

# **PG DEPARTMENT OF ZOOLOGY**

## **M.Sc. ZOOLOGY**

**(Students admitted during 2021 – 2022 Onwards)**

**(UnderCBCSwithOutcomeBased Education(OBE)Pattern)**

## **SYLLABUS**



**H.H. THE RAJAH'S COLLEGE (Autonomous)**

**(Affiliated to Bharathidasan University, Tiruchirappalli)**

**PUDUKKOTTAI- 622001**

**H.H THE RAJAH'S COLLEGE (Autonomous)  
PUDUKKOTTAI- 622001**

**M.Sc. ZOOLOGY**

S.NO	SEM	SUB CODE	PAPER	HOURS/ WEEK	CREDI T	EXAM HOUR S	MARKS		
							INTERNAL	EXTERNAL	TOTAL
1	I	21PZO1	CC I INVERTEBRATES AND CHORDATES	7	5	3	25	75	100
2	I	21PZO2	CC II CELL AND MOLECULAR BIOLOGY	7	5	3	25	75	100
3	I	21PZOE1A 21PZOE1B 21PZOE1C	EC I BIOINSTRUMENTATION / POULTRY FARMING / BIOCHEMISTRY	6	5	3	25	75	100
4	II	21PZO5	CC V ANIMAL PHYSIOLOGY	5	5	3	25	75	100
5	II	21PZO6	CC VI MICROBIOLOGY	5	5	3	25	75	100
6	II	21PZOE2A 21PZOE2B 21PZOE2C	EC II FISHERY BIOLOGY / RESEARCH METHODOLOGY / PARASITOLOGY	5	5	3	25	75	100
7	II	21PZOED1	EDC ECONOMIC ZOOLOGY (ONLINE PAPER)	5	5	3	25	75	100
8	II	21PZO3P	CC III PRACTICAL-I ( COVERING CCI-CCII)	5+5	5	3	40	60	100
9	II	21PZO4P	CC IV PRACTICAL-II ( COVERING CC V- CC VI)	5+5	5	3	40	60	100
10	III	21PZO7	CC VII ENVIRONMENTAL BIOLOGY	7	5	3	25	75	100
11	III	21PZO8	CC VIII GENETICS	6	5	3	25	75	100
12	III	21PZO9	CC IX EVOLUTION & ANIMAL BEHAVIOUR	6	5	3	25	75	100
13	III	21PZOE3A 21PZOE3B 21PZOE3C	EC III API CULTURE & SERICULTURE / BIOPROCESS TECHNOLOGY / APPLIED ENTOMOLOGY	6	5	3	25	75	100
14	IV	21PZO10	CC XI DEVELOPMENTAL BIOLOGY	5	5	3	25	75	100
15	IV	21PZO11	CC XII IMMUNOLOGY & BIOTECHNOLOGY	5	5	3	25	75	100
16	IV	21PZO12	CC XIII COASTAL AQUACULTURE	5	5	3	25	75	100
17	IV	21PZO13P	CCXIV PROJECT WORK	10	5	3			100
18	IV	21PZO14	CC X PRACTICAL-III ( COVERING CC V- CC VI)	5+5	5	3	40	60	100
				120	90				1800

**M.Sc. Zoology - Course Structure under CBCS pattern**

**(For the Candidates Admitted from the academic year 2021 - 2022 onwards)**

<b>Core Courses ( 14 )</b>				
<b>Sl. No.</b>	<b>Sub. Code</b>	<b>Code</b>	<b>Title of the Paper</b>	<b>Credits</b>
1	21PZO1	CC-I	INVERTEBRATES AND CHORDATES	5
2	21PZO2	CC-II	CELL AND MOLECULAR BIOLOGY	5
3	21PZO3P	CP-III	PRACTICAL-I ( COVERING CCI-CCII)	5
4	21PZO4P	CP-IV	PRACTICAL-II ( COVERING CC V- CC VI)	5
5	21PZO5	CC-V	ANIMAL PHYSIOLOGY	5
6	21PZO6	CC-VI	MICROBIOLOGY	5
7	21PZO7	CC-VII	ENVIRONMENTAL BIOLOGY	5
8	21PZO8	CC-VIII	GENETICS	5
9	21PZO9	CC-IX	EVOLUTION & ANIMAL BEHAVIOUR	5
10	21PZO10	CC-X	PRACTICAL-III ( COVERING CC V- CC VI)	5
11	21PZO11	CC-XI	DEVELOPMENTAL BIOLOGY	5
12	21PZO12	CC-XII	IMMUNOLOGY & BIOTECHNOLOGY	5
13	21PZO13P	CC-XIII	COASTAL AQUACULTURE	5
14	21PZO14	CCXIV-PW	PROJECT WORK	5
				<b>70</b>
<b>Elective Courses ( 3 )</b>				
1	21PZOE1	EC-I	BIOINSTRUMENTATION	5
			POULTRY FARMING	
			BIOCHEMISTRY	
2	21PZOE2	EC-II	FISHERY BIOLOGY	5
			RESEARCH METHODOLOGY	
			PARASITOLOGY	
3	21PZOE3	EC-III	API CULTURE & SERICULTURE	5
			BIOPROCESS TECHNOLOGY	
			APPLIED ENTOMOLOGY	
				<b>15</b>
<b>Extra Disciplinary Courses ( 1 )</b>				

1	21PZOED1 OBJECTIVE TYPE	EDC-I	ECONOMIC ZOOLOGY (ONLINE PAPER)	5
<b>OVERALL TOTAL CREDIT FOR PG COURSE</b>				
1	Core Courses	13 ( 12 X 5 + 1 X 10 )14X5		70
2	Elective Courses	3 X5		15
3	Extra Disciplinary Course	1 X5		5
	<b>Total Credits</b>			<b>90</b>

### BLOOM'S TAXONOMY BASED ASSESSMENT PATTERN

K1-Remember; K2- Understanding; K3- Apply; K4-Analyze; K5- Evaluate

#### 1. Theory: 75 Marks

Knowledge Level	Section	Marks	Description	Total
K1	A (Answer All)	10 x 2 = 20	Very Short Answers	75
K2	B (Either Or)	5 x 5 = 25	Short Answers	
K3 & K4	C (3 out of 5)	3 x 10 = 30	Descriptive / Detailed	

#### 2. Practical Examinations: 60 Marks

Knowledge Level	Section		Total
	Practical & viva voce	Record Work	
K3	50	10	60
K4			
K5			

## **PROGRAM – M.Sc. Zoology**

### **PROGRAM OBJECTIVES**

- 1 Students will be gained skills to apply fundamental scientific knowledge to create innovative ideas in a multidisciplinary way for the development of the nation to compete at a global level.
- 2 Pupils will be promoted to develop a passion for lifelong learning to develop their individual and team skills for their ever success towards the evolving professional demands in the modern era.
- 3 Students will be motivated for their higher education in highly reputed national and international institutions towards their intellectual careers.
- 4 Students will be provided with a high level of relevant knowledge and expertise in the contemporary area of Zoology which will lead to engaging in significant, independent, and innovative research.
- 5 Students will be able to prove capability in techniques and analytical methods in the vast area of biological sciences and other related fields.
- 6 Graduates will be provided skill based programs and encourage for self-employment in applied field of Zoology
- 7 Students will be able to gain knowledge and skills for better planning, conservation and management of animal resources in the environment.

### **Programme Specific Outcomes (PSO)**

After the completion of the M.Sc Course, the student would be

- 1 Students will be gained skills to apply fundamental scientific knowledge to create innovative ideas in a multidisciplinary way for the development of the nation to compete at a global level.
- 2 Pupils will be promoted to develop a passion for lifelong learning to develop their individual and team skills for their ever success towards the evolving professional demands in the modern era.
- 3 Students will be motivated for their higher education in highly reputed national and international institutions towards their intellectual careers.
- 4 Students will be provided with a high level of relevant knowledge and expertise in the contemporary area of Zoology which will lead to engaging in significant, independent, and innovative research.
- 5 Students will be able to prove capability in techniques and analytical methods in the vast area of biological sciences and other related fields.
- 6 Graduates will be provided skill based programs and encourage for self-employment in applied field of Zoology
- 7 Students will be able to gain knowledge and skills for better planning, conservation and management of animal resources in the environment.

## PROGRAM OUTCOMES

Upon completion of the M.Sc. Degree programme, the graduate will be able to

PO1	Students acquire fundamental knowledge and skills on the taxonomy of animals and their interactions in nature and Gain knowledge on anatomical structure and functions of various animals of different phyla, their relationship with environment
PO2	Acquire a comprehensive knowledge of biology in a diversity of organisms encompassing different ecosystem levels. Understand the new avenues of the biological sciences and imbibe the knowledge from different perspectives
PO3	Familiarize the major evolutionary pattern, adaptation and behaviour of various group of animals and Assess the biodiversity of animals in the natural ecosystems and their importance and conservation measures
PO4	Understand structure of biomolecules and its various physiological processes at cellular and molecular level of animals and Gain information on diseases, disorders associated with humans to improve the health and hygiene of public
PO5	Demonstrate the ability to engage in critical, independent, and creative thinking and Acquire skill in the field of live stock, sericulture, apiculture, fisheries, poultry, and agricultural pests etc., to improve the employment opportunities
PO6	. Acquire the practical skills and ability to perform experiments and analyses to obtain accurate results and thus gain the ability to solve problems .and they become familiar with good laboratory practices and the basic skill of recent bioinstrumentation and biological techniques for research career.
PO7	Execute collection and preservation techniques of biological samples and apply suitable statistical methods to research studies using computer.



**I  
SEMESTER**

**SEMESTER - I – CC-I  
21PZO1**

**HOURS/ WEEK – 7  
CREDIT- 5**

## **INVERTEBRATES AND CHORDATES**

### **Course Objectives:**

1. Know the functional aspects of different systems of invertebrates and vertebrates
2. Study the fundamentals classification of invertebrates
3. Understand the behavior mechanism of non-chordates
4. Study the mechanism of various organ systems of invertebrates and vertebrates
5. Learn the integumentary and skeletal systems of animals

### **UNIT – I: INVERTEBRATES**

Symmetry in animal organization –Protozoan parasites-- Origin, types and significance of coelom – Polymorphism in coelenterate – Locomotion in Annelids foot in Mollusca– Feeding mechanism in Polychaetes - Arthropod vectors- water vascular system in Echinoderms.

### **UNIT – II: RESPIRATORY, EXCRETARY AND NERVOUS SYSTEM**

Respiration: Gill respiration in prawn tracheal respiration in cockroach- ctenidial and pulmonary respiration in phyla – Excretion: Contractile vacuole in paramecium, flame cells in planaria, green glands in prawn. Excretory organs in invertebrates. Nervous system: Nervous system in Arthropods, Mollusca and Echinoderms. Metamorphosis in insects.

### **UNIT – III: LARVAL ADAPTATIONS AND MINOR PHyla**

Invertebrates, larval forms, adaptations and transformation Minor phyla classification Mesozoa, Rotifera, Brachiopoda, and Cheatognatha.

### **UNIT – IV: BIOLOGY OF CHORDATES**

Integumentary system: Structure – Derivatives (Glands, Hairs, Scales, Horns, Skin Pigments). Dentition in Mammals –Parental care in fishes – Comparison of brain of chordates- flying reptiles- and circulatory system of fishes. Fossil birds (Archaeopteryx).

### **UNIT –V: RESPIRATION IN FISHES**

Pulmonary respiration in birds Excretory system: Types and evolution of kidneys. . Adaptive radiation in mammals and the phylogenic relationship. Evolution of vertebrate of hearts.



**Course out come**

CO 1	Understand, apply and evaluate the processes and mechanisms of nutrition and digestive system in selected examples of invertebrates and chordates.
CO 2	Understands the organs and the physiology of respiration and excretion in invertebrates and chordates
CO 3	Apply, analyze and evaluate the Circulation in invertebrates and chordates.
CO 4	Evaluate the techniques relating to the Nervous system, and how they work within the body to respond to challenges.
CO 5	Understand and apply the concepts of chemical coordination and reproduction.

**Mapping Course Outcomes with Programme Outcomes**

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO1	9	9	3	3	1	9	3
CO2	9	3	3	9	9	3	9
CO3	9	9	9	3	3	9	1
CO4	9	3	3	9	9	9	3
CO5	3	9	3	3	1	9	9
Weightage	39	33	21	27	23	39	25
weighted percentage of course contribution of pos	5.2	4.6	3.6	4.3	4.3	5.7	4.4

Level of correlation Between CO's and PO's

**1 - Low    3 - Medium    9 - High    0 - No correlation**

**Text Books:**

Barrington, E.J.W. (1979): —Invertebrate Structure and Function, II Edn. The English Language Book Society and Nelson.

Thangamani A., Prasannakumar,S., Narayan,L.M., Arumugam.N.(2007) Animal diversity Vol.2 Chordata. Saras Publication.

