Indian major carps, Ornamental fishes and artificial spawning techniques. | K2, K4 & K5                                     |
| CO 5 | Trace the deeper knowledge on characteristics, feeding and breeding methods of dairy and poultry.                                     | K2, K4 & K5                                     |

**K1-Remembering K2-Understanding K3-Applying K4- Analyzing K5- Evaluating**

### Mapping of CO with PO

|       | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|-------|------|------|------|------|------|------|------|
| CLO 1 | 3    | -    | 3    | 3    | 3    | 3    | 3    |
| CLO 2 | 3    | -    | 3    | 3    | 3    | 3    | 3    |
| CLO 3 | 3    | -    | 3    | 3    | 3    | 3    | 3    |
| CLO 4 | 3    | -    | 3    | 3    | 3    | 3    | 3    |
| CLO 5 | 3    | -    | 3    | 3    | 3    | 3    | 3    |
|       | 15   |      | 15   | 15   | 15   | 15   | 15   |

### Mapping of CO with PSO

|       | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|-------|-------|-------|-------|-------|-------|
| CLO 1 | 9     | -     | 3     | 3     | 9     |
| CLO 2 | 9     | -     | 3     | 3     | 9     |
| CLO 3 | 9     | -     | 9     | 3     | 9     |
| CLO 4 | 9     | -     | 9     | 3     | 9     |
| CLO 5 | 9     | -     | 9     | 3     | 9     |
|       | 45    |       | 33    | 15    | 45    |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

### Syllabus

**UNIT-I: Unit I: Vermiculture (18 Hrs)**

Earthworm – Biology, Vermicomposting – process – methods – harvesting – vermicast - its characteristics – application; preparation of vermish – characteristics and applications of vermish Role of Vermiculture in organic farming

- UNIT-II: Unit II: Apiculture (18 Hrs)**  
Honey bee – Races of Bees – life cycle – bee hives – bee keeping methods – Bee disease and enemies, Pollination, Royal jelly, Bee venom - Apiary site- Harvesting of honey – Nutritive and Medicinal value of honey-Value added products-Marketing
- UNIT- III: Unit III: Sericulture (18 Hrs)**  
Moriculture – propagation – pests and diseases – control measures. Sericulture – Mulberry silkworm – Biology of *Bombyx mori* – Rearing – pests and diseases – control measures- Brief account on Non-mulberry silkworms (Eri, Muga and Tasar) – Brief account on grainage and silk technology.
- UNIT- IV: Unit IV: Pisciculture (18 Hrs)**  
Food fish – fish larval rearing – live feed culture, Biology of Indian major carps, Characteristics of Culturable fishes, Ornamental fish culture - Induced spawning technique – pests and diseases – control measures.
- UNIT- V: Unit V: Dairy Farming and Poultry (18 Hrs)**  
Characteristics of Dairy breeds – Exotic, Hybrid and Native, Housing system, feeding and breeding– artificial insemination, Dairy products. Poultry – common breeds – housing – feeding – management – diseases and control measures.

#### Text Books

- Shukla and Upadhyay, 2015. Economic Zoology, Rastogi publications, Meerut
- Arumugam, N, 2017. Applied Zoology, Saras Publications, Nagercoil

#### Reference Books

- Scientific Farm Animal Production An Introduction to Animal Science 2012, T.G. Field PHI Learning Private limited, New Delhi
- P.K.Gupta, 2003. Vermicomposting for Sustainable Agriculture AgroBios (India) P.K.Gupta., Jodhpur
- E.F.Phillips 2003. Beekeeping AgroBios (India) P.K.Gupta., Jodhpur
- G.C.Banerjee, 2012. A Text Book of Animal Husbandary Oxford & IBH Publishing Co. Pvt.Ltd, New Delhi
- G.Ganga and J. Sulochana Chetty 2006. An introduction to Sericulture– Oxford and IBH Pub. Co. Pvt.Ltd, New Delhi
- V.G.Jhingram 1983. Fish and Fisheries of India, Hindustan Publishing Corporation (India) New Delhi.

