# B.Sc. Zoology

(Choice Based Credit System)
For the students admitted in the academic year
2019 - 2020


**PG AND RESEARCH DEPARTMENT OF ZOOLOGY**
**Bishop Heber College (Autonomous)**
**(Nationally Reaccredited at the A+ level by NAAC)**
**(Reaccredited with 'A' Grade (CGPA – 3.58/4.0) by the NAAC &**
**Identified as College of Excellence by the UGC)**
**TIRUCHIRAPPALLI – 620017**
**TAMIL NADU, INDIA**
**2019 - 2020**

# Vision

**Envisage quality higher education and research in the field of animal sciences with global perspectives by promoting discoveryand learning contemporary fields in Zoology inculcating social values for the holistic development and to conserve nature thus contributing for nation building.**

# Mission

- **Bestow quality education emphasizing the cognitive learning and concern towards the animal kingdom**
- **Promulgate biodiversity conservation, training and entrepreneurship skills in the applied zoological sciences**
- **Enhance highest level of academic accomplishment with interdisciplinary approach through research, industrial collaboration and amalgamate with reputed national and international universities**
- **Foster globally competent individuals with interpersonal skills and environmental consciousness for the betterment of the world.**

# Programme Outcomes

On successful completion of the Program the Under Graduant of Zoology will be able to:

## Knowledge

**PO1 –** Interpret the fundamental concepts, theoretical principles, internal structures, physiological, molecular, evolutionary processes and environmental conservation

**PO2 –**Analyze the complex interactions among the various animals of different phyla, their distribution and their relationship with the environment

**PO3** – Relate the principles, mechanism of inheritance and epidemiology of disease-causing organisms in reference to human health

## Skills

**PO4 -** Categorize the distribution of faunal diversity based on taxonomical ranking in animal kingdom through field survey and animal census

**PO5 –**Exhibit analytical skills from cellular to molecular level in thrust areas of zoology

**PO6 -** Apply transferable skills in the field of economic zoology encompassing more employment opportunities and entrepreneurship

## Attitudes

**PO7**- Perceiveeffective communication and social interaction through field visits and outreach programmes.

## Ethical & Social Values

**PO8-**Exhibit professional ethics with environmental consciousness, bioethics and concern towards conservation ofbiodiversity.

**PO9-**Drawing together the theoretical concepts and analytical skills from cognitive and computational perspectives that underlie self directed and lifelong learning.

# Programme Specific Outcomes

## Knowledge and Skills

**PSO1**- Categorize the taxonomical principles, hierarchy and functional aspects of various phyla with evolutionary significance

**PSO2 -** Relate the biochemical processes, molecular and cellular level, development, physiology and reproduction, microbes, genetics, evolution and ecological impact on animal behaviour.

**PSO3-** Exhibit entrepreneurial skills in establishing agro based industries like Vermicompost preparation, Silk production unit, Apiculture, Fish farming and Integrated Farming System in association with government organizations.

**PSO4 -**Perform experiments in the areas of Taxonomy, Physiology, Ecology, Cell and molecular biology, Genetics, Biochemistry, Developmental biology, Immunology, Microbiology, Biotechnology and Bioinformatics and develop innovative ideas keeping abreast with the recent developments

## Structure of the Curriculum

| Parts of the Curriculum | No. of Courses | Credits |
|---|---|---|
| **Part – I** : Language | 4 | 12 |
| **Part – II** : English | 4 | 12 |
| **Part – III** | | |
| Major | | |
| Core (Theory) | 8 | 43 |
| Core (Practical) | 6 | 16 |
| Elective | 3 | 15 |
| Allied | | |
| Allied (Botany) | 3 | 10 |
| Allied (Chemistry) | 3 | 10 |
| Group Project | 1 | 5 |
| **Part – IV** | | |
| SBEC | 3 | 6 |
| NMEC | 2 | 4 |
| VLOC | 1 | 2 |
| Env. Studies | 1 | 2 |
| SBC | 1 | 1 |
| **Part – V** | | |
| Extension Activities | 1 | 1 |
| Gender Studies | 1 | 1 |
| **Total** | **42** | **140** |

**B.Sc. Zoology – Programme Description**

# (For the students admitted in the academic year 2019 -2020)

| Sem. | Part | Course | Course Code | Course Title | Prerequisites | Hrs/ week | Credits | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | CIA | ESA | Total |
| I | I | Tamil I /* | U15TM1L1 | செய்யுள்இலக்கியவரலாறு, உரைநடை,மொழிப்பயிற்சியும் படைப்பாக்கமும | | 6 | 3 | 25 | 75 | 100 |
| | II | English I | U16EGPL1 | English Communication Skills-I | | 6 | 3 | 40 | 60 | 100 |
| | III | Core I | U19ZY101 | Invertebrata | | 6 | 6 | 25 | 75 | 100 |
| | | Core Prac. I | U19ZY1P1 | Core Practical – I | | 3 | 2 | 40 | 60 | 100 |
| | | Allied I | U16BYY11 | Allied Botany I | | 4 | 3 | 25 | 75 | 100 |
| | | Allied Prac. | U16BYYP1 | Allied Botany Practical | | 3 | -- | -- | -- | -- |
| | | Val.Edu | U15VL1:1 / U15VL1:2 | Value Education ( RI / MI ) | | 2 | 2 | 25 | 75 | 100 |
| II | I | Tamil II /* | U18TM2L2 | செய்யுள்இலக்கியவரலாறு, சிறுகதை,தத்தர்டு மொழிப்பயிற்சிறுபடைப்பாக்கம | | 6 | 3 | 25 | 75 | 100 |
| | II | English II | U16EGPL2 | English Communication Skills –II | | 6 | 3 | 40 | 60 | 100 |
| | III | Core II | U19ZY202 | Chordata | U19ZY101 | 6 | 6 | 25 | 75 | 100 |
| | | Core Prac. II | U19ZY2P2 | Core Practical – II | | 3 | 2 | 40 | 60 | 100 |
| | | Allied II | U16BYY22 | Allied Botany II | | 4 | 4 | 25 | 75 | 100 |
| | | Allied Prac. | U16BYYP1 | Allied Botany Practical | | 3 | 3 | 40 | 60 | 100 |
| | IV | Env. Stud. | U16EST 21 | Environmental Studies | | 2 | 2 | 25 | 75 | 100 |
| III | I | Tamil III/* | U18TM3L3 | செய்யுள்-கதைப்பங்களஇலக்கியவரலாறுநாவலமொழிப்பயிற்சி | | 6 | 3 | 25 | 75 | 100 |
| | II | English III | U16EGPL3 | English for Competitive Examinations | | 6 | 3 | 40 | 60 | 100 |
| | III | Core III | U19ZY303 | Ecologyand Evolution | U19ZY202 | 4 | 4 | 25 | 75 | 100 |
| | | Core Prac. III | U19ZY3P3 | Core Practical – III | | 3 | 2 | 40 | 60 | 100 |
| | | Allied III | U19CHY33 | Allied Chemistry- I | | 4 | 3 | 25 | 75 | 100 |
| | | Allied Prac. | U19CHYP2 | Volumetric and Organic Analysis | | 3 | -- | -- | -- | -- |
| | IV | SBEC I | U19ZYPS1 | Vermiculture and Sericulture | | 2 | 2 | 40 | 60 | 100 |
| | | NMEC I | U19ZY3E1 | ***Public health and Hygiene*** | | 2 | 2 | 25/ 40 | 75/ 60 | 100 |

| Sem. | Part | Course | CourseCode | Course Title | Prerequisites | Hrs/ Week | Credits | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | CIA | ESA | Total |
| IV | I | Tamil IV/* | U18TM4L4 | செய்யுள்-நாடகம்இலக்கியவரலாறுமொழிப்பயிற்சி | | 5 | 3 | 25 | 75 | 100 |
| | II | English IV | U16EGPL4 | English through Literature | | 5 | 3 | 40 | 60 | 100 |
| | III | Core IV | U19ZY404 | Cell and Molecular Biology | U19ZY101<br>U19ZY202 | 4 | 4 | 25 | 75 | 100 |
| | | Core Prac. IV | U19ZY4P4 | Core Practical – IV | | 3 | 2 | 40 | 60 | 100 |
| | | Allied IV | U19CHY44 | Chemistry for Life Sciences | | 4 | 4 | 25 | 75 | 100 |
| | | Allied Prac. II | U19CHYP2 | Volumetric and Organic Analysis | | 3 | 3 | 40 | 60 | 100 |
| | IV | NMEC II | | ***To be selected from courses offered by other departments*** | | 2 | 2 | 25/ 40 | 75/ 60 | 100 |
| | | SBEC II | U19ZYPS2 | Pisciculture | | 2 | 2 | 40 | 60 | 100 |
| | | NMEC | U19ZY4E2 | Industrial Zoology | | 2 | 2 | 25 | 75 | 100 |
| | | Soft skills | U16LFS41 | Life Skills | | 2 | 1 | -- | -- | 100 |
| | V | Extension Activities | U16ETA41 | NSS, NCC, Rotaract, Leo Club, etc… | | | 1 | - | - | - |
| V | III | Core V | U19ZY505 | Genetics | U19ZY404 | 6 | 6 | 25 | 75 | 100 |
| | | Core VI | U19ZY506 | Microbiology | U19ZY404 | 6 | 6 | 25 | 75 | 100 |
| | | Core Prac. V | U19ZY5P5 | Core Practical – V | | 6 | 4 | 40 | 60 | 100 |
| | | Group Project | U19ZY5PJ | Project | | 5 | 5 | - | - | 100 |
| | | Elective I | U19ZY5:1 | Biophysics and Biochemistry | | 5 | 5 | 25 | 75 | 100 |
| | IV | SBEC III | U19ZYPS3 | Wild life ecology and Economic Entomology | | 2 | 2 | 40 | 60 | 100 |
| VI | III | Core VII | U19ZY607 | Animal Physiology | U19ZY101<br>U19ZY202 | 6 | 6 | 25 | 75 | 100 |
| | | Core VIII | U19ZY608 | Developmental Biology and Immunology | U19ZY202 | 6 | 5 | 25 | 75 | 100 |
| | | Core Prac. VI | U19ZY6P6 | Core Practical – VI | | 6 | 4 | 40 | 60 | 100 |
| | | Elective II | U19ZY6:2 | Biotechnology | U19ZY404<br>U19ZY506 | 6 | 5 | 25 | 75 | 100 |

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|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | Elective III | U19ZY6:3 | Biostatistics and Bioinformatics | U19ZY404<br>U19ZY506 | 6 | 5 | 25 | 75 | 100 |
| | V | Gender studies | U16GST 61 | Gender Studies | | | 1 | - | - | 100 |
| **Total** | | | | | | | **140** | | | **4100** |

| | |
|---|---|
| **SBEC-Skill Based Elective Course** | **NMEC- Non Major** |
| **VLOC- Value added Life Oriented Course** | **SBC- Skill Based Course** |

**Internal Assessment** **ESA- End Semester Assessment**

| * OTHER LANGUAGES | HINDI | SANSKRIT | FRENCH | SEMESTER | HINDI | SANSKRIT | FRENCH |
|---|---|---|---|---|---|---|---|
| SEMESTER I | U14HD1L1 | U15SK1L1 | U14FR1L1 | III | U14HD3L3 | U15SK3L3 | U14FR3L3 |
| SEMESTER II | U14HD2L2 | U15SK2L2 | U14FR2L2 | IV | U14HD4L4 | U15SK4L4 | U14FR4L4 |

NMEC offered bytheDept.: 1. Public Health and Hygiene U19ZY3E1

2. Industrial Zoology U19ZY4E2

## CORE I: INVERTEBRATA

**SEMESTER: I** **CODE: U19ZY101**
**CREDITS: 6** **HOURS/WEEK: 6**

### 1. COURSE OUTCOMES

After the successful completion of this course the students will be able to:

| CO. No. | COURSE OUTCOMES | LEVEL | UNIT |
|---|---|---|---|
| CO1 | Classify the level of organization in invertebrates | K4 | I |
| CO2 | Explain the functional significance of associated morphologies and behaviours | K5 | II |
| CO3 | Categorize the parasites and its associated diseases | K5 | III |
| CO4 | Explain the specific characteristics of molluscs and Echinodermata | K4 | IV |
| CO5 | Compare the diversity and adaptation of invertebrates | K5 | V |
| CO6 | Construct the phylogenetic relationship of various invertebrate phyla | K5 | V |

### 2. A. Syllabus

**UNIT I - PHYLUM PROTOZOA** **(18 Hrs)**

**Phylum protozoa:** General characters and classification up to orders with suitable examples. Detailed Study: Paramecium

General Topic: Nutrition in protozoa - Host-parasitic interactions in Entamoeba and Plasmodium - locomotion in Protozoa.

**UNIT II- PHYLUM PORIFERA, COELENTRATA** **(18 Hrs)**

**Phylum Porifera**: General characters and classification up to orders with suitable examples. General topic: Canal System in Sponges.

**Phylum Coelenterata**: General characters and Classification up to orders with suitable examples.

Detailed study: Obelia. General Topic: Polymorphism in Hydrozoa,

**UNITIII- PHYLUM PLATYHELMINTHES AND NEMATHELMINTHES** **(18 Hrs)**

**Phylum Platyhelminthes**: General characters and Classification up to orders with suitable examples. Detailed study: *Fasciola hepatica*,

**Phylum Nemathelminthes**; General characters and classification up to orders with suitable examples.

General Topic: Parasitic interactions of helminth parasites

**UNITIV - PHYLUM ANNELIDA AND ARTHROPODA (18 Hrs)**

**Phylum Annelida**: General Characters and classification up to orders with suitable examples Detailed Study: Leech.

General topic: Nephridium and coelomoducts - mode of life in Annelids

**Phylum Arthropoda**: General characters and classification up to orders with suitable examples. Detailed study: *Penaeus*

General topic: Larval forms of Crustacea.

**UNIT V - PHYLUM MOLLUSCA AND ECHINODERMATA (18 Hrs)**

**Phylum Mollusca**: General Characters and Classification up to orders with suitable example. Detailed study: Pila.

General topics: Torsion in molluscs.

**Phylum Echinodermata**: General Characters and Classification up to orders with suitable examples. Detailed Study: Asterias.

General topics: Larval forms in Echinoderms.

**B. Topics for Self-Study**

| Sl.No. | Topics | Web Links |
|---|---|---|
| 1 | Anti-Malaria Campaign in India | https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6206767/ |
| 2 | Sponge Industry | https://fcit.usf.edu/florida/docs/s/sponge.htm |
| 3 | Filariasis | https://www.cdc.gov/parasites/lymphaticfilariasis/index.html |
| 4 | Mosquito-borne diseases | https://www.worldmosquitoprogram.org/en/learn/mosquito-borne-diseases |
| 5 | Pearl Culture | http://www.fao.org/3/AB726E/AB726E00.htm |

**C. Text Books**

1. EkambaranathaIyer and Ananthakrishnan. T. N., A Manual of Zoology Vol.I& II
2. E.L.Jordan. &Verma.P.S.2006, Invertebrate Zoology, S.Chand& Company Ltd, NewDelhi.

**D. Reference Books**

1. Barrington. E.J.W. Invertebrates Structure and Function.
2. Barnes, R.D., 1974, Invertebrate Zoology, 4th Ed., Holt Saunders International Edition
3. Kotpal, R.L., A **Text Book** of Invertebrates, Rastogi Publishers, Meerut.
4. The invertebrates-vol I to vol II –Hyman L.H-McGraw Hill Book Co.1940-1955.
5. A **Text Book** of Zoology Vol. I -Parker,J. and Haswell - Williams and Williams. 1978.
6. A **Text Book** of Invertebrate Zoology- Srivastava,M.D.L and Srivastava,U.S- Central Book Depot,Allahabad.1969.

**E. Web Links**

1. https://www.who.int/news-room/fact-sheets/detail/zoonoses
2. http://www.fao.org/fishery/countrysector/naso_india/en#:~:text=India%20is%20also%20an%20important,about%209.06%20million%20metric%20tonnes
3. https://www.acs.edu.au/courses/invertebrate-animals-730.aspx

**3. SPECIFIC LEARNING OUTCOMES (SLO)**

| Unit/ Section | Course Contents | Specific Learning Outcomes | Highest Bloom's Taxonomic Level of Transaction |
|---|---|---|---|
| **I** | **Classification of Phylum Protozoa & Detail Study on Paramecium** | | |
| **1.1** | **Phylum Protozoa & General Studies:**<br>General characters and classification of Protozoa | • Explain the characteristic features of phylum protozoa<br>• Classify the phylum protozoa up to the order level | **K2** |
| **1.2** | Study of paramecium | • Demonstrate the external characteristic features of paramecium<br>• Explain the various functions like locomotion, nutrition, reproduction, excretion and reproduction of Paramecium | **K2** |
| **1.3** | Nutrition in protozoa | • Elaborate the process of nutrition occur in protozoa | **K6** |
| **1.4** | Host parasitic interaction | • Relate the interaction between host and the parasites | **K2** |
| **1.5** | Locomotion in Protozoa | • Compare the different modes of locomotion in protozoans | **K4** |

| | | | |
|---|---|---|---|
| **II** | **Classification of Phylum Porifera &Coelenterata, Canal System in Sponges** | | |
| **2.1** | **Phylum Porifera, Colenterata:**<br><br>General characters and classification of Porifera and Coelenterata | • Discuss the characteristic features of phylum Porifera and Coelenterata | **K6** |
| **2.2** | | • Classify the phylum Porifera and Coelentera up to the order level | **K2** |
| **2.3** | Canal system in sponges | • Discuss the canal system in sponges | **K6** |
| **2.4** | Study of Obelia | • Examine the different systems and their functions | **K4** |
| **2.6** | Polymorphism in hydrozoa | • Discuss the concepts of polymorphism in hydra | **K6** |
| **III** | **Classification of Phylum, Platyhelminthes & Nemethelminthes, Detail study on Leech** | | |
| **3.1** | **Phylum Platyhelminthes, Nemathelminthes:**<br><br>General Characters and classification of Platyhelminthes and Nemathelminthes | • Discuss the characteristic features of phylum Platyhelminthes and Nemathelminthes | **K6** |
| **3.2** | | • Classify the phylum Platyhelminthes and Nemathelminthes up to the order level | **K2** |
| **3.3** | Study of *Fasciola hepatica* | • Explain the external structures of *Fasciola hepatica*<br>• Explain the different functions of various systems including digestive, respiration, nervous, excretion and reproduction | **K5** |
| **3.4** | Parasitic interaction of Helminth parasaties | • Relate the interaction between the parasites and Helminth worms | **K2** |
| **IV** | **Classification of Phylum Arthropoda & Annelida, Detail Study on Prawn** | | |
| **4.1** | **Phylum Annelida, Arthropoda:**<br><br>General Characters and classification of Annelida and Arthropoda | • Discuss the characteristic features of phylum Annelida and Arthropoda<br>• Classify the phylum Annelida and Arthropoda up to the order level | **K6** |
| **4.2** | Study of Nephridium & Coelomoducts | • Compare the two different functions excretory systems | **K4** |
| **4.3** | Study of Penaeus | • Explain the external structures of Penaeus<br>• Explain the different functions of various systems including digestive, respiration, nervous, excretion and reproduction | **K5** |

| | | | |
|---|---|---|---|
| **4.4** | Larval forms of Crustacea | • Explain the different forms of larvae in crustaceans | **K5** |
| **V** | **Classification of phylum Mollusca & Echinodermata, detail study on snail, Torsion in Mollusca** | | |
| **5.1** | **Phylum Mollusca, Echinodermata:** General Characters and Classification of Mollusca and Echinodermata | • Explain the characteristic features of phylum Mollusca and Arthropoda | **K5** |
| **5.2** | | • Classify the phylum Mollusca and Echinodermata up to the order level | **K2** |
| **5.3** | Study of Pila | • Explain the external structures of Pila<br>• Explain the different functions of various systems including digestive, respiration, nervous, excretion and reproduction | **K5** |
| **5.4** | Torsion in molluscs | • Explain the unique function of mollusc | **K5** |
| **5.5** | Study of Asterias | • Explain the external structures of Asterias<br>• Explain the different functions of various systems including digestive, respiration, nervous, excretion and reproduction | **K5** |
| **5.6** | Larval forms of Echinoderms | • Explain the different forms of larvae in crustaceans | **K5** |

## 4. MAPPING (CO, PO, PSO)

| U19ZY101 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | H | H | M | H | M | H | M | H | H | M | H |
| **CO2** | H | H | H | H | M | H | H | H | M | H | H | M | H |
| **CO3** | H | H | H | M | H | - | - | M | - | H | H | M | H |
| **CO4** | H | H | - | H | - | - | - | H | M | H | H | - | H |
| **CO5** | H | H | H | H | - | H | H | H | H | H | H | H | H |
| **CO6** | H | H | H | H | H | M | H | H | H | H | H | - | H |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT METHODS

| **DIRECT** |
| --- |
| 1. Continuous Assessment Test I, II<br>2. Online Quizzes, Assignment, Poster preparation, Field Visit, Field Visit Report etc.<br>3. Pre-Semester & End Semester Theory Examination |
| **INDIRECT** |
| 1. Course-end survey (Feedback) |

**Course coordinators:**

1. **Mr.Y. Babu**
2. **Dr. S. Bhuvaneshwari**

# Core Practical-I: INVERTEBRATA

**SEMESTER: I** **COURSE CODE: U19ZY1P1**
**CREDITS: 2** **HOURS/WEEK: 3**

## 1. COURSE OUTCOMES

After the successful completion of this course the students will be able to:

| CO.No. | COURSE OUTCOMES | LEVEL | EXPERIMENTS |
|---|---|---|---|
| CO1 | Analyze the structural organization of the different systems in Earthworm and Cockroach | K4 | I |
| CO2 | Compare the structural organization of mouthparts. (Cockroach, mosquito& Housefly) | K4 | II |
| CO3 | Identify the body setae in a muscle squash of earthworm and show under the compound microscope and Show the Appendages of Prawn in dissection microscope | K3, K4 | II |
| CO4 | Asses the organ systems of insects through dissection and virtual labs. | K6 | III |
| CO5 | Identify the specimen and write their classification a its Significance | K3, K4 | III |
| CO6 | Discuss the diversity and adaptations of invertebrates | K6 | III |

## 2. A. Syllabus

**INVERTEBRATA**

**I DISSECTION**

Earthworm : Digestive system and Nervous system
Cockroach : Digestive system and Nervous system

**II MOUNTINGS**

Paramecium : Hay culture and observation
Earthworm : Body setae
Mouth parts : Cockroach, Housefly and Mosquito
Appendages of Prawn

**III SPOTTERS**

Protozoa : Amoeba, Euglena, Paramecium, Paramecium conjugation, Entamoeba.
Porifera : Sycon, Spicules, Gemmule
Coelenterata : Obelia colony, Physalia, Sea anemone, Aurelia, Fungia, Meandrina, Tubipora
Platyhelminthes : Fasciola, Redia larva of fasciola, Cercaria larva of fasciola,Tapeworm, Scolex of Tapeworm
Nemathelminthes : Ascaris: male and female, Enterobius vermicularis,

Wuchereriabancrofti,
Annelida : Leech, Nereis, Parapodium of Nereis,
Arthropoda : Millipede, Centipede, Penaeus, Nauplius larva of Penaeus, Zoea larva of Penaeus, Peripatus, Scorpion, Limulus, Honey bee, Termites
Mollusca : Fresh water mussel, Pearl oyster, Chiton, Dentalium, Sepia, Glochidium larva
Echinodermata : Starfish, Bipinnaria larva of Starfish, Pedicellaria, Sea cucumber, Seaurchin,

**B. Topics for Self-Study**

| Sl.No. | Topics | Web Links |
|---|---|---|
| 1. | Earthworm | https://biologywise.com/earthworm-classification-taxonomy |
| 2. | Pila | https://www.biologydiscussion.com/invertebrate-zoology/phylum-mollusca/pila-globosa-habitat-sense-organs-and-development/29154 |
| 3. | Cockroach | https://www.britannica.com/animal/cockroach-insect |

**C. Text Book**

1. Advanced practical zoology by S. Chand & company LTD.1995

**D. Reference Books**

1. Lal S.S., A Textbook of Practical Zoology Invertebrate, Rastogi Publication, 2004
2. Lal S.S., A Textbook of Practical Zoology Vertebrate, Rastogi Publication, 2004
3. Sinha J.,Chatterjee A.K., Chattopadhyay., Advanced Practical Zoology, Books and Allied (P) Ltd., 2011.