**REFERENCE BOOKS:**

1. Jan A.Pechenik (2014). Biology of Invertebrates. MC Grew Hill Education.
2. Ayyar, E.K., and Anandhakrishnan, T.N. (1992). A Manual of Zoology. Vol. II (Chordata).Viswanathan Publishers.
3. Barnes, R.D. (1982) – Invertebrate Zoology, IV Ed., Holt Saunders – International Edition.
4. Barrington, E.J.W. (1979) Invertebrate Structure and Function, II Ed., ELBS and Nelson.
5. Hymen, G.H., (1993). The Invertebrates, Vols. I to VII, McGraw Hill Book Co Inc., New York.
6. Kent, G.C. (1976). Comparative Anatomy of the Vertebrates, McGraw Hill Book Co Inc., New York.
7. Kotpal, R.L., (2002). Minor Phyla.Rastogi Publication, Meerut.
8. Vasantika Kashyap (1997). Life of Invertebrates, Vikas Publishing House Pvt. Ltd., New Delhi.
9. Waterman, A.J., (1971), Chordate Structure and Function.The Macmillan Company.

**SEMESTER - I – CC-II  
21PZO2**

**HOURS/ WEEK – 7  
CREDIT- 5**

## **CELL AND MOLECULAR BIOLOGY**

The main objectives of this course are to:

1. Provide students with relevant knowledge, skills and values in contemporary molecular cell biology.
2. Apply experimental techniques to carry out high quality teaching and scientific research.
3. Acquire advanced knowledge of molecular biology of prokaryotes, and eukaryotes.
4. Study principles of cell communication and adhesion
5. Study cancer/ oncogenes, virus induced cancer and therapies, Cellular morphology and markers

### **UNIT – I: CELL ORGANELLES: PLASMA MEMBRANE AND NUCLEUS**

Plasma membrane: Ultra structure – Models proposed (Trilaminar Model, unit Membrane model, Lattice Model, Micellar Model and Fluid Mosaic Model) – Functions movement across plasma membrane (Permeability, Osmosis, Passive transport, Active transport and Permease system, Endocytosis, Exocytosis and Phagocytosis). Nucleus: Ultra Structure and functions – Nucleolus Ultra structure and function.

### **UNIT – II: CELL ORGANELLES: MITOCHONDRIA, ENDOPLASMIC RETICULUM, GOLGI COMPLEX, LYSOSOME AND CENTROSOME**

Mitochondria: Structure – Electron transport system, oxidative phosphorylation. Endoplasmic reticulum: Morphology and Functions Golgi complex: Structure - Functions in s. Lysosome – Morphology, and functions. Ribosome types and functions.

### **UNIT – III: DNA**

DNA structure and types, Watson and Crick's model of DNA ( Double helical structure)- DNA as genetic material (Griffith experiment, Avery and McLeod Experiment) - DNA replication (Messelson and Stahl's experiment) Circular and Theta model of replication– Enzymes involved in DNA replication in prokaryotes and eukaryotes (Nucleases, polymerases, and its types, ligases and Helicase ). Enumeration of genetic code.

### **UNIT – IV: RNA**

**RNA Structure:** Types of Non genetic RNA: r RNA, m RNA t RNA anti sense RNA - Mechanism of transcription in prokaryotes and eukaryotes – Reverse Transcription- Post transcriptional modifications- Mechanism of protein synthesis.

## UNIT – V: VECTORS AND THERAPY

Vector system (Cosmids, plasmids, YACS, BACS) - Methods of construction of recombinant vectors- application of viral vectors in gene therapy –Prospectus and problems.

### Course outcomes

CO 1	Get knowledge about cell organelles and their functions understand the structure of DNA, its denaturation and renaturation, transposable elements.
CO 2	Understand the various functions adapted inside the cells.,analyse the process of Cell cycle, DNA replication and DNA repair mechanisms
CO 3	Understand the process of gene expression. Apply knowledge on molecular mechanisms of protein synthesis
CO 4	Analyse the gene expression, control mechanisms and understand the concept of antisense RNA.
CO 5	Understand membrane transport and analyze protein sorting and vesicular transport.

### Mapping Course Outcomes with Programme Outcomes

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO1	9	9	3	3	1	3	1
CO2	9	9	3	3	3	3	3
CO3	3	9	3	9	9	9	9
CO4	9	3	9	9	9	3	3
CO5	9	9	9	3	3	9	9
Weightage	39	39	27	27	25	27	25
weighted percentage of course contribution of pos	5.2	5.4	4.7	4.3	4.6	4	4.4

Level of correlation Between CO's and PO's

**1 - Low    3 - Medium    9 - High    0 - No correlation**

**REFERENCE BOOKS:**

1. De Robertes, E.D. P. and De Robertes, E.M.F. (1987). Cell and Molecular Biology, VIII Ed. Lea and Febiger, Philadelphia.
2. Cooper, J.M., Hausman, R.E. (2009). The Cell. Sinauer Associates, Inc., USA.
3. Bruce Alberts and Dennis Brey, (1994). Molecular Biology of the Cell. 3rd Edition. Garland Publishing, Inc. New York and London.
4. Becker and Deamer, (1991). The World of the Cell. 2nd Edition. The Benjamin and Cumming Publishing Company, Inc. California.
5. Alberts, B., Johnson, A., Luwis, J. Raff, M. Robertes, K., Walter, P. (2002). Molecular Biology of Cell. Garland Science (Taylor & Francis Group), New York.
6. Sambrook, J., Russell, D.W., (2001). Molecular cloning: A Laboratory Manual, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.

**SEMESTER –I- ECI  
21PZOE1A**

**HOURS/ WEEK – 6  
CREDIT- 5**

## **BIO INSTRUMENTATION**

### **Course objectives:**

1. To understand the principle, working and the applications of the instruments used in biological sciences,
2. to acquire knowledge on the recent and advanced techniques used in the field of biological sciences

### **UNIT- I - MICROSCOPY**

Principle and applications of Light microscope, Phase contrast microscope, Fluorescence microscope, Atomic force microscope, Scanning and Transmission Electron microscope (SEM and TEM).

### **UNIT -II – ANALYTICAL INSTRUMENTS**

Principle and uses of analytical instruments: balances, pH meter, Electrophoresis techniques (native, SDS-PAGE, AGE). Principle and working of different types of centrifuge. Autoclave, laminar air flow, colony counter.

### **UNIT- III - CHROMATOGRAPHIC TECHNIQUES**

Principle and applications of Chromatography, Paper Chromatography, Thin Layer Chromatography, Column chromatography - High Performance Liquid Chromatography (HPLC), Gas Chromatography Mass Spectrometry GC-MS,

### **UNIT -IV - ELECTROCHEMICAL TECHNIQUES**

Principle and application of Spectrophotometry – UV visible spectrophotometer, Spectrofluorimeters – Flame photometry- Atomic Absorption Spectrophotometer, IR Spectroscopy,

### **UNIT -V- BLOTTING TECHNIQUES**

Blotting technique: Southern blotting, Western blotting, ELISA and DNA finger printing. Biosensors and Biochips – Principle Hybridoma technology and monoclonal antibodies.

### Course Outcome

<b>CO 1</b>	understand and analyse the principles and applications of microscopy and spectroscopy
<b>CO 2</b>	Understand the principles and application of various instruments for biological Science
<b>CO 3</b>	understand and analyse the principles of Micro techniques, Immunocytochemistry and photometry
<b>CO 4</b>	Understand and analyse the types of Chromatography
<b>CO 5</b>	Evaluate the application of various instruments and to understand and analyse the types of Electrophoresis

### Mapping Course Outcomes with Programme Outcomes

<b>PO CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>
<b>CO1</b>	9	9	9	3	3	9	3
<b>CO2</b>	9	3	9	9	3	9	3
<b>CO3</b>	9	3	3	9	9	3	9
<b>CO4</b>	3	9	9	9	3	3	9
<b>CO5</b>	9	9	3	9	9	9	9
<b>Weightage</b>	<b>39</b>	<b>33</b>	<b>33</b>	<b>39</b>	<b>27</b>	<b>33</b>	<b>33</b>
<b>weighted percentage of course contribution of pos</b>	<b>5.2</b>	<b>4.6</b>	<b>5.7</b>	<b>6.3</b>	<b>5</b>	<b>4.9</b>	<b>5.8</b>

Level of correlation Between CO's and PO's

**1 - Low    3 - Medium    9 - High    0 - No correlation**

**REFERENCE BOOKS:**

1. Daniel, M., (1992). Basic Biology, Wiley International, NewDelhi.
2. Das. A., (1996). Biophysics and Biological chemistry. Academic publishers, Calcutta.
3. P.K. Gupta (2010). Elements of Biotechnology (Rastogi publication), New Delhi.



**SEMESTER –I- ECI  
21PZOE1B**

**HOURS/ WEEK – 6  
CREDIT- 5**

## **POULTRY FARMING**

### **Course objectives**

1. Make the students to develop knowledge on the history and the role of poultry in rural development and its structure.
2. Students can learn the methods of rearing, breeding and production of poultry.
3. Get the knowledge about the preparation of feed antibiotics, vaccines and marketing.
4. It gives an idea for the self-employment opportunities to the students. The role of different research organizations and funding agencies to promote poultry farming

### **UNIT- I INTRODUCTION TO POULTRY SCIENCE**

Origin and history of poultry species: Chicken, turkey, duck and quail – Poultry industry India. Common poultry breeds – Indian, Asiatic, Mediterranean, English, American breeds. . Nomenclature of breeds of fowl, classification of fowls, Choosing commercial layers and broilers. Housing and equipment – General principles in building poultry sheds, deep litter system, laying cages.

### **UNIT- II BROODING AND REARING**

Natural and artificial brooding - Methods of brooding: brood temperature, space and duration; feed, water and space allowance – brooder rings Management of growers, layers, broilers – lighting of chicks, growers and layers. Summer and winter management, debeaking, sanitation and hygiene. Poultry manure – volume, composition, value and disposal.

### **UNIT- III FEED ADDITIVES**

Feed additives – definition – classification the impact on human health. Food stuffs for poultry in relation to protein, amino acids, minerals (Ca, Na and P), vitamins and fats . Feed formulations for chicks, growers, phase I to phase III layers and broilers. Nutritive value of egg, factors affecting egg size, storage and preservation of egg, marketing, incubation and hatching of eggs.

### **UNIT- IV DISEASE MANAGEMENT**

Symptoms, prevention, control and treatment of viral (New castle disease, Fowl pox), bacterial (Salmonellosis, Fowl cholera), fungal (Aspergillosis, Aflatoxicosis ), protozoan and worm infection, ticks, mites and lice tape worm- vaccination methods.

## UNIT- V ECONOMICS OF POULTRY

Processing, Preservation, grading, storage and trade of eggs and cuts of poultry.  
Economics of Poultry production – problems in poultry production.

### Course Outcomes

<b>CO1</b>	Get knowledge about the importance of poultry farming
<b>CO2</b>	Understand the types of poultry breeding with Brooding and Rearing
<b>CO3</b>	Apply the knowledge in types of incubators for poultry breeding
<b>CO4</b>	Analyze the importance of poultry marketing
<b>CO5</b>	Analyze the importance of poultry Economics and with Disease management

### Mapping Course Outcomes with Programme Outcomes

<b>PO CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>
<b>CO1</b>	3	3	9	3	3	9	9
<b>CO2</b>	9	3	3	9	9	3	3
<b>CO3</b>	3	9	3	9	3	9	3
<b>CO4</b>	3	3	9	3	9	9	9
<b>CO5</b>	9	9	3	3	9	3	3
<b>Weightage</b>	<b>27</b>	<b>27</b>	<b>27</b>	<b>27</b>	<b>33</b>	<b>33</b>	<b>27</b>
<b>weighted percentage of course contribution of pos</b>	<b>3.6</b>	<b>3.7</b>	<b>4.7</b>	<b>4.3</b>	<b>6.1</b>	<b>4.9</b>	<b>4.7</b>

Level of correlation Between CO's and PO's

**1 - Low    3 - Medium    9 - High    0 - No correlation**

**REFERENCE BOOKS:**

1. Ahsan, J. and Sinha, S.P. (2003). A Hand book on Economic Zoology. S. Chand & Company Ltd., New Delhi.
2. Arumugam, N., Murugan, T., Johnson Rajeshwar, J. and Ram Prabhu, R. (2009). Applied Zoology. Saras Publication, Nagercoil.
3. Banerjee G.C. (1992) A textbook of animal husbandary, Oxford and IBM Publishing Co., New Delhi.
4. Crawford RD.(1990). Poultry Breeding and Genetics.
5. Elsevier. Hutt FB. (2003). Genetics of Fowl. Norton Greek Press.
6. Gupta, S.B., Indian Poultry Industry year book (1975) –C-34, New Bactak Road, New Delhi
7. Intensive Poultry Management for egg production. Bulletin NO. 152, London.
8. Shukula, G.S. and Upadhyay V.B. (1997) Economic Zoology, Rakesh Rastogi Meerut.
9. Singh RP and KumarJ. (1994). Biometrical Methods in Poultry Breeding. Kalyani.
10. Tomar, B.S. and Singh, N. (2007). A Text Book of Applied Zoology. Emkay Publications, Delhi.
11. Sunil Kumar Das (1994) – Poultry production, CBC Publishers and Distributors, Delhi.
12. Babu, M. and Lurthu Reetha, T. (2011). A Handbook on Poultry farming. Tamilnadu Veterinary and Animal Sciences University, Tiruchirappalli.