#### • Pedagogy

- Chalk & Talk, Group Discussion, PPT

#### • Teaching Aids

- Green Board, LCD Projector, Chart models, Interactive White Board

#### • Course Contents and Lecture Schedule

| Module No.              | Topic  | No. of Lectures | Content Delivery Method | Teaching Aids         |
|-------------------------|--|-----------------|-------------------------|-----------------------|
| Unit -1 Vermitechnology |  | (18 hrs)        |                         |                       |
| 1.1                     | Earthworm – Biology  | 2               | Discussion              | Green Board<br>Charts |
| 1.2                     | Vermicomposting – process – methods – harvesting                         | 4               | Chalk & Talk            | Green Board           |
| 1.3                     | vermicast - its characteristics – application                            | 4               | Chalk & Talk            | Green Board           |
| 1.4                     | preparation of vermiwash – characteristics and applications of vermiwash | 4               | Chalk & Talk            | Green Board           |
| 1.5                     | Role of Vermitechnology in organic farming                               | 4               | Chalk & Talk            | Green Board           |

| Unit -2      |  | Apiculture                | (18 hrs)      |                                 |
|--------------|--|---------------------------|---------------|---------------------------------|
| 2.1          | Honey bee – Races of Bees  |                           | 2             | Lecture                         |
| 2.2          | life cycle –bee hives  |                           | 2             | Chalk & Talk                    |
| 2.3          | bee keeping methods  |                           | 4             | Chalk & Talk,<br>display models |
| 2.4          | Bee disease and enemies  |                           | 3             | Chalk & Talk,<br>PPT            |
| 2.5          | Apiary site- Harvesting of honey   |                           | 3             | Chalk & Talk,<br>PPT            |
| 2.6          | Nutritive and Medicinal value of honey-Value added products-Marketing              |                           | 4             | Chalk & Talk,<br>PPT            |
| Unit -3      |  | Sericulture               | (18 hrs)      |                                 |
| 3.1          | Moriculture – propagation  |                           | 2             | Chalk & Talk                    |
| 3.2          | pests and diseases – control measures  |                           | 3             | Chalk & Talk                    |
| 3.3          | Sericulture – Mulberry silkworm – Biology of <i>Bombyx mori</i>                    |                           | 3             | Chalk & Talk                    |
| 3.4          | Rearing methods  |                           | 3             | Chalk & Talk                    |
| 3.5          | pests and diseases – control measures  |                           | 3             | PPT                             |
| 3.6          | Brief account on Non-mulberry silkworms (Eri, Muga and Tasar)                      |                           | 2             | Chalk & Talk                    |
| 3.7          | Brief account on grainage and silk technology                                      |                           | 2             | Chalk & Talk                    |
| Unit -4      |  | Pisciculture              | (18 hrs)      |                                 |
| 4.1          | Food fish – fish larval rearing – live feed culture, Biology of Indian major carps |                           | 4             | Discussion                      |
| 4.2          | Characteristics of Culturable fishes   |                           | 4             | Chalk & Talk                    |
| 4.3          | Ornamental fish culture  |                           | 4             | Chalk & Talk                    |
| 4.4          | Induced spawning technique   |                           | 3             | Chalk & Talk                    |
| 4.5          | pests and diseases – control measures  |                           | 3             | Lecture                         |
| Unit -5      |  | Dairy Farming and Poultry | (18 hrs)      |                                 |
| 5.1          | Characteristics of Dairy breeds – Exotic, Hybrid and Native                        |                           | 3             | Lecture                         |
| 5.2          | Housing system   |                           | 2             | Chalk & Talk                    |
| 5.3          | feeding  |                           | 2             | Chalk & Talk                    |
| 5.4          | breeding– artificial insemination  |                           | 2             | Chalk & Talk                    |
| 5.5          | Dairy products   |                           | 2             | Chalk & Talk                    |
| 5.6          | Poultry – common breeds  |                           | 2             | Chalk & Talk                    |
| 5.7          | housing— feeding – management  |                           | 3             | Chalk & Talk                    |
| 5.8          | diseases and control measures  |                           | 2             | Chalk & Talk                    |
| <b>Total</b> |  |                           | <b>90 hrs</b> |                                 |

### E-Resources

<https://www.slideshare.net/sudharajput/vermicomposting-47669414>

<https://www.slideshare.net/safeermanhas/apiculture-95442492>

<https://www.studyandscore.com/studymaterial-detail/apiculture-introduction-bee-colony-and-bee-dance>

<https://www.youtube.com/watch?v=9LpDTMkyblo> (Life cycle of Silkworm)

<https://www.slideshare.net/nehagarwal357/induced-breeding-in-fishes>

[https://www.shcollege.ac.in/wp-content/uploads/NAAC\\_Documents\\_IV\\_Cycle/Criterion-II/2.3.2/ppt/Ms\\_LeenaRaphael\\_Inducedbreeding.pdf](https://www.shcollege.ac.in/wp-content/uploads/NAAC_Documents_IV_Cycle/Criterion-II/2.3.2/ppt/Ms_LeenaRaphael_Inducedbreeding.pdf)