**E. Web Links**

1. https://www.acs.edu.au/courses/invertebrate-animals-730.aspx
2. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/vermiculture

**3. SPECIFIC LEARNING OUTCOMES (SLO)**

| Experiments | Course Contents | Specific Learning Outcomes | Highest Bloom's Taxonomic Level of Transaction |
|---|---|---|---|
| **I** | **INVERTEBRATA –DISSECTION** | | |
| **1.** | Earthworm-Digestive system | • Identify the morphological characters of the animal<br>• To Illustrate the digestive system the animal. | **K4**<br>**K3** |
| **2.** | Earthworm-Nervous system | • Cut open the animal and show the nervous system of Earthworm. | **K3** |
| **3.** | Cockroach - Digestive system | • Find and locate the digestive system of cockroach | **K1** |

| | | | |
|---|---|---|---|
| **4.** | Cockroach - Nervous system | • Construct the nervous system and Propose its parts | **K5** |
| **III** | **MOUNTINGS** | | |
| **5.** | Paramecium-Hayculture | | |
| **6.** | Earthworm – Body setae | • Mount the body setae of earthworm and analyse under the microscope | **K4** |
| **7.** | Mouth parts- Housefly | • Examine the mouthparts and distinguish the types | **K3** |
| **8.** | Mouth parts- Mosquito | • Examine the mouthparts and distinguish the types | **K3** |
| **9.** | Mouthparts-Cockroach | • Examine the mouthparts and distinguish the types | **K3** |
| **10.** | Prawn Appendages | • Predict the structure of various appendages in prawn | **K5** |
| **III** | **SPOTTERS** | | |
| **11.** | Protozoa, Porifera | • Classify the given animal and discuss its characters | **K3** |
| **12.** | Coelenterata, Platyhelminthes, Nemathelminthes | • Discuss the significance of the animal | **K6** |
| **13.** | Annelida, Arthropoda | • Identify and describe the structure | **K4** |
| **14.** | Millipede, Centipede | • Compare the given animal | **K4** |
| **15.** | Mollusca | • Classify the given animal and discuss its characters | **K3** |
| **16.** | Echinodermata | • Discuss the significance of the animal | **K6** |

## 4. MAPPING (CO, PO, PSO)

| U19ZY1P1 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | M | H | H | H | L | - | H | H | - | - | H |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO2** | H | M | M | M | H | H | - | L | H | H | M | - | H |
| **CO3** | H | L | L | H | H | H | - | - | H | M | - | - | M |
| **CO4** | H | H | M | H | H | M | - | L | H | H | M | - | H |
| **CO5** | H | H | M | H | H | H | - | - | H | H | M | - | H |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT

| **DIRECT** |
|---|
| 1.Continuous Assessment Test I, II<br>2. Online Quizzes, Assignment, Poster preparation, Field Visit, Field Visit Report etc.<br>3. Pre-Semester & End Semester Theory Examination |
| **INDIRECT** |
| 1. Course-end survey (Feedback) |

**Course coordinators:**

1. **Mr.Y. Babu**
2. **Dr. S. Bhuvaneshwari**

## CORE II: CHORDATA

**SEMESTER: II** **Code: U19ZY202**
**CREDITS: 6** **HOURS/WEEK: 6**

### 1. COURSE OUTCOMES

After the successful completion of this course the students will be able to:

| CO.No. | COURSE OUTCOMES | LEVEL | UNIT |
|---|---|---|---|
| CO1 | Classify the levels of organisation in vertebrates. | K4 | I |
| CO2 | Explain the unique characteristics of vertebrates from fishes to mammals | K5 | I – V |
| CO3 | Analyse and compare the external morphology, different systems and sexual dimorphism in chordates. | K4 | I – V |
| CO4 | Compare and analyse the difference between venomous and non-venomous snakes. | K4 | III |
| CO5 | Appraise the diversity and adaptation of vertebrates. | K5 | IV, V |
| CO6 | Develop knowledge in specific behavioural aspects in chordates. | K3 | V |

### 2. A. Syllabus

**UNIT I INTRODUCTION TO CHORDATES & CLASS PISCES** **12Hrs**

Origin of Chordates - General characters and classification of phylum Chordata
**Prochordata**: Amphioxus:Organisation and affinities. Ascidia: Retrogressive metamorphosis
**Class Pisces**
General characters and classification of Super Class Pisces up to orders with suitable examples of biological interest
**Detailed study: Shark** (excluding endoskeleton)
**General topics:** Accessory respiratory organs in fishes

**UNIT II CLASS AMPHIBIA** **12 Hrs**
**Class Amphibia**
General characters and classification of Class Amphibia upto orders with suitable examples of biological interest
**Detailed study: Frog**
**General topics:** Parental care in Amphibians - Neoteny

**UNIT III CLASS REPTILIA** **12 Hrs**
General characters and Classification of Class Reptiliaupto orders with suitable examples of biological interest
**Detailed study: Calotes (excluding Endoskeleton)**
**General topics:** Identification of poisonous and non- poisonous snakes in India, Poison apparatus, biting mechanism and Venom

**UNIT IV CLASS AVES** **12 Hrs**
General characters and Classification up to orders with suitable examples of biological interest
**Detailed study: Pigeon (excluding Endoskeleton)**

**General topics:** Flight adaptations in birds – Flightless birds and their distribution - Migration in birds

**UNIT V CLASS MAMMALIA** **12 Hrs**

General characters and Classification upto orders with suitable examples of biological interest

**Detailed study: Rabbit (excluding Endoskeleton)**

**General topics**: Aquatic mammals and their adaptations - Adaptive radiation in mammals – Monotremes and Marsupials

**B. Topics for Self-Study**

| Sl. No. | Topics | Web Links |
|---|---|---|
| 1. | Type study of Balanoglossus | https://www.biologydiscussion.com/animals-2/phylum-chordata/quick-notes-on-balanoglossus/40474 |
| 2. | Parental care in fishes (Hippocampus) | https://marinebio.org/species/pacific-seahorses/hippocampus-ingens/ |
| 3. | Fossil Rhyncocephalians | https://www.ucl.ac.uk/museums-static/obl4he/vertebratediversity/rhynchocephalians.html |
| 4. | Sex determination in reptiles | https://www.slideshare.net/AashishPatel14/sex-determination-73410095 |
| 5. | Colour pattern in Birds | https://hascpbbirds.weebly.com/bird-anatomy.html |

**C. Text Book**

1. Ayyar E.K. and Ananthakrishnan, T.N Vol II. Part I.- Manual of Zoology –Viswanathan Pvt. Ltd.1992.

**D. Reference Books**

1. Jordan E.L, Verma P.S, Chordate Zoology, S. Chand & Company Ltd., 2008.
2. Kotpal R.L., A Modern **Text Book** of Zoology Vertebrates, Rastogi publications, 2009.
3. Sinha, Adhikari, Ganguly, Bharati Goswami, Biology of animals Vol. II, New Central Book Agency (p) Ltd. 2004

**E. Web Links**

1.https://www.khanacademy.org/science/biology/crash-course-bio-ecology/crash-course-biology-science/v/crash-course-biology-123
2.https://courses.lumenlearning.com/suny-biology2xmaster/chapter/chordates/

## 3. SPECIFIC LEARNING OUTCOMES (SLO)

| Unit/ Section | Course Contents | Specific Learning Outcomes | Highest Bloom's Taxonomic Level of Transaction |
|---|---|---|---|
| **I** | **Introduction to chordates, Prochordata & Class Pisces** | | |
| 1.1 | General characters and classification of chordate | • Classify the general characters of chordate | **K2** |
| | | • Identify the classification of chordata | **K4** |
| 1.2 | Organisation and affinities of amphioxus | • Construct the organization of amphixious | **K3** |
| | | • Explain the affinities of amphioxus | **K5** |
| 1.3 | Retrogressive metamorphosis in asicidian | • understand the metamorphotic changes in ascidian | **K2** |
| | | • Analyse the characteristic features of Ascidian | **K5** |
| 1.4 | General characters of pisces | • Explain the characters of fishes | **K5** |
| 1.5 | Classification of Pisces upto orders | • Illustrate the classification of Pisces | **K2** |
| | | • Compare the class and orders of Pisces | **K5** |
| 1.6 | External structure, Digestive circulatory, Respiratory, nervous, excretory and reproductive systems of shark | • Explain the external structure of shark | **K5** |
| | | • Analyze the various systems and their functions in shark | **K5** |
| **II** | **Class Amphibia** | | |
| 2.1 | General characters and classification of amphibian | • Illustrate and classify the general characters of Amphibia | **K4** |
| 2.2 | External structure , Digestive circulatory, nervous, excretory and reproductive systems of frog | • Analyze the external structure of frog | **K4** |
| | | • Analyze the various systems and their functions in frog | **K4** |
| 2.3 | Different modes of respiration in frog | • Compare the different modes of respiration in frog | **K5** |
| 2.4 | Parental care in amphibian and neoteny | • Assess the parental care in amphibian | **K5** |

| | | | |
|---|---|---|---|
| **III** | **Class Reptilia** | | |
| 3.1 | General characters and classification of reptiles | • Define and classify the general characters of Reptilia | **K2** |
| 3.2 | External structure, Digestive circulatory, Respiratory, nervous, excretory and reproductive systems of Calotes | • Analyze the external structure of frog | **K5** |
| | | • Infer the functions of the various systems inCalotes | **K4** |
| 3.3 | Poisonous and non poisonous snakes in India | • Analyze the poisonous and non poisonous snakes in India | **K4** |
| 3.4 | Poisonous apparatus | • Categorize the different poisonous apparatus | **K4** |
| 3.5 | Biting mechanism | • Explain biting mechanism of snakes | **K5** |
| **IV** | **Class Aves** | | |
| 4.1 | General characters and classification of Aves | • Define and classify the general characters of aves | **K2** |
| 4.2 | General characters of pigeon | • Explain the general characters of pigeon | **K2** |
| 4.3 | Digestive, Circulatory Nervous excretion and Reproductive system of pigeon | • Analyze the various systems and their functions in Pigeon | **K4** |
| 4.4 | Flight adaptation in birds | • Explain the flight adaptations in birds | **K5** |
| 4.5 | Migration in birds | • Assess the purpose of migration in birds | **K5** |
| **V** | **Class Mammalia** | | |
| 5.1 | General characters and classification of Mammals | • Define and classify the general characters of Mammals | **K2** |
| 5.2 | General character of rabbit | • Explain the general characters of rabbit | **K2** |
| 5.3 | Digestive, Circulatory Nervous excretion and Reproductive system of rabbit | • Analyze the various systems and their functions in rabbit | **K4** |
| 5.4 | Adaptive radiation in mammals | • Explain the adaptive radiation in mammals | **K5** |
| 5.5 | Aquatic mammals and their adaptations | • Classify the aquatic mammals and their adaptations | **K4** |

## 4. MAPPING (CO, PO, PSO)

| U19ZY202 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | M | H | M | H | H | H | H | H | H | M | M |
| CO2 | H | H | M | H | M | H | H | H | H | H | H | H | H |
| CO3 | H | H | - | H | M | H | H | H | H | H | H | H | H |
| CO4 | H | H | H | H | M | M | H | H | H | H | H | - | H |
| CO5 | H | H | L | H | M | M | H | H | H | H | H | M | M |
| CO6 | H | H | - | H | M | H | H | H | H | H | H | H | H |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT

| DIRECT |
|---|
| 1. Continuous Assessment Test I, II<br>2. Online Quizzes, Assignment, Poster preparation, Field Visit, Field Visit Report etc.<br>3. Pre-Semester & End Semester Theory Examination |
| **INDIRECT** |
| 1. Course-end survey (Feedback) |

**Course coordinators:**

1. **Mr.Y. Babu**
2. **Dr. S. Bhuvaneshwari**

## CORE PRACTICAL II: CHORDATA

**SEMESTER: II** **Code: U19ZY2P2**
**CREDITS: 2** **HOURS/WEEK: 3**

### 1.COURSE OUTCOMES

After the successful completion of this course the students will be able to:

| CO.No. | COURSE OUTCOMES | LEVEL | EXPERIMENTS |
|---|---|---|---|
| CO1 | Explain the structure and functions of organ systems in frog through virtual Dissections | K5 | I |
| CO2 | Identification of different fishes based on their scales | K3 | II |
| CO3 | Analyse the scales of fishes by mounting and observation under the microscope. | K4 | II |
| CO4 | Identifythe characteristic features of different species of Chordates. | K5 | III |
| CO5 | Examine the skeletal systems of frog. | K4 | III |
| CO6 | Interpret the different types of dentitions in mammals. | K5 | III |

### 2. Syllabus

### I VIRTUAL DISSECTION OF FROG

Digestive system, Respiratory system,
Arterial system, Venous system and Nervous system
Male and Female reproductive systems

### II MOUNTINGS

Scoliodon (Shark) : Placoid scales
Labeorohita (Rohu) : Cycloid scales
Mugil : Ctenoid scales
Fish : Brain

### III SPOTTERS

Prochordates : Amphioxus, Ascidian and Balanoglossus
Pisces : Scoliodon, Narcine, Arius, Gambusia, Hippocampus, Exocoetus, Anabas, Echeneis, Anguilla.
Amphibia : Bufo, Hyla, Ambystoma, Ichthyopis, Axolotyl larva
Reptiles : Hemidactylus, Draco, Varanus, Najanaja, Hydrophis, Viper,Chelone
Aves : Pigeon, Owl, Quill feather.
Mammalia : Rabbit, Synsacrum of Rabbit, Rat, Bat.
Skeletal system of frog: Skull, pectoral girdle, pelvic girdle, forelimb and hind limb.
Dentition : Rabbit, Dog and Man.

### Supplementary Web Resources for Laboratory Exercises

1. Anatomy of Frog: Pro Dissector (CD)-www.prodissector.com
2. Physiology of Frog: Physio Ex 4.0 (CD)-www.physioex.com

**B. Text Book**

1. Ayyar E.K. and Ananthakrishnan, T.N Vol II. Part I.- Manual of Zoology –Viswanathan Pvt. Ltd.1992.

**C. Topics for Self-Study**

| Sl. No. | Topics | Web Links |
|---|---|---|
| 1. | Shark Dissection and Anatomy | https://www.youtube.com/watch?v=j93luDc_F2U |
| 2. | Sea Lamprey | https://marinebio.org/species/sea-lampreys/petromyzon-marinus/ |
| 3. | Pippa | https://www.nationalgeographic.com/animals/2020/06/surprising-ways-animals-give-birth-live-young/ |
| 4. | Nesting pattern in birds | https://www.youtube.com/watch?v=lneBlxZn6sg |
| 5. | Skeletal system of Man | https://www.youtube.com/watch?v=f-FF7Qigd3U |

**3. SPECIFIC LEARNING OUTCOMES (SLO)**

| Experiments | Course Contents | Specific Learning Outcomes | Highest Bloom's Taxonomic Level of Transaction |
|---|---|---|---|
| **I** | **VIRTUAL DISSECTION OF FROG** | | |
| **1.** | Digestive system | • Describe the structure and function of digestive system using virtual dissections | **K4** |
| **2.** | Respiratory system | • Explain the process of pulmonary, buccopharyngeal and cutaneous respiration using virtual experiments | **K5** |
| **3.** | Arterial system | • Assess the process of arterial circulation with the device | **K5** |
| **4.** | Venous system | • Deduct the ability of carrying venous blood from the various parts of the body with computer tool | **K5** |
| **5.** | Nervous system | • Explain the Central and Peripheral nervous system in the frog. | **K5** |

| | | | |
|---|---|---|---|
| **6.** | Reproductive systems | • Categorize the male and female reproductive system virtually. | **K4** |
| **II** | **MOUNTINGS** | | |
| **1.** | Placoid scales<br>Cycloid scales<br>Ctenoid scales | • Identify the different types of scale in fishes by mounting in a slide. | **K3** |
| | | • Analyze the type of fishes based on scale pattern<br>• Observation of the scales using microscope | **K4** |
| **2.** | Brain of fish | • Dissect the brain of fish<br>• Identify the different parts of brain in fishes | **K4** |
| **III** | **SPOTTERS** | | |
| **1.** | Prochordates (Amphioxus, Ascidian and Balanoglossus) | • Compare the evolutionary significance of prochordates based on characteristic features | **K4** |
| **2.** | Pisces (Scoliodon, Narcine, Arius, Gambusia, Hippocampus, Exocoetus, Anabas, Echeneis, Anguilla) | • Identify the special adaptation in each fish | **K3** |
| **3.** | Amphibia (Bufo, Hyla, Ambystoma, Ichthyopis, Axolotyl larva) | • Examine the characteristic features of different amphibians | **K4** |
| **4.** | Reptiles (Hemidactylus, Draco, Varanus, Najanaja, Hydrophis, Viper,Chelone) | • Distinguish poisonous and non poisonous snakes based on morphological characters. | **K4** |
| | | • Explain the evolutionary relationship between species in reptiles. | **K5** |
| **5.** | Aves (Pigeon, Owl, Quill feather.) | • Analyse the characteristic features of various birds | **K4** |
| **6.** | Mammalia (Rabbit, Synsacrum of Rabbit, Rat, Bat.) | • Explain the characteristic features of mammals | **K3** |
| **7.** | Skeletal system of frog | • Examine the structure of the animal body using skeletal system | **K4** |
| **8.** | Dentition of Rabbit<br>Dentition of Dog<br>Dentition of Man | • Explain the formation of teeth and calculate dental formula | **K5** |

## 4. MAPPING (CO, PO, PSO)

| U19ZY2P2 | PO1 | PO2 | PO3 | PO4 | | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | - | H | | - | L | H | H | H | H | - | - | H |
| CO2 | H | H | - | H | | - | H | H | H | - | H | - | H | H |
| CO3 | H | H | - | H | | - | H | M | M | - | M | - | H | H |
| CO4 | H | H | - | H | | - | M | H | H | - | H | - | - | - |
| CO5 | H | H | - | H | | - | - | H | - | - | H | H | - | - |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT

| DIRECT |
|---|
| 1. Continuous Assessment Test I, II<br>2. Online Quizzes, Assignment, Poster preparation, Field Visit, Field Visit Report etc.<br>3. Pre-Semester & End Semester Theory Examination |
| **INDIRECT** |
| 1. Course-end survey (Feedback) |

**Course coordinators:**

1. **Mr.Y. Babu**
2. **Dr. S. Bhuvaneshwari**

# CORE III: ECOLOGY AND EVOLUTION

**SEMESTER: III** **Code: U19ZY303**
**CREDITS: 4** **HOURS/WEEK: 4**

**1.COURSE OUTCOMES**
After the successful completion of this course the students will be able to:

| CO.No. | COURSE OUTCOMES | LEVEL | UNIT |
|---|---|---|---|
| CO1 | List out the biotic and abiotic factors. | K1 | I |
| CO2 | Relate the role of biogeochemical cycle in the environment. | K1 | I |
| CO3 | Explain different aspects of population ecology | K4 | II |
| CO4 | Summarize the types, key characters and adaptations of terrestrial habitat. | K2 | III |
| CO5 | Explain the importance of biodiversity and its conservation | K5 | IV |
| CO6 | Interpret the concept of origin of earth, compare the theories of evolution and relate the concept of speciation and evolutionary process. | K5 | V |

**2. A. Syllabus**

**ECOLOGY**

**UNIT I ABIOTIC & BIOTIC FACTORS** **5 Hrs**
**Abiotic factors:** Light, temperature, soil, water – Biotic factors: symbiosis, commensalism, mutualism,predation, parasitism and competition- Biogeochemical cycles: Nitrogen, phosphorous. - Trophic levels: Food chain, Food web -Ecological Pyramids:Pyramid of biomass, number, and energy.