SEMESTER –I- ECI  
21PZOE1C

BIOCHEMISTRY

HOURS/ WEEK – 6  
CREDIT- 5

**OBJECTIVES:**

- To understand the chemical basis of life.
- To study the bio molecules, their structure and reactions and energy metabolism of the cell.

**UNIT – I**

**Chemical bonds and interaction:** Hydrogen bond, ionic bond and covalent bonds- Vanderwaals force and hydrophobic interactions - Water as a solvent - **pH and buffers:** Acid-base reactions- dissociation constants (Ka) - role of buffers in biological systems. **Carbohydrates:** Monosaccharides: linear and heterocyclic structure- conformational structure- isomers - epimers. Disaccharides - oligosaccharides - polysaccharides- Glycoproteins and glycolipids.

**UNIT – II**

**Proteins:** Primary structure – peptide bond. Secondary structure – $\alpha$ helix -  $\beta$  pleated sheet and bends-Prediction of secondary structure: Ramachandran plot. Tertiary structure - Forces stabilizing tertiary structure - Domains and motifs. Quaternary structures - Molecular chaperones - prions. **Lipids:** Structure – Steroids – Cholesterol.

**UNIT – III**

**Enzymes:** Classification of enzymes - co-enzymes- iso-enzymes- ribozyme - abzymes. Enzyme specificity: Mode of enzyme actions - Formation of enzyme substrate complex. **Enzyme kinetics:**Equilibrium and steady-state assumptions- Michaelis -Menten equation-significance of Km Value- MM &LB plots - Enzyme regulation

**UNIT – IV**

**Carbohydrate metabolism:** Glycolysis- Pentose phosphate pathway- citric acid cycle-oxidative phosphorylation. Gluconeogenesis - Cori cycle. Glycogenesis - Glycogenolysis - Adenylate cascade system- Regulation of glycogen synthesis – Intermediate metabolism.

**UNIT – V**

**Metabolism of Proteins:** Deamination, transamination and trans deamination. **Metabolism of lipids:**  $\beta$  oxidation – alpha oxidation - omega oxidation -synthesis of triacylglycerols - **Synthesis of essential amino acids:** methionine and valine - synthesis of purine and pyrimidine nucleotides.

**Course Outcomes**

<b>CO1</b>	Get knowledge about the importance of Chemical bonds and interaction
<b>CO2</b>	Understand the structure and functions of carbohydrates, proteins and lipids
<b>CO3</b>	Apply the knowledge in knowing about Classification of enzymes and Enzyme kinetics
<b>CO4</b>	Analyze the importance of Carbohydrate metabolism
<b>CO5</b>	Analyze the importance of the Metabolism of Proteins, lipids and Synthesis of essential amino acids

**Mapping Course Outcomes with Programme Outcomes**

<b>PO CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>
<b>CO1</b>	9	9	9	3	1	9	9
<b>CO2</b>	3	3	3	9	9	9	3
<b>CO3</b>	9	9	1	3	3	3	9
<b>CO4</b>	9	3	9	9	9	9	3
<b>CO5</b>	3	9	3	3	1	3	9
<b>Weightage</b>	<b>33</b>	<b>33</b>	<b>25</b>	<b>27</b>	<b>23</b>	<b>33</b>	<b>33</b>
<b>weighted percentage of course contribution of pos</b>	<b>4.4</b>	<b>4.6</b>	<b>4.3</b>	<b>4.3</b>	<b>4.3</b>	<b>4.9</b>	<b>5.8</b>

Level of correlation Between CO's and PO's

**1 - Low    3 - Medium    9 - High    0 - No correlation**

### **TEXT BOOKS**

1. Cox M.M. and Nelson D.L. Lehninger's Principles of Biochemistry, 4th Ed., New York: W.H. Freeman, 2005.
2. Ambika Shanmugam, Fundamentals of Biochemistry for Medical Students, Revised Ed., 2001.

### **REFERENCE BOOKS:**

1. VoetD. and Voet, J.G., Biochemistry, 4th Ed., John Wiley & Sons, 2011.
2. BergJ.M., TymoczkoJ.L. and StryerL. Biochemistry, 6th Ed., W.H Freeman and Company, New York, 2007.
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**II  
SEMESTER**

**SEMESTER -II – CC-V  
21PZO5**

**HOURS/ WEEK – 5  
CREDIT- 5**

## **ANIMAL PHYSIOLOGY**

### **Course Objectives:**

1. Understand the internal physical and chemical functions of animals and their parts
2. Study the digestion and excretion, blood and circulatory system,
3. Understand the respiration and nervous system
4. Understand the sense organs and reproduction of Animals
5. Learn about the mammalian organs

### **UNIT- I- DIGESTION AND NUTRITION**

Food: Definition, types, calorific values and its requirements. **Digestion:** Definition and types – Nutrition-Food requirements. Balanced diet. Physiology of Digestion in stomach. Digestive enzymes and their role in the digestion of carbohydrates, proteins and lipids. Absorption and assimilation.. BMR and BMI.

### **UNIT – II – RESPIRATION AND CIRCULATION**

Respiration: Definition, Structure of Mammalian lungs , gaseous exchange- Transport of oxygen–Formation of oxyhaemoglobin, - Transport of CO<sub>2</sub>, Chloride shift, Bohr Effect. Circulation: Structure of mammalian heart and its working mechanism – Heart beat and cardiac cycle-Functions of blood. Mechanism of blood coagulation.

### **UNIT- III – EXCRETION AND MUSCLES**

Excretion: – Organization of mammalian excretory system-structure and function of kidney and nephron – Mechanism of urine formation  
. Muscles : –General structure and types of muscles. Ultra structure of skeleton muscle- Mechanism of muscle contraction.- Sliding filament theory.

### **UNIT – IV- NERVE AND RECEPTORS**

Structure of neuron, types , Nature of nerve impulse – Conduction of nerve impulse, Structure of synapse, mechanism of synaptic transmission – Electrical and Chemical transmissions -Receptors: types, Photoreceptor – structure of human eye. rods and cones, blind-spot, image formation in brain. Phonoreceptors – structure of human ear. Mechanism of hearing.

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### **UNIT- V – ENDOCRINE SYSTEM**

Endocrine glands – Hypothalamus and Pituitary gland. Hormones of Pituitary gland - Structure and Hormones of Pineal gland, Thyroid gland, Parathyroid, Adrenal and Pancreas. Sex hormones – Hormonal control of menstrual cycle in humans.

#### **Course out come**

<b>CO 1</b>	Understand and analyse the adaptations, mechanism of homeostasis in invertebrates and vertebrates.and Know the importance of nutrients and digestion
<b>CO 2</b>	Remember, understand, analyse, and evaluate the physiology of circulation, respiration ,excretion and muscle
<b>CO 3</b>	Understand and analyse the physiology of effectors, receptors and neuronal conduction.
<b>CO 4</b>	Understand and analyse the physiology of endocrine glands and their secretions. in insects and man.
<b>CO 5</b>	Understand, analyse physiology of reproductive organs and apply the techniques for infertility.

### Mapping Course Outcomes with Programme Outcomes

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO1	3	9	9	3	3	9	3
CO2	9	3	9	3	3	9	3
CO3	9	9	3	9	9	9	9
CO4	3	3	3	9	3	3	9
CO5	9	9	9	3	9	9	3
Weightage	33	33	33	27	27	39	27
weighted percentage of course contribution of pos	4.4	4.6	5.7	4.3	5	5.7	4.7

Level of correlation Between CO's and PO's

**1 - Low    3 - Medium    9 - High    0 - No correlation**

#### REFERENCE BOOKS:

1. Baldwin, E. (2004). An Introduction to Comparative Biochemistry, Cup, London.
2. Beck, W.S. (1991). Human Digestion, Harcourt Brace Jorandorich Inc.
3. Dawson, H. (1994). General Physiology, Little Brown Co., Boston.
4. Echert, R. and Randall, D. (1987). Animal Physiology, Cbs Publishers and Distributors.
5. Giese, A.C. (2009). Cell Physiology and Biochemistry, Prentice Hall.
6. Prosser, C.L. Brown (1985). Comparative Animal Physiology, Satish Book Enterprise, Agra.
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**SEMESTER -II – CC-VI  
21PZO6**

**HOURS/ WEEK – 5  
CREDIT- 5**

## **MICROBIOLOGY**

### **Course Objectives:**

1. Know the structure, functions and classification of bacteria, viruses, fungi and yeast
2. Apply knowledge on the Cultivation and control of microorganism
3. Understand the distribution of microorganisms
4. Learn about the microorganisms and their detection
5. Understand the application of microorganisms in microbial technology

### **UNIT – I-HISTORY, STRUCTURE AND ECONOMIC IMPORTANT OF MICROBES**

History and Scope of microbiology- Classification of microbes- Whittaker's five kingdom classification - Carl Woese's three domains concept-Types of culture – culture media-culture methods - culture techniques Sterilization. Structure of bacteria, virus, yeast and fungi, - Economic importance of bacteria and fungi. Maintenance of bacteria culture.

### **UNIT – II- MICROBIAL TECHNOLOGY**

Mass production of rhizobium - – Single Cell Protein (SCP) – Production of ethanol, citric acid – Antibiotics – Microbial toxins . Microbial Genetics: Recombination in Bacteria – Transformation – conjugation – Sex duction; Recombination in Bacteriophage – Transduction – Lytic and Lysogenic cycle.

### **UNIT – III- MICROORGANISMS AND ENVIRONMENT**

Soil microbiology - interactions with the atmosphere. Distribution of Microorganisms in Aquatic environment – Microbiol analysis of water samples- in fresh water and marine water. Microorganisms in sewage. Microorganism in extreme environments- thermophilic, methanogenic and halophilic. Photosynthetic bacteria, Cyanobacteria, bioleaching

### **UNIT- IV- FOOD AND INDUSTRIAL MICROBIOLOGY**

Food Microbiology: Microbes of milk and food, – Food preservation methods- Spoilage of food, fruits, vegetables, cereals, meat, egg, seafood and canned food *Salmonellosis*, - Food borne infections, food poisoning and intoxications (*Clostridium*, *Salmonella*, and *Staphylo*

*coccus*) mycotoxins in food with reference to *Aspergillus* species. Industrial Microbiology: Production of lactic acids- hormones and enzyme – production of penicillin.

## UNIT – V - MICROBIAL DISEASES

General account of Pathogenic Bacteria – prognosis, diagnosis and treatment for diseases caused by viruses (Yellow fever, Dengue, Corona) - Bacteria (Pneumonia, Whooping cough, leprosy, botulism,) Fungi (Cutaneous mycoses, , Athlete’s foot, , Mycotoxicosis) and Protozoa (Malaria, Amoebic dysentery, Trypanosomiasis).

### Course Outcome

<b>CO 1</b>	Classify the microbes and understand the structure and characteristic features of bacteria and other microbes
<b>CO 2</b>	Understand and analyze the growth, factors affecting growth, growth characteristics and requirements of bacteria and Identification of microbes
<b>CO 3</b>	Understand and apply the physical and chemical control measure, explains mode of action of antibiotics and lists the microbial diseases in farm animals.
<b>CO 4</b>	Understand and apply role of microbes in food and industries
<b>CO 5</b>	Understand and apply the beneficial role of microbes in biotechnology

**Mapping Course Outcomes with Programme Outcomes**

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO1	9	3	3	9	3	9	3
CO2	3	9	3	3	9	9	9
CO3	9	3	9	9	3	9	1
CO4	9	9	9	9	9	3	9
CO5	9	3	3	9	3	9	3
<b>Weightage</b>	<b>39</b>	<b>27</b>	<b>27</b>	<b>39</b>	<b>27</b>	<b>39</b>	<b>25</b>
<b>weighted percentage of course contribution of pos</b>	<b>5.2</b>	<b>3.7</b>	<b>4.7</b>	<b>6.3</b>	<b>5</b>	<b>5.7</b>	<b>4.4</b>

Level of correlation Between CO's and PO's

**1 - Low    3 - Medium    9 - High    0 - No correlation**

**REFERENCE BOOKS:**

1. R.C. Dubey, D.U. Maheshwari (2005). A Text book of Microbiology. S.Chand and Company Ltd, New Delhi.
2. Burden, K.L. and R.P. Williams (6th Ed.) (1968). Microbiology. The Macmillan Co., London
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9. Roberts, T.A. and F.A. Skinner (Eds.) (1983). Food Microbiology: Advances and Prospects, Academic Press, Inc. London, 393 pp.
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**SEMESTER - II – EC-II  
21PZOE2A**

**HOURS/ WEEK – 5  
CREDIT- 5**

## **FISHERY BIOLOGY**

### **Course Objectives**

1. To explore the aquatic resources of the edible and economically important organisms.
2. To make use of the inland waters and marine potential to substitute the protein requirements by the human population.
3. To provide self employment opportunities and knowledge for students.
4. Acquire basic knowledge on Oceanography
5. Study the ecological and economic importance of marine flora and fauna
6. Understand biodiversity and its conservation strategies of marine organisms
7. Know the pharmacological importance of marine organisms
8. Understand the various threats for marine life

### **UNIT -I MARINE AND FRESH WATER FISHERIES**

World and Indian fisheries, Marine fisheries – Sardines, Mackerals, Carangids and Sharks. Inland fisheries – Freshwater, riverine, reservoir, pond and cold water fisheries. Estuarine and brackish water fisheries- Crustacean fisheries, molluscan fisheries Deep sea fishing.