[http://www.agritech.tnau.ac.in/expert\\_system/cattlebuffalo/Breeds%20of%20cattle%20&%20buffalo.html](http://www.agritech.tnau.ac.in/expert_system/cattlebuffalo/Breeds%20of%20cattle%20&%20buffalo.html)

<https://www.notesonzoology.com/poultry/common-breeds-of-fowl-used-for-farming-in-india/477>

## DEPARTMENT OF ZOOLOGY

Programme: M.Sc., Zoology, (CBCS and LOCF)

(For those students admitted during the Academic Year 2021-22 and after)

|   |                           |                              |
|---|---------------------------|------------------------------|
| PART-III: <b>Discipline Specific Elective</b> |                           | <b>SEMESTER-IV</b>           |
| Course Title: <b>ENTOMOLOGY</b>               |                           |                              |
| Course Code: <b>31DS4B</b>                    | Hours per week: <b>6</b>  | Credits: <b>5</b>            |
| CIA Marks: <b>25Marks</b>                     | ESE Marks: <b>75Marks</b> | Total Marks: <b>100Marks</b> |

### Preamble

The course provides a comprehensive insight on the basic and applied aspects of Entomology. The syllabus offers morphological as well as molecular based taxonomy and systematic of insects, beneficial and harmful nature of insects and their management.

### Course Outcomes (CO)

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

| No.        | Course Outcome  | Knowledge Level (according to Bloom's Taxonomy) |
|------------|---|---|
| <b>CO1</b> | Discuss the morphology-based variation, diversity among all insect groups and their social behaviour.                 | K1, K2, K3, K4 & K5                             |
| <b>CO2</b> | Emphasize and compare the structural and functional aspects of insects  | K1, K2, K3, K4 & K5                             |
| <b>CO3</b> | Explain the trophic interaction of insects with their host plants, management and tools of control                    | K1, K2, K3, K4 & K5                             |
| <b>CO4</b> | Apply/Utilize natural enemies for the control of insect pests   | K1, K2, K3, K4 & K5                             |
| <b>CO5</b> | Understand the economic importance of insects and mode of transmission and control measures of vector borne diseases. | K1, K2, K3, K4 & K5                             |

Note: K1-Remembering; K2-Understanding; K3-Applying; K4-Analysing; K5-Evaluating

### Mapping of CO with PO

|              | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
|--------------|-------|-------|-------|-------|-------|-------|-------|
| <b>CLO 1</b> | 9     | -     | 3     | -     | -     | 3     | 3     |
| <b>CLO 2</b> | 3     | -     | -     | 1     | -     | 3     | 3     |
| <b>CLO 3</b> | 3     | -     | 3     | 1     | 3     | 3     | 3     |
| <b>CLO 4</b> | 3     | -     | 3     | 1     | 3     | 3     | 3     |
| <b>CLO 5</b> | 3     | -     | 9     | 3     | 3     | 3     | 3     |
|              | 21    |       | 18    | 6     | 9     | 15    | 15    |

### Mapping of CO with PSO

|              | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|--------------|-------|-------|-------|-------|-------|
| <b>CLO 1</b> | 9     | -     | -     | 9     | 9     |
| <b>CLO 2</b> | 3     | 9     | -     | -     | -     |
| <b>CLO 3</b> | -     | -     | 9     | 3     | 3     |
| <b>CLO 4</b> | -     | -     | 9     | 3     | 3     |
| <b>CLO 5</b> | -     | -     | 3     | 9     | -     |
|              | 12    | 9     | 21    | 24    | 15    |

Note:

Mapping Score: - Strong- 9, Medium- 3 and Low- 1

## Syllabus

|          |  |         |
|----------|--|---------|
| UNIT-I   | Classification of Insects-General characteristics of class Insecta and Modern scheme of insect classification up to order level - Apterygota-Pterygota: Exopterygota (Hemimetabolous) and Endopterygota (Holometabolous) - characteristics of each order with examples-Studies on molecular evolutionary relationship between different groups of insects – Classification and social behaviour of honey bee, ants and termites  | (18Hrs) |
| UNIT-II  | Anatomy and Physiology of Insects: Respiratory system: Spiracle, tracheal gills, air sacs, trachea and tracheoles -Excretory system: in aquatic and terrestrial insects- Reproductive system: Male - accessory glands - vas efferense, vas difference, aediagus; Female - panoistic, meroistic, telotrophic, polytrophic ovaries, spermatheca, - Endocrine system: Structure of Corpora cardiac(CC), Corporaallata (CA) and neurosecretory cells(NSC); ecdysone, neuropeptides, prothoracicotropic hormone (PTf H), ATH, JH and JH analogues   | (18Hrs) |
| UNIT-III | Pests and Pest Management - Economic threshold level, Pests: Pests of Cotton ( <i>Pectinophora gossypiella</i> , and <i>Helicoverpa armigera</i> ) Paddy ( <i>Scirpophaga incertulus</i> and <i>Leptocorisa acuta</i> ), Sugarcane ( <i>Tryporyza nivella</i> and <i>Aleurolobus barodensis</i> ). Ground nut ( <i>Ammseta albistica</i> and <i>Aphis craccivora</i> ), Tomato ( <i>Amrasca biguttata</i> and <i>Aphis sp.</i> ) Brinjal- ( <i>Leucinodes orbanails</i> and <i>Pthemberule affinis</i> )- IPM concept, methods and tools -Chemical control: Insecticide - Classification, nomenclature, toxicity, mode of entry, mode of action, synergistic - formulations, repellents, attractants- law and regulations. | (18Hrs) |
| UNIT-IV  | Biological Control: Parasitoids (Egg, larval, pupal and adult parasitoids) and predators- Genetic Control –Release of sterilized males andSterilizing insects in the natural population by chemosterilants: Ecological control - Cultural and mechanical; microbial control - Bacteria - <i>Bacillus thuringiensis</i> -Fungi – <i>Metarhizium anisopliae</i> , <i>Beauveria bassiana</i> - Virus – <i>Nuclear Polyhedral Virus</i> (NPV) and <i>Granulosis virus</i> (GV)-Protozoans: <i>Nozemalocustae</i> Nematode: <i>Stenernema sp.</i> , and <i>Heterorhabditis sp.</i>  | (18Hrs) |
| UNIT-V   | Beneficial Insects – Life cycle and economic importance of silkworm and Lac insect -Vector Borne Disease: Mode of transmission – mechanical and biological – Characters, life cycle, diseases and control measures with special reference to mosquitoes and houseflies   | (18Hrs) |

### Text Books

- Rajendra Singh and Sachan, G.C. 2012ElementsofEntomology, Rastogi Publications, Meerut.
- Tembhare,D.B.2009ModernEntomology,Himalayapublishinghouse,Mumbai.

### Reference Books

- Chapman, R.F. 2008. The insects: Structure and Function. ELBS.
- Chapman, R.F. and Joern, A. 1990. (e d s.). Biology of Grasshoppers. John Wiley & Sons, New York.
- Romoser,W.S., Stoffolano Jr, J.G .1998, Entomology, fourth edition, WCB Mc Graw Hill Publishing Co.
- David, B.V and. Ananthkrishnan, T. N. 2004. General and Applied Entomology. Tata Mc Graw Hill Publishing Co.
- Pedigo, L.P. 2009. Entomology and Pest Management. Prentice Hall of India, New Delhi
- Regupathy, A., Palanisamy, S., Chandramohan, N. and Gunathilagaraj,K. 1997. A guide on Crop Pests. Sooriya Desktop Publishers, Coimbatore, India.
- Wiggles worth, V.8. 1972. The principles of Insect Physiology. Chapman & Hall, New York.

