

# 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 2021-22 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-based knowledge and research methods	<b>Head</b>



<b>PO 4</b>															
<b>PO 5</b>															

### Assessment

Distribution of questions and marks

PG: Section A – Remembering (K1)  
**LOCF** Section B – Understanding (K2)  
**Syllabus** 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**  
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#### 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**  
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#### Continuous Internal Assessment (CIA) - Distribution of Marks

	UG		PG	
<b>Part - I, II 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) 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 2021 - 22 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

**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>



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(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.
- 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

#### E-Resources

- <https://www.slideshare.net/angellal2010/cell-mitochondria-ppt>
- <https://www.slideshare.net/Dilippandya/mitochondria-46636401>

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

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

<https://www.slideshare.net/chelubaraya20/protein-sorting-and-targeting>

<https://www.slideshare.net/ssmvjunwani/protein-targetting-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

## **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

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO6	PLO7
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, 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



## 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> a) History, generations and components of computers b) Classifications of computer-main frame, mini, micro and super computer c) Operating system-Windows, Microsoft office and components 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> a) Internet- Modem- TCP/IP protocols -online services -commercial organization-Education, web browsers and portals- b) Creation of web pages using HTML- web page c) Electronic mail – Creation and management, data storage using email d) Virus- Booting virus -EXE. virus and antivirus	<b>(18 Hrs)</b>
<b>UNIT- III:</b>	<b>Databases:</b> a) Bioinformatics– Databases- classification- Data type, Maintainer status, data access, Data source, Data Design and Organisation- b) NCBI –Structure, Tools and database, Sequence submission, Sequence retrieval c) EMBL – Structure, Sequence submission, Sequence retrieval d) DDBJ – Structure, Mass submission, Sequence retrieval.	<b>(18 Hrs)</b>
<b>UNIT- IV:</b>	<b>Sequence analysis:</b> a) Sequence alignment- Concept- Scoring matrices- PAM, BLOSUM b) Sequence pairing – BLAST, Multiple sequence alignment c) Methods of Gene prediction methods and difficulties 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> a) Protein structure and prediction - Confirmation parameters of secondary structures, Secondary structure types- Secondary structure prediction – their limitations. b) Methods of protein modeling – Homology, Abnitio and Threading – Model refinement c) Comparative modeling – Swiss model 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 & Talk, Group Discussion, PPT

## **Teaching Aids**

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

## **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)

<b>PART – III : Discipline Specific Elective</b>		<b>SEMESTER - I</b>
<b>Course Title: 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)
<b>CO 1</b>	identify, design and execute various biological experiments	K1, K2
<b>CO 2</b>	know diverse research problem identification and get right methods to solve	K1, K2, K3
<b>CO 3</b>	understand the working principles and applications of various analytical instruments	K3, K4
<b>CO 4</b>	To utilize the various instruments and learnt techniques able to complete research work and prepare research report scientifically	K3, K4, K5
<b>CO 5</b>	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**

	<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	-	1	3	3
<b>CLO 2</b>	3	-	3	-	3	3	3
<b>CLO 3</b>	9	-	3	-	3	-	3
<b>CLO 4</b>	3	3	3	-	9	-	9
<b>CLO 5</b>	3	3	3	-	9	-	9
	21	6	15		25	6	27

**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>	3	-	3	3	1
<b>CLO 2</b>	3	-	3	3	1
<b>CLO 3</b>	3	9	9	3	1
<b>CLO 4</b>	3	9	9	3	1
<b>CLO 5</b>	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

### 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=ET4c7hiRgmM>
- 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)
<b>CO 1</b>	Learn the fundamentals of antigens, antibodies, and diversity of antibodies	K1& K2
<b>CO 2</b>	Acquire knowledge on the types of immune response (humoral and cell mediated) and hypersensitivity reactions	K1 & K3
<b>CO 3</b>	Differentiate the self and non-self immunity, organs transplantation, auto immune diseases, immunology of tumour and AIDS in human	K1, K2 & K5
<b>CO 4</b>	Understand the immune response to protozoan, bacterial and viral infections in human	K2, K4 & K5
<b>CO 5</b>	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	PLO6	PLO7
<b>CLO 1</b>	3	-	-	-	-	-	3
<b>CLO 2</b>	9	-	3	1	1	-	3
<b>CLO 3</b>	9	-	9	3	9	3	9
<b>CLO 4</b>	3	-	9	3	3	9	3
<b>CLO 5</b>	9	-	-	-	1	-	9
	33		21	7	14	12	27