### **UNIT- II FISH MIGRATION**

History of Ichthyology –. Fishes and their evolutionary history. Fish migration – Types of migratory fishes: Diadromous fishes - Anadromous, Catadramous and Amphidromous - Potomodromous and Oceanodromous fishes. Methods of migration - Factors influencing migration.

### **UNIT- III FISH POPULATION STUDIES**

Assessment of fish stocks: marking and recapture method, area sampling method. Age and growth studies- length-frequency methods, scale method, otolith methods and other skeletal parts as age indicators. Length –weight relationship- condition factor.

### **UNIT- IV- CRAFTS AND GEARS**

Principle and methods of exploitation of sea fishes- ingenious modern gears and crafts – Types of gears used in Indian fishery. Different Types of crafts used in Indian fishery. Material used for making of gears and crafts.



## UNIT -V FISH PROCESSING AND MARKETING

Factors influencing spoilage of fishes Methods of fish preservation: curing, (drying, salting, smoking, chilling) accelerated freeze drying (AFD). Principles of canning of fish and fishery products. Packaging and marketing: trends of domestic and export marketing of fishes.

### Course Outcomes

<b>CO1</b>	Get knowledge about the production of cultivable candidate fish species
<b>CO2</b>	Understand the global, national, traditional and modern techniques related to fishes for food security
<b>CO3</b>	Apply practical knowledge into the aquaculture field to enhance production level
<b>CO4</b>	Analyze students theoretical and technical knowledge useful for teaching, research, extension and entrepreneurship in the field of Aquaculture
<b>CO5</b>	Assess and evaluate the ecological and economic importance of marine organisms

**Mapping Course Outcomes with Programme Outcomes**

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO1	3	3	9	3	3	3	9
CO2	9	3	3	9	3	9	3
CO3	9	9	3	9	9	9	9
CO4	3	3	9	3	3	3	3
CO5	9	9	3	3	9	3	9
Weightage	33	27	27	27	27	27	33
weighted percentage of course contribution of pos	4.4	3.7	4.7	4.3	5	4	5.8

Level of correlation Between CO's and PO's

**1 - Low    3 - Medium    9 - High    0 - No correlation**

**REFERENCE BOOKS:**

1. Bose, A.N., Yang, C.T., and Misra, A. (1991) Coastal Aquaculture Engineering. Oxford and Ibh Publishing Co., Pvt. Ltd., New Delhi.
2. Chakrabarti, N.M., (1994) Diseases of Cultivable Freshwater Fishes and Their Control. International Books and Periodicals Supply Service, New Delhi.
3. Day, F., (1986). The Fishes Of India, Vols. I & II. Today and Tomorrow's Book Agency, New Delhi.
4. Govindan, T.K. (1992) Fish Processing Technology, Oxford And Ibh Publishing Co., Pvt. Ltd., New Delhi.
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6. New, M.B., Tacon. A.G.J. and Csavas. I. (1993). Farm – Made – Aqua Feeds. Food and Agrilculture Organization of UnitedNations, Rome.
7. Santhanam, R., (1990). Fisheries Science, Daya Publishing House, New Delhi.
8. Seghal, K.K. (1992). Recent Researches in Cold WaterFisheries, Today and tomorrow's Publishers and Printers, New Delhi.
9. Sinha, V.R.P. (1993) A Compendium of Aquaculture Technologies for Developing Countries. Center for Science and Technology and Oxford Publishing Co., Pvt., Ltd., New Delhi.
10. Pillai, T.V.R. (1993). Aquaculture: Principles and Practices. Fishing News Agency, London.
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12. Biswas, S.P., (1993). Manual of Methods in Fish Biology, International Book Co. Absecon Highlands, New Jersey.
13. Jhingran, V.G., (1991). Fish and Fisheries of India.Hindustan Publishing Copr. New Delhi.

**SEMESTER - II – EC-II  
21PZOE2B**

**HOURS/ WEEK – 5  
CREDIT- 5**

## **RESEARCH METHODOLOGY**

### **Course Objectives:**

1. Acquire basic knowledge on Research
2. Acquire knowledge on dissertation writing and publishing of research papers
3. Understand the basic principle and application of bio-instruments
4. Study the Regulation framework, Good Laboratory Practices and CPCSEA Guidelines
5. Learn the Intellectual Property Rights and patent filing

### **UNIT – I RESEARCH OBJECTIVES**

Types – significance-Components of research- Research process-Selection and defining a research problem- Sources and retrieval of information: journals, monographs, books and computer aided searches-search engines- Formulating a research Hypothesis- Research Design: features of a good design – concept and principles of Experimental design. Research Paper: oral and poster presentation.

### **UNIT – II THESIS WRITING**

Format of thesis- preparation of manuscript and editing- forms of presentation of results-components of Discussion- citing the references- Research papers for publication-writing a research proposal-Impact factor-citation index- manuscript preparation-IPR and patenting.

### **UNIT – III JOURNALS AND ONLINE BROWSING OF RESEARCH ARTICLES**

Details of Popular Magazines and periodicals (monthly, quarterly and half-yearly journals and reviews). Online browsing of research articles: infonet, inflibnet and Pubmed. Peer-reviewed journals, indexed and non-indexed journals.

### **UNIT –IV PREPARATION OF SCIENTIFIC PAPER' FOR PUBLICATION IN A JOURNAL**

Preparation and presentation of research paper for Symposia, Seminar and Conferences. Technical papers and Monographs. Internet and e-journals. Selection of animal models – Maintenance – CPCSEA regulations. Using computers in research – Computer aided techniques for data analysis, data interpretation and presentation.

## UNIT – V BIOSTATISTICS

Collection of data – Collection of primary data, sampling. Descriptive statistics: Measures of central tendency-Mean, median, mode. Measures of dispersion – Standard deviation, standard error, co-efficient of variance. Diagrammatic representation- Bar diagram, Pie diagram, histogram, frequency curve and line graph. Inferential statistics: Hypothesis testing, Student t' test, Chi square test, Analysis of variance (ONE-WAY ANOVA), Correlation, Regression – Application of SPSS package

### Course Outcomes:

<b>CO1</b>	Analyze the basic information on research methods
<b>CO2</b>	Plan the dissertation writing and publishing of a paper
<b>CO3</b>	Understand; and Apply the principle and application of various bio-instruments
<b>CO4</b>	List out the Indian regulatory framework, Good laboratory Practices and CPCSEA Guidelines
<b>CO5</b>	Analyze the procedure, types of patent system and application procedure in India and abroad

**Mapping Course Outcomes with Programme Outcomes**

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO1	3	3	9	3	3	9	9
CO2	9	3	3	9	9	3	3
CO3	3	9	3	9	3	9	3
CO4	3	3	9	3	9	9	9
CO5	9	9	3	3	9	3	3
Weightage	27	27	27	27	33	33	27
weighted percentage of course contribution of pos	3.6	3.7	4.7	4.3	6.1	4.9	4.7

Level of correlation Between CO's and PO's

**1 - Low 3 - Medium 9 - High 0 - No correlation**

**REFERENCE BOOKS:**

1. Pingoud, A. Biochemical Methods. Wiley-VCH, 2003.
2. Venn, R.F. Principles and Practice of Bioanalysis. Taylor & Francis, 2003.
3. Holme, D.J. and Peck, H. Analytical Biochemistry. 3rd Ed., Pearson Education, 1998.
4. Wilson, K. and Walker, J. Practical Biochemistry: Principles and Techniques. 5th Ed., Cambridge University Press, 2000.
5. Wilson, K. and Walker, J. Principles and Techniques of Biochemistry and Molecular Biology. 7<sup>th</sup> Ed., Cambridge University Press, 2010.
6. Holmes, D., Moody, P., Dine, D., Moody, P. and Holmes, D.S. Research Methods for the

Biosciences. Oxford University Press, New Delhi, 2006.

7. Ramadass, P. and Wilson Aruni, A. Research and Writing-across the Disciplines. MJP Publishers, Chennai, 2009.
8. McCleery, R.H. and WATT, T.A. Introduction to Statistics for Biology. 3rd Ed., Chapman & Hall / CRC, 2007.
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SEMESTER - II – EC-II  
21PZOE2C

HOURS/ WEEK – 5  
CREDIT- 5

## PARASITOLOGY

### Objective:

1. To study the types of parasites, lifecycle and diseases.

### UNIT-I

Parasitism: General consideration- Types of parasites - Type of hosts - Symbiosis and commensalism.

Protozoan parasites: Distribution, habit and habitat, structure life cycle and diseases caused by selected pathogenic protozoan parasites of man: Intestinal and urogenital protozoa:

*Entamoebahistolytica* (Amoebae) - *Balantidium coli* (Ciliates)- *Giardia lamblia* (Flagellates)- *Trichomonas vaginalis* (Flagellates)- *Cryptosporidium parvum* (Sporozoa)- *Isospora belli* (Sporozoa).

### UNIT- II

Blood and tissue protozoa: Trypanosoma (*T. brucei* and *T. cruzi*)- Leishmania (*L. donovani*, *L. tropica*, *L. braziliensis*, *L. mexicana* and *L. peruviana*)- Plasmodium (*P. falciparum*, *P. ovale*, *P. malariae* and *P. vivax*)- *Toxoplasma gondii*.

### UNIT –III

Helminth parasites - General characters, organization and larval forms of Platyhelminthes and Nematelminthes. Intestinal helminthes:- *Ascaris lumbricoides* (Large intestinal roundworm)- *Trichinella spiralis* (Trichinosis)- *Trichuris trichiura* (Whipworm)- *Enterobius vermicularis* (Pinworm)- *Strongyloides stercoralis* (Threadworm)- *Necator americanus* and *Ancylostomaduodenale* (Hookworms).

### UNIT- IV

Blood and tissue helminthes: *Dracunculus medinensis* (Guinea worm)- *Toxocara canis* and *T. catti* (Visceral larva migrans)- *Ancylostoma braziliensis*, *Ancylostoma caninum* (Cutaneous larva migrans)- *Wuchereria bancrofti* (Filariasis)- *W. (Brugia) malayi*- *Onchocerca volvulus* (Blinding



worm)- *Loa loa* (Eye worm). :Cestodes (Tapeworms): *Teniasolium* (Pork tapeworm)- *T. saginata* (Beef tapeworm) –*Diphyllobothriumlattum*(Fish tapeworm)- *Hymenolepis nana* (Dwarf tapeworm)-*Echinococcusgranulosus* (Dog tapeworm).

#### UNIT –V

Trematodes (Flukes; Flatworms):- Blood flukes: *Schistosomamansoni*, *S. japonicum* and *S. hematobium*- Intestinal flukes: *Fasciolopsisbuski*- Liver flukes: *Clonorchissinensis*, *Fasciola hepatica*-Lung flukes: *Paragonimuswestermani*. Vector Biology: Vectors and its importance in transmission of parasites- Major malaria vectors of India. Arthropods and Ectoparasites.

#### Course Outcomes:

<b>CO1</b>	Analyze the basic information and General considerations about Types Parasitism
<b>CO2</b>	Understand and Analyze the Blood and tissue protozoan parasites
<b>CO3</b>	Understand and Analyze the Helminth parasites
<b>CO4</b>	Understand and Analyze the Blood and tissue helminthes
<b>CO5</b>	Understand and Analyze the characteristic features of Trematodes

**Mapping Course Outcomes with Programme Outcomes**

<b>PO CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>
<b>CO1</b>	<b>9</b>	<b>3</b>	<b>9</b>	<b>9</b>	<b>9</b>	<b>9</b>	<b>9</b>
<b>CO2</b>	<b>3</b>	<b>9</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>CO3</b>	<b>3</b>	<b>3</b>	<b>9</b>	<b>9</b>	<b>3</b>	<b>9</b>	<b>3</b>
<b>CO4</b>	<b>9</b>	<b>9</b>	<b>9</b>	<b>3</b>	<b>9</b>	<b>3</b>	<b>9</b>
<b>CO5</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>9</b>	<b>3</b>	<b>9</b>	<b>3</b>
<b>Weightage</b>	<b>27</b>	<b>27</b>	<b>33</b>	<b>33</b>	<b>27</b>	<b>33</b>	<b>27</b>
<b>weighted percentage of course contribution of pos</b>	<b>3.6</b>	<b>3.7</b>	<b>5.7</b>	<b>5.3</b>	<b>5</b>	<b>4.9</b>	<b>4.7</b>

Level of correlation Between CO's and PO's

**1 - Low 3 - Medium 9 - High 0 - No correlation**

**TEXT BOOK**

1. Chandler A.S. and Read C.P., Introduction to Parasitology, Wiley, 1970.

**REFERENCES**

1. Chatterjee K.D., Parasitology, Chatterjee Medical Publishers, 1981.
2. Noble E.R and Noble G.A., Parasitology, Lea and Febiger, 1973.
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5. Chiodini P.L. Moody A.H., Manser, D.W. and Livingstone C, Atlas of Medical Helminthology and Protozoology, 4th Ed., 2001.