### Pedagogy

Chalk&Talk. Group Discussion. PPT

### TeachingAids

Green Board, LCD Projector, Chart models, Interactive White Board

## Course Contents and Lecture Schedule

| Module No.   | Topic   | No. of Lectures | Content Delivery Method | Teaching Aids |
|--|---|-----------------|-------------------------|---------------|
| <b>Unit-1 Classification of Insects (18 hrs)</b>         |   |                 |                         |               |
| 1.1  | General characteristics of class Insecta and Modern scheme of insect classification up to order level   | 2               | Discussion              | Green Board   |
| 1.2  | Apterygota- characteristics of each order with examples   | 4               | Chalk&Talk              | Green Board   |
| 1.3  | Exopterygota (Hemimetabolous)- characteristics of each order with examples  | 4               | Chalk&Talk              | Green Board   |
| 1.4  | Endopterygota (Holometabolous)- characteristics of each order with examples   | 4               | Chalk&Talk              | Green Board   |
| 1.5  | Studies on molecular evolutionary relationship between different groups of insects  | 2               | Chalk&Talk              | Green Board   |
| 1.6  | Classification and social behaviour of honey bee, ants and termites   | 2               | Chalk&Talk              | Green Board   |
| <b>Unit-2 Anatomy and Physiology of Insects (18 hrs)</b> |   |                 |                         |               |
| 2.1  | Respiratory system: Spiracle, tracheal gills, air sacs, trachea and tracheoles  | 3               | Lecture                 | Green Board   |
| 2.2  | Excretory system: in aquatic and terrestrial insects  | 3               | Chalk&Talk              | Green Board   |
| 2.3  | Reproductive system: Male - accessory glands - vas efferense, vas deference, aediasus; Female - panoistic, meroistic, telotrophic, polytrophic ovaries, spermatheca | 4               | Chalk&Talk,             | Green Board,  |
| 2.4  | Endocrine system: Structure of Corpora cardiac(CC), Corpora allata (CA) and neurosecretary cells(NSC)   | 4               | Chalk&Talk,             | Green Board,  |
| 2.5  | ecdysone, neuropeptides, prothoracicotropic hormone (PTf H), ATH, JH and JH analogues   | 4               | Chalk&Talk,             | Green Board,  |
| <b>Unit-3 Pests and Pest Management (18 hrs)</b>         |   |                 |                         |               |
| 3.1  | Economic threshold level, Pests   | 2               | Chalk&Talk              | Green Board   |
| 3.2  | Pests of Cotton ( <i>Pectinophora gossypiella</i> , and <i>Helicoverpa armigera</i> )   | 2               | Chalk&Talk              | Green Board   |
| 3.3  | Paddy ( <i>Scirpophaga incertulus</i> and <i>Leptocorisa acuta</i> )  | 2               | Chalk&Talk              | Green Board   |
| 3.4  | Sugarcane ( <i>Tryporyza nivella</i> and <i>Aleurolobus barodensis</i> ). Ground nut ( <i>Ammseta albistica</i> and <i>Aphis craccivora</i> )                       | 2               | Chalk&Talk              | Green Board   |
| 3.5  | Tomato ( <i>Amrasca biguttalabiguttala</i> and <i>Aphis sp.</i> )   | 2               | PPT                     | LCD           |
| 3.6  | Brinjal- ( <i>Leucinodes orbanais</i> and <i>Pemberule affinis</i> )  | 2               | Chalk&Talk              | Green Board   |
| 3.7  | IPM concept, methods and tools  | 2               |                         |               |
| 3.8  | Chemical control: Insecticide - Classification, nomenclature, toxicity, mode of entry, mode of action,  | 4               | Chalk&Talk              | Green Board   |



|         |   |              |            |             |
|---------|---|--------------|------------|-------------|
|         | synergistic - formulations, repellents, attractants- law and regulations  |              |            |             |
| Unit-4  | <b>Biological Control</b>   | (18 hrs)     |            |             |
| 4.1     | Parasitoids (Egg, larval, pupal and adult parasitoids)  | 3            | Discussion | Smart Board |
| 4.2     | predators   | 2            | Chalk&Talk | Green Board |
| 4.3     | Genetic Control –Release of sterilized males andSterilizing insects in the natural population by chemosterilants  | 4            | Chalk&Talk | Green Board |
| 4.4     | Ecological control - Cultural and mechanical  | 3            | Chalk&Talk | Green Board |
| 4.5     | Microbial control - Bacteria - <i>Bacillus thuringiensis</i> -Fungi – <i>Metarhizium anisopliae</i> , <i>Beauveria bassiana</i> - Virus – <i>Nuclear Polyhedral Virus</i> (NPV) and <i>Granulosis virus</i> (GV)-Protozoans: <i>Nozomalocustae</i> Nematode: <i>Stenernema sp.</i> , and <i>Heterorhabditis sp.</i> | 6            | Chalk&Talk | Green Board |
| Unit -5 | <b>Beneficial Insects and Vector Borne Diseases</b>   | (18 hrs)     |            |             |
| 5.1     | Life cycle and economic importance of silkworm and Lac insect   | 4            | Lecture    | Green Board |
| 5.2     | Vector Borne Disease: Mode of transmission – mechanical and biological  | 4            | Chalk&Talk | Green Board |
| 5.3     | Characters, life cycle, diseases and control measures with special reference to mosquitoes  | 6            | Chalk&Talk | Green Board |
| 5.4     | Characters, life cycle, diseases and control measures with special reference to houseflies  | 4            | Chalk&Talk | Green Board |
|         | <b>Total</b>  | <b>90hrs</b> |            |             |

### E-Resources

<http://www.ahschools.us/cms/lib08/MN01909485/Centricity/Domain/5091/Entomology.ppt>

<https://www.ars.usda.gov/ARUserFiles/80420580/CollectingandPreservingInsectsandMites/collpres.pdf>

[https://youtu.be/mhWbEcf7\\_xA](https://youtu.be/mhWbEcf7_xA)

<https://youtu.be/IRIb7foLLU8>

[https://youtu.be/QRu\\_xGDijO4](https://youtu.be/QRu_xGDijO4)