**Mapping of CO with PSO**

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
<b>CLO 1</b>	3	3	9	9	-
<b>CLO 2</b>	3	9	9	3	-
<b>CLO 3</b>	3	3	9	9	9
<b>CLO 4</b>	3	3	3	9	3
<b>CLO 5</b>	3	3	9	9	9
	15	21	39	39	21

Note:

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

**Syllabus**

<b>UNIT-I:</b>	<b>Fundamentals of Immunology</b> a) <b>Antigen and its characters:</b> 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) <b>Genetic basis of antibody diversity:</b> 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	<b>(18 Hrs)</b>
<b>UNIT-II:</b>	<b>Immune Effector Mechanism</b> 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)	<b>(18 Hrs)</b>
<b>UNIT- III:</b>	<b>Immune System in Health</b> 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.	<b>(18 Hrs)</b>
<b>UNIT- IV:</b>	<b>Immune Response to Infectious Diseases</b> 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- <i>Plasmodium</i> and Trypanosomal infection and immunity. ii) Immune response against Helminthic parasites-role of B cells in Helminth infection.	<b>(18 Hrs)</b>
<b>UNIT- V:</b>	<b>Immunotechniques</b> a) Principles of precipitations- VDRL slide test.	<b>(18 Hrs)</b>



	b) Radioimmuno assay of Insulin. c) ELISA Test d) Immunodiffusion and Immunoelectrophoresis	
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### 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

### E-Resources

UNIT – I a) 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-immunodifusion>

## 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> a) Data-Collection, tabulation, classification, presentation and frequency distribution. Calculation of mean, median, mode, variance and standard deviation. b) Chi-Square analysis-degrees of freedom-Goodness of fit, calculation of chi-square value for genetic experiments and 2X2 contingency table. 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> a) Sampling-characters-sample size-types b) Sampling distribution-comparison of means (samples and population) – Calculation of Student’s ‘t’ test-paired and unpaired data. 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> a) Correlation - Calculation of Karl Pearson’s correlation coefficient and rank correlation-applications. b) Scatter diagram-linear regression-plotting of regression lines ‘y on x’ and ‘x on y’. c) Regression coefficient-testing the significances of regression.	<b>(15 Hrs)</b>
<b>UNIT- IV:</b>	<b>F- test and analysis of variance</b> a) F – distribution - definition and applications b) One way classification - total variation - variation with treatments, Variation between treatments, distribution of variations- Calculation. c) Two-way classification-variation of 2 factors experiment.	<b>(15 Hrs)</b>
<b>UNIT- V:</b>	<b>Vital Statistics and Demography</b> a) Introduction - uses of vital statistics, basic formulae, mortality and fertility rates. b) Construction of a life table, structure and applications 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

#### 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)
<b>CO 1</b>	Acquire knowledge on spermatogenesis, oogenesis, fertilization, egg activation and parthenogenesis.	K1 & K2
<b>CO 2</b>	Understand the reproductive cycle, menstruation, ovulation, embryo development, extra embryonic membrane, placenta in human.	K1 & K2
<b>CO 3</b>	Distinguish the organizer concept, gradient theory and nuclear transplantation based on experiments.	K3, K4 & K5
<b>CO 4</b>	Differentiate the molecular aspects of cell differentiation, chemo differentiation, stem cells and gene action.	K1, K3, K4
<b>CO 5</b>	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
<b>CLO 1</b>	3	-	3	3	-	3	3
<b>CLO 2</b>	9	-	3	3	-	3	3
<b>CLO 3</b>	3	-	3	-	3	1	1
<b>CLO 4</b>	9	-	3	1	3	-	9
<b>CLO 5</b>	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
<b>CLO 1</b>	3	3	-	9	-
<b>CLO 2</b>	3	3	1	9	3
<b>CLO 3</b>	1	3	1	9	1
<b>CLO 4</b>	3	1	1	9	3
<b>CLO 5</b>	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> Spermatogenesis-oogenesis- Spermatozoon-egg types - fertilization -Molecular basis of egg activation, Parthenogenesis.	<b>(18 Hrs)</b>
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<b>UNIT-II:</b>	<b>Early development of human embryo</b> 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> 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> 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> 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