**SEMESTER - II – EDC  
21PZOED1**

**HOURS/ WEEK – 5  
CREDIT- 5**

## **ECONOMIC ZOOLOGY (Online paper)**

### **Course Objectives:**

1. Study the economic importance of agricultural entomology
2. Learn the communicable and non-communicable diseases in humans
3. Study the importance of animal husbandries
4. Know culture practice and economic importance aquaculture
5. Learn various techniques for food preservation and preparation of value added products

### **UNIT I LAC CULTURE**

Introduction, Taxonomy of lac insect, , Lac culture practice in india. lac insect- life cycle. Important lac - host plants and distribution general practise for lac cultivation- lac products and their uses. Enemies of lac insects and the control.

### **UNIT II DUCK FARMING**

Introduction-- Duck feeding- Advantages of duck rearing over poultry chickens- Breeds of duck- Egg production in ducks-. Common duck diseases.

### **UNIT III GOAT FARMING**

Introduction – breeds of goats found in India- Goat management – Selection of goat breeding stock- Feeding management – Breeding management – Care of goats during pregnancy- management diseases- research and development of goat in India.

### **UNIT IV DAIRY**

Cow- species of cattle, - Indian breeds and Exotic breeds – Milking animals Dairy management -- Diseases- Protection against diseases characterics of buffalo-- Buffalo management - Buffalo Husbandry, Breeding – Economic uses of Buffalos.

### **UNIT V PIG AND RABBIT FARMING**

Breeding pigs used in India, selection of pigs for farming from the available breed,– Economy- Introduction Rabbit breeds, Advantages of rabbit farming- Rabbit house, Rearing feeding and breeding management- Diseases management.

**Course Outcomes:**

CO1	Understand the significance of insects in agriculture
CO2	List the awareness of diseases in humans
CO3	Create the self-employment opportunities to students
CO4	Distinguish the better platform aqua-industries
CO5	Understand the various food preservations techniques.

**Mapping Course Outcomes with Programme Outcomes**

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO1	9	9	3	3	1	3	3
CO2	9	9	3	3	3	3	3
CO3	9	3	9	3	3	9	9
CO4	3	9	3	9	9	3	3
CO5	9	9	9	9	3	9	9
Weightage	39	39	27	27	19	27	27
weighted percentage of course contribution of pos	5.2	5.4	4.7	4.3	3.5	4	4.7

Level of correlation Between CO's and PO's

**1 - Low    3 - Medium    9 - High    0 - No correlation**

**REFERENCE BOOKS:**

1. Jawaid Ahsan and Dr. Subhas Prasad sinha (2010). A Hand Book on Economic Zoology- S.Chand Company Ltd.
2. Vinita Jaiswal and Kamal Kumar Jaiswal (2014). Economic Zoology- PHL Learning.
3. Chaudhuri. S. (2017). Economic Zoology – New Central Book Agency (NCBA).
4. Aminul Islam (2006). Text Book of Economic Zoology. IK. International.

**SEMESTER – I & II – CC –III  
21PZO3P**

**HOURS/ WEEK – 5  
CREDIT- 5**

**CORE PRACTICAL – I (COVERING CCI&CCII)**

**INVERTEBRATE AND CHORDATE**

**VIRTUAL DISSECTION –**

- Cockroach – Digestive and Nervous System.  
Fish – Digestive and Nervous System

**MOUNTING -**

- Teleost : Scales  
Shark : Placoid Scale  
Carps : Cycloid scales

**SPOTTERS:** Invertebrate – Larval forms, Rotifera, Phoronida, Chaetognatha, Amoeba, Parmecium, *Fasciola hepatica*, *Taenia solium*, Peripatus, Sepia, Sea urchin, Trilobite, Nautiloids, Hippocampus, Bufo, Labyrinthodont, Hydrophis, Ichthyosar, Archeopteryx and Platypus.

**CELL BIOLOGY:**

- ❖ Onion Root Tip - Squash Preparation – To Study Different Stages of Mitosis.
- ❖ Measurement of the Size and Volume of Cells Using Ocular and Stage Micrometer.
- ❖ Differential Cell Count – Human Blood Sample
- ❖ Enumeration of RBC and WBC count by using hemocytometer.

**SPOTTERS:**

Ocular Micrometer and Stage Micrometer, Giant Chromosome

**MOLECULAR BIOLOGY:**

- ❖ Isolation of DNA from Animal Tissue
- ❖ Isolation of Plasmid DNA from Bacteria (Demo)
- ❖ Protein estimation by Lowry Method

Course Outcomes:

CO Number	CO Statement
CO1	Evaluate General characters of the Nervous Systems & Digestive System of Cockroach
CO2	Evaluate General characters of the Nervous Systems & Digestive System of fish
CO3	Familiar with the mounting of Teleost: Scales, Shark: Placoid Scales Carps: Cycloid scales
CO4	Familiar with the mounting of Onion Root Tip - Squash Preparation
CO5	Familiar with the Enumeration of RBC and WBC by using hemocytometer

### Mapping Course Outcomes with Programme Outcomes

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO1	9	9	3	9	3	9	3
CO2	3	9	3	9	3	3	9
CO3	9	3	9	3	9	9	3
CO4	3	9	3	9	3	9	9
CO5	9	3	9	3	9	3	3
Weightage	33	33	27	33	27	33	27
weighted percentage of course contribution of pos	4.4	4.6	4.7	5.3	5	4.9	4.7

Level of correlation Between CO's and PO's

**1 - Low    3 - Medium    9 - High    0 - No correlation**

**SEMESTER – I & II – CC –III  
21PZO4P**

**HOURS/ WEEK – 5  
CREDIT- 5**

**CORE PRACTICAL – II (COVERING CC- V & CC-VI)**

**ANIMAL PHYSIOLOGY:**

- Estimation of oxygen consumption by fish
- Estimation of haemoglobin in human blood
- Salt loss and salt gain in fish
- Test for urea and sugar in urine sample
- Quantitative estimation of amylase activity
- Quantitative estimation of ammonia and urea

**SPOTTERS:** Sphygmomanometer (BP apparatus), Stethoscope and ECG.

**MICROBIOLOGY:**

- ❖ Sterilization procedures and maintenance of laboratory.
- ❖ Media preparation and bacterial culture inoculation.
- ❖ Serial dilution and pour plate method and determination of colony number/gram.
- ❖ Culture techniques: Broth culture, Spread plate, Streak plate and Slant culture
- ❖ Identification of bacteria by gram staining method.
- ❖ Observation of bacterial motility by hanging drop method.
- ❖ Enumeration of microbial colony by colony counter.
- ❖ MPN technique for the identification of coliforms in water samples.

**SPOTTERS** : Bacteria, Virus, Fungi and culture plates, laminar air flow, Colony Counter, inoculation loop, autoclave.

**EDUCATIONAL TOUR:**



Visit to R & D labs and different natural habitats zoologically important place such as sea – shore, sanctuary, forest area and the students should write an illustrated study tour report and the same is to be submitted for evaluation at the time of practical Examination.

Course Outcomes:

CO Number	CO Statement
CO1	Evaluate the oxygen consumption, salt loss and salt gain by fish
CO2	Evaluate the Quantitative estimation of amylase activity from saliva and estimation of ammonia and urea
CO3	Familiar with the Sterilization procedures and maintenance of laboratory
CO4	Familiar with the,Media preparation ,Serial dilution and bacterial culture inoculation.in plates and determination of colony number
CO5	Familiar with the water quality analysis

### Mapping Course Outcomes with Programme Outcomes

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO1	9	9	3	3	1	3	3
CO2	9	3	3	3	3	3	3
CO3	9	3	9	9	9	9	9
CO4	3	9	3	9	3	9	9
CO5	9	9	9	3	9	9	3
Weightage	39	33	27	27	25	33	27
weighted percentage of course contribution of pos	5.2	4.6	4.7	4.3	4.6	4.9	4.7

Level of correlation Between CO's and PO's

**1 - Low    3 - Medium    9 - High    0 - No correlation**



**III  
SEMESTER**

**SEMESTER -III – CC-VII  
21PZO7**

**HOURS/ WEEK – 7  
CREDIT- 5**

## **ENVIRONMENTAL BIOLOGY**

The main objectives of this course are to:

1. Understand the nature of relationships among organisms that comprise functioning of ecosystems
2. Provide the knowledge on interactions between organisms and their environments to drive the dynamics of populations and communities.
3. Understand different habitat ecology, resource ecology and their management.
4. Know the different types of pollution and their management to protect the health and welfare of human population in the world
5. Acquire broad knowledge of the field of environmental toxicology.

### **UNIT – I ENVIRONMENT FACTORS**

Abiotic factors: Water, humidity, light. Biotic factors; Intra (Aggregation, colony formation, social organization) and inter specific associations (Neutralism, symbiosis and antagonism). Structure and function of an ecosystem: -Autotrophic and heterotrophic- producers, consumers - – primary and secondary productivity - methods of measurements -different trophic level - energy flow in an ecosystem - food chain - food web -. pyramids.. - intraspecific and inter specific competition.

### **UNIT – II - BIO GEO CYCLES AND POPULATION ECOLOGY**

Nutrient cycles – Nitrogen, phosphorus, Carbon and sulphur – role of microbes in nutrient cycle .Biotic community – Concepts – Stratification – ecological niches – ecotone and ecological succession. Population ecology- definition, natality, mortality Population growth — Population fluctuation - Human population and urbanization.

### **UNIT – III HABITAT ECOLOGY**

Ecosystem - Fresh water, marine, estuary, grassland, forest and desert- adaptations of animals and plants in different ecosystem. Intertidal fauna: Rocky, sandy and muddy shore fauna. Remote sensing, Satellite imaging – Aerial photography – Thermal and infrared images, radar in ecological applications. Instrumentation – GPS, radio telemetry and satellite telemetry. Techniques used in ecological research: GIS techniques in ecological research.

## UNIT - IV ENVIRONMENTAL POLLUTION

Air, Water, thermal, oil, radiation and Marine pollution. Effects and control measures Acid rain, Ozone layer depletion, green house effect, global warming . Bio accumulation – Bio magnification, BOD, COD, TDS, TSS. EIA – Steps in Environment Impact Assessment – Methods of EIA. Sewage and solid waste management - Natural resources - sustainable development –survey. Energy resources - environmental quality standards – soil conservation.

## UNIT V BIODIVERSITY AND CONSERVATION

Biodiversity – basic concepts, types, mega diversity and hotspots of bio diversity, . Endangered and endemic species of India. Conservation biology: Principles of conservation, major approaches to conservation of wild life management, Indian initiatives for conservation of wild life (Project Tiger, Project Elephant and Bio reserves).

### Course Outcome

<b>CO1</b>	Understand the energy transformations across trophic levels and to understand how elements are cycling in the environment
<b>CO2</b>	Explain the concept of limiting factors and interactions of populations and communities in relation to dynamic environmental processes
<b>CO3</b>	Analyze the habitat ecology and to identify various types of natural resources and their management practice.
<b>CO4</b>	Apply the knowledge in monitoring the quality of the environment and to promote bioremediation., and control pollution
<b>CO5</b>	Analyze and evaluate the toxicity of pollutants on living organisms physiology

**Mapping Course Outcomes with Programme Outcomes**

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO1	3	9	9	9	3	3	3
CO2	9	3	9	3	9	3	3
CO3	3	9	3	9	9	9	9
CO4	9	3	9	3	9	1	9
CO5	9	9	3	9	1	9	3
Weightage	33	33	33	33	31	25	27
weighted percentage of course contribution of pos	4.4	4.6	5.7	5.3	5.8	3.7	4.7

Level of correlation Between CO's and PO's

**1 - Low    3 - Medium    9 - High    0 - No correlation**

**REFERENCE BOOKS:**

1. Chapman, B.C and Reigs. M.J. (1997). Ecology principles and application. Cambridge University Press, U.K.
2. Clark, G.C. (1963). Elements of ecology. John Wiley and Sons Inc., New York.
3. Odum, E.P. (1996). Fundamentals of Ecology (III Ed.). Nataraj Publishers, Dehradun. P 574.

4. Ahmad, Y.J and Sammy, G.K. (1985). Guidelines to Environment Impact Assessment in developing countries. Hodder and Stoughton Ltd., London.
5. Asthana, D.K and Asthana, M. (2001). Environment problems and solutions. S. Chand and Co., New Delhi.
6. Bhatia, H.S. (1998). A Text Book on Environmental Pollution and Control, Galgotia, New Delhi.
7. Kumar, H.D. (1997). Modern concepts of ecology. Modern Printers, New Delhi. P 478.
8. Paul Colinvaux, (1986). Ecology. John Wiley and Sons, New York.
9. Srivastava, R.P. and Saxena, R.C.1989. Textbook of Insect toxicity. Himansha publications, Rajasthan.
10. Trivedi, P.R and Gurdeepraj, K. (1992). Environmental biology. Akashdeep Publishing House, New Delhi.
11. Williams.R.T (1959). Detoxification mechanisms. Wiley. New York.