**UNIT II POPULATION AND COMMUNITY ECOLOGY** **5 Hrs**
**Population :** Definition -natality- mortality- age pyramids- population equilibrium- fluctuation-regulation Community Ecology: Types of community - characteristics of community - stratification –ecotone edge effect - ecological Niche - ecological succession.Ecosystem: Structure of Pond ecosystem.

**UNIT III HABITATS AND BIODIVERSITY** **5 Hrs**
**Terrestrial Habitats:** Types, characteristics and adaptations of Forest, Grassland, Desert-Aquatichabitats: Fresh water characteristics and adaptations of lentic (ponds and Lakes) and lotic (River,estuary and Marine)Biodiversity: Concepts and levels of biodiversity - hotspots - threats and conservation.

**EVOLUTION**

**UNIT IV ORIGIN OF LIFE** **5 Hrs**
**Origin of Earth–Theories:** Abiogenesis, Biogenesis, Special creation, Biochemical theories of evolution of life. Evidences for evolution: Paleontological evidences – Physiological evidences - Biochemical evidences Comparative anatomy - Geological time scale-Theories of Evolution: Lamarckism- Darwinism –DeVries theory of mutation -Modern Synthetic theory of evolution

**UNIT V HARDY-WEINBERG LAW** **5 Hrs**

**Speciation:** Species concept, Patterns of speciation- factors influencing speciation. Isolating mechanisms: geographical and reproductive. Hardy Weinberg Principle-Genetic drift Founder's principle. Evolutionary process: Mimicry and animal colouration, Adaptive Radiation -Evolution of Man.

**B. Topics for Self-Study**

| Sl.No. | Topics | Web Links |
|---|---|---|
| **Evolution** | | |
| **1** | Zoogeographical realms | https://www.notesonzoology.com/zoogeography/zoogeographical-realms-meaning-and-types/2563 |
| **2** | Evolution of horse- orthogenesis | https://evolution-outreach.biomedcentral.com/articles/10.1007/s12052-012-0394-1 |
| **3** | Fosils, method of fossilisation and their types | https://profiles.uonbi.ac.ke/cnyamai/files/lecture_8.pdf |
| **4** | Genepool | https://www.slideshare.net/indranilbhattacharjee58/03-concept-of-gene-pools |
| **Ecology** | | |
| **6** | Conservation of wild life management | https://www.iaszoology.com/wildlife-management-conservation/ |
| **7** | Resources management –renewable and non renewable energy | http://www.whsd.net/userfiles/1524/Classes/7398/Renewable%20and%20Nonrenewable%20Resources%20Notes.pdf |
| **8** | Pollution: types and their control measures | http://www.bbau.ac.in/dept/UIET/Study%20Materials%20for%20TCE-0.pdf |
| **9** | Environmental degradation –pesticides and residual effects | https://www.intechopen.com/books/pesticides-toxic-aspects/pesticides-environmental-impacts-and-management-strategies |

**C. Text Books**


1. Rastogi V.B, Organic Evolution, Kedar Nath Ram Nath Publications, 1985
2. Rastogi V.B. and Jayaraj M.S., Animal Ecology and Distribution of Animals, Kedarnath Ramnath Pub., 1987.
3. Odum E.P., Fundamentals of ecology, W.B Saunders Company, V Edition, 2012.
4. John M. Fryxell, Anthony R. E. Sinclair, Graeme Caughley, Wildlife Ecology, Conservation, and Management, 3rd Edition.


**D. Reference Books**


1. Sinha, Adhikari, Ganguly, Bharati Goswami, Biology of Animals Vol. II., New Central BookAgency (p) Ltd., 2004.
2. Sanjib Chattopadhyay, Evolution Adaptation Ethology, Books and Allied (p) Ltd., 2002.
3. Tomar B.S. Singh, Evolutionary Biology, S.P. Rastogi Publications, 2003.
4. Strickberger Monroe, Evolution, W., CBS, 1994.
5. Verma P.S. and Agarwal, Principles of Ecology, S. Chand & Co., 2003.
6. Kendiegh S.C., Animal Ecology, Prentice Hall, 1961.
7. Sharma P.D., Ecology and Environment, Rastogi Publications, 1990.

**E. Web Links**

1. https://plato.stanford.edu/entries/ecology/
2. https://ucmp.berkeley.edu/?176,62

## 3. SPECIFIC LEARNING OUTCOMES (SLO)

| Unit/ Section | Course Contents | Specific Learning Outcomes | Highest Bloom's Taxonomic Level of Transaction |
|---|---|---|---|
| **I** | **ABIOTIC FACTORS** | | |
| 1.1 | Abiotic factors: Light, temperature, soil, water | • List out the abiotic factors | **K4** |
| | | • Identify the role of light,soil,waterect... | **K3** |
| 1.2 | Biotic factors: symbiosis, commensalism, mutualism,predation, parasitism and competition | • explain the animal interaction | **K4** |
| | | • Justify the animal behaviours | **K5** |
| 1.3 | Biogeochemical cycles: Nitrogen, phosphorous. | • Examine the Biogeochemical cycles | **K4** |
| | | • Analyse the importance of chemical cycles | **K4** |
| 1.4 | Trophic levels: Food chain, Food web | • Assess the food habits | **K5** |
| 1.5 | Ecological Pyramids: Pyramid of biomass, number, and energy. | • Measure the classification of energy | **K5** |
| | | • measure the energy level | **K5** |
| | | • explain the different level energy production | **K5** |
| | | • Analyzethe level of consumers | **K5** |
| II | **POPULATION** | | |
| 2.1 | Population : Definition - natality- mortality- age pyramids- population equilibrium- fluctuation- regulation | • Measure and classify the population characteristics | **K5** |
| 2.2 | Community Ecology: Types of community - characteristics of community – stratification | • Assess the types of community - characteristics | **K5** |
| | | • Analyzethe various systems and their functions | **K5** |
| 2.3 | Ecotone edge effect - ecological Niche - ecological succession. | • Compare and contrast the each aspect | **K5** |

| | | | |
|---|---|---|---|
| | Ecosystem: Structure of Pond ecosystem. | • Analyze the pond ecosystem. | **K4** |
| III | **TERRESTRIAL HABITAT** | | |
| 3.1 | Terrestrial Habitats | • Classify the Terrestrial Habitats and their impotant | **K2** |
| 3.2 | Fresh water characteristics | • Estimate the distribution level<br>• | **K5** |
| 3.3 | Estuary | • Survey the flora and fauna communities | **K4** |
| 3.4 | Marine | • Survey the flora and fauna communities | **K4** |
| 3.5 | Concepts and levels of biodiversity | • Elaborate the concept and levels of biodiversity | **K5** |
| IV | **ORIGIN OF EARTH–THEORIES** | | |
| 4.1 | Origin of Earth–Theories: | • Define the various theory | **K3** |
| 4.2 | Evidences for evolution: | • Explain the evidences for evolution | **K5** |
| 4.3 | Paleontological evidences Physiological evidences Biochemical evidences | • Classify the various era | **K4** |
| 4.4 | Comparative anatomy | • Compare the structure and relate their functions | **K5** |
| 4.5 | Geological time scale-Theories of Evolution: | • List out the various theories | **K4** |
| V | **SPECIATION** | | |
| 5.1 | Speciation | • Identify and classify the species | **K3** |
| 5.2 | Isolating mechanisms | • Explain the specific mechanisms | **K5** |
| 5.3 | Hardy Weinberg Principle-Genetic drift Founder's principle. | • Justify and the solve the laws | **K5** |
| 5.4 | Evolutionary process | • Explain the Evolutionary process | **K5** |
| 5.5 | Evolution of Man | • Prove the evolutionary significance of man. | **K5** |

## 4. MAPPING (CO, PO, PSO)

| U19ZY303 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | H | H | H | H | H | H | - | H | - | H | H |
| CO2 | H | H | H | H | H | M | H | H | - | H | - | H | M |
| CO3 | H | H | H | H | H | - | H | H | - | H | - | H | - |
| CO4 | H | H | H | H | H | H | H | H | H | H | - | H | H |
| CO5 | H | H | M | H | H | H | M | H | H | H | - | - | H |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT METHODS

| DIRECT |
|---|
| 1. Continuous Assessment Test I, II<br>2. Online quizzes, Assignment, Group Presentation, Poster preparation, Field Visit, Field Visit Report etc.<br>3. End Semester Examination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinators:**

1. **Dr .J. Nesarajan**
2. **Dr. S. Bhuvaneshwari**

**SBEC I: VERMICULTURE AND SERICULTURE**

**SEMESTER: III** **Code: U19ZYPS1**
**CREDITS: 2** **HOURS/WEEK: 2**

## 1. COURSE OUTCOMES

After the successful completion of this course the students will be able to:

| CO.No. | COURSE OUTCOMES | LEVEL | UNIT |
|---|---|---|---|
| CO1 | Analyse the economic importance of earthworms and silkworms. | K4 | I & III |
| CO2 | Classify the earthworms based on ecological and morphological concepts. | K4 | II |
| CO3 | Explain the importance of vermicompost with agricultural wastes. | K5 | II |
| CO4 | Construct sericulture unit based on the gained expertise. | K3 | III |
| CO5 | Explain the commercial characteristics of silk and analyse the diseases of silkworm. | K5 | IV |
| CO6 | Analyse the skills in establishing vermiculture and sericulture unit through field visit. | K5 | V |

## 2. A. Syllabus

**UNIT - I Vermiculture& Taxonomic classification** **5 Hrs**

**Vermiculture:** Scope and economics of vermiculture.**Taxonomical classification**
Ecological classification of earth worm: epigeic, endogeic,anecic- morphology and life cycle of *Eudriluseugeniae*

**UNIT – II Types and Methods** **5 Hrs**

Organic waste sources – various types and ratios of organic waste sources - vermicomposting methods: small scale, large scale, pit method, heap method, shadow method, Windrow's method, indoor method, advantages -Vermiwash.

**UNIT – III Sericulture & Classification** **5 Hrs**

Scope and economics of sericulture-Sericulture in India:Central Silk Board – Types of Silk worm;Mulberry and non- mulberry (Tasar,Eri and Muga) – Life cycle of *Bombyx mori*- Anatomy of silkgland, Mulberry varieties – Harvesting and preservation– Rearing and rearing appliances for silkworm.

**UNIT - IV Mounting Methods & Diseases** **5 Hrs**

Methods of mounting – Commercial characters of cocoons – Reeling of cocoons – Stifling and storage, diseases of silk worm: Pebrine, Muscardine and Flacherie

**UNIT -V FIELD TRIP AND SPOTTERS** **10 Hrs**

**Field visit: Field visit to a vermiculture** unit to observe various methods of Vermicomposting (pit method, heap method, shadow method, indoor method, breeding pits and Vermiwash
1. Effect of vermicompost on the growth of plants (Group projects)
2. Estimation of nitrogen in vermicasts (Demo)

**SPOTTERS**: Eudriluseugeniae, Perionyxexcavatus, Lampitomauritii, Eiseniafoetida,cocoon, vermicasts, vermiwash.

**Field visit: Field visit to the egg production unit, modern sericulture unit**

**SPOTTERS:** Bombyxmori - Eggs, larvae, pupa, silk gland, adult male and adult female - cocoons – localand hybrid varieties -netrika-chandrika(mountages)- silkthread.

**B. Topics for Self-Study**

| Sl. No. | Topics | Web Links |
|---|---|---|
| 1. | Species used for Vermicomposting | http://faunaofindia.nic.in/PDFVolumes/spb/022/index.pdf |
| 2. | Diseased for Earthworm | https://icl-sf.com/global-en/article/pests-and-diseases-focus-on-earthworms-and-red-thread-on-lawns/ |
| 3. | Life cycle of non mulberry silkworms | https://www.notesonzoology.com/sericulture/life-cycle-of-various-silk-moths/323 |
| 4. | Dyeing of silk fabrics | https://www.advantour.com/silkroad/dyeing-of-silk-fabrics.htm |
| 5. | Marketing | https://hts.assam.gov.in/information-services/marketing |

**C. Text Books**

1. Gupta P.K, - Agrobios - Vermicomposting ,(India)2003
2. Ganga &Sulochanacetty – Introduction to sericulture

**D. Reference Books**

1. Ismail S.A.,Vermicology, The biology of earth worm, Orient longman, London, 1970.
2. Lee, K.E., Earthworms-their ecology and relationship with soil and land use., Acadamic Press, Sydney,1985.
3. Edwards, C.A. and P.J. Bohlen, 1996., Ecology of earthworm, 3rd Edn., Chapman and Hall.11

**E. Web Links**

1. https://agritech.tnau.ac.in/sericulture/seri_index.html
2. http://csb.gov.in/silk-sericulture/sericulture/

3. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/vermiculture
4. https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/E-Learning/Moocs/Solid_Waste/W4/Manual_On_Farm_Vermicomposting_Vermiculture.pdf

## 3. SPECIFIC LEARNING OUTCOMES (SLO)

| Unit/ Section | Course Contents | Specific Learning outcomes | Highest Bloom's Taxonomic Level of Transaction |
|---|---|---|---|
| **I** | **VERMICULTURE & TAXONOMIC CLASSIFICATION** | | |
| 1.1 | Scope and Economics of Vermiculture | • Examine the importance of and scope of vermiculture | **K4** |
| 1.2 | Ecological classification of earthworm | • Classify the characteristic features of earthworms | **K2** |
| 1.3 | Morphology and life cycle of *Eudriluseugeniae* | • Explain the external structure and the complete lifecycle of the Eudrilus | **K5** |
| **II** | **TYPES AND METHODS** | | |
| 2.1 | Organic waste resources | • Interpret the importance and uses of organic wastes | **K5** |
| 2.2 | Vermicomposting methods | • Categorize the various methods followed in vermicomposting | **K6** |
| 2.3 | Vermiwash | • List out the process of vermiwash | **K4** |
| **III** | **SERICULTURE & CLASSIFICATION** | | |
| 3.1 | Scope and economics of sericulture | • Examine the economic importance and the scope of sericulture | **K4** |
| 3.2 | Types of silkworm | • Compare and classify the different types of silkworm | **K4** |
| 3.3 | Life cycle of *Bombyx mori* | • Analyze the life cycle of silkworm | **K4** |
| 3.4 | Varieties of mulberries Harvesting and preservation | • Categorize the various varieties of mulberries | **K4** |
| | | • Assess the silk harvesting and preservation techniques | **K5** |
| 3.5 | Rearing and rearing appliances | • Examine the process of rearing and the appliances used for rearing | **K4** |
| **IV** | **MOUNTING METHODS & DISEASES** | | |
| 4.1 | Methods of mounting cocoons | • Explain the diverse methods of mounting the cocoons | **K5** |
| 4.2 | Commercial characters of cocoons | • Evaluate the commercial values of cocoons | **K5** |
| 4.3 | Diseases of silkworm | • Analyze the type of diseases in silkworm | **K4** |
| **V** | **FIELD TRIP AND SPOTTERS** | | |
| 5.1 | Field visit to vermiculture unit | • Inspect the process and purpose of vermiculture unit | **K4** |

| | | | |
|---|---|---|---|
| 5.2 | Vermicompost in growth of plants | • Explain the importance of relationship between growth of plants and vermicompost | **K5** |
| 5.3 | Nitrogen in vermicasts | • Analyze the importance of nitrogen in vermicasts | **K4** |
| 5.4 | Spotters- *Eudriluseugeniae*, *Perionyx excavates*, *Lampitomauritii*, *Eisenia foetida*, Cocoon, Vermicast and Vermiwash | • Classify and discuss the various species of earthworms, its life cycle and by-products | **K4** |
| 5.5 | Field visit to sericulture unit | • Judge the process and rationale of a sericulture unit | **K5** |
| 5.6 | Spotters- *Bombyx mori* – eggs, larva, pupae, silk gland, male and female<br>Cocoons – varieties<br>Netrika, chandrika, silk thread | • Explain about the species used for the production of silk | **K5** |
| | | • Distinguish the differences in male and female worms | **K4** |
| | | • Build a knowledge about the various techniques involved in silk production and the significance of silk threads | **K3** |

## 4. MAPPING (CO, PO, PSO)

| U19ZYPS1 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | - | H | H | H | H | H | M | H | H | H | H |
| **CO2** | H | H | - | H | H | H | H | H | M | H | H | H | H |
| **CO3** | H | H | - | H | H | H | H | H | M | H | H | H | H |
| **CO4** | H | H | - | H | H | H | H | H | M | H | H | H | H |
| **CO5** | H | H | - | H | H | H | H | H | M | H | H | H | H |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT METHODS

| |
|---|
| **DIRECT** |
| 1. Continuous Assessment Test I, II<br>2. Assignment, Group Presentation, Field Visit, Field Visit Report etc.<br>3. End Semester Examination |
| **INDIRECT** |

1. Course-end survey

**Course coordinators:**

1. **Dr. Susan. G. Suganya**
2. **Dr. Faridha Banu**

## CORE PRACTICAL III: ECOLOGY AND EVOLUTION

**SEMESTER: III** **Code: U19ZY3P3**
**CREDITS: 2** **HOURS/WEEK: 3**

### 1. COURSE OUTCOMES

On completion of this course, the students will be able to:

| CO.No. | COURSE OUTCOMES | LEVEL | EXPERIMENTS |
|---|---|---|---|
| CO1 | Examine and analysing the water quality and its parameters through quantitative estimations in different habitats | K4 | I |
| CO2 | Distinguish the evolutionary significance and their adaptations of animals | K3 | I – V |
| CO3 | Examine the significance of fossils in evolution. | K4 | I – V |
| CO4 | Compare the theories of evolution and modifications | K3 | III |
| CO5 | Relate the concept of speciation and evolutionary process. | K2 | IV, V |
| CO6 | Identify, Compare the marine planktons and develop the skills of documenting the geological ages through field visit | K5 | V |

### 2. A. Syllabus

**ECOLOGY**

1. Estimation of Dissolved oxygen in water samples
2. Estimation of Free $CO_2$ in water samples
3. Estimation of salinity in water samples
4. Animal association-Parasitism, Mutualism, Commensalism, Predation
5. Identify the animals related to Inter tidal habitat- Rocky, Sandy and Muddy (4 examples in each)
6. Identification of marine planktons

Spotters: Anemometer, Hygrometer, Seechi disc

**EVOLUTION**

Animals of evolutionary significances : Peripatus, Archeopteryx.
Homologous organs : Fore limb modifications
Analogous organs : Wing modifications
Coloration and mimicry : Chamaeleon, leaf insect, stick insect.
Fossils : Ammonite, Nautiloid,

**FIELD VISIT**

Paleontological field visit to ARIYALURand submission of field report.

**B. Topics for Self-Study**

| Sl.No. | Topics | Web Links |
|---|---|---|
| 1 | Estimation of primary productivity | Agarwal, A.K. Ecology and Environmental Biology. Student Edition, Agrobios (India) Behind Nasrani Conema, Chopasani Road, Jodhpur -342 002. |
| 2 | Pond Ecosystem (Chart) | https://www.biologydiscussion.com/ecosystem/pond-and-lake-as-ecosystem-with-diagram/6683 |
| 3 | Gene Frequency : Hardy Weinberg law-probability Experiment- | Moody, Introduction To Evolution |
| 4 | Variations : variation and finger prints | Dobzhansky, Th.: Genetics And The Origin Of Species 1951,ColumbiaUty. Press |

**C. Text Book**

1. A Verma P.S. and V. K. Agarwal (2008) Cell biology, Genetics, molecular Biology, Evolutionary Ecology, S. Chand & Co. New Delhi.

**D. Reference Book**

1. Agarwal, A.K. Ecology and Environmental Biology. Student Edition

**E. Web Links**

1. https://youtu.be/m0_W3xXIgDE
2. https://www.youtube.com/watch?v=8Qc-8ZPqtnU-Shomu's biology

## 3. SPECIFIC LEARNING OUTCOMES (SLO)

| Experiments | Course Contents | Specific Learning Outcomes | Highest Bloom's Taxonomical Level of Transaction |
|---|---|---|---|
| **1** | Estimation of Dissolved oxygen O2,Salinity | • Estimate and analysing the water quality | **K5** |
| **1 & 4** | Animal association | • Examine the animals and their adaptations | **K4** |
| **1 & 4** | Identify the animals related to Inter tidal habitat | • Examine the animals related to Inter tidal habitat | **K4** |
| **4** | Identification of marine planktons | • Identify and analyze the types and importance of planktons | **K5** |
| **1** | Spotters: Anemometer, Hygrometer, Seechi disc | • Measure the abiotic factors in the enviroment | **K4** |
| **3** | Animals of evolutionary significances | • Evaluate the gradual development of animal modifications | **K5** |
| **5** | Homologous organs | • Examine the various animals but functions are same | **K5** |
| **5** | Analogous organs | • Examine the similarity in organs but different functions | **K4** |
| **5** | Coloration and mimicry | • Examine the coloration and mimicry characteristics | **K3** |
| **5** | Fossils | • Identify and calculating the ages of earth through the evidences | **K3** |
| **5** | Paleontological field visit to **ARIYALUR** | • Identify and calculating the ages of earth through the evidences | **K3** |

## 4. MAPPING (CO, PO, PSO)

| U19ZY3P3 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | H | H | H | H | M | - | H | - | H | - | H |
| CO2 | H | H | H | H | H | H | M | - | M | - | H | - | H |
| CO3 | H | H | H | H | H | H | H | - | M | - | H | - | H |
| CO4 | H | H | H | H | H | H | H | - | H | - | H | - | H |
| CO5 | H | H | H | H | H | H | M | - | H | - | H | - | H |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT METHODS

| |
|---|
| **DIRECT** |
| 1. Continuous Assessment Test I, II<br>2. Assignment, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable)<br>**3.** End Semester Examination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinators:**

1. **Dr. J. Nesarajan**
2. **Dr. S. Bhuvaneshwari**

## CORE - IV: CELL AND MOLECULAR BIOLOGY

**SEMESTER: IV** **CODE: U19ZY404**
**CREDITS : 4** **HOURS/WEEK: 4**

**COURSE OUTCOMES**
After the successful completion of this course the students will be able to:

| CO. No. | COURSE OUTCOMES | LEVEL | UNIT |
|---|---|---|---|
| CO1 | Explain the principles and applications of microscopes, cell theory and micro techniques | K2 | I |
| CO2 | Distinguish the ultrastructure of cell organelles and their functions. | K2 | II |
| CO3 | Relate the rapid advances in cell and molecular biology to a better understanding of diseases, including cancer. | K2 | III |
| CO4 | Explain the structure of protein folding and sorting | K4 | IV |
| CO5 | Justify the processes that control eukaryotic cell cycle and cell death. | K5 | V |
| CO6 | Illustrate the structural organization of genes and the control of gene expression. | K2 | V |

**2. A. Syllabus**

**UNIT I FUNDAMENTALS OF CELL BIOLOGY** **18 Hrs**
Microscopy – Principles and applications of Light, Fluorescent and Electron microscopes – SEM, TEM, Inverted Microscope. Microtechnique – tissue fixation, sectioning and staining. Cell theory- Prokaryotic and Eukaryotic cells – Ultrastructure of an animal cell. Plasma membrane: Ultrastructure, Unit membrane and fluid mosaic models - functions of Plasma membrane.