### 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/drashutoshtiware/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-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	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.
5. Injection schedule in rabbit to induce antibody.
  6. Bleeding technique in rabbit and preparation of anti serum.
  7. Ouchterlony double immune diffusion and Mancini single radial immune diffusion.
  8. Haemagglutination titration assay: Commercial kits use-ELISA-HIV/Hepatitis, Blood grouping.
  9. Immuno electrophoresis.

**Spotters:**

1. Lymphoid organs.
2. Primary and secondary immune response curves.
3. Latex test.
4. Blood group anti serum.
5. Anaphylatic reactions.
6. Arthus reaction.
7. Tuberculin types hypersensitivity.
8. Contact hypersensitivity.
9. Hashimoto's thyroiditis.

**BIOSTATISTICS**

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

**DEVELOPMENTAL BIOLOGY**

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

**Spotters**

1. Extraembryonic membranes (Human)
2. *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



## 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 - II
Course Title: <b>EVOLUTION</b>		
Course Code: <b>31DS2A</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 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)
CO 1	Study the modern concepts of natural selection	K1, K2
CO 2	Imparting knowledge on molecular evolution from amino acid-protein –DNA phylogeny	K1, K2, K3
CO 3	Understand species concept and distribution of animals	K2, K5
CO 4	Trace the origin of higher taxa and its deviation	K2, K3, K4, K5
CO 5	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

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO6	PLO7
CLO 1	3	-	3	-	-	9	3
CLO 2	9	3	3	-	1	3	3
CLO 3	3	-	1	-	1	9	3
CLO 4	3	-	3	-	3	3	3
CLO 5	9	-	3	-	3	3	3
	27	3	13	-	8	27	15

### Mapping of CO with PSO

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	-	9	-	1	-
CLO 2	-	2	9	1	-
CLO 3	-	9	3	-	-
CLO 4	9	3	3	-	-
CLO 5	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

#### 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=FAeJNq9jHI>

<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, diapause, reproduction, osmoregulation, Colorchanges – 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 – pituitary 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 lactation – 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

### 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%20Systemnew.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

## 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-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/zooology/wp-content/uploads/sites/51/2016/11/Gene-and-Fine-structure-of-gene\\_Fazlul.pptx](http://www.ru.ac.bd/zooology/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.uwoy.edu/molecbio/courses/molb-3000/files/13/13-miller-chap-5a-lecture.ppt>

<https://www.uwoy.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/samiurrehmankhan/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/kaberinath123/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/kaberinath123/plasmid-85751383>

<https://capricorn.bc.edu/bi204/wp-content/uploads/2015/08/10-Plasmids.pptx>

[https://www.slideshare.net/Mona\\_Al bureikan/transformation-in-bacteria](https://www.slideshare.net/Mona_Al bureikan/transformation-in-bacteria)

<https://www.slideshare.net/rbanthia2/bacterial-conjugation>

<https://www.slideshare.net/megansuara/conjugation-microbiology>

<https://www.slideshare.net/AmolPawar71/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.uwyo.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.	
<b>UNIT – II:</b>	<b>Light, Bioelectricity &amp; Physiology of therapies</b>	<b>(18 Hrs)</b>
	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.	
<b>UNIT-III</b>	<b>Effector Organs, Counter Current Exchange &amp; Circulation</b>	<b>(18 Hrs)</b>
	a. Mechanics of Muscle and animal movements	
	b. Mechanics of pulmonary ventilation and counter current mechanism	
	c. Haemodynamics and cardiac cycle.	
<b>UNIT- IV:</b>	<b>Nervous Integration</b>	<b>(18 Hrs)</b>
	a. Neuron to brain; Reflex to planned action.	
	b. Properties of inter neuron.	
	c. Organization of Nervous system.	
	d. Physiology of behaviour	
<b>UNIT- V:</b>	<b>Circulation of Body Fluids</b>	<b>(18 Hrs)</b>
	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

#### **E-Resources**

<https://www.slideshare.net/LubnaAbuAIRub/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.