**SEMESTER -III – CC-VII  
21PZO8**

**HOURS/ WEEK – 6  
CREDIT- 5**

## **GENETICS**

### **Course Objectives:**

1. Get knowledge about the structure, organization and functions of genetic materials.
2. Understand the expression, regulation and mutation of gene.
3. Apply the knowledge on the role of genes in heritability and its measurements
4. Analyze the importance of viral oncogenes, regulation of gene expression and signal transduction by oncoproteins.
5. Under the functional concepts of genetics, human related genetic problems, inborn errors and genetic counseling.
6. Acquire knowledge on the applied branches of genetics.

### **UNIT – I INTRODUCTION TO GENETICS**

Gene- concept , Mendel's experiments, —Mono hybrid –and dihybrid cross– laws of inheritance; incomplete dominance–over dominance–co–dominance and gene interaction–epistasis multiple alleles - blood groups -ABO blood group and Rh system–Rh and ABO incompatibility

### **UNIT – II CHROMOSOME AND MUTATIONS**

Chromosome structure, types, Autosomes and Sex chromosomes – determination of sex. Barr bodies – cytoplasmic inheritance – Linkage – complete and incomplete linkage. Crossing over–definition – mechanism — Chromosome numerical changes: aneuploidy, euploidy (haploidy and polploidy). Structural changes–deletion, duplication, translocation, inversion.

### **UNIT – III NATURE OF GENETIC MATERIAL**

DNA – Genome organization, structure of gene (prokaryotes,eukaryotes) –Fine structure of gene–cistron, recon and muton–Gene expression and regulation in prokaryotes–Lac Operon, Trp Operon, Ara Operon – Gene regulation in Eukaryotes–Britten and Davidson's model. Gene mutations: Types , Addition, deletion, substitution, Frame shift mutation,suppressor mutations–mutagens.

#### **UNIT – IV MICROBIAL GENETICS**

Genetics of bacteria–transformation, conjugation, transduction, introduction to plasmids, movable genes:transposons and IS Elements.–life cycle of Bacteriophage– recombination in phage.

#### **UNIT – V HUMAN GENETICS**

Human chromosome and sex determination, Syndromes and metabolic disorders–, eugenics, eugenics. Pedigree studies. Human genome Sequencing and their impact – individualized medicines

#### **Course Outcome**

CO 1	Understand the concept of Bacterial recombination and its types
CO 2	Remember and understand the types of mutation and mutagens, molecular basis of errors in DNA replication and apply the knowledge on detection of mutation.
CO 3	Remember and understand the eukaryotic gene regulation and genetic basis of cancer.
CO 4	Understand and apply the techniques and therapies in human genetics.
CO 5	Remember and understand the metabolic disorders and apply the tools in genetic counseling.



**Mapping Course Outcomes with Programme Outcomes**

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO1	9	3	3	9	9	3	9
CO2	3	9	3	3	3	3	3
CO3	9	3	9	9	3	9	9
CO4	9	9	9	3	9	3	3
CO5	3	3	9	9	3	9	9
Weightage	33	27	33	33	27	27	33
weighted percentage of course contribution of pos	4.4	3.7	5.7	5.3	5	4	5.8

Level of correlation Between CO's and PO's

**1 - Low 3 - Medium 9 - High 0 - No correlation**

**REFERENCE BOOKS:**

1. Daniel, L. Hartl (1994) Genetics (III Edn) Jones and bartlet publishers, Boston.
2. Elof Axel Carlson (1985) Genetics, Tata McGraw Hill Publishing Co.
3. Jenkins, J.B. (1975) Genetics, Houghton Mifflin Co., Boston.
4. Robert, H. Tamarin (1996) Principles of Genetics, WCB Publishers.
5. Ruthwell, M.W. (1978) Human Genetics Prentices Hall of India Pvt., Ltd.,
6. Strickberger, W. (1996).Genetics, Prentices Hall of India Pvt., Ltd.,

**SEMESTER -III – CC-VII  
21PZO9**

**HOURS/ WEEK – 6  
CREDIT- 5**

## **EVOLUTION AND ANIMAL BEHAVIOUR**

### **Course Objectives:**

1. Know the history and concept of evolution
2. Understand the mechanisms and factors involving in evolution process
3. Understand the process and patterns of social selection of animals
4. Know the evolutionary patterns of various animals at classical and molecular level
5. Study the interaction and adaptation among species

### **UNIT – I ORIGIN OF LIFE**

Evolution of life- Abiogenesis- theories and concepts – Current challenges to Darwinism, Lamarckism, and Neo Darwinism – Chemical evolution and origin of life - evidences of evolution – modern theories of evolution –sources of variation.

### **UNIT – II ORIGIN OF SPECIES**

Orthogenesis – evolution of horse and Fossil evidences of human evolution - Zoogeography – mimicry and colourations in evolution –. Concept of exobiology.

### **UNIT – III PATTERNS OF EVOLUTION**

Divergent evolution- micro evolution- mega evolution- macro evolution- quantum evolution – co evolution. Evolutionary time scale: eras- periods and epoch – major events in the evolutionary time scale.– Cultural evolution and evolutionary future of mankind.

### **UNIT - IV ECOLOGICAL ASPECTS OF BEHAVIOUR**

Introduction to Ethology - Habitat selection, food selection, optimal foraging theory, anti-predator defenses, aggression, homing, territoriality, dispersal, Biological rhythms: Circadian and circannual rhythms, orientation and navigation, migration of fishes Learning and memory: Conditioning, habituation, insight learning, associative learning and reasoning. Communication chemical, visual, light and audio, evolution of language.

### **UNIT – V REPRODUCTIVE BEHAVIOUR**

Evolution of sex and reproductive strategies, mating systems, courtship, sexual selection, parental care. Social behaviour: aggregations, schooling in fishes, flocking in birds, herding in

mammals, group selection, kin selection, altruism, reciprocal altruism, inclusive fitness, social organization in insects and primates.

**Course Outcomes:**

<b>CO1</b>	Understand the theories and concepts of evolution
<b>CO2</b>	Explain the process of evolution in animals
<b>CO3</b>	Compare and understand the evolution of social life in animals
<b>CO4</b>	Analyze the patterns of evolutionary changes in animals and the population dynamics, speciation and types of evolution
<b>CO5</b>	Interpret the ecological interaction, adaptation of animals and role of Artificial intelligence in of animal's ecology

**Mapping Course Outcomes with Programme Outcomes**

<b>PO CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>
<b>CO1</b>	9	9	3	3	1	3	3
<b>CO2</b>	9	3	3	9	9	9	9
<b>CO3</b>	9	9	1	9	3	9	3
<b>CO4</b>	9	9	9	3	9	3	9
<b>CO5</b>	3	9	3	3	1	3	1
<b>Weightage</b>	<b>39</b>	<b>39</b>	<b>19</b>	<b>27</b>	<b>23</b>	<b>27</b>	<b>25</b>
<b>weighted percentage of course contribution of pos</b>	<b>5.2</b>	<b>5.4</b>	<b>3.3</b>	<b>4.3</b>	<b>4.3</b>	<b>4</b>	<b>4.4</b>

Level of correlation Between CO's and PO's

**1 - Low    3 - Medium    9 - High    0 - No correlation**

**REFERENCE BOOKS:**

1. Strickberger's (2008). Evolution. 4th Ed., Jones and Bartlett Publishers, Inc.
2. Goodenough, J., Betty, M. and Wallace, R.A (1993). Perspectives on Animal Behaviour. John Wiley Publishers.
3. Odum, E.P (1996), Fundamental of Ecology (III<sup>rd</sup> Edn), Nataraj Publishers, Dehradun.
4. Bhatia, H.S. (1998). A Text book on Environmental Pollution and Control, Galgotia, Publishers, New Delhi.
5. Clarke, G.L. (1963). Elements of Ecology, Wiley Eastern Limited. New Delhi.
6. Paul Colinvaux, (1986). Ecology. John Wileyans Sons, New York.
7. Alcock, J (2001). Animal Behaviour: An Evolutionary Approach. 7th Ed., Sinaur Associates, Inc.3.
8. Krebs, J.R and Davis, N.B. (2004). Behavioural Ecology. 3rd Ed., Wiley Publishers, New York.
9. Blackwell and Ridley, M. (1993). Evolution. 2nd Ed., (Indian Edition). Blackwell Scientific Publishers, Oxford, UK, 2004.
10. Rastogi, V.B. (2007).Organic Evolution. 12th Ed., KedarNath Ram Nath Publishers, Meerut.

**SEMESTER - III – EC- III  
21PZOE3A**

**HOURS/ WEEK – 6  
CREDIT- 5**

## **APICULTURE AND SERICULTURE**

### **Course Objectives:**

1. The main aim is to give exposure about the culture of silkworm and bees.
2. It gives an idea for the self- employment opportunities to the students
3. It gives an idea about the role of different research organizations and funding agencies to promote Apiculture and Sericulture.

### **UNIT-I SILKWORM REARING**

Types of Silkworm Mulberry Silkworms: Morphology and life cycle of silkworms. Management of egg of silkworm. Silkworm rearing equipments (Rearing racks and trays, disinfectants, rearing appliances, black boxing) Chawki rearing, bed cleaning, mountages. Types of rearing house, harvesting of cocoons.

### **UNIT-II SILKWORM DISEASES AND MANAGEMENT**

Bacterial Disease	: Flacherie, Septicemia and Sotro Disease
Fungal Disease	: Muscardine
Viral Disease	: Grasserie and Infectious Flacherie,
Protozoan Disease	: Pebrine
Parasites	: Uzi fly, Dermestid beetles

**Management** – Enemies of silk moths. Selection of raw material for reeling, Storage and preservation of raw materials. Marketing and the role of Central Silk Board in the Development of sericulture. silk reeling techniques. Selection of raw material for reeling, Storage and preservation of raw materials. Marketing and the role of Central Silk Board in the Development of sericulture.

### **UNIT-III MORICULTURE**

Mulberry Species – Classification, cultivation, irrigation and Common Indian mulberry plants and their morphology. Harvesting – various methods -leaf picking – shoot leaf harvesting-branch cutting. Chemical composition and nutritional values of Mulberry leaves.– mulberry planting methods sexual and asexual propagation –. Classification of disease of mulberry. Moriculture: Food and feeding habits of silkworm

#### UNIT-IV APICULTURE METHODS

Natural bee colonies and their yield. Present status of apiculture in india. Types of bee hives - structure - location, care and management. Setting up an apiary: (brood and storage chambers, iron frames and comb sheets, drone excluder) rearing equipments, handling of bees-managing bees for honey production- managing bees for crop pollination. Bee foraging - polan and nectar are yielding plants.

#### UNIT-V DISEASES OF APICULTURE

Bacterial Disease	: American Foulbrood , European foulbrood.
Fungal Disease	: Stone brood
Viral Disease	: Dicistroviridae, Sacbrood, lake Sinai virus
Parasites	: Varroa Mites, Acarine mites, Nosema Disease

Honey harvesting and extraction process; physicochemical analysis of honey. Uses of honey, bee venom and beeswax in Indian medicine.

#### Course out come

<b>CO 1</b>	Comprehend the structure, life cycle and various species of silkworm
<b>CO 2</b>	Understand the cultivation, harvest and preservation of mulberry leaves
<b>CO 3</b>	Analyze the genetics in the development of new strains
<b>CO 4</b>	Understand and analyze the different pests infecting silkworm and their control
<b>CO 5</b>	Analyze and Understand the silkworm rearing and silk thread reeling in developing silk farm

**Mapping Course Outcomes with Programme Outcomes**

<b>PO CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>
<b>CO1</b>	9	9	9	3	1	3	1
<b>CO2</b>	9	3	3	9	9	9	3
<b>CO3</b>	9	9	1	3	3	3	9
<b>CO4</b>	9	9	9	3	3	9	3
<b>CO5</b>	3	9	3	9	1	9	1
<b>Weightage</b>	<b>39</b>	<b>39</b>	<b>25</b>	<b>27</b>	<b>17</b>	<b>33</b>	<b>17</b>
<b>weighted percentage of course contribution of pos</b>	<b>5.2</b>	<b>5.4</b>	<b>4.3</b>	<b>4.3</b>	<b>3.1</b>	<b>4.9</b>	<b>3</b>

Level of correlation Between CO's and PO's

**1 - Low    3 - Medium    9 - High    0 - No correlation**

**REFERENCE BOOK**

1. Venkatanarasaiah (2013). Sericulture, APH Publishing.
2. Amarder Singh and Ravinder Kumar, (2013). Hand book sericulture part – I.
3. Suresh K.Rao and Sajana Rawat (2013). Economic importance of Apiculture, Campus Books international.
4. Yoshimaro Tanaka.Sericology, Central Silk Board, 99-B, Meghdoot, Marine Drive, Bombay-2
5. Kovaleve, P.A. Silkworm breeding Stocks, Central Silk Board, Marine Drive, Bombay.
6. Sharma P.L. and Singh, S.H. Book of Bee keeping.S.Chand publishers

**SEMESTER - III – EC- III  
21PZOE3B**

**HOURS/ WEEK – 6  
CREDIT- 5**

## **BIOPROCESS TECHNOLOGY**

### **OBJECTIVES**

1. This provides complete knowledge about various parameters involved in culturing of microorganisms in large scale
2. Complete understanding of designs of fermentor and fermentor of special purposes.
- 3 Know the history and concept of fermentation
- 4 Understand the mechanisms and factors involving in fermentation process
- 5 Understand the process and patterns of Design and components of fermentor
6. Know the Industrial application of microbial enzymes

### **UNIT- I BIOPROCESS ORGANISMS**

Introduction and scope of bioprocess technology Screening of industrially important of microorganisms - Strain improvement -Preservation and maintenace of cultures.