**UNIT II CELL ORGANELLES** **18 Hrs**
Cytoplasm: Physico and biological properties - Cytoskeleton: Microtubules, microfilaments and Intermediate filaments. Endoplasmic reticulum: Ultrastructure and functions, Golgi complex: Morphology, structure, role in secretion and other functions. Lysosomes and Centrosomes – Morphology, chemistry and functions Mitochondria: Ultrastructure and functions – Ribosomes – Ultrastructure and functions.

**UNIT III MEMBRANE-BOUND ORGANELLE** **18 Hrs**
Nucleus: Ultrastructure of interphase nucleus. Nucleolus and Chromosomes – structure and functions; Giant chromosomes - Polytene and Lampbrush chromosomes - Cell cycle and its significance - Cell divisions: Mitosis and Meiosis. Cancer Biology, Apoptosis, Stem cells.

**UNIT IVGENE EXPRESSION** **18 Hrs**

Molecular structure of DNA - types of DNA - DNA replication in Prokaryotes and Eukaryotes – DNA repair mechanisms- Types and functions of RNA- Genetic code – Protein synthesis: Transcription, Translation and post-translational modifications.

**UNIT V GENE REGULATION** **18 Hrs**

Gene concept: cistron, recon, muton. Regulation of gene expression in prokaryotes: Lac and Tryptophan Operons.

**B. Topics for Self-Study**

| Sl.No. | Topics | Web Links |
|---|---|---|
| 1. | Cell Migration | https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4457291/pdf/nihms689535.pdf |
| 2. | Cell Cycle Checkpoint in cancer | https://jeccr.biomedcentral.com/articles/10.1186/s13046-016-0433-9 |
| 3. | Epithelial Mesenchymal Transition | https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2689101/pdf/JCI39104.pdf |
| 4. | Alternative Splicing | https://bitesizebio.com/10148/what-is-alternative-splicing-and-why-is-it-important/ |
| 5. | ubiquitin-proteasome pathway | https://jasn.asnjournals.org/content/jnephrol/17/7/1807.full.pdf?with-ds=yes |

**C. Text Books**


1. De Robertis, E.D.P and De Robertis, E.M.F., Cell and Molecular Biology, International Edition, Hong Kong, 8th Edition, 1998.
2. Verma P.S and Agarwal V.K, Cytology (Cell Biology and Molecular Biology), S Chand & Co. Ltd., 2006.
3. Jeyanthi, G.P., Molecular Biology, MJP Publishers, Chennai, 2009.


**D. Reference Books**


1. Albert's B. et al., Molecular Biology of the Cell, 4th Edition Garland Science, 2002.
2. Karp, G John, Cell and Molecular Biology, Wiley & Sons, 2008.
3. Cooper, G.M and Hausman R.E, The Cell-A molecular approach, 4th edn, Sinauer Associates Inc. USA., 2007.
4. Ed: Lewin , B.et. al, Cells, Jones and Barlett Publishers, USA, 2007.
5. Rastogi, S.C, Cell Biology, New Delhi, Tata McGraw Hill, 1998.
6. Lodish, H.*et.al*., Molecular Cell Biology, W. H. Freeman & Co., 2000.
7. Malacinski G, M Freifelder's Essential of Molecular Biology, Narosa Publishing House, New Delhi, 2003.
8. Sadava. D. E., Cell biology, organalle, structure and function, Panima Publishing Corporation, New Delhi, 2004.
9. Clark D. P. Molecular Biology, Understanding the Genetic Revolution, Elsevier, 2005
10. Epstein, R.J., Human Molecular biology, An Introduction to the molecular basis of health and disease, Cambridge University press, 2003.
11. Ed: ColldoVides, J. et.al., Integrative approaches to Molecular Biology, Ane books, New Delhi, 2004.


**E. Web Links**

1. https://www.youtube.com/embed/8hGXemnPJi4
2. https://www.khanacademy.org/science/ap-biology/cell-communication-and-cell-cycle/cell-communication/a/introduction-to-cell-signaling
3. https://bio.libretexts.org/Bookshelves/Human_Biology/Book%3A_Human_Biology_(Wakim_and_Grewal)/05%3A_Cells/5.06%3A_Cell_Organelles

## 3. SPECIFIC LEARNING OUTCOMES (SLO)

| Unit/ Section | Course Contents | Specific Learning Outcomes | Highest Bloom's Taxonomical Level of Transaction |
|---|---|---|---|
| **I** | **Fundamentals of Cell Biology** | | |
| **1.1** | **Microscopy** – Principles and applications of Light, Fluorescent and Electron microscopes – SEM, TEM, Inverted Microscope. | • Interpret the principles and applications of microscopy<br>• Identify the functions of different types of microscopy | **K2** |
| **1.2** | Microtechnique – tissue fixation, sectioning and staining. | • Explain the technique of tissue processing | **K2** |
| **1.3** | Cell theory - Prokaryotic and Eukaryotic cells – Ultra structure of an animal cell. | • Classify different cell types | **K2** |
| **1.4** | **Plasma membrane** – Ultra structure, Unit membrane and fluid mosaic models - functions of Plasma membrane. | • Compare the unit membrane structure and fluid mosaic models | **K2** |
| **II** | **Cell organelles** | | |
| **2.1** | **Cytoplasm** -Physico and biological properties | • Summarize the physical and chemical properties of cytoplasm | **K2** |
| **2.2** | **Cytoskeleton** - Microtubules, microfilaments and Intermediate filaments. | • Explain the functions of cytoplasm in the cells | **K2** |
| **2.3** | **Endoplasmic reticulum** – Ultra structure and functions | • Define structure and function<br>• Explain the biochemical properties of each of the cell organelles | **K2** |
| **2.4** | **Golgi complex** - Morphology, structure, role in secretion and other functions. | | |
| **2.5** | **Lysosomes and Centrosomes** - Morphology, chemistry and functions**.** | | |
| **2.6** | **Mitochondria –** Ultra structure and functions. | | |
| **2.7** | **Ribosomes –** Ultra structure and functions. | | |
| **III** | **Membrane-Bound Organelle** | | |
| **3.1** | **Nucleus:** Ultra structure of interphase nucleus. | • Illustrate the ultrastructure of interphase nucleus | **K2** |
| **3.2** | **Nucleolus and Chromosomes** – structure and functions; Giant chromosomes - Polytene and Lampbrush chromosomes. | • Distinguish the different types and its the functions. | |

| | | | |
|---|---|---|---|
| **3.3** | Cell cycle and its significance. | • Analyse the stages of cell cycle and its significance | **K4** |
| **3.4** | Cell divisions: Mitosis and Meiosis. | • Explain the process of mitotic and meiotic division | **K2** |
| **3.5** | Cancer Biology | • Explain the concept of cancer cells | **K2** |
| **3.6** | Apoptosis | • Assess the cellular changes and cell death | **K5** |
| **3.7** | Stem cells | • Justify the importance of stem cell therapy | **K5** |
| **IV** | **Gene Expression** | | |
| **4.1** | Molecular structure of DNA - types of DNA - DNA replication in Prokaryotes and Eukaryotes – DNA repair mechanisms - Types and functions of RNA- Genetic code – | • Define the structure and functions of DNA and RNA<br>• Demonstrate the biological process of replication | **K2** |
| **4.2** | **Protein synthesis**: Transcription, Translation and post-translational modifications. | • Categorise the steps involved in protein synthesis | **K4** |
| **V** | **Gene regulation** | | |
| **5.1** | Gene concept: cistron, recon, muton. | • Compare the functions of cistron, recon and muton | **K2** |
| **5.2** | **Regulation of gene expression in prokaryotes**: Lac and Tryptophan Operons. | • Categorize the regulation of genes based on their functions | **K5** |

## 4. MAPPING (CO, PO, PSO)

| U19ZY404 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | M | - | H | - | L | - | L | - | H | L | - |
| CO2 | - | - | M | - | M | - | L | L | - | - | H | - | L |
| CO3 | - | L | - | - | H | M | - | - | - | L | H | L | - |
| CO4 | M | - | - | L | - | M | - | - | L | - | M | - | H |
| CO5 | - | L | - | M | - | - | M | - | - | L | - | - | L |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT METHODS

| **DIRECT** |
|---|
| 1. Continuous Assessment Test I, II<br>2. Assignment; Journal paper review, Group Presentation, Project report, Poster preparation<br>3. End Semester Examination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinators:**

1. **Dr. Priscilla Suresh**
2. **Dr. Faridha Banu**

## SBEC II: PISCICULTURE

**SEMESTER: IV** **CODE: U19ZYPS2**
**CREDITS : 2** **HOURS/WEEK: 2**

### 1. COURSE OUTCOMES

On completion of this course, the students will be able to:

| CO. No. | COURSE OUTCOMES | LEVEL | UNIT |
|---|---|---|---|
| CO1 | Assess the scope and economic importance of fish culture | K5 | I |
| CO2 | Create an employment opportunity for rural students | K5 | II |
| CO3 | Classify the fishes based on ecological and morphological concepts. | K3 | III |
| CO4 | Make use of the expertise to generate the high revenue | K4 | IV |
| CO5 | Design the unit based on the gained expertise. | K5 | V |
| CO6 | Apply skills to establish a fish form unit and identify the various diseases and their controlling measures through field visit. | K5 | V |

### 2. A. Syllabus

**UNIT I: Introduction of Fishes** **6 Hrs**

Scope and economics- Important cultivable fresh water fishes -Major carps: Catla, Rohu, Mrigal–Cyprinus, Clariasbatrachus,*Tilapia.* Ornamental fishes–*types and breeding*
Minor carps**:** common carp, silvercarp, grass carp. Beneficial fishes – Food fishes, Game fishes, Ornamental fishes, Medicinal fishes, Productive fishes, Mosquito fishes. Harmful fishes – Toxic fishes, Fishes as Vectors, Fishes as Destroyers

**UNIT II: Pond Construction and Maintenances** **6 Hrs**

Pond construction- site selection- Construction, Ploughing, Liming, Irrigation, Fertilization, water source, Weed control, Predator control, Stocking, Supplementary feeding, Disease control, Fish pond implements and environmental / *hydrological* parameters-Types of Pond: Breeding, nursery, stocking, rearing pond and Marketing pond

**UNIT III: Cultural System and Diseases** **6 Hrs**

Types of culture: mono, poly and integrated farming - feed: Live, artificial and probiotics. Inducedbreeding. *Major diseases* of freshwater fishes- White spot disease, Gill rot disease,Epizootic ulcerative syndrome

**UNIT IV: Field Visit to Aquaculture Industry** **6 Hrs**

Field visit to nearby aqua farm: observation and recording of breeding, stocking, culture and harvesting practices.

**UNIT V: Water Quality Management and Live Feed Organisms** **6 Hrs**

1. Measurement of pH in the pond water samples

2. Analysis of Phytoplankton and Zooplankton

Spotters: Catla – Rohu – Mrigal - Common carp,silvercarp,grass carp-Fries- Fingerlings.

**B. Topics for Self-Study**

| Sl.No. | Topics | Web Links |
|---|---|---|
| **1** | Age determination, Schooling in fish, Spawning migration | Bal, D.V. and K.V. Rao, 1984. Marine Fisheries, Tata McGraw Hill, New Delhi. 470 pp |
| **2** | Collection of fish seeds. | Bardah, Ryther and MoLarrey, 1972. Aquaculture, John Wiley, New York, 868 pp |
| **3** | Hybridization in fishes | Mills, Dick, 1993. Aquarium Fish, DK Publishing Inc., New York - 100 016 |
| **4** | Hormonal manipulation in advancing maturity and reproduction. | file:///C:/Users/dell/Downloads/The_mechanism_of_reproduction_and_hormonal_functio.pdf |
| **5** | Molecular markers used in fisheries and aquaculture | file:///C:/Users/dell/Downloads/Molecular_markers_and_their_applications_in_fisher.pdf |

**C. Text Books**

1. Manual of freshwater aquaculture. – Santhanam. R. Oxford and IBH
2. Shukla G.S and Updhay V.B, Economic Zoology, Rastogi Publicatio ns, 2004.

**D. Reference Books**

1. Jhingaran, Fish and fisheries, Hindustan Publishing Corporation, New Delhi, 1982.
2. Ramasamy P, Diseaes in freshwater aquaculture systems, Vanitha publications, 1992.
3. Biswas K.P., A **Text Book** of fish, fisheries and technology, Narendra publishing House, 1980.
4. S.K. Gupta, P.C. Gupta, General and Applied Ichthyology, Chand Publications.

**E. Web Links**

1. https://www.nationalgeographic.com/foodfeatures/aquaculture/
2. https://www.hindawi.com/journals/vmi/2018/5432497/
3. https://www.nationalgeographic.com/foodfeatures/aquaculture/

**3. SPECIFIC LEARNING OUTCOMES (SLO)**

| Unit/Section | Course Contents | Specific Learning outcomes | Highest Bloom's Taxonomic Level of Transaction |
|---|---|---|---|
| **I** | **INTRODUCTION OF FISHES** | | |

| | | | |
|---|---|---|---|
| **1.1** | Scope and Economics of Pisciculture | • Elaborate the importance of and scope of Pisciculture | **K4** |
| **1.2** | Ecological classification of fishes | • Classify the characteristic features of fishes | **K3** |
| **1.3** | Morphology and cultivable fishes | • Explain the external structure and the adopting abilities | **K5** |
| **II** | **POND CONSTRUCTION AND MAINTENANCES** | | |
| **2.1** | Pond construction methods | • Interpret the importance of site selection | **K5** |
| **2.2** | Various ponds | • Discuss the various types of ponds | **K5** |
| **2.3** | Rearing | • Explain the process of rearing methods | **K5** |
| **III** | **CULTURAL SYSTEM AND DISEASES** | | |
| **3.1** | Mono culture, poly culture, | • Discuss the culture methods | **K4** |
| **3..2** | Probiotics, feeding | • Compare and classify the different feeding ant its methods | **K3** |
| **3.3** | IFS | • Create innovative methods in IFS | **K4** |
| | | • Elaborate the techniques in IFS | **K4** |
| **3.4** | Fish diseases | • Categorize the various diseases and their control measures | **K5** |
| **3.5** | Induced breeding | • Examine the process of Inducedbreeding and its benefits | **K5** |
| **IV** | **FIELD VISIT TO AQUACULTURE INDUSTRY** | | |
| **4.1** | Field visit to Pisciculture unit | • Inspect the process and Purpose of unit Pisciculture | **K4** |
| **4.2** | Commercial value of fishes | • Evaluate the commercial values of fishes | **K4** |
| **4.3** | Harvesting methods | • Explain the different type of Harvesting methods | **K4** |
| **V** | **WATER QUALITY MANAGEMENT AND LIVE FEED ORGANISMS** | | |
| **5.1** | Measurement of pH | • Estimate the pH of water samples. | **K5** |
| **5.2** | Phytoplankton and Zooplankton | • Analyze the importance of planktons | **K5** |
| **5.3** | Spotters :Catla – Rohu – Mrigal - Common carp,silver carp, grass carp-Fries-Fingerlings. | • Identify the different types of fresh water fishes based on the morphology | **K3** |

## 4. MAPPING (CO, PO, PSO)

| U19ZYPS2 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | H | H | H | H | H | H | H | H | M | H | H |
| CO2 | H | H | H | H | H | H | H | H | H | H | H | H | H |
| CO3 | H | H | H | H | H | H | H | H | H | H | H | H | H |
| CO4 | M | H | H | H | H | H | H | H | M | H | - | H | H |
| CO5 | H | H | H | H | H | H | H | H | M | H | H | H | H |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT METHODS

| DIRECT |
|---|
| 1. Continuous Assessment Test I, II<br>2. Assignment, Project report, Poster preparation, Field trip and Survey<br>3. End SemesterExamination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinators:**

1. **Ms. Hadline Kiruba**
2. **Dr. S. Bhuvaneshwari**

## CORE PRACTICAL IV: CELL AND MOLECULAR BIOLOGY

**SEMESTER: III** **Code: U19ZY4P4**

**CREDITS: 2** **HOURS/WEEK: 3**

### 1. COURSE OUTCOMES

On completion of this course, the students will be able to:

| CO. No. | COURSE OUTCOMES | LEVEL | EXPERIMENTS |
|---|---|---|---|
| CO1 | Apply practical skills in the cell and molecular biology techniques | K4 | I&II |
| CO2 | Identify and to describe the structure and functions of different types of cells present in the animals. | K3 | I |
| CO3 | Develop skills in squash preparation, permanent slides and staining | K6 | I |
| CO4 | Interpret the principles and applications of various instruments used in cell and molecular biology | K2 | I &II |
| CO5 | Identify DNA and RNA by differential staining | K2 | II |
| CO6 | Construct models of various nucleic acids | K6 | I |

### 2. A. Syllabus

**CELL BIOLOGY**

1. Determination of a cell size by Micrometry
2. Preparation and Identification of Polytene chromosomes in the salivary gland of Chironomous larva
3. Squash preparation of mitosis in onion root tip
4. Squash preparation of meiosis in Grasshopper testis
5. Buccal Smear preparation and Identification of Barr Body
6. Microtechnique – tissue fixation, sectioning and staining.

**SPOTTERS:** Compound Microscope, Centrifuge and Microtome
Prepared slides: Columnar, Ciliated, Squamous epithelium, Cardiac, Striated, Non- Striated muscle cells, Nerve cell, Blood cells of Man and Frog.

**MOLECULAR BIOLOGY**

7. Isolation of Chromosomal DNA in Eukaryotes
8. Differential staining of DNA and RNA
9. Models of DNA, DNA replication, RNA types

**B. Topic for Self-Study**

| Sl.No. | Topic | Web Links |
|---|---|---|
| **1.** | Real Time – PCR | **https://www.frontiersin.org/articles/10.3389/fmicb.2017.00108/full** |
| **2.** | Restriction digestion | **https://www.genscript.com/what-is-restriction-digestion.html** |
| **3.** | Flow cytometry | **https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5939936/** |
| **4.** | Immunofluorescence | **https://www.sinobiological.com/category/principle-of-if** |

**C. Text Book**

1. CELL AND MOLECULAR BIOLOGY : A Lab Manual. K. V. Chaitanya, PHI Publication. 30 October 2013.

**D. Reference Books**

1. Molecular Biology Techniques, Sue Carson Heather Miller Melissa Srougi D. Scott Witherow 4th Edition.

**E. Web Links**

1. https://www.lybrate.com/lab-test/buccal-smear-for-barr-bodies

**3. SPECIFIC LEARNING OUTCOMES (SLO)**

| Experiments | Course Contents | Specific Learning Outcomes | Highest Bloom's Taxonomical Level of Transaction |
|---|---|---|---|
| **I** | **CELL BIOLOGY** | | |
| **1.** | Determination of a cell size by Micrometry | • Determine the size of a cell | **K5** |
| **2.** | Preparation and Identification of Polytene chromosomes in the salivary gland of Chironomous larva | • Analyze the polytene chromosome prepared from chironomous larva | **K4** |
| **3.** | Squash preparation of mitosis in onion root tip | • Analyze different stages of mitosis from onion root | **K4** |
| **4.** | Squash preparation of meiosis in Grasshopper testis | • Distinguish different stages of meiosis in grasshopper testis | **K4** |
| **5.** | Buccal Smear preparation and Identification of Barr Body | • Identify the sex of an organism from buccal smear | **K3** |
| **6.** | Microtechnique – tissue fixation, sectioning and staining. | • Develop permanent tissue slides | **K3** |
| **II** | **MOLECULAR BIOLOGY** | | |
| **7.** | Isolation of Chromosomal DNA in Eukaryotes | • Analyze the DNA isolated from Eukaryotic organism | **K4** |
| **8.** | Spotters: Compound Microscope, Centrifuge and Microtome | • Identify different instruments used in cell and molecular biology | **K3** |

| | | | |
|---|---|---|---|
| **9.** | Prepared slides: Columnar, Ciliated, Squamous epithelium, Cardiac, Striated, Non- Striated muscle cells, Nerve cell, Blood cells of Man and Frog. | • Construct different slides from tissues and organs | **K3** |
| **10.** | Models of DNA, DNA replication, RNA types | • Construct different nucleic acid models | **K3** |

## 4. MAPPING (CO, PO, PSO)

| U19ZY4P4 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | L | - | H | - | M | - | - | H | - | - | L | - |
| **CO2** | M | - | - | - | L | - | - | L | - | L | - | - | M |
| **CO3** | M | - | M | - | - | - | H | - | - | - | M | - | H |
| **CO4** | M | - | - | H | - | M | - | - | - | M | L | - | - |
| **CO5** | M | - | - | - | M | - | - | L | - | L | M | - | M |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT METHODS

| |
|---|
| **DIRECT** |
| 1. Continuous Assessment Test I, II<br>2. Assignment, Group Presentation, Poster preparation<br>3. End Semester Examination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinators:**

1. **Dr. Priscilla Suresh**
2. **Dr. Faridha Banu**

## CORE V: GENETICS

**SEMESTER: V** **Code: U19ZY505**
**CREDITS: 6** **HOURS/WEEK: 6**

### 1. COURSE OUTCOMES

On completion of this course, the students will be able to:

| CO. No. | COURSE OUTCOMES | LEVEL | UNIT |
|---|---|---|---|
| CO1 | Describe the mechanism of inheritance pattern | K4 | I |
| CO2 | Describe the concept of sex determination and its genetic significance | K5 | II |
| CO3 | Develop knowledge in molecular mutation and its applied aspects | K5 | III |
| CO4 | Describe the microbial genetic and its patterns of inheritance | K4 | IV |
| CO5 | Understand the chromosomal inheritance and expression of human | K5 | V |
| CO6 | Appraise the genetic disorders of human | K5 | V |

### 2. A. Syllabus

**UNIT I INTRODUCTION TO GENETICS** **18 Hrs**

Introduction to Genetics: Mendel and his experiments, Mendel's laws of inheritance.
Interaction of genes: Allelic and nonallelic interaction, Complementary genes, epistasis, pleotropism. Polygenic action: skin colour in man -Multiple alleles: ABO blood group system, Rh group and its inheritance.