<b>UNIT-II:</b>	<b>Molecular Tools– I</b> Restriction endonucleases: types and mode of action Nucleases: exo- and endo-nucleases (DNAses, RNAses) DNA-ligases and DNA modifying enzymes. DNA and RNA markers	<b>(18 Hrs)</b>
<b>UNIT- III:</b>	<b>Molecular Tools -II</b> 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)	<b>(18 Hrs)</b>
<b>UNIT- IV:</b>	<b>Techniques</b> 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	<b>(18 Hrs)</b>
<b>UNIT- V:</b>	<b>Gene Cloning and Gene Libraries</b> Methods of gene transfer: cDNA synthesis and genomic libraries Gene cloning strategies Screening strategies: Screening by DNA hybridization and colony hybridization	<b>(18 Hrs)</b>

#### 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

#### 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/sitofinity/docs/default-source/biotech-basics/restriction-endonucleases.pdf?sfvrsn=1e563407\\_4](https://sfvideo.blob.core.windows.net/sitofinity/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

## 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-Appling 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	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

UNIT-I:	<b>Vermiculture</b> Vermiculture – Introduction – General morphology of earthworm – biology of <i>Eisenia foetida</i> – Process of vermicomposting ( bedding, layering and watering) – harvesting – vermicast – vermishash- Role of	(15 Hrs)
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	vermitechnology in organic farming	
<b>UNIT-II:</b>	<b>Apiculture</b> 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> 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> 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> 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

#### 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, releaching 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/e1XyQVmuBDs>

<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

### **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>		
Course Code: <b>31CP44</b>	Hours per week: <b>6</b>	Credits: <b>3</b>
CIA: <b>40 Marks</b>	ESE: <b>60 Marks</b>	Total: <b>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-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	-	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**

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
<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**

(12 Hrs)



## 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

	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	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



<b>UNIT-II:</b>	<b>Unit II: Apiculture</b> 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	<b>(18 Hrs)</b>
<b>UNIT- III:</b>	<b>Unit III: Sericulture</b> Moriculture – propagation – pests and diseases – control measures. Sericulture – Mulberry silkworm – Biology of <i>Bombyx mori</i> – Rearing – pests and diseases – control measures- Brief account on Non-mulberry silkworms (Eri, Muga and Tasar) – Brief account on grainage and silk technology.	<b>(18 Hrs)</b>
<b>UNIT- IV:</b>	<b>Unit IV: Pisciculture</b> 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.	<b>(18 Hrs)</b>
<b>UNIT- V:</b>	<b>Unit V: Dairy Farming and Poultry</b> 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.	<b>(18 Hrs)</b>

#### 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

#### 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.notesonzooology.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 deferens, aedeagus; Female - panoistic, meroistic, telotrophic, polytrophic ovaries, spermatheca, - Endocrine system: Structure of Corpora cardiac(CC), Corpora allata (CA) and neurosecretory cells(NSC); ecdysone, neuropeptides, prothoracicotropic hormone (PTfH), 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 albistrica</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. 2012 Elements of Entomology, Rastogi Publications, Meerut.
- Tembhare, D.B. 2009 Modern Entomology, Himalaya publishing house, Mumbai.

#### Reference Books

- Chapman, R.F. 2008. The insects: Structure and Function. ELBS.
- Chapman, R.F. and Joern, A. 1990. (ed 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. Ananthakrishnan, 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.
- Wigglesworth, V.8. 1972. The principles of Insect Physiology. Chapman & Hall, New York.

#### Pedagogy

Chalk & Talk, Group Discussion, PPT

#### Teaching Aids

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

#### E-Resources

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

<https://www.ars.usda.gov/ARSUserFiles/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)