### **UNIT- II FERMENTATION TECHNOLOGY**

Types of fermentation- methods of fermentation – Control of fermentation Sterilization: air and media sterilization-moist heat, dry heat, batch sterilization and continuous sterilization. Inoculum preparation, development of inocula for bacteria and yeast.

### **UNIT- III COMPONENTS OF FERMENTOR**

Design and components of fermentor. Bioreactor instrumentation types of biorection – stirrer, agitator, aerator, seal, valves, steam trap, sterilization unit. Sensors – measurement and control of process variables.

### **UNIT –IV INDUSTRIAL ENZYMES**

Industrial application of microbial enzymes. Production of enzymes - Thermophilic enzymes, Lipases, Protease, invertase, reinnin, lactase, Production of Antibiotics -penicillin, streptomycin, chloramphenicol tetracycline, Food production- cheese, bread, beverages- wine and beer.



## UNIT- V PROCESS OF FERMENTATION

Stages of fermentation process Bioseparation - methods of fermentation - Filtration centrifugation, sedimentation, Cell disruption: Physical and chemical methods. Purification: Membrane based technique- Ultrafiltration, reverse osmosis, and dialysis

### Course out come

<b>CO 1</b>	Complete knowledge about various parameters involved in culturing of microorganisms in large scale
<b>CO 2</b>	Analyze the mechanisms and factors involving in fermentation process
<b>CO 3</b>	Analyze and Comprehend the structural designs of fermentor and fermentor of special purposes
<b>CO 4</b>	Understand and analyze Industrial application of microbial enzymes. Production of enzymes
<b>CO 5</b>	Analyze and apply new methodology in Production of enzymes

### Mapping Course Outcomes with Programme Outcomes

<b>PO CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>
<b>CO1</b>	9	9	3	3	3	9	3
<b>CO2</b>	9	3	3	9	3	3	9
<b>CO3</b>	9	9	1	3	9	9	1
<b>CO4</b>	9	9	9	9	9	9	3
<b>CO5</b>	3	9	3	3	1	9	3
<b>Weightage</b>	<b>39</b>	<b>39</b>	<b>19</b>	<b>27</b>	<b>25</b>	<b>39</b>	<b>19</b>
<b>weighted percentage of course contribution of pos</b>	<b>5.2</b>	<b>5.4</b>	<b>3.3</b>	<b>4.3</b>	<b>4.6</b>	<b>5.7</b>	<b>3.3</b>

Level of correlation Between CO's and PO's

**1 - Low    3 - Medium    9 - High    0 - No correlation**

**REFERENCE BOOKS:**

- 1) Nakra BC and chaudry KK (2004). Instrumentation and measurement and analysis,. II edition tata McGraw hill publishing co. ltd, New Delhi.
- 2) Mansi El Mansi and Charli Bryce (2002). Fermentation microbiology and biotechnology. Taylor and Francis ltd., London.
- 3) Shijie liu (2012). Bioprocess Engineering. Elsevier publisher.
- 4) Paulne M. Doran (2012). Bioprocess Engineering Principles Elsevier Publisher.
- 5) Pogaku Ravindra (2016). Advances in Bioprocess technology- Springer Publisher.

**SEMESTER - III – EC- III**  
**21PZOE3C**

## **APPLIED ENTOMOLOGY**

### **Objectives:**

1. To study the different types of insects and their economic importance.
2. To understand the different pest control measures and Integrated Pest Management.

### **Unit- I - INSECT CLASSIFICATION**

Introduction to Entomology - General characters of Class Insecta – Classification of insects upto orders Classification of following insect orders (a) Orthoptera (b) Hemiptera (c) Diptera (d) Hymenoptera (e) Lepidoptera (f) Coleoptera- Insect Pest and their Classification

### **Unit-II - INSECTS OF AGRICULTURAL AND INDUSTRIAL IMPORTANCE**

Life history, nature of damage and control measures of major pests of Pest of rice: Rice stem borer (*Scirpophagaincertulas*) - Pest of Sugarcane: The shoot borer (*Chiloinfuscatellus*) - Pest of coconut: The rhinoceros beetle (*Oryctes rhinoceros*) - Pest of cotton: The spotted bollworm (*Eariasinsulana*). **Insects of Industrial importance** -Biology and rearing of Honey bees, Silk worm, Lac insect – Useful Products and their Economic Values.

### **Unit-III - INSECTS OF MEDICAL AND VETERINARY IMPORTANCE**

Insect vectors of human diseases; Mosquitoes, Housefly, Bedbug, Sand fly, TseTse fly - Identification, nature of attack, and control measures. Veterinary pests: Identification, nature of attack, and control measures of insect pest of domestic animals – cattle, sheep and goat, fowl. Insects of forensic importance – crime detection using entomological science.

#### Unit-IV

**PEST CONTROL MEASURES:** Cultural – mechanical – physical and legal methods-  
Chemical control-

Insecticides - classification of insecticides based on mode of entry – mode of action and chemical nature –

Insecticidal formulations– insecticidal toxicity (LD 50 / LC 50).

#### Unit-V

**INSECT PEST-MANAGEMENT: BIOLOGICAL CONTROL;** Ecological basis and agents of biological control – Parasites, Parasitoids, Predators. Autocidal control – Sterile male technique, Chemo sterilants, methods of sterilisation, Pheromonal control, Insect repellents, Insect anti feedants, Insect attractants – definition, applications, advantages and disadvantages. Microbial control of crop pests by employing bacteria, virus and fungi-Integrated pest management(IPM).

#### Course out comes

<b>CO 1</b>	Analyze and Comprehend about the Insect Classification
<b>CO 2</b>	Analyze the importance of Agricultural and industrial important insects
<b>CO 3</b>	Analyze and Comprehend the insects of medical and veterinary importance
<b>CO 4</b>	Understand and analyze the Pest control measures
<b>CO 5</b>	Analyze and apply new methodology in Insect pest-Management

**Mapping Course Outcomes with Programme Outcomes**

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO1	9	3	3	3	9	9	9
CO2	3	9	3	3	3	3	1
CO3	3	3	9	9	3	9	3
CO4	9	3	9	3	9	3	9
CO5	3	9	9	9	3	9	3
Weightage	27	27	33	27	27	33	25
weighted percentage of course contribution of pos	3.6	3.7	5.7	4.3	5	4.9	4.4

Level of correlation Between CO's and PO's

**1 - Low    3 - Medium    9 - High    0 - No correlation**

**Text Books**

1. David, B.V. and Ananthakrishnan, T.N. General and Applied Entomology. 2nd Ed., Tata McGraw Hill, New Delhi. 2004.
2. Ignacimuthu, S. S and Jayaraj S, Biological Control of Insect Pests. Phoenix Publ, New Delhi, 2003.

**References**

1. David, B.V. Elements of Economic Zoology. Popular Book Depot, Chennai, 2003.
2. Nalinasundari, M.S. and Santhi, R. Entomology. MJP Publishers Chennai, 2006.

3. Awasthi, V.B. Introduction to General and Applied Entomology. Scientific Publishers, Jodhpur, 2002
4. Norris, R.F., Caswell-chen, E.P. and Kogan, M. Concepts in Integrated Pest management Prentice Hall, New Delhi, 2002.
5. Racheigl and Racheigl. Biological and Biotechnological Control of Insect Pests. CRC Press, 1998.
6. Srivastava, K. P., A textbook of Applied Entomology Vol.I. 2nded. Kalyani Publishers, New Delhi,1988.



**IV  
SEMESTER**

**SEMESTER - IV – CC-X  
21PZO10**

**HOURS/ WEEK – 5  
CREDIT- 5**

## **DEVELOPMENTAL BIOLOGY**

### **Course Objectives:**

1. Learn about the development of gametogenesis, Oogenesis, spermatogenesis and fertilization.
- 2: Illustrate the patterns of cleavage, neural induction and morphogenetic movements.
- 3: Discuss the chemical basis of differentiation, development of ageing and teratogenesis.
- 4: Summarize the morphogenetic process of ontogenesis and asexual reproduction.
5. provides the process of early embryonic development and review the current development in the field of embryology.
6. The formation of embryo and embryological disorders and treatment methodology
7. Learn about Precaution and health care during pregnancy and gestation

### **UNIT - I INTRODUCTION TO DEVELOPMENTAL BIOLOGY**

History and theories of Development biology - Gametogenesis – Spermatogenesis – Cells in seminiferous tubules, spermiogenesis, structure and types of sperm. Oogenesis – development of oocyte, , hormone control of oogenesis - vitellogenesis, and organization of egg cytoplasm. Types of eggs. Egg membrane – patterns of egg. Fertilization : Events of fertilization- Acrosomal reaction reaction in egg - recognition of egg and sperm, cytoplasmic – cortical reaction

### **UNIT -II NUCLEO CYTOPLASMIC INTERACTION**

Cleavage – Patterns of cleavage – radial, spiral and bilateral; Types – meroblastic, holoblastic and superficial, factors affecting cleavage. Stem cells- totipotency and pluripotency. Blastulation – Types of blastula. Fate maps. Morphogenetic movements in the egg. Gastrulation in frog and chick.

### **UNIT- III ORGANOGENESIS**

Ectodermal derivatives: formation of neural tube development of brain and eye in frog. Mesodermal derivatives: heart and kidney in frog Organogenesis in Chick – Embryonic adaptation - development of heart. Extra embryonic membranes structure in reptiles Placentation in mammals – types.



#### **UNIT- IV POLARITY AND GRADIENT**

Gradient theory -.Organiser concept - embryonic induction - mechanism of induction.  
Regeneration: Types of regeneration- amphibian limb regeneration- – Wolffian regeneration  
Metamorphosis- types- amphibian metamorphosis- hormonal regulation of metamorphosis in insect and amphibians

#### **UNIT- V PRECAUTION AND HEALTH CARE DURING PREGNANCY AND GESTATION**

Impotency: Causes of Impotency and sterility in male and infertility in female – Concept of test-tube baby - Artificial Insemination in humans - In Vitro Fertilization (IVF) – Assisted Reproduction Technology – Sperm banking- Advantages and disadvantages of IVF.

#### **Course Outcome**

<b>CO 1</b>	Understand the basic concepts of development and the role of genes in sex determination
<b>CO 2</b>	Analyse the molecular perspectives of fertilization and Get knowledge about the spermatogenesis oogenesis and ovulation in humans
<b>CO 3</b>	Analyse and apply the concept of organizer and induction in the development of organs and metamorphosis
<b>CO 4</b>	Understand and analyze the mechanism of fertilization , metabolic activities and molecular changes in cleavage process and concept of differentiation in human
<b>CO5</b>	Analyze and Evaluate the development of various organs of Humans

**Mapping Course Outcomes with Programme Outcomes**

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO1	9	9	3	3	1	3	9
CO2	9	9	3	3	3	3	3
CO3	9	3	9	9	9	9	3
CO4	9	9	1	9	3	9	3
CO5	9	9	9	3	9	3	3
Weightage	45	39	25	27	25	27	21
weighted percentage of course contribution of pos	6	5.4	4.3	4.3	4.6	4	3.7

Level of correlation Between CO's and PO's

**1 - Low    3 - Medium    9 - High    0 - No correlation**

**REFERENCE BOOKS:**

1. Lewis Wolpart, Cheryll Tickle (2010). Principles of Development Biology. Oxford University Press.
2. Lewis Wolpart (2011). Principles of Development Biology. Oxford University Press.
3. Subramaniam T. (2001). Molecular Development Biology. Alpha Science intl. Ltd.
4. Wanninger and Andreas (2015). Evolutionary Developmental Biology of invertebrates, Springer Publisher.
5. Arumugam.N. (1998). Developmental Biology, Saras Publications,

6. Balinsky, B.I. (1981). *An Introduction to Embryology*. W.B. Saunders Company.
7. Philadelphia.Berry.A.K. (2007). *An Introduction To Embryology*, Emkay Publications, New Delhi-51.
8. Beril., N.J. (1986). *Developmental Biology*. Tata Mcgraw-Hill Publishing Ltd. New Delhi.
9. Browder, L.N. (1980). *Developmental Biology*, Saunders College, Philadelphia.
10. Deuchar, E.M. (1976). *Cellular Interaction in Animal Development*, Chapman and Hall, London.
11. Verma, P.S. and Agarwal V.K. (2005). *Developmental Biology*. S. Chand and Company Ltd., New Delhi.