**UNIT II LINKAGE& CROSSING OVER** **18 Hrs**

Linkage, crossing over: types - mechanism- recombination Sex determination: Chromosomal control of sex determination, genic balance theory in drosophila, hormonal control of sex determination, environmental control of sex determination. Sex linkage: Sex linked inheritance of man: colour blindness and haemophilia - Sex limited genes andsex influenced genes.

**UNIT III MUTATION** **18 Hrs**

Mutation: Chromosomal aberrations in number and structure - Types of mutation: somatic, germinal, spontaneous, induced, autosomal and allosomal, - Molecular basis of mutation, phenotypic effects ofmutation, significance and practical application of mutation, mutagenic agents. Extra chromosomal inheritance: Kappa particles in paramecium, maternal effect in snail shell coiling. Drosophila mutants

**UNIT IV BACTERIAL GENETICS** **18 Hrs**

Bacterial Genetics: Conjugation: F+ - Hfr Cells - Plasmid - DNA mediated Transformation - Transduction:Generalized transduction, Specialized Transduction – Sexduction.

**UNIT V HUMAN GENETICS** **18 Hrs**

Human genetics: Karyotyping, pedigree analysis, allosomal and autosomal: dominant and recessive; Human Syndromes (Down, Klinefelter's, Turner)- Inborn errors of Metabolism – PKU – Alkaptonuria –Tyrosine metabolism.

**B. Topics for Self- Study**

| Sl.No. | Topics | Web Links |
|---|---|---|
| 1 | History of G.J. Mendel | Gregor Mendel - Life, Experiments & Facts - Biography |
| 2. | Solenoid model of DNA | What is Nucleosome Solenoid Model ?\|\| Biology \| Study Buddy - YouTube |
| 3. | Eugenics | Eugenics - an overview \| ScienceDirect Topics |
| 4. | RNA Interference | RNA Interference (RNAi): A Process Of Gene silencing (geneticeducation.co.in) |
| 5. | Neo Lamarckism | Neo lamarckism - Padeepz |

**C. Text Book**

1. Gardner E.J. et al., Principles of Genetics, 8th edition, Wiley India, 2007.

**D. References Books**

1. Miglani G.S., Advanced Genetics, 2nd Edn, Narosa Publishing House, New Delhi, 2007.
2. Klug W.S and Cummings M.R., Concepts of Genetics, 7th edition, Pearson Education, 2003.
3. Lewin B, Genes IX, Jones and Bartlett Publishers, Boston, 2008.
4. Russel P.J., Genetics: A Molecular approach, 2nd Edn, Pearson Education, 2006.
5. Maloy S.R. et.al., Microbial Genetics, 2nd edition, Narosa Publishing House, New Delhi, 2008.

**E. Web Links**

1. https://www.nature.com/scitable/topic/genetics-5/
2. https://www.genome.gov/genetics-glossary/Gene

**3. SPECIFIC LEARNING OUTCOMES (SLO)**

| Unit/ Section | Course Contents | Specific Learning Outcomes | Highest Bloom's Taxonomic Level of Transaction |
|---|---|---|---|
| **I** | **INTRODUCTION TO GENETICS** | | |
| **1.1** | **Mendel and his experiments** | • Define the history of genetics<br>• Describe the experimental patterns and laws of Mendel | **K2** |
| **1.2** | **Interaction of genes** | • Define different gene expression patterns<br>• Analyze the lethal effects of gene interaction | **K3** |

| | | | |
|---|---|---|---|
| **1.3** | **Polygenic action** | • Apply the polygenic action of genes<br>• Evaluate the colour pattern in human | **K2** |
| **1.4** | **Multiple alleles: ABO blood group system,** | • Describe the gene interaction of multiple genes | **K4** |
| **1.5** | **Allelic and nonallelic interaction** | • Analyze the impact of gene interaction on the autosome and allosome | **K4** |
| **II** | **LINKAGE, CROSSING OVER** | | |
| **2.1** | **Linkage, crossing over: types - mechanism- recombination** | • Describe the cause and effects of recombination | **K3** |
| **2.2** | **Sex determination:** | • Describe the different kind of sex determinations in organisms. | **K4** |
| **2.3** | **Chromosomal control of sex determination, genic balance theory, hormonal and environmental control of sex determination** | • Relate different kinds of sex determination through illustrations | **K5** |
| **2.4** | **Sex linkage: Sex linked inheritance of man: -** | • Define the somatic effect of allosomes<br>• Illustrate the gender based genetic expression | **K3** |
| **III** | **MUTATION** | | |
| **3.1** | **Mutation: Chromosomal aberrations in number and structure** | • Explain the chromosomal defects in human<br>• Analyze the modifications of gene in chromosomal level | **K4** |
| **3.2** | **Types of mutation: somatic, germinal, spontaneous, induced, autosomal and allosomal, -** | • Classify the mutation at its level | **K3** |
| | **Molecular basis of mutation,** | • Analyze the reasons for the mutations | **K4** |
| **3.3** | **phenotypic effects of mutation,** | • Illustrate the effects of molecular mutations | **K5** |
| | **Extra chromosomal inheritance:** | • Define ECI through Kappa particles in paramecium, maternal effect in snail shell coiling. Drosophila mutants | **K5** |
| | **significance and practical application of mutation, mutagenic agents** | • Construct the application procedure for the mutagens | **K5** |
| **IV** | **BACTERIAL GENETICS** | | |
| **4.** | **Bacterial Genetics: Conjugation: F+ - Hfr Cells - Plasmid - DNA mediated Transformation - -** | • Describe the different genetic transformation patterns in in microbes<br>• Classify bacterial genetics | **K5** |

| | | | |
|---|---|---|---|
| **4.1** | **Transduction:Generalized transduction, Specialized Transduction – Sexduction.** | • Describe the contribution of virus in bacterial genetics<br>• Analyze the significance of different transductions and transducing particles | **K3** |
| **V** | **HUMAN GENETICS** | | |
| **5.1** | **Human genetics: Karyotyping, pedigree analysis,** | • Describe the chromosomal inheritance and expression of human genetic characters<br>• Differentiate and identify the human Karyotypes | **K4**<br>**K5** |
| **5.2** | **Human Syndromes** | • illustrate the chromosomal aberration and its effect | **K6** |
| **5.3** | **Inborn errors of Metabolism** | • Describe the influence of recessive gene effect on the metabolic path ways | **K3** |

## 4. MAPPING (CO, PO, PSO)

| U19ZY505 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | H | H | M | M | M | L | M | M | H | H | H |
| CO2 | H | H | H | M | M | M | M | L | M | - | H | L | H |
| CO3 | H | H | M | M | L | M | M | L | M | - | H | M | H |
| CO4 | H | M | H | M | L | H | L | M | L | M | H | - | H |
| CO5 | H | H | H | H | H | M | M | L | M | - | H | - | H |
| CO6 | H | H | M | H | H | M | M | L | M | L | H | M | H |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT METHODS

| DIRECT |
|---|
| 1. Continuous Assessment Test I, II<br>2. Assignment; Journal paper review, Group Presentation, Project report, Poster preparation<br>3. End Semester Examination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinators:**

1. **Mr.Y. Babu**
2. **Dr. S. Bhuvaneshwari**

## CORE VI: MICROBIOLOGY

**SEMESTER: V** **Code: U19ZY506**

**CREDITS: 6** **HOURS/WEEK: 6**

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### 1. COURSE OUTCOMES

On completion of this course, the students will be able to:

| CO. No. | COURSE OUTCOMES | LEVEL | UNIT |
|---|---|---|---|
| CO1. | Classify and compare the characteristics of microbes | K5 | I |
| CO2 | Explain the methods of isolating pure culture of Bacteria | K5 | II |
| CO3 | Examine the role of microbes in Biogeochemical cycle. | K6 | III |
| CO4 | Assess the drinking water standard by water potability test. | K5 | IV |
| CO5 | Evaluate the products of milk & dairy. | K5 | IV |
| CO6 | Assess the causes and preventive measures of various microbial diseases. | K5 | V |

### 2. A. Syllabus

**UNIT I SCOPE AND INTRODUCTION TO BACTERIA** **18 Hrs**

Scope of Microbiology - Whittaker's five kingdom Concept - morphology and structure of bacteria (E.coli) - nutritional types of bacteria - Reproduction and bacterial growth.

**UNIT II BACTERIAL CULTURE ISOLATION** **18 Hrs**

Sterilization techniques - types of culture media - methods of isolating pure cultures-methods of preservation of pure cultures-colony characteristics - staining: simple staining, Gram's staining and Acid fast staining.

**UNIT III MICROBIAL METABOLISM, VIRUSES AND FUNGI** **18 Hrs**

Microbial metabolism: energy production by anaerobic processes and aerobic processes-Viruses: General characteristics - major DNA and RNA viruses- Bacteriophage: Structure, lytic and lysogenic cycle - Fungi: Morphology and structure of fungi

**UNIT IV MICROBIOLOGY OF SOIL, WATER AND FOOD** **18 Hrs**

Microbiology of soil: Biogeochemical role of soil microorganisms.
Microbiology of Domestic water: Water Portability tests: MPN of coliforms, Drinking water standard - Microbiology of foods: Food poisoning - Preservation of foods - Probiotics - Dairy Microbiology: Microbiology of milk and milk products.

**UNIT V DISEASES CAUSED BY BACTERIA, VIRUS AND FUNGI** **18 Hrs**

Microbial diseases: Causative organisms, mode of transmission, pathogenicity, diagnosis and their preventive measures of Bacterial Diseases: Tuberculosis, Typhoid and Syphilis - Viral Diseases: Hepatitis-B, Rabies, AIDS - Fungal Diseases: Candidiasis and Dermatophytosis.

**B. Topics for Self-Study**

| Sl.No. | Topics | Web Links |
|---|---|---|
| 1. | Plastic Degradation | https://www.sciencedirect.com/science/article/pii/S0141391007003539 |
| 2. | Biofilm formation mechanism and its applications. | https://www.future-science.com/doi/10.4155/fmc.15.6 |
| 3. | COVID and its epidemiology | https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7154215/ |
| 4. | Biochemical tests for bacterial identification (IMViC) | https://microbeonline.com/imvic-tests-principle-procedure-and-results/ |

**C. Text Books**

1. Dubey, R.C, Textbook of Microbiology, S Chand & Co 2005.
2. Pelczar. M., et al., Microbiology, 5th ed.,2000, Tata-McGraw Hill

**D. References Books**


1. Stanier, RY., et al., General Microbiology, 5th ed. Macmillan Press.
2. Atlas, RM., Principles of Microbiology, 2nd ed.,1997, McGraw-Hill
3. Salle, AJ., Fundamental Principles of Bacteriology, 7th ed.,1999, Tata- McGraw Hill
4. Prescott, LM., Microbiology, 6th ed. 2005, McGraw-Hill.
5. Powar C.B and Daginawala, General Microbiology H.F., Himalaya Publishing House.
6. Tartora, G.J. et al., Microbiology, An Introduction, 8th edition, Pearson Benjamin Cummings,NewYork, 2004.
7. Ananthanarayanan R and JayaramPanicker, Text Book of Microbiology, C.K Orient Longman,1990.


**E. Web Links**

1. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/water-microbiology
2. https://www.frontiersin.org/articles/10.3389/fmicb.2017.01264/full
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3106255/

**3. SPECIFIC LEARNING OUTCOMES (SLO)**

| Unit/ Section | Course Contents | Specific Learning outcomes | Highest Bloom's Taxonomy Level of transaction |
|---|---|---|---|
| **I** | **SCOPE AND INTRODUCTION TO BACTERIA** | | |
| **1** | **History & scope** | • Explain the history of microbiology | **K5** |

| | | | |
|---|---|---|---|
| | **of Microbiology** | • List out the scope of microbiology | **K4** |
| **1.1** | **Whittaker's five kingdom Concept** | • Classify and explain the Whittaker's five kingdom concept.<br>• Explain the levels of organization | **K5**<br>**K5** |
| **1.2** | **Morphology & Structure of bacteria** | • Explains the morphology and structure of bacteria<br>• Explains the functions of different cellular organelles | **K5**<br>**K5** |
| **1.3** | **Nutritional Types of bacteria** | • Classify and categorize the nutritional types of bacteria<br>• Explain the mode of nutrition in bacteria | **K5** |
| **1.4** | **Reproduction and bacterial growth** | • Explain the types of reproduction in bacterial growth | **K5** |
| | **Bacterial Growth** | • Compare the stages of bacterial growth | **K5** |
| **II** | **BACTERIAL CULTURE MEDIA AND PURE CULTURE ISOLATION** | | |
| **2.1** | **Microbial Metabolism** | • Explain the process of metabolism | **K5** |
| **2.2** | **Energy Production by Aerobic metabolism** | • Discuus the various metabolic pathwaays and the energy gained by aerobic processes. | **K6** |
| **2.3** | **Energy production by anaerobic metabolism** | • Discuus the various metabolic pathwaays and the energy gained by anaerobic processes | **K6** |
| **2.4** | **Virus** | • Compare the general characteristics of virus | **K5** |
| **2.5** | **Classification of Viruses** | • classify and infer the classification of virus | **K5** |
| | | • Classify the types of viruses- Baltimore classification | **K5** |
| **2.7** | **Structure of T4 Bacteriophage** | • Explain the morphology and structure of T4 Bacteriophage | **K5** |
| **2.8** | **Virus replication** | • Explains the mechanism of virus replication. | **K5** |
| | | • Analyse the process of viral replication in the host. | **K4** |

| | | | |
|---|---|---|---|
| **2.9** | **Fungi** | • Explain the structure and morphology of fungi | **K5** |
| | | • Explain the types and nutrition in fungi | **K4** |
| **III** | **MICROBIAL METABOLISM, VIRUSES AND FUNGI** | | |
| **3.1** | **Sterilisation procedures** | • Classify the types of sterilization techniques.<br>• Discuss the types and processes of sterilization | **K5**<br>**K5** |
| **3.2** | **Types of Culture Media** | • Compare and explain he different types of media used for bacterial growth<br>Explain the applications of different media used in bacterial growth. | **K5**<br>**K5** |
| **3.3** | **Methods of Isolating pure culture** | • Explain the methods used in isolating pure culture<br>• Explain the various culture techniques used isolating pure culture. | **K5**<br>**K5** |
| **3.4** | **Preservation of Culture** | • Describe the various methods used in culture preservation. | **K5** |
| **3.5** | **Colony Characteristics** | • Explain the morphology of a bacterial colony by observing its characteristics. | **K5** |
| **3.6** | **Staining procedures Gram staining and Acid Fast staining** | • Compare the various staining procedures used for bacterial identification.<br>• Explain the procedure of Gram Staining | **K5**<br>**K5** |
| **3.7** | **Microbiology of soil** | • Explain the role of microbes in<br>• biogeo chemical cycle<br>• Infer and relate the biogeochemical role of soil microbes | **K5**<br>K2 |
| **3.8** | **Microbiology of Domestic water** | • Determine the drinking water standard by water potability tests<br>• Evaluate the standard of drinking water by MPN test | **K5** |
| **4** | **MICROBIOLOGY OF SOIL, WATER AND FOOD** | | |

| | | | |
|---|---|---|---|
| **4.1** | **Microbiology of foods: - -: Food poisoning** | • Determine the products obtained from microbes Evaluate the causes and prevention of food poisoning | **K5** |
| **4.2** | **Preservation of foods Probiotics** | • Explain the types of food preservation methods<br>• Analyse the role of microbes in probiotics | **K5** |
| **4.3** | **Dairy Microbiology Microbiology of milk and milk products** | • Differentiate the types of dairy products obtained from bacteria<br>• Evaluate the components of milk<br>• Determine the quality of milk by various tests | **K5**<br>**K6** |
| **V** | **DISEASES CAUSED BY BACTERIA, VIRUS AND FUNGI** | | |
| **5.1** | **Microbial diseases- Causative organisms, mode of transmission, pathogenicity, diagnosis** | • Classify and evaluate the epidemiology of microbes | **K5** |
| **5.2** | **Bacterial Diseases- Tuberculosis, Typhoid and Syphilis** | • Examine the epidemiology of bacterial diseases<br>• Classify and evaluate the epidemiology of diseases | **K5** |
| **5.3** | **Viral diseases- Hepatitis-B, Rabies, AIDS** | • Examine the epidemiology of viral diseases<br>• Classify and evaluate the epidemiology of diseases | **K4** |
| **5.4** | **Fungal Diseases- Candidiasis and Dermatophytosis.** | • Examine the epidemiology of fungal diseases<br>• Classify and evaluate the epidemiology of diseases | **K5** |

## 4. MAPPING (CO, PO, PSO)

| U19ZY506 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | M | H | M | H | M | M | M | M | H | L | H |
| CO2 | H | H | M | H | M | H | M | M | M | M | H | L | H |
| CO3 | H | H | M | M | L | H | H | M | M | M | H | - | H |
| CO4 | M | H | H | M | H | H | M | L | M | - | H | - | H |
| CO5 | M | H | H | L | H | H | H | L | M | - | H | L | H |
| CO6 | M | M | H | L | M | H | H | L | H | - | H | | H |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT METHODS

| DIRECT |
|---|
| 1. Continuous Assessment Test I, II<br>2. Assignment; Journal paper review, Group Presentation, Project report, Poster preparation<br>3. End Semester Examination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinators:**

1. **Dr. J. Joonu**
2. **Dr. Faridha Banu**

## ELECTIVE I: BIOPHYSICS AND BIOCHEMISTRY

**SEMESTER:VI** **CODE: U19ZY5:1**
**CREDITS: 5** **HOURS/WEEK: 5**

### 1. COURSE OUTCOMES:

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

| CO. No. | COURSE OUTCOMES | LEVEL | UNIT |
|---|---|---|---|
| CO1 | Analyze the significance of Biophysics in Biology | K5 | I |
| CO2 | Elaborate the principle and biological applications of Biophysical instruments. | K4 | II |
| CO3 | Explain the basic principles of Biochemistry and Metabolism | K6 | III |
| CO4 | Classify the types and properties of biomolecules and its metabolic pathways | K3 | III |
| CO5 | Explain the characteristics and mechanism of enzyme action. | K5 | IV |
| CO6 | Analyze the importance of enzyme kinetics and rate of enzyme action | K3 | V |

### 2. A. Syllabus

**UNIT I ATOMS & THERMODYNAMICS** **15 Hrs**

Scope of Biophysics in Biology – structure and properties of atoms and molecules – chemical bonds – types – molecular interactions – colloids – description and properties. Thermodynamic principles – Tyndall effect, surface tension, Brownian movement, filtration, osmosis, dialysis.

**UNIT – II BIOPHYSICAL INSTRUMENTS** **15 Hrs**

Biophysical instruments: Principles, description and applications of pH meter, analytical and ultra centrifuge, colorimeter – Visible spectroscopy, Electrophoresis , Chromatography:Paper, thin layer – column – Ion-exchange.

**BIOCHEMISTRY**

**UNIT III CLASSIFICATION OF BIOMOLECULES** **15 Hrs**

Classification and Significance of Organic compounds and their related diseases
Scope of Biochemistry, Classification of organic compounds – Carbohydrates, Proteins, Lipids and Nucleic acids – pH measurement, regulation and importance of pH – Vitamins:
Water soluble and fat soluble vitamins, occurrence, functions and deficiency diseases - Minerals and their importance.

**UNIT IVMETABOLIC REACTIONS** **15 Hrs**

Metabolism of carbohydrates: Glycolysis – TCA cycle - Glycogenesis - Glycogenolysis - Electron transport chain. Metabolism of proteins: General pathway of aminoacid metabolism - deamination, transamination and decarboxylation – Urea cycle - Metabolism of lipids: β Oxidation of fatty acids –Nucleic acids – metabolism of purine and pyrimidine nucleotides.

**UNIT V ENZYMES AND ITS SIGNIFICANCE** **15 Hrs**

Enzymes: Definition, nomenclature and classification of enzymes- structure, properties and functions of enzymes and coenzymes. Mechanism of enzyme action – active site, Lock and Key model, induced fit hypothesis. Mechanism of enzyme catalysis, enzyme-substrate complex formation, Allosteric enzymes.

| Sl.No. | Topics | Web Links |
|---|---|---|
| **1.** | Structure and molecular interactions of atoms and molecules | https://www.springer.com/gp/book/9781468487794 |
| **2.** | Poly Acrylamide Gel Electrophoretic technique | https://microbenotes.com/polyacrylamide-gel-electrophoresis-page/ |
| **3.** | pH meter | https://www.azolifesciences.com/article/What-is-a-pH-Meter-and-How-Does-it-Work.aspx |
| **4.** | Vitamins and related Diseases | https://www.ncbi.nlm.nih.gov/books/NBK235010/ |
| **5.** | Metabolism – overview and imbalance | https://www.medicalnewstoday.com/articles/263834 |
| **6.** | Enzymes and mechanism of enzyme action and diseases abnormalities | https://www.sciencedirect.com/topics/medicine-and-dentistry/enzyme-deficiency |

**B. Topics for Self-Study**

**C. Text Books**


1. Casey, E.J, Biophysics: Concepts and Mechanism, East West Press Pvt. Ltd., NewDelhi, 1962
2. Sathyanarayana.U. 2005. Biochemistry ,Arunabha Sen, books and Allied(P) Ltd.,Kolkatta.
3. Lehninger L. Albert, David. L. Nelson, Michael M. Cox, Principles of Biochemistry 1993, CBS Publishers and Distributors, Delhi,1993.