**SEMESTER - IV – CC-XI  
21PZO11**

**HOURS/ WEEK – 5  
CREDIT- 5**

## **IMMUNOLOGY AND BIOTECHNOLOGY**

### **Course Objectives:**

The main objectives of this course are to:

1. Study the innate and adaptive immunity, antigens and antibodies interactions.
2. Understand the host defense mechanism in clinical immunology.
3. Learn the immunological disorders.
4. Gain knowledge on immunotechniques
5. Perceiving information on artificial intelligence in immunodeficiency diseases.

### **UNIT – I IMMUNITY**

Innate and Acquired immunity- Ultra structure and functions of primary and secondary lymphoid organs. Cell of immunity - origin and specific functions. Antigens and Immunogens - characteristics – epitopes, paratopes. Immunoglobulins: structure-classes- functions and significance

### **UNIT – II IMMUNE RESPONSE**

Antigen recognition- processing and presentation-interaction of T and B cells – cell mediated and humoral immunity - cytokines and immune response –immunological memory – agglutination - antigen-antibody interactions. Auto immunity, auto immune disease- Rheumatoid arthritis, Lupus and Celiac disease - and its treatment.

### **UNIT – III IMMUNOTECHNIQUES**

Precipitin reactions: immuno diffusion and immuno electrophoresis RIA – ELISA (Antigen fixed, antibody fixed and sandwich ELISA), Western blotting- Monoclonal antibody production - Hybridoma technology and applications- Fluorescent immunoassay (FIA) -.

### **UNIT – IV INTRODUCTION TO BIOTECHNOLOGY**

Current developments – Commercial applications of biotechnology. Strategies of Recombinant DNA technology – Preparation of DNA, vector, types of vectors – Transgenic animals – production (Microinjection, Embryonic stem cell methods) and its applications. – Human Genome Project.

## UNIT – V MOLECULAR MARKERS AND GENE THERAPY

Diagnosis of genetic disorders by RFLP, PCR, Northern and Southern blotting– DNA finger printing - Treatment of Cancer – Bone marrow transplantation – Gene Therapy: *Ex vivo* and *in vivo* gene therapy, and Gene silencing.

### Course outcome

CO 1	understand the structure and functions of lymphoid organs, types of immunity, structure, types and properties of antigens and immunoglobulins and analyse antibody diversity.
CO 2	explain the process and mechanism of Humoral and Cell mediated immune response & Complements pathways
CO 3	understand and analyse the structure, typing, genetics organization of MHC and its significance in organ transplantation and the mechanism of immune response to tumour.
CO 4	understand and analyse the process of immune tolerance, autoimmunity, hypersensitivity and explains immune response in microbial infection
CO 5	understand and apply Antigen –Antibody reactions, various Immunotechniques and Hybridoma technique.

**Mapping Course Outcomes with Programme Outcomes**

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO1	9	9	3	3	1	3	3
CO2	9	3	9	9	3	9	3
CO3	3	9	1	9	3	9	9
CO4	9	9	9	3	9	1	1
CO5	3	9	3	3	1	9	9
Weightage	33	39	25	27	17	31	25
weighted percentage of course contribution of pos	4.4	5.4	4.3	4.3	3.1	4.6	4.4

Level of correlation Between CO's and PO's

**1 - Low    3 - Medium    9 - High    0 - No correlation**

**REFERENCES BOOKS:**

1. Roitt, I.M., and Delves, P.J. Roitt's (2001). Essential Immunology. 10th Ed., Oxford: Blackwell Science.
2. William E.Paul (2012). Fundamental of immunology, L.W.W Publisher.
3. Joel Fuhrman M.D. (2013). Super immunity- Harperone Publisher.
4. Abul K. Abbas, Andrew H. Lichman, Shiv Pillai (2014). Cellular and molecular immunology- Saunders publisher.
5. Abul K. Abbas, Andrew H. Lichman, Shiv Pillai (2017). Cellular and molecular immunology- Elsever publisher.
6. Goldsby, R.A., Kindt, T. J. and Osborne, B. A. Kuby's (2003). Immunology. 5th Ed., WH Freeman & Co.
7. Janeway, C. (2001). Immunobiology. 5th Ed., Garland Publications.
8. Benjamin, E., Richard, C., and Sunshine, G. (2000). Immunology: A Short Course. 4th Ed., John Wiley, New York.

**SEMESTER - IV – CC-XII  
21PZO12**

**HOURS/ WEEK – 5  
CREDIT- 5**

## **COASTAL AQUACULTURE**

### **Course Objectives:**

1. Acquire basic knowledge on marine environment
2. Study the economic importance of marine organisms and about the culture of fishes and crabs.
3. Understand biodiversity and its conservation strategies of marine organisms
4. Know the pharmacological importance of marine organisms
5. Understand the various threats for marine life
6. It gives an idea for the self- employment opportunities to the students.

### **UNIT – I – HISTORY AND TYPES OF AQUACULTURE**

Overview – importance of coastal aquaculture -Aquaculture in India, Role of aquaculture on economic development, constraints in aquaculture, types of aquaculture- coastal aquaculture and marine aquaculture. marine water cultivable fishes.

### **UNIT- II - BRAKISH WATER PONDS**

Selection of site: topography water availability soil conditions. Designing and layout-farm construction. Preparation of pond for fish culture, management of fish ponds, water quality management of fish pondsTypes of feed, larval adult feeds - wet and dry feeds, Artificial and live feeds- Artemia, Diatoms and Daphnia.

### **UNIT –III - TYPES OF CULTURES**

Extensive culture, Intensive culture and semi-intensive culture, monosex culture, monoculture, polyculture, cage culture and pen culture. Integrated fish farming – Culture practices:, Shrimp culture, mud crab, Lobster, Pearl Oyster, Edible Oyster, Mussels and seaweeds.

### **UNIT – IV - DISEASE AND MANAGEMENT**

Common bacterial, viral, fungal, protozoans and crustaceans diseases, their symptoms and treatment.. Diseases diagnosis: concepts – ELISA, western blotting: DNA based diagnosis (PCR test).

## UNIT- V –POST HARVEST TECHNOLOGY

Harvesting and transport of fish and shrimp. Fish and shrimp preservation and fish and shrimp processing technology –Government organizations in Aquaculture. ICAR, CMFRI, CIFRI, CICFRI, CIFA, CIBA, CIFT, RGCA and MPEDA.

### Course Outcomes:

<b>CO1</b>	Explain the basic information on the marine environments
<b>CO2</b>	Assess the economic importance of marine organisms
<b>CO3</b>	Discuss the significance of marine conservation
<b>CO4</b>	Identify the pharmaceuticals from marine resources
<b>CO5</b>	Find marine the possible treats of marine life

### Mapping Course Outcomes with Programme Outcomes

<b>PO CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>
<b>CO1</b>	9	9	9	9	3	9	9
<b>CO2</b>	3	9	3	9	9	9	9
<b>CO3</b>	9	3	9	3	9	3	9
<b>CO4</b>	9	3	9	9	9	9	3
<b>CO5</b>	9	9	9	3	3	9	9
<b>Weightage</b>	<b>39</b>	<b>33</b>	<b>39</b>	<b>33</b>	<b>33</b>	<b>39</b>	<b>39</b>
<b>weighted percentage of course contribution of pos</b>	<b>5.2</b>	<b>4.6</b>	<b>6.8</b>	<b>5.3</b>	<b>6.1</b>	<b>5.7</b>	<b>6.9</b>



Level of correlation Between CO's and PO's

**1 - Low    3 - Medium    9 - High    0 - No correlation**

**REFERENCE BOOKS:**

1. Robert R. Stickney (2017). Aquaculture an introductory text 3<sup>rd</sup> Edition - Oxford University Press.
2. John S. Lucas, Paul C. Southgate (2012). Aquaculture farming, Wiley – Blackwell, Publishers.
3. Kenn Christenson (2015). Aquaculture 3<sup>rd</sup> Edition – Createspace independent Publishing Platform.
4. Pillay, T.V.R. (1995). Aquaculture principles and practices. Fishing News Books, Blackwell Science Ltd., Oxford.
5. Shanmugam, K. (1990). Fishery biology and Aquaculture. Leo Pathipagam, Madras.
6. Santhanam, Sugumaran and Natarajan, P. (1997). A Manual of freshwater aquaculture. Oxford and IBH Pub. Co. Ltd., New Delhi.
7. Arumugam, N. (2008). Aquaculture Saras Publications, Nagercoil.
8. Baradach, J.E., J.H. Ryther and W.O. McLarney (1972) Aquaculture. The farming and Husbandry of Freshwater and Marine Organisms. Wiley Interscience, New York.
9. Chadar, S.L. (1980). Hypophysation of Indian major carps. Satish Book Enterprise, Agra, PP.146.
10. Exporters manual and Documentation (1999). Jain Book Agency. New Delhi.
11. Jhingran, V.C. (1991). Fish and fisheries of India, Hindustan, New Delhi.
12. Kurian, C.V and Sebastin. (1992). Prawn and prawn fisheries of India, Hindustan Publications, New Delhi.
13. Rath, R.K. (2000) Freshwater Aquaculture. Scientific Publishers, (India), PO.Box.91, Jodhpur.

**SEMESTER –III & IV    CC-XIII  
21PZO14**

**HOURS/ WEEK – 5  
CREDIT- 5**

**CORE PRACTICAL- III**

**(COVERING CC-VII, CC-VIII, CC-IX, CC- XI, CC- XII, CC- XIII)**

**ENVIRONMENTAL BIOLOGY:**

- + Estimation of dissolved oxygen in water.
- + Estimation of dissolved carbon dioxide
- + Estimation of chlorides
- + Estimation of calcium
- + Estimation of total alkalinity
- + Estimation of total phosphates
- + Identification of fresh water and marine water plankton

**SPOTTERS:** Secchi Disc, Colorimeter, pH meter, Thermometer

**DEVELOPMENTAL BIOLOGY**

- ✓ Preparation of sperm suspension: Bull's spermatozoa
- ✓ Mounting of blastoderm in chick
- ✓ Effect of thyroxine or iodine on metamorphosis of frog
- ✓ Vaginal smear preparation of cow to study the stages of estrous cycle.

**GENETICS**

- ❖ Drosophila Culture – Identification of mutants and sexes –
- ❖ ABO Blood groups & Rh factor determination and its genetic significance.
- ❖ Study of mendelian traits in Human beings
- ❖ Identification of syndromes
- ❖ Hardy – Weinberg Law and calculation of gene frequency

**SPOTTERS:** Drosophila - male and female, Human karyotyping - male and female. Syndromes

**EVOLUTION:**

**SPOTTERS:** Fossils (Nautiloid, Ammonoid, and Trilobite), Colouration and Mimicry.

**IMMUNOLOGY:**

- ❖ Identification of lymphoid organs in chick.
- ❖ Lymphoid organs- Primary and Secondary.

- ❖ Immunodiffusion - Immuno-electrophoresis (Demo)
- ❖ WIDAL test

**SPOTTERS:** T.S of lymphoid organs: Thymus, Bone marrow, lymph node, spleen, T cells and B cells

Course Outcomes:

CO Number	CO Statement
CO1	Evaluate the dissolved oxygen and CO <sub>2</sub>
CO2	Evaluate the Quantitative estimation of dissolved salts like chlorides, Calcium ,total phosphates in the water sample
CO3	Familiar with the Preparation of sperm suspension and Vaginal smear preparation of cow to study the stages of estrous cycle.
CO4	Familiar with the enumeration of ABO Blood groups & Rh factor and evaluation of its genetic significance
CO5	Familiar with Identification of Primary and Secondary lymphoid organs in chick.

**Mapping Course Outcomes with Programme Outcomes**

<b>PO CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>
<b>CO1</b>	<b>3</b>	<b>9</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>3</b>	<b>1</b>
<b>CO2</b>	<b>9</b>	<b>9</b>	<b>3</b>	<b>3</b>	<b>9</b>	<b>3</b>	<b>9</b>
<b>CO3</b>	<b>9</b>	<b>9</b>	<b>9</b>	<b>9</b>	<b>3</b>	<b>9</b>	<b>3</b>
<b>CO4</b>	<b>9</b>	<b>3</b>	<b>1</b>	<b>9</b>	<b>9</b>	<b>9</b>	<b>9</b>
<b>CO5</b>	<b>3</b>	<b>9</b>	<b>9</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>Weightage</b>	<b>33</b>	<b>39</b>	<b>25</b>	<b>27</b>	<b>25</b>	<b>27</b>	<b>25</b>
<b>weighted percentage of course contribution of pos</b>	<b>4.4</b>	<b>5.4</b>	<b>4.3</b>	<b>4.3</b>	<b>4.6</b>	<b>4</b>	<b>4.4</b>

Level of correlation Between CO's and PO's  
**1 - Low    3 - Medium    9 - High    0 - No correlation**