**D. References Books**


1. Harper H.A, Review of Physiological Chemistry, Muruzen Asian Ed,1973.
2. Stryer, L, Biochemistry, W.H Freeman and Company, NewYork,1988.
3. Voet D and Voet, Biochemistry, John Wiley and Sons, New York,1995
4. Kothari, C.R. Research Methodology: Methods and Techniques. 2nd Ed., NewAge International Publishers, New Delhi, 2004. 8. Ramadass, P. and WilsonA

## 3. SPECIFIC LEARNING OUTCOMES (SLO)

| Unit/ Section | Course Contents | Specific Learning outcomes | Highest Bloom's taxonomic Level of transaction |
|---|---|---|---|
| I | **PROPERTIES OF ATOMS, CHEMICAL BONDS, MOLECULAR INTERACTIONS, THERMODYNAMIC PRINCIPLES** | | |
| 1.1 | **Scope and importance of Biophysics** | • Analyze the various scopes and importance of Biophysics and applications of theinstrumentation<br>• techniques in biology. | **K4** |
| 1.2 | **Structure and properties of atoms and molecules** | • Explain the structure and properties of the chemical components in thebiological<br>• Systems | **K5** |
| 1.3 | **Chemical bonds** – types | • Classify the various bonds according to their structure and functions | **K4** |
| 1.4 | **Molecular interactions** – colloids – description and properties. | • Distinguish the structure and properties of the molecules and theirinteractions | **K4** |
| 1.5 | **Thermodynamic principles** – Tyndall effect, surface tension, Brownian movement, filtration, osmosis, Dialysis | • Evaluate the principles of thermodynamics and the process it workson | **K5** |
| II | **CENTRIFUGE, COLORIMETRY, ELECTROPHORESIS AND CHROMATOGRAPHY** | | |
| 2.1 | **Biophysical instruments:** Principles, description and applications of pH meter | • Evaluate the Principle and applications ofpH | **K5** |
| 2.2 | **Analytical and Ultra centrifuge** | • Explain the Principle, working mechanism, types, and applications ofCentrifuge | **K5** |
| 2.3 | **Colorimeter** – Visible spectroscopy | • Elaborate the Principle, working mechanism and functions of Calorimeter | **K6** |
| 2.4 | **Electrophoresis** | • Experiment with the Electrophoresis technique in the isolation ofproteins | **K3** |

| | | | |
|---|---|---|---|
| | **Chromatography**: Paper, thin layer – column – Ion-exchange | • Explain the various types of Chromatographic techniques and apply it in the separationof<br>• different compounds | **K5** |
| **III** | **CLASSIFICATION OF BIOMOLECULES** | | |
| **3.1** | **Scope of Biochemistry,** Classification of organic compounds – **Carbohydrates, Proteins, Lipids and Nucleic acids** | • Explain the significance of Biochemistry and to classify the essential compounds like Carbohydrates, Proteins and Lipids | **K5** |
| **3.2** | **pH** measurement, regulation and importance of pH | • Explain the importance of pH and its functions in biological systems | **K5** |
| **3.4** | **Minerals** and their importance | • Interpret the various functions of minerals in the biologicalsystem | **K5** |
| **IV** | **METABOLISM OF CARBOHYDRATES, PROTEINS AND LIPIDS** | | |
| **4.1** | **Metabolism of carbohydrates**: Glycolysis – TCAcycle<br>- Glycogenesis - Glycogenolysis - Electron transportchain. | • Explain in detail the mechanism of energy production in the biological system through the various biochemical cycles | **K5** |
| **4.2** | **Metabolism of proteins**: General pathway of aminoacid metabolism - deamination, transamination and decarboxylation – Urea Cycle | • Analyze the role of proteins in various metabolism through differentchains/cycles/process | **K4** |
| **4.3** | **Metabolism of lipids:** β Oxidation of fatty acids –Nucleic acids – metabolism of purine and pyrimidine nucleotides. | • Elaborate the functions of lipids and its role in the formation of compounds | **K6** |
| **V** | **ENZYMES, MECHANISM OF ENZYME ACTION AND CATALYSIS** | | |
| **5.1** | **Enzymes :**Definition, nomenclature and classification of enzymes-structure, properties and functions of enzymes and coenzymes | • Classify the enzymes based on its structure, properties and functions | **K4** |
| **5.2** | **Mechanism of enzyme action** – active site, Lock and Key model, induced fit hypothesis. | • Elaborate the process of enzyme action. To explain the various methods involved in the synthesis ofenzymes | **K6** |

| | | | |
|---|---|---|---|
| **5.3** | **Mechanism of enzyme catalysis**, enzyme-substrate complex formation, Allosteric enzymes. | • Explain the rate of enzyme action and the factors which are responsible for enzymeaction | **K5** |

## 4. MAPPING (CO, PO, PSO)

| U19ZY5:1 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | M | M | H | H | M | H | H | M | H | H | H |
| **CO2** | H | M | - | H | H | H | H | H | M | H | H | M | - |
| **CO3** | H | H | H | H | M | - | - | M | H | H | M | M | H |
| **CO4** | M | H | H | M | - | H | H | H | - | H | - | M | H |
| **CO5** | H | H | M | M | - | - | H | H | H | H | - | M | - |
| **CO6** | M | - | M | H | H | M | H | H | - | - | - | H | H |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT METHODS

| **DIRECT** |
|---|
| 1. Continuous Assessment Test I, II<br>2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable)<br>3. End Semester Examination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinators:**

1. **Ms. Hadline Kiruba**
2. **Dr. Faridha Banu**

## SBEC III: WILDLIFE ECOLOGY AND ECONOMIC ENTOMOLOGY

**SEMESTER: III** **Code: U19ZYPS3**
**CREDITS: 2** **HOURS/WEEK: 2**

**1.COURSE OUTCOMES:**
On completion of the course, the students will be able to:

| CO. No. | COURSE OUTCOMES | LEVEL | UNIT |
|---|---|---|---|
| CO1 | Explain the wildlife ecology and the interaction between the elements of ecosystem | K4 | I |
| CO2 | Explain the communication and reproductive strategies of amphibians, reptiles, birds and mammals | K5 | II |
| CO3 | Familiar with the forest ecosystem and its pattern | K5 | III |
| CO4 | Explain the biology of wildlife and their communication methods | K4 | IV |
| CO5 | Explain about the beneficial and harmful insects and its management | K5 | V |
| CO6 | Acquire field exposure to various kinds of habitat and the management | K6 | V |

**2. A. Syllabus**

**UNIT I INTRODUCTION TO WILDLIFE MANAGEMENT** **6 Hrs**
Introduction – Basic tools in wildlife management: RS & GIS maps and toposheets, radio telemetry, satellite tracking, and use of radio-isotopes – Wildlife population monitoring: terrestrial, wetlands and marine PAs

**UNIT II BIOLOGY OF HABITAT** **6 Hrs**
Biology of unique habitats: caves, tree-holes, subterranean burrows, termite mounds, etc – Habitat edges, ecotones, and interiors – Habitat patches and corridors – Habitat quality – Factors affecting habitat quality.

**UNIT III FAUNA & THREATS** **6 Hrs**
Introduction to herpetofauna, birds and mammals -Diversity, distribution, and endemism. communication– Breeding – Territoriality. migratory birds – Threats to migratory bird populations Social organization in mammals –Threatened species of India and their conservation.

**UNIT IV AGRICULTURAL PESTS & IPM** **6 Hrs**

Insect pests, life cycle and types of damage to plants: Pest of rice: Rice stem borer (*Scirpophagaincertulas*) - Pest of coconut: The rhinoceros beetle (*Oryctes rhinoceros*) Pest of cotton: The spotted bollworm (*Eariasinsulana*) - Pests of vegetable: Brinjal-The shoot and fruit borer(*Leucinodesorbonalis*) -Pests of fruit: Citrus butterfly(*Papiliodemoleus*) - Pest of stored products: The rice weevil(*Sitophilus oryzae*) - Principles of Integrated Pest Management
Beneficial Insects: Economic importance of Honey bees, and Lac insect –pollinators, soil builders and scavangers. Biological control agents of insect pests- Pathogens- Predators – Parasites.

**UNIT V FIELD VISIT & SPOTTERS** **6 Hrs**

Field report in capture and marking techniques, Field identification of birds, observation of acoustic communication in birds, Field identification of mammal signs and habitat use, field visit to apiary unit.

**SPOTTERS**: Hygrometer, nesting pattern, birds and animal vocalization, Territorial markings: dung, pellets, scat, Termites, Honey bees, Silk moth, *Oryctes rhinoceros, Leucinodesorbonalis, Papiliodemoleus*

**B. Topics for Self-Study**

| Sl.No. | Topics | Web Links |
|---|---|---|
| 1. | satellite tracking | https://amsat-uk.org/beginners/satellite-tracking/ |
| 2. | Integrated Pest Management | https://www2.ipm.ucanr.edu/What-is-IPM/ |
| 3. | Threatened species of India and their conservation | https://www.conservationindia.org/topics/endangered-species |

**C. Text Books**

1. Verma P.S. and Agarwal, Principles of Ecology, S. Chand & Co., 2003.
2. Shukla G.S and Updhay V.B, Economic Zoology, Rastogi Publications, 2004.

**D. Reference Books**

1. Sharma P.D., Ecology and Environment, Rastogi Publications, 1990.
2. Clarke. G.L John, Elements of Ecology, Wiley & Sons, 1954.
3. Kendiegh S.C., Animal Ecology, Prentice Hall, 1961.

**E. Web Link**

1.https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(OpenStax)/8%3A_Ecology/47%3A_Conservation_Biology_and_Biodiversity/47.4%3A_Preserving_Biodiversity

## 3. SPECIFIC LEARNING OUTCOMES (SLO)

| Unit/ Section | Course Contents | Specific Learning Outcomes | Highest Bloom's Taxonomic Level of Transaction |
|---|---|---|---|
| **I** | **INTRODUCTION TO WILDLIFE MANAGEMENT** | | |
| **1.1** | Basic tools in wildlife management | • Explain the biology of wildlife<br>• Study the ecological patterns of wildlife | **K3** |
| **1.2** | Wildlife population monitoring | • Apply the strategies for conservation.<br>• Document the communication in the wildlife ecology | **K2** |
| | terrestrial, wetlands and marine | • Track the animals and its habitat change<br>• Inculcate the conservation of wildlife | **K4** |
| **II** | **BIOLOGY OF HABITAT** | | |
| **2.1** | Biology of unique habitats: Habitat edges, ecotones, and interiors | • Perceive the significance of Habitat<br>• Know the characteristics of ecotone | **K3** |
| **2.2** | Habitat patches and corridors –<br>. | • Distinguish the difference between ecotone and interior.<br>• Evaluate the ecological succession in the habitats | **K4** |
| **2.3** | Habitat quality<br>Factors affecting habitat quality | • Study the habitat quality and its modifications | **K3** |
| **III** | **FAUNA & THREATS** | | |
| **3.1** | herpetofauna, | • Study the population and ecological contribution of herpetofauna | **K2** |

| | | | |
|---|---|---|---|
| **3.2** | birds and mammals -Diversity, distribution, and endemism | • Assess the diversity, distribution<br>• Explain the ecological significance of endemism | **K2** |
| **3.3** | Communication | • Explain the different communication strategies of animals | **K3** |
| **3.4** | Breeding – Territoriality | • Relate the communication methods adopted for breeding<br>• Assess the territorial conflicts between species | **K2** |
| **3.5** | migratory birds – Threats to migratory bird | • Explain the migratory behaviour of birds<br>• Study the migratory strategies of birds<br>• Evaluate the treats of migratory birds | **K3** |
| **3.6** | populations Social organization in mammals | • Explain the evolution of behaviour in mammals | **K3** |
| **3.7** | Threatened species of India and their conservation | • Analyse the species status of India<br>• Study the conservation projects in India | **K2** |
| **IV** | **AGRICULTURAL PESTS & IPM** | | |
| **4.1** | Insect pests, life cycle and types of damage to plants: | • Distinguish the insect pests of different plants<br>• Explain the life cycle of insect pest<br>• Establish effective pesticide according to its life cycle<br>• Analyse pest host interaction | **K3** |
| **4.2** | Integrated Pest Management | • Define the pest management<br>• Develop pest management plans | **K2** |
| **4.3** | Beneficial Insects | • Explain the economic importance of insects<br>• Define commercial aspects of beneficial insects | **K3** |
| **4.4** | Biological control agents of insect pests | • Define the biological control methods through Pathogens Predators Parasites. | **K4** |
| **V** | **FIELD VISIT & SPOTTERS** | | |
| **5.1** | Field report in capture and marking techniques | • Inculcate the scientific documentation technique | **K3** |
| **5.2** | Field identification of birds, | • cense the bird population temporally | **K4** |
| **5.3** | observation of acoustic communication in birds | • Illustrate the bird communication | **K4** |
| **5.4** | Field identification of mammal signs and habitat use | • Explore the communication in mammals | **K5** |
| **5.5** | field visit to apiary unit | • Explore the field of economic zoology | **K5** |

## 4. MAPPING (CO, PO, PSO)

| U19ZYPS3 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | L | H | M | M | M | M | L | M | M | H | H | H |
| CO2 | H | M | M | H | M | M | M | M | H | M | L | L | H |
| CO3 | H | H | M | M | L | M | H | L | - | M | L | M | M |
| CO4 | H | M | H | M | H | H | - | M | H | M | H | - | M |
| CO5 | H | M | M | H | L | M | - | L | M | - | M | - | H |
| CO6 | H | H | M | H | H | M | M | L | M | L | H | M | L |

L-Low M-Moderate H- High

## 5.COURSE ASSESSMENT METHODS

| DIRECT |
|---|
| 1. Continuous Assessment Test I, II<br>2. Assignment; Group Presentation, Project report, Poster preparation, Field visit, Field visit Report, etc.<br>3. End SemesterExamination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinators:**

**1. Mr. K. Jeremiah Kirubananth**
**2. Dr. R. Sudha**

## ELECTIVE III: PROJECT

**SEMESTER: V** **Code: U19ZY5PJ**
**CREDITS: 5** **HOURS/WEEK: 5**

**CORE PRACTICAL V**
**GENETICS, MICROBIOLOGY AND BIOCHEMISTRY**

**SEMESTER: V** **Code: U19ZY5P5**
**Credit: 4** **HOURS/WEEK: 6**

**1. COURSE OUTCOMES**
After the successful completion of this course the students will be able to:

**2. A. Syllabus**

**I GENETICS**

| CO. No. | COURSE OUTCOMES | LEVEL | EXPERIMENTS |
|---|---|---|---|
| CO1 | Explain the importance of Mendelian traits in human beings | K4 | I |
| CO2 | Assess the significance of Karyotyping and genetic disorders | K5 | I |
| CO3 | Examine the different techniques involved in microbiology using various analysis | K5 | II |
| CO4 | Identify the various macronutrients using biochemical concepts | K4 | III |
| CO5 | Analyze the functions of laboratory equipments for research | K5 | III |
| CO6 | Survey of animals in natural habitat and assess the ecological importance | K5 | IV |

1. Recording of Mendelian traits in man
2. Pedigree analysis
3. Drosophila genetic importance and culture
4. Human karyotype: Normal male and female, Klinefelter's syndrome, Down's syndrome and Turner's syndrome.

**II MICROBIOLOGY**
1. Serial dilution technique, pour plate technique, streaking plate
2.Observation of bacterial motility by hanging drop method
3.Quality of milk testing – Methylene blue reductase test
4.Staining – Gram Staining.
5. Lactophenol Cotton blue staining for fungi
6.Enumeration of bacterial colony count using Colony counter
7. Identification of bacterial colony and its characteristics

**SPOTTERS:**
Autoclave, Laminar air flow, Hot air oven, Incubator, Inoculation loop, Petridish
Prepared microslides: AFB and Candida

**III BIOCHEMISTRY**

1. pH measurement of various samples using pH meter
2. Qualitative tests for Proteins
3. Qualitative tests for carbohydrates
4. Qualitative tests for Lipids
5. Separation of aminoacids by Paper Chromatography
6. Quantitative estimation of protein by Biuret method

**Spotters:** Spectrophotometer, TLC and pH meter

**IV EDUCATIONAL TOUR**

Educational Tour to the places of ecological importance and observation of organisms in their Natural habitat and submission of tour report

**B. Topics for Self-Study**

| Sl.No. | Topics | Web Links |
|---|---|---|
| **1.** | Drosophila genetic importance and culture | **https://www.frontiersin.org/articles/10.3389/fgene.2019.00051/full** |
| **2.** | Lactophenol Cotton blue staining for fungi | **https://microbiologynote.com/lactophenol-cotton-blue-staining-principle-procedure-result/** |
| **3.** | Separation of amino acids by Paper Chromatography | **https://www.macalester.edu/~kuwata/Classes/2001-02/Chem%2011/Revised%20Amino%20Acids%20(9%201%2001).pdf** |

**C. Text Book**

1. J. Jayaraman (2011). Laboratory Manual in Biochemistry, New Age International Pvt Limited

**D. Reference Book**

1. Shivaraja Shankara YM, Ganesh MK, Shivashankara AR (2012). Laboratory Manual for Practical Biochemistry, Jaypee Brothers, Medical Publishers Pvt. Limited.

**E. Weblink**

1. https://www.frontiersin.org/articles/10.3389/fgene.2019.00051/full

## 3. SPECIFIC LEARNING OUTCOMES (SLO)

| Experiments | Course contents | Specific Learning outcome | Bloom's Taxonomic Level of Transaction |
|---|---|---|---|
| **I** | **GENETICS** | | |
| **1.1** | Mendelian traits in man | • Analyze the mendelian traits in man | **K4** |
| **1.2** | Pedigree analysis | • Create a pedigree to study the inheritance in human being | **K6** |
| **1.3** | Drosophila culture | • Interpret the importance of genes through Drosophila culture | **K5** |
| **1.4** | Human karyotyping | • Demonstrate the pattern of chromosomes in male and female in man | **K2** |
| | | • Assess the normal chromosome and chromosomes with genetic disorder in man | **K5** |
| **II** | **MICROBIOLOGY** | | |
| **2.1** | Serial dilution technique | • Explain the stepwise dilution of a substance in a solution | **K5** |
| **2.2** | Pour plate technique | • Evaluate the number of colony forming bacteria in a liquid sample | **K5** |
| **2.3** | streaking plate | • Deduct and isolate a pure strain form a single species of micro organisms | **K5** |
| **2.4** | Observation of bacterial motility | • Inspect the motility of bacteria using hanging drop method | **K4** |
| **2.5** | Quality of milk | • Test the quality of milk using Methylene blue reductase test | **K6** |
| **2.6** | Gram Staining | • Classify the various type of bacteria using Grams stain | **K2** |
| **2.7** | Lactophenol Cotton blue staining | • Identify the fungi in a given sample by Lactophenol Cotton blue staining method | **K4** |

| | | | |
|---|---|---|---|
| **2.8** | Bacterial colony count | • Test the bacterial colonies using a colony counter | **K6** |
| **2.9** | Identification of bacteria | • Identify the bacterial colonies in a sample | **K4** |
| | | • Discuss the characteristic features of identified bacteria | **K6** |
| **2.10** | Spotters - Autoclave, Laminar air flow, Hot air oven, Incubator, Inoculation loop, Petridish | • Explain about the functions of various equipments used in microbiology laboratories | **K2** |
| **2.11** | Prepared microslides: AFB and Candida | • Identify the microbial spotters in prepared microslides | **K4** |
| **III** | **BIOCHEMISTRY** | | |
| **3.1** | Measurement of pH | • Measure the pH range in a given samples using pH meter | **K5** |
| **3.2** | Qualitative tests for Proteins | • Test the presence of proteins in a given sample | **K6** |
| **3.3** | Qualitative tests for carbohydrates | • Test the presence of carbohydrates in a given sample | **K6** |
| **3.4** | Qualitative tests for Lipids | • Find the presence of lipids in a given sample | **K1** |
| **3.5** | Separation of amino acids | • Classify the different amino acids in a sample using paper chromatography technique | **K2** |
| **3.6** | Quantitative estimation of protein | • Estimate the amount of protein in the given sample using Biuret method | **K6** |
| **3.7** | Spotters : Spectrophotometer, TLC and pH meter | • Elaborate the functions of different instruments used for biochemistry practical | **K6** |
| **3.8** | Educational tour | • Plan an educational trip to various h ecologically important places | **K6** |
| | | • Survey the organisms found in natural habitat | **K4** |

## 4. MAPPING (CO, PO, PSO)

| U19ZY5P5 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | - | - | H | M | - | - | H | H | H | H | H |
| CO2 | H | H | - | H | H | M | - | - | H | H | H | H | H |
| CO3 | H | H | - | H | H | H | H | H | H | H | H | H | H |
| CO4 | H | H | - | H | H | H | H | H | H | H | H | H | H |
| CO5 | - | M | H | M | M | H | - | - | H | H | H | H | H |
| CO6 | H | H | M | H | H | H | H | H | H | H | H | H | H |

L-Low M-Moderate H- High

## 5.COURSE ASSESSMENT METHODS

| DIRECT |
|---|
| 1. Continuous Assessment Test I, II<br>2. Recording Lab Demos, Model Assessments, Group Project Presentation<br>3. End Semester Practical Examination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinators:**

**1. Dr. Priscilla Suresh**

**2. Dr. R. Sudha**

## CORE VII: ANIMAL PHYSIOLOGY

**SEMESTER: VI** **Code: U19ZY607**
**CREDITS: 6** **HOURS/WEEK: 6**

### 1.COURSE OUTCOMES

After the successful completion of this course the students will be able to:

| CO. No. | COURSE OUTCOMES | LEVEL | UNIT |
|---|---|---|---|
| CO1 | Describe the structural organization of the animals. | K4 | I |
| CO2 | Analyse the functional aspects of organ systems in the body of animals. | K5 | II |
| CO3 | Compare the structural and functional adaptations of the animals. | K5 | III |
| CO4 | Describe different systems of animals | K4 | IV |
| CO5 | Illustrate the function of receptor organs | K5 | V |
| CO6 | Explain the hormonal changes in reproductive cycle of male and female | K5 | V |

### 2. A. Syllabus

**UNIT I NUTRITION& RESPIRATION** **18 Hrs**

Nutrition types - feeding mechanism in animals- Physiology of digestion in mammal. Balanced diet, BMR and BMI

Respiratory pigments in animals. Transport of oxygen and carbondioxide in mammals, Physiology of respiration.

**UNIT IICIRCULATION& MUSCLE PHYSIOLOGY** **18 Hrs**

Types of heart.Structure and function of Human heart, cardiac rhythm- Composition and functions of blood -coagulation of blood

Types of muscles, chemistry and mechanism of muscle contraction

**UNIT III EXCRETION & OSMO- IONO REGULATION** **18 Hrs**

Nitrogenous wastes and their formation -ammonotelism, ureotelism, uricotelism -structure and function of mammalian kidney and Nephron- mechanism of urine formation - Osmotic and ionic regulation by freshwater and marine animals

**UNIT IV NERVE PHYSIOLOGY & RECEPTORS** **18 Hrs**

Types of neurons nerve impulse and its transmission- neuromuscular junction – mechanism of synaptic transmission- Bioluminescence – Biological clocks.

Structure and Physiology of Receptors: optic, olfactory, auditory, gustatory, tango receptors in man.

**UNIT V ENDOCRINE GLANDS & REPRODUCTIVE PHYSIOLOGY** **18 Hrs**

Structure and hormones of Pituitary, adrenal, thyroid, parathyroid and Pancreas – Endocrine control of mammalian reproduction-Male and female hormones- hormonal control of menstrual cycle in humans. Hormones of insects

**B. Topics for Self-Study**

| Sl.No. | Topics | Web Links |
|---|---|---|
| 1 | Respiratory disorders | respiratory disorders - Books - NCBI (nih.gov) |
| 2. | CVD | Cardio-vascular disease - PubMed (nih.gov) |
| 3. | Micturition | Micturition - an overview \| ScienceDirect Topics |
| 4. | Animal communication | Animal communication (article) \| Ecology \| Khan Academy |
| 5. | Estrus cycle | The Female Rat Reproductive Cycle: A Practical Histological Guide to Staging - F. Russell Westwood, 2008 (sagepub.com) |

**C. Text Books**

1. Goyal A, Sasthry KV, Animal Physiology, Rastogi Publications, 2004.
2. Hoar, W.S, General Comparative Physiology, Prentice Hall of India, 1983.27

**D. References Books**

1. Rastogi SC, Essentials of Animal Physiology, New Age International Publication, 2001
2. Parameshwaran R, Anathakrishnan, Outline of Animal Physiology, TN,
3. Anantha Subramaniam K.S., Viswanathan Publishers, Pvt, LTD.,1980.
4. Sasthry K.V., Animal Physiology and Biochemistry, Rastogi Publications, 2003-2004.
5. Verma P.S., Agarwal S, Animal Physiology, S Chand and Co, NewDelhi, 1997.
6. Wilson J.A., Principles of Animal Physiology, MacMillan, 1984.
7. Harper H.A., Review of Physiological Chemistry, Muruzen Asian Ed, 1973.
8. Prosser C.L., Brown FA, Comparative Animal Physiology, Saunders W.B, 1985.

**E. Web Links**

1.https://bio.libretexts.org/Courses/Hanover_College/Comparative_Anatomy_and_Physiology_of_Animals/01%3A_Fundamentals_of_Animal_Physiology

2.https://med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Book%3A_Anatomy_and_Physiology_(OpenStax)/Unit_3%3A_Regulation_Integration_and_Control/17%3A_The_Endocrine_System

## 3.SPECIFIC LEARNING OUTCOMES

| Unit/ Section | Course Contents | Specific Learning Outcomes | Highest Bloom's Taxonomic Level of Transaction |
|---|---|---|---|
| **I** | **NUTRITION & RESPIRATION** | | |
| 1.1 | Nutrition | • Describe the feeding mechanism of animals<br>• Define the Physiology of digestion in mammal | **K2** |
| 1.2 | Respiration | • Explain respiratory pigments in animals.<br>• Describe the physiology of respiration<br>• Describe the gaseous exchange<br>• Comparatively analyse different respiratory mechanism | **K3** |
| II | **CIRCULATION & MUSCLE PHYSIOLOGY** | | |
| 2.1 | Circulation: Types of heart. Structure and function of Human heart, cardiac rhythm- Composition and | • Describe the structure and function of Heart<br>• Define the Physiology of circulation in mammal | **K4** |
| 2.2 | functions of blood - coagulation of blood Muscle Physiology: Types of muscles, chemistry and mechanism of muscle contraction | • Explain composition of blood in animals.<br>• Describe the types physiology of muscle<br>• Describe the chemistry of muscle contraction | **K3** |
| III | **EXCRETION & OSMO- IONO REGULATION** | | |
| 3.1 | Excretion | • Nitrogenous wastes and their formation - ammonotelism, ureotelism, uricotelism - | **K2** |
| | Mechanism of urine formation | • Compare the structure and function of mammalian kidney and urine formation | **K3** |
| | Osmotic and ionic regulation by freshwater and marine animals | • Infer the osmotic and ionic regulation in aquatic animals | **K2** |
| IV | **NERVE PHYSIOLOGY & RECEPTORS** | | |
| 4.1 | Nerve Physiology: Types of neurons nerve impulse and its transmission- neuromuscular junction – mechanism of synaptic transmission- | • Describe the nerve physiology and impulse transmission<br>• Describe the neuromuscular transmission and synaptic transmission | **K3** |

| | | | |
|---|---|---|---|
| 4.2 | Bioluminescence – Biological clocks. | • Analyse the bioluminescence in animals<br>• Examine the patterns of biological clock | **K5** |
| 4.3 | Structure and Physiology of Receptors: optic, olfactory, auditory, gustatory, tango receptors in man | • Describe the structure and physiology of different receptor<br>• comparatively analyse the evolution of receptors in animals<br>• Describe the signal transmission mechanism in receptors | **K5** |
| V | **ENDOCRINE GLANDS & REPRODUCTIVE PHYSIOLOGY** | | |
| 5.1 | Endocrine glands Reproduction-Male and female hormones-. | • Describe Structure and hormones secreted by endocrine organs | **K4** |
| | | • Analyse Endocrine control of mammalian Reproduction<br>• Infer the hormones control of menstrual cycle in humans | **K3** |

## 4. MAPPING (CO, PO, PSO)

| U19ZY606 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | H | H | M | M | M | L | M | M | H | H | H |
| CO2 | H | M | M | H | M | M | M | M | H | M | - | L | H |
| CO3 | H | H | M | M | L | M | M | L | M | - | H | M | H |
| CO4 | H | M | H | M | H | H | L | M | H | M | H | - | H |
| CO5 | H | H | M | H | H | M | - | L | M | - | - | - | H |
| CO6 | H | H | M | H | H | M | M | L | M | L | H | M | H |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT METHODS

| **DIRECT** |
|---|
| 1. Continuous Assessment Test I, II<br>2. Online Quiz test, Assignment; Journal paper review, Group Presentation, Poster preparation.<br>3. End Semester Examination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinators:**

**1. Mr. K. Jeremiah Kirubananth**
**2. Dr. S. Bhuvaneshwari**

## CORE VIII : DEVELOPMENTAL BIOLOGY AND IMMUNOLOGY

**SEMESTER: VI** **Code: U19ZY608**
**CREDITS: 5** **HOURS/WEEK: 6**

### 1.COURSE OUTCOMES

After the successful completion of this course the students will be able to:

| CO.No. | COURSE OUTCOMES | LEVEL | UNIT |
|---|---|---|---|
| CO1 | Illustrate the process of fertilization and development. | K2 | I |
| CO2 | Explain the process of placentation in mammals | K5 | II |
| CO3 | Discuss the basic concepts of stem cells and IVF | K6 | III |
| CO4 | Interpret the role of organiser through experiments. | K5 | IV |
| CO5 | Discuss the basis of immune system, lymphoid organs, cells and its functions | K6 | V |
| CO6 | Evaluate the various immunological techniques and its applications | K5 | V |

### 2. A. Syllabus

**UNIT I Fundamentals in embryology** **12 Hrs**

Historical review of embryology- Theories of Development: Germplasm theory, Biogenetic law, Hertwig's law - Gametogenesis: Spermatogenesis, Oogenesis - structure of mammalian sperm and ovum- Ovulation-Fertilization- Physiological changes during fertilization.

**UNIT II Developmental stages** **12 Hrs**

Types of eggs - Cleavage planes and patterns – Chemodifferentiation- types of blastula - Blastulation and gastrulation in frog -Fate map of frog-Organogenesis: Development of eye, brain and heart in frog- Organizer: Spemann'sprimary organizer - mechanism of embryonic induction.

**UNIT III Embryonic Membranes** **12 Hrs**

Foetal membranes in chick and mammals - Placentation in mammals- Nucleocytoplasmic relationship- Metamorphosis of Insects and Amphibians, Regeneration in Planarians and Amphibians - **Artificial Fertilization Techniques**: IVF and Embryo transfer technology- Factors involved in Teratogenesis.

**IMMUNOLOGY**

**UNIT IV Introduction to Immune System** **12 Hrs**

Immune system: Innate and acquired immunity- active and passive- Primary lymphoid organs: thymus,bone marrow and Secondary lymphoid organs: spleen, lymph node, GALT, MALT, tonsil, Peyer'spatches - cells of lymphoid lineage: lymphocytes and NK cells-Cells of myeloid lineage: monocytes, PMN leukocytes, accessory cells.

**UNITV Types of Immune Responses** **12 Hrs**

Immune response: nature of antigen - types of antibodies- General structure of Immunoglobulin – types and functions of Immunoglobulins - cell mediated and humoral immunity- MHC- Auto immunity –Hypersensitivity Immediate (Type I, Delayed Type IV) - **Immuno techniques:** principles of precipitation- double immune diffusion, immunoelectrophoresis - ELISA.

**B. Topics for Self-Study**

| Sl.No. | Topics | Web Links |
|---|---|---|
| 1 | Fate Maps in Human Embryo | https://embryo.asu.edu/pages/fate-map |
| 2 | IVF- further studies | https://www.mayoclinic.org/tests-procedures/in-vitro-fertilization/about/pac-20384716#:~:text=In%20vitro%20fertilization%20(IVF)%20is,by%20sperm%20in%20a%20lab. |
| 3 | Tonsillitis | https://www.mayoclinic.org/diseases-conditions/tonsillitis/symptoms-causes/syc-20378479 |
| 4 | Types of ELISA | https://www.cellsignal.com/contents/_/types-of-elisa-(enzyme-linked-immunosorbent-assay)-tests/types-of-elisas |

**C. Text Books**

1. Verma P.S., Agarwal V.K and Tyagi R, Chordate Embryology, Chand & Co., Ltd.,1991.
2. Rao C.V., An Introduction to Immunology, Narosa, New Delhi, 2002.

**D. References Books**

1. Balinsky B.I, An Introduction to Embryology, W.B. Saunders Company, Philadelphia, 1981.
2. S.K. Gupta, Immunology, Narosa Publishing House, New Delhi, 1999.
3. Muller Werner A, Developmental Biology, Berlin, Springer, 2010
4. Gilbert, Scott F, Developmental Biology, Sunderland, Sinaver Associates, 2000.
5. Kuby, Richard A, Goldsby et al., Immunology, 4th edition, W.H. Freeman & Co., 2003.
6. Roitt J.M, Essential Immunology, Blackwell Scientific Publishers,1998.
7. Kenneth Murphy, Paul Travers and Mark Walport, Janeway's Immunobiology, 7th Edition Garland Science, Taylor and Francis Group, LLC., 2008.
8. Berril, N.T, Developmental Biology, 1971, McGraw Hill Co., New York.
9. Berril, N.T, Karp, G, Development, 1988. Tata McGraw Hill Co., New York.30

**E. Web Links**

1. https://msu.edu/
2. https://immunology.sciencemag.org/
3. https://www.youtube.com/embed/pttau909f8A

## 3. SPECIFIC LEARNING OUTCOMES (SLO)

| Unit/ Section | Course Contents | Specific Learning Outcomes | Highest Bloom's Taxonomic Level of Transaction |
|---|---|---|---|
| **I** | **FUNDAMENTALS IN EMBRYOLOGY** | | |
| **1.1** | Historical review of embryology | • Discuss the approaches of developmental biology | **K6** |
| **1.2** | Theories about embryology-: Germplasm theory, Biogenetic law, Hertwig's law | • Explain the theories of embryology<br>• Compare the theories of development | **K5** |
| **1.2** | Gametogenesis- importance of gametogenesis | • Explain the process of gametogenesis<br>• Interpret the importance of gametogenesis | **K5** |
| **1.3** | Spermatogenesis- Stages of spermatogenesis- Spermatocytogenesis and spermiogenesis | • Outline the process of maturation of sperm<br>• Explain the types of spermatogenesis | **K5** |
| **1.4** | Oogenesis- Stages of oogenesis | • Outline the process of oogenesis and development of ovum | **K2** |
| | Structure of mammalian sperm | • Explains the structure of mature sperm | **K5** |
| **1.5** | Structure of ovum | • Explains the structure of mature ovum | **K5** |
| | Ovulation | • Elaborate the development of mature egg<br>• Summarize the steps involved in the release of egg | **K6** |
| **1.6** | Fertilization- Acrosomal reaction Binding of sperm with Zona pellucida of ovum | • Explains the process of fertilization<br>• Analyze the process of acrosomal reaction<br>• Outline the events of fertilization | **K4** |
| **II** | **DEVELOPMENTAL STAGES** | | |

| | | | |
|---|---|---|---|
| **2.1** | Types of eggs- based on quantity of yolk-<br>1. Macrolecithal<br>2. Microlecithal<br>3. Telolecithal<br>4.Centrolecithal<br>5. Homolecithal- | • Classify the types of eggs | **K2** |
| **2.2** | Cleavage planes and patterns | • Explains the types & patterns of cleavage | **K5** |
| **2.3** | Blastulation& Gastrulation in frog | • Illustrate the process of blastulation Summarize the events of gastrulation in frog.<br>• Compare the process of blastulation and gastrulation. | **K2** |
| **2.4** | Fate map of frog | • Construct the fate map of frog.<br>• Create a fate map of frog | **K6** |
| **2.5** | Organogenesis | • Explain the process of organogenesis | **K2** |
| **2.6** | Organizer | • Explain the concepts and functions of Organiser<br>• Define Organiser | **K2** |
| **2.7** | Spemann's experiment | • Elaborate Spemann's experiment of organizer in Salamander<br>• Compare the Spemann's experiment on the dorsal lip of blastopore as organiser | **K6** |
| **2.8** | Mechanism of induction | • Discuss the process of mechanism of induction<br>• Determine the role of organizer in embryonic induction | **K6** |
| **III** | **EMBRYONIC MEMBRANES, ARTIFICIAL FERTILIZATION TECHNIQUES** | | |
| **3.1** | Foetal membranes in Chick | • Explain the development of fetal membranes in chick<br>• List out the types of fetal membranes in chick | **K5** |
| **3.2** | Placentation in mammals | • List out the types of placenta in mammals<br>• Compare the types of placenta formation in mammals | **K4** |
| **3.3** | Nucleocytoplasmic relationship | • Explain the process of nucleocytoplasmic interaction | **K5** |
| **3.4** | Post embryonic developmental events | • Elaborate the post embryonic developmental events<br>• Discuss the events of post embryonic development | **K6** |

| | | | |
|---|---|---|---|
| **3.5** | Regeneration in various animals | • Explain the process of regeneration in animals<br>• List out types of regeneration in animals | **K5** |
| **3.6** | Basics of stem cells | • Examine the basics of stem cells | **K4** |
| **3.7** | Basic concepts of cloning | • Analyze the applications of stem cells | **K4** |
| **3.8** | IVF – types<br>Artifical insemination and Embryo transfer techniques | • Explain the basic concepts of cloning<br>• Explain the IVF process and its types<br>• Interpret the significance of artificial insemination | **K2** |
| **3.9** | Factors affecting teratogenesis<br>Teratogen-Types | • Explain out the factors affecting teratogenesis | **K2** |
| **IV** | **INTRODUCTION TO IMMUNE SYSTEM** | | |
| **4.1** | Immunity<br>Ultra structure and functions of primary and secondary lymphoid organs<br>1. Thymus<br>2. Bone marrow<br>3. Spleen<br>4. Lymph node<br>6/ GALT, MALT and Peyer's patches | • Interpret immunity<br>• Explain the types of immunity Discuss the ultrastructure of primary and secondary lymphoid organs<br>• Analyze the structure and functions of<br>• Thymus<br>• Bone marrow<br>• Spleen<br>• Lymph node<br>• 6/ GALT, MALT and Peyer's patches | **K4** |
| **4.2** | Cell types-<br>Lymphoid lineage<br>Myeloid lineage | • Distinguish the cells of immune system<br>• Explain the cells of lymphoid lineage and myeloid lineage with its functions. | **K4** |
| **V** | **TYPES OF IMMUNE RESPONSES** | | |
| **5.1** | Immune response: Primary and secondary immune response<br>nature of antigen<br>Antigen-properties<br>Immunogen | • Categorize the types of immune response<br>• Compare the types of immune response<br>• List out types of properties of antigen.<br>• Compare the difference between antigen and immunogen. | **K4** |

| | | | |
|---|---|---|---|
| **5.2** | Types of antibodies | • Outline the types of antibodies | **K2** |
| **5.3** | Immunoglobulins- types- Ig G,A,M,D,E | • Explain the basic structure of Immunoglobulin<br>• List out its types and its functions<br>• Interpret and compare the functions of antibodies | **K2** |
| **5.4** | Cell mediated and humoral immunity Cell mediated immunity-cytotoxic cells – perforated channels- antigen degradation. Humoral immunity- Activation of B cells- | • Elaborate the process of cell mediated immune response<br>• Describe the process of humoral immunity and its functions.<br>• List out the functions of antibodies | **K6** |
| **5.5** | MHC and antigens Presentation | • Explain the structure of MHC and its functions | **K2** |
| | | • Explain the mechanism of antigen presentation | **K2** |
| **5.6** | Autoimmune diseases | • Discuss the causes and types of autoimmune diseases<br>• Compare systemic and organ specific auto immune diseases | **K6** |
| **5.7** | Hypersensitivity reactions Types-I, II, III, IV, V | •<br>• Discuss the types of hypersensitivity reaction and the diseases associated to it<br>• List out the various pharmacological mediators involved in hypersensitivity reaction. | **K6** |
| **5.8** | Immuno techniques | • Explain the basics of immuno-techniques | **K2** |
| **5.9** | Precipitin reactions | • Demonstrate the basics of precipitin reactions | **K2** |
| **5.10** | Immunodiffusion techniques | • Demonstrate the principle and applications of immunodiffusion techniques | **K2** |
| **5.11** | Immunoelectrophoresis | • Demonstrate the principle and applications of immunoelectrophoresis techniques | **K2** |
| **5.12** | ELISA- Direct, indirect and Sandwich ELISA | • Demonstrate the principle and applications ELISA | **K2** |
| **5.13** | ELISA Types | • Categorize out the types of ELISA | **K4** |

**4. MAPPING (CO, PO, PSO)**

| U19ZY607 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | H | - | M | - | M | H | - | - | H | H | M |
| CO2 | H | H | H | - | - | - | - | M | H | - | H | - | H |
| CO3 | H | H | H | - | H | H | - | H | H | - | H | - | H |
| CO4 | H | H | H | - | H | H | - | H | H | - | H | - | H |
| CO5 | H | H | H | M | - | - | - | - | - | - | H | - | H |
| CO6 | H | H | H | - | H | H | - | H | H | - | H | H | H |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT METHODS

| DIRECT |
|---|
| 1. Continuous Assessment Test I, II<br>2. Online Quiz test, Assignment; Journal paper review, Group Presentation, Poster preparation.<br>3. End Semester Examination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinators:**

**1. Dr. J. Joonu**
**2. Dr. Faridha Banu**

## ELECTIVE II: BIOTECHNOLOGY

**SEMESTER: VI** **Code: U19ZY6:2**
**CREDITS: 5** **HOURS/WEEK: 6**

### 1. COURSE OUTCOMES

After the successful completion of this course the students will be able to:

| CO.No. | COURSE OUTCOMES | LEVEL | UNIT |
|---|---|---|---|
| CO1 | Comprehend the basic and recent concepts of biotechnology. | K4 | I |
| CO2 | Demonstrate the methods used to establish animal/stem cell cultures | K5 | I |
| CO3 | Acquire knowledge in tools and techniques in genetic engineering | K5 | II |
| CO4 | Utilize novel procedures to increase industrial products | K6 | III |
| CO5 | Improvise new ideas for the production of transgenic animals, vaccines and plants through gene transfer | K6 | IV |
| CO6 | Apply nanobiotechnology in agriculture, medicine and environmental bioremediation. Exposure to IPR, biosafety and practice bioethics. | K6 | V |

### 2. A. Syllabus

**UNIT I BIOTECHNOLOGY HISTORY AND ANIMAL CELL CULTURE** **18 Hrs**

Scope and importance of Biotechnology - Animal cell culture:Concepts in tissue culture: Basicrequirements, equipment, growth kinetics- Primary and established cell lines, stem cell culture, organculture, applications of cell culture.

**UNIT II RDNA/MOLECULAR TOOLS AND GENE CLONING** **18 Hrs**

Genetic engineering: Scope and importance - Tools and techniques of genetic engineering: Restriction Enzymes,Vectors: plasmids, phagemids, cosmids - cDNA Library-Gene cloning: Isolation of desired DNA,insertion of DNA vector- introducing rDNA-Identification and selection of cloned DNA.Moleculartools:Electrophoresis, Western-Southern-Northern blotting, PCR

**UNIT III INDUSTRIAL BIOTECHNOLOGY** **18 Hrs**

Industrial Biotechnology: Fermenter design and types - Process of fermentation: Upstream andDownstream process - Production of ethanol, antibiotics, SCP.

Enzyme technology:Sources, applications of enzymes - Extraction, purification-Immobilization ofenzymes: methods and types.

**UNIT IV BIOTECHNOLOGY APPLICATIONS** **18 Hrs**

Animal biotechnology: Transgenic methods, electroporation, viral mediation, biolistics, Transgenicsheep and mice production. Medical Biotechnology: Vaccines- Insulin Interferons-gene therapy, DNA finger printing, DNA micro array. Agriculture Biotechnology:Biofertilizers - Nitrogen Fixation: Nitrogen fixing organisms, mechanism of fixation- Biopesticides.

**UNIT V NANOBIOTECHNOLOGY** **18 Hrs**

Nanobiotechnology:Nanoparticles and its synthesis - nanotechnology in agriculture – Nanomedicine.EnvironmentalBiotechnology:Bioremediation-Bioleaching, Biofuel, Biochips andBiosensor -Bioethics and Biosafety: Biosafety guidelines and regulations - IPR.

**B. Topics for Self-Study**

| Sl.No. | Topics | Web Links |
|---|---|---|
| 1. | Lentivirus | https://www.abmgood.com/marketing/knowledge_base/The_Lentivirus_System.php |
| 2. | RAPD | https://www.ncbi.nlm.nih.gov/probe/docs/techrapd/ http://www.nbpgr.ernet.in/Portals/6/DMX/GENOMIC_RESOURCES/PCR%20amplification%20assays-RAPD.pdf |
| 3. | RFLP | https://www.ncbi.nlm.nih.gov/probe/docs/techrapd/ |
| 4. | Genomic library | https://www.biotechnologynotes.com/dna-libraries/notes-on-genomic-libraries-dna-libraries/479 https://bio.libretexts.org/Bookshelves/Cell_and_Molecular_Biology/Book%3A_Basic_Cell_and_Molecular_Biology_(Bergtrom)/15%3A_DNA_Technologies/15.04%3A_Genomic_Libraries |
| 5. | Human Genome Project | https://web.ornl.gov/sci/techresources/Human_Genome/project/index.shtml |

**C. Text Book**

1. Dubey R.C, **Text Book** of Biotechnology, S Chand & Co., 1995.

**D. Reference Books**

1. Gupta P.K, Elements in Biotechnology, Rastogi Publications, Meerut, 1997.
2. Balasubramaniam D, Concepts in Biotechnology, University Press (India) Ltd., 1996.
3. Dharmalingam M, Genetic Engineering, Viswanathan, S Chand & Co., 1989.
4. Glick, B.R. and Pasternak J.I., Molecular Biotechnology, SSM Press, Washington,1998.
5. Primrose, S.M., Modern Biotechnology, Blackwell Scientific Publishers, Oxford, 1990.
6. Trehan K, Biotechnology, Wiley Eastern Ltd., New Delhi, 1996.
7. Satyanarayana U, Biotechnology, Kolkata, Books and Allied, 2009.
8. Chatwal G.R, **Text Book** of Biotechnology, New Delhi, Anmol, 1995.
9. Barnum, Susan R, Biotechnology: An Introduction, Australia, Thomson, 2000.

10. Rastogi S.C., Biotechnology: Principles and Applications, New Delhi, Narosa, 2008.

**E. Weblink**

**1**. https://b-ok.asia/book/3525684/144212

**3. SPECIFIC LEARNING OUTCOMES (SLO)**

| Unit/ Section | Course Contents | Specific Learning Outcomes | Highest Bloom's Taxonomic Level of Transaction |
|---|---|---|---|
| **I** | **BIOTECHNOLOGY HISTORY AND ANIMAL CELL CULTURE** | | |
| **1.1** | Scope and importance of Biotechnology | • Define the basics of animal biotechnology | **K2** |
| **1.2** | Animal cell culture: Concepts in tissue culture: Basic requirements, equipment, growth kinetics- | • Illustrate the concepts in Animal cell culture | **K2, K3** |
| **1.3** | Primary and established cell lines, stem cell culture, organ culture, applications of cell culture. | • Define the role of different cell types and its application. Development of new cell types | **K3, K6** |
| **1.4** | Genetic engineering: Scope and importance | • Explains the basic of genetic engineering | **K2** |
| **II** | **rDNA/MOLECULAR TOOLS AND GENE CLONING** | | |
| **2.1** | Tools and techniques of genetic engineering: Restriction Enzymes,Vectors: plasmids, phagemids, cosmids | • Define the role of tools in DNA manipulation and Construct novel vectors for efficient gene transfer. | **K6** |
| **2.2** | cDNA Library | • Construct of genomic libraries | **K6** |
| **2.3** | Gene cloning: Isolation of desired DNA,insertion of DNA vector- introducing rDNA-Identification and selection of cloned DNA | • Illustrate basic steps in gene cloning and construction of vector in rDNA technology | **K2, K6** |

| | | | |
|---|---|---|---|
| **2.4** | Molecular tools:Electrophoresis, Western-Southern-Northern blotting, PCR | • Enabling to separate biomolecules and its amplification techniques & their role in disease identification | **K3, K6** |
| **III** | **INDUSTRIAL BIOTECHNOLOGY** | | |
| **3.1** | Industrial Biotechnology: Fermenter design and types - Process of fermentation: Upstream andDownstream process<br><br>Production of ethanol, antibiotics, SCP. | • Understand and Develop novel methods for the production of food and health care products | **K2, K6** |
| **3.2** | Enzyme technology:Sources, applications of enzymes - Extraction, purification- Immobilization ofenzymes: methods and types. | • Understands and create new methods in enzyme technology. | **K6** |
| **IV** | **BIOTECHNOLOGY APPLICATIONS** | | |
| **4.1** | Animal biotechnology: Transgenic methods, electroporation, viral mediation, biolistics, Transgenic sheep and mice production | • Improve the production of food supplements through animal biotechnology | **K2,K6** |
| **4.2** | Medical Biotechnology: Vaccines- Insulin Interferons-gene therapy, DNA finger printing, DNA micro array | • Expand the strategies for vaccine through medical biotechnology | **K6** |
| | Agriculture Biotechnology:Biofertilizers - Nitrogen Fixation: Nitrogen fixing organisms, mechanism of fixation- Biopesticides. | • Develop the approaches for the creation of disease resistant plants and pesticides. | **K6** |
| **V** | **NANOBIOTECHNOLOGY & ENVIRONMENTAL BIOTECHNOLOGY** | | |
| **5.1** | Nanobiotechnology:Nanoparticles and its synthesis - nanotechnology in agriculture – Nanomedicine. | • Study and Develop strategies for production & application of novel bioremediation methods | **K6** |
| **5.2** | Environmental Biotechnology:Bioremediation- | • Create stratagems for production & application | **K6** |

| | | | |
|---|---|---|---|
| | Bioleaching, Biofuel, Biochips and Biosensor | of innovative bioremediation process | |
| **5.3** | Bioethics and Biosafety: Biosafety guidelines and regulations - IPR. | • Define legal & socio, economic issues related to biotechnology and their ethical issues | **K2** |

## 4. MAPPING (CO, PO, PSO)

| **U19ZY6:2** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | H | H | H | H | H | M | M | H | H | H | M |
| **CO2** | H | H | H | H | H | H | H | H | L | H | H | H | M |
| **CO3** | H | H | H | M | M | H | H | H | L | H | H | H | M |
| **CO4** | H | H | H | H | M | H | H | M | L | H | H | H | M |
| **CO5** | H | H | M | H | H | H | H | M | M | H | H | H | M |
| **CO6** | H | H | H | H | H | H | H | H | L | H | H | H | M |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT METHODS

| **DIRECT** |
|---|
| 1. Continuous Assessment Test I, II<br>2. Online Quiz test, Assignment; Journal paper review, Group Presentation, Poster preparation.<br>3. End Semester Examination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinators:**

**1. Dr. Benjamin Tamilselvan**
**2. Dr. R. Sudha**

**ELECTIVE III: BIOSTATISTICS AND BIOINFORMATICS**

**SEMESTER: VI** **CODE: U16ZY6:3**

**CREDITS: 5** **HOURS/WEEK: 6**

## 1. COURSE OUTCOMES:

On completion of the course, the student will be able to:

| CO.No. | COURSE OUTCOMES | LEVEL | UNIT |
|---|---|---|---|
| CO1 | Analyze the various methods of data collection and the application of statistical tools in solving biologicalproblems | K4 | I |
| CO2 | Assess biologically important predictions from annotated data and transformation of these data for DNA analysis | K5 | II |
| CO3 | Apply the statistical tools in solving biological problems | K3 | III |
| CO4 | Distinguish the various biological databases | K4 | III |
| CO5 | Analyze various databases of proteins, nucleic acids. Primary, secondary and composite databases. BLAST, FASTA, DOT PLOT | K4 | IV |
| CO6 | Compare and relate the alignment tools used in evolution and in drug designing. Make phylogenetic predictions or prediction of structure of proteins and nucleic acids | K5 | V |

## 2. A. Syllabus

**UNIT I COLLECTION AND REPRESENTATION OF DATA** **15 Hrs**

Collection of data – Types – Classification and tabulation of data- Presentation of data: Bar diagram and its types , Pie diagram, histogram, frequency polygon, frequency curve and Ogives-Types of variables: Continuous and discontinuous variables, Qualitative and quantitative variables.

**UNIT II MEASURES OF CENTRAL TENDENCY** **15 Hrs**

Measures of Central tendency: Mean, Median and Mode-Uses and calculation of Mean, Median and Mode. Measures of dispersion: Range and Standard deviation calculations and uses.Co-efficient of variation and Standard Error.

**UNIT III CORRELATION AND REGRESSION** **15 Hrs**

Correlation analysis: Types and methods of studying correlation-Scatter diagram, Karl Pearson's co-efficient of correlation and Rank correlation. Regression analysis based on biological data. Testing of hypothesis: Chi-square test, Student *t* test-ANOVA: one way and two way analysis. BIOINFORMATICS

**UNIT IV SCOPE AND METHODS OF DNA SEQUENCING** **15 Hrs**

Scope and importance of Bioinformatics – Genomics: Genome mapping - Sanger's method of DNA sequencing – Expressed sequence tags. Proteomics: Protein sequencing – Determination

and prediction of protein structure – DNA microarrays. Human genome project (HGP): goals-major scientific strategies and approaches.

**UNIT V SEQUENCE ANALYSIS AND ALIGNMENT** **15 Hrs**

Biological databases: Nucleic acid sequence databases: NCBI, EMBL, GenBank, and DDBJ - Protein sequence databases: Swiss- Prot and TrEMBL – Sequence alignment: pair wise alignment: Dot Matrix - FASTA – BLAST, Multiple sequence alignment: Clustal X- Phylogenetic Tree –Structural Data Bases (PDB) – Secondary Data bases (SCOP).

**B. Topics for Self-Study**

| Sl.No. | Topics | Web Links |
|---|---|---|
| **1.** | Representation of data through diagrams, graphs and charts | https://www.statisticshowto.com/probability-and-statistics/descriptive-statistics/pie-chart/ |
| **2.** | Calculation of arithmetic mean, median, mode and standard deviation | https://statisticsbyjim.com/basics/measures-central-tendency-mean-median-mode/<br><br>https://byjus.com/commerce/measures-of-dispersion/ |
| **3.** | Correlation, Regression and ANOVA | https://www.surveysystem.com/correlation.htm<br><br>https://www.statisticshowto.com/probability-and-statistics/regression-analysis/<br><br>https://statistics.laerd.com/statistical-guides/one-way-anova-statistical-guide.php |
| **4.** | Chi square test | https://www.statisticshowto.com/probability-and-statistics/chi-square/ |
| **5.** | Determination of the structure of protein | https://lubrizolcdmo.com/technical-briefs/protein-structure/ |
| **6.** | Alignment tools and methods of DNA sequencing | https://www.ncbi.nlm.nih.gov/tools/cobalt/re_cobalt.cgi<br><br>https://www.britannica.com/science/DNA-sequencing |

**C. Text Books**

1. An Introduction to Biostatistics, N. Gurumani Second Revised Edition, www. MJP publishers, Chennai, 2008
2. McCLEERY, R.H. and WATT, T.A., Introduction to Statistics for Biology, 3rdEd., Chapman & Hall/CRC,2007.

**D. Reference Books**

1. Arthur. M. Lesk, Introduction to Bioinformatics. Oxford University Press, 2003.
2. Gupta S P, Statistical Methods S.Chand & Sons, 2008.

3. Zar, J.H, Biostatistical analysis – Prentice Hall Inc., New Jersey, USA, 1974.

**E. Web Link**

**1.** https://www.statisticshowto.com/probability-and-statistics/descriptive-statistics/bar-chart-bar-graph-examples/

## 3.SPECIFIC LEARNING OUTCOMES (SLO)

| Unit/ Section | Course Contents | Specific Learning outcomes | Highest Bloom's Taxonomic Level of Transaction |
|---|---|---|---|
| **I** | **Data – Collection, Presentation, Variables and its types** | | |
| 1.1 | **Collection of data** – Types – Classification and tabulation of data | • Classify the various types ofdata | **K4** |
| **1.2** | **Presentation of data**: Bar diagram and its types , Pie diagram, histogram, frequency polygon, frequency curve and O gives | • Apply and present the data through diagrammatic and graphicalrepresentation | **K3** |
| **1.3** | **Types of variables**: Continuous and discontinuous variables, Qualitative and quantitative variables. | •Classify the various types of variables | **K4** |
| **II** | **Mean, Median, Mode, Standard deviation, Variance and Standard error** | | |
| **2.1** | **Measures of Central tendency**: Mean, Median and Mode-Uses and calculation of Mean, Median and Mode | •Apply the methods to find out the mean, median and mode for the calculateddata | **K3** |
| **2.2** | **Measures of dispersion**: Range and Standard deviation calculations and uses | •Experiment with the method of calculating Standard deviation to process thedata | **K3** |

| | | | |
|---|---|---|---|
| **2.3** | **Co-efficient of variation and Standard Error** | • Assess the precision of a technique and is used to measure the variability for thedata | **K5** |
| **III** | **Correlation and Regression** | | |

| | | | |
|---|---|---|---|
| **3.1** | **Correlation analysis**: Types and methods of studying correlation-Scatter diagram, Karl Pearson's co-efficient of correlation and Rank correlation. | • Identify and quantify the degree to which the two variables are related | **K3** |
| **3.2** | **Regression analysis** based on biological data | • Identify the strength of the effect that the independent variable has on the dependentvariable<br>• through regression analysis | **K3** |
| **3.3** | **Testing of hypothesis**: Chi-square test, Student *t* test-ANOVA: one way and two way analysis. | • To apply and find the differences between categorical variables in the same population using Chi square test and to identify the presence of statistically significant differencesbetween<br>• the means of two or more group | **K3** |
| **IV** | **Bioinformatics – Scope, Proteomics, Human Genome Project (HGP)** | | |
| **4.1** | **Scope and importance of Bioinformatics** | • Explain the significance of Bio informatics | **K5** |
| **4.2** | **Proteomics**: Protein sequencing – Determination and prediction of protein structure – DNA microarrays | • Elaborate the idea of protein sequencing and to determine the structure ofproteins | **K6** |
| **4.3** | **Human genome project (HGP):** goals- major scientific strategies and approaches. | • Explain in depth the concept of Human Genome Project and its applications | **K5** |
| **V** | **SEQUENCING TOOLS AND APPLICATIONS** | | |

| | | | |
|---|---|---|---|
| 5.1 | **Biological databases**: Nucleic acid sequence databases: NCBI, EMBL, GenBank, and DDBJ | • Analyze the significance and role of the databases in distinguishing the structural changes of bio molecules which is evidentfor<br>• Evolution | **K4** |
| **5.2** | **Protein sequence databases**: Swiss- Prot and TrEMBL | • Elaborate the function of protein, its domain structure, post translational modifications, variants through comparingthe<br>• sequence of proteins | **K6** |
| **5.3** | **Sequence alignment**: pair wise alignment: Dot Matrix - FASTA – BLAST, Multiple sequence alignment: Clustal X | • Compare the sequencesimilarity, producing phylogenetic trees and developing homology models of proteinstructures | **K5** |
| **5.4** | **Phylogenetic Tree** – Structural Data Bases (PDB) – Secondary Data bases (SCOP). | • Relate the evolutionary pathways and connections among organisms using phylogenetic tree | **K3** |

## 4. MAPPING (CO, PO, PSO)

| **U16ZY6:3** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | H | H | H | M | H | M | M | H | H | M | M |
| **CO2** | H | H | M | H | - | H | H | H | H | H | H | H | H |
| **CO3** | H | - | H | H | H | H | H | H | H | H | H | H | H |
| **CO4** | H | H | H | H | M | H | H | M | H | H | H | H | H |
| **CO5** | H | H | H | - | M | H | M | H | H | H | M | H | H |
| **CO6** | M | H | - | M | H | - | H | H | H | H | M | - | H |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT METHODS

| **DIRECT** |
|---|

| |
|---|
| 1. Continuous Assessment Test I, II<br>2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc.(as applicable)<br>3. End Semester Examination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinators:**

**1. Ms. Hadline Kiruba**
**2. Dr. Faridha Banu**

**CORE PRACTICAL VI: ANIMAL PHYSIOLOGY, DEVELOPMENTAL BIOLOGY, IMMUNOLOGY, BIOTECHNOLOGY AND BIOINFORMATICS**

**SEMESTER: VI** **Code: U19ZY6P6**
**CREDITS: 4** **HOURS/WEEK: 6**

**1.COURSE OUTCOMES:**

On completion of this course, the students will be able to:

| CO.No. | COURSE OUTCOMES | LEVEL | EXPERIMENTS |
|---|---|---|---|
| CO1 | Analyze the physiological functions of animals through experiments | K4 | I |
| CO2 | Compare the developmental stages of frog and chick | K5 | II |
| CO3 | Examine the blood grouping and its parameters with modern immunological techniques | K4 | III |
| CO4 | Develop skills in the advanced Biotechnological techniques | K3 | IV |
| CO5 | Explain the basic tools of Bioinformatics | K5 | V |
| CO6 | Construct the Phylogenetic tree based on the analysis sequences | K3 | V |

**2. A. Syllabus**

**I ANIMAL PHYSIOLOGY**

1. Salivary amylase activity in human saliva in relation to pH
2. Qualitative test for ammonia, urea and uric acid
3. Effect of temperature on the ciliary activity of fresh water mussel/Opercular activity in fish.
4. Estimation of Hemoglobin content.
5. Total count of RBC in human blood.

**SPOTTERS:**

Haemoglobinometer, Haemocytometer, Kymograph and Sphygmomanometer

**II DEVELOPMENTAL BIOLOGY**

**1.**Observation of sperm motilityinBull's semen

2. Mounting of developmental stages in chick embryo

**SPOTTERS**

a) **Frog:** Egg, 2 cellstage, 4 cell stage, blastula, gastrula and yolk plug stage.
b) Chick developmental stages-24hrs, 48hrs, 72hrs

**III IMMUNOLOGY**

1. WBC Differential count
2.ABO blood grouping in man
4. Lymphoid organs in mouse (Demo)

**SPOTTERS:** T.S of thymus, T.S of spleen, T.S of lymph node, Bone marrow

**IV BIOTECHNOLOGY**
Separation of Proteins by PAGE Electrophoresis
**Spotters:** PCR, Western blotting, Southern blotting, Vector pBR 322

**V BIOINFORMATICS**
1. Basic Sequence Retrieval – NCBI
2. Literature Data Base – PubMed
3. Basic Alignment – BLAST, FASTA
4. Pair wise and Multiple Alignment –Clustal X
**SEQUENCES:** Amino acid, Nucleotide, Multiple sequence alignment, Dot Plot, Phylogenetic tree

**B. Topics for Self-Study**

| Sl. No. | Topics | Web Links |
|---|---|---|
| 1. | Prothrombin Time (Quick time) | http://www.phys.szote.u-szeged.hu/edu/angla/labprac1+2.pdf |
| 2. | Erythrocyte sedimentation test | https://www.youtube.com/watch?v=_y1CHEytZr0 |
| 3. | Investigation of the protein digesting function of pepsin in gastric content | https://www.youtube.com/watch?v=_BPEuLcR4_I |
| 4. | Isolation of Protoplasm | http://www.unice.fr/EB/USTH%202013/BP04_practical_2_protoplast_boncompagni.pdf |
| 5. | Docking | https://www.youtube.com/watch?v=k6tqCeDIwEk |

**C. Text Books**

1. A Practical Manual on Innovative Animal Physiology by R.P. Mali

2. Practicals in Bioinformatics Paperback by P. Shanmughavel

3. Practical Manual of Biotechnology Paperback by Dr. R.K. Mahajan Dr. Ritu Mahajan, Dr. J. Sharma

4. A Handbook of Practical and Clinical Immunology by by TALWAR VOL 1 & 2

**D. Reference Books**

1. Practical Immunology Paperback by Frank C. Hay, Olwyn M. R. Westwood

2. Advance In Biotechnology Laboratory Practical Paperback by Kalaria R.K. et al.,

**E. Web Link**

1. http://www.phys.szote.u-szeged.hu/edu/angla/labprac1+2.pdf

## 3. SPECIFIC LEARNING OUTCOMES (SLO)

| Experiments | Course contents | Specific Learning outcome | Highest Bloom's Taxonomic Level of Transaction |
|---|---|---|---|
| **I** | **ANIMAL PHYSIOLOGY** | | |
| **1.1** | Salivary amylase activity | • Determine the salivary activity in human saliva with pH | **K5** |
| **1.2** | Qualitative test for ammonia, urea and uric acid | • Deduct the amount of ammonia, urea and uric acid in the given sample | **K5** |
| **1.3** | Ciliary activity on Fresh water mussel/opercular activity | • Estimate the effect of temperature on the ciliary activity of mussel | **K5** |
| | | • Analyze the opercular activity of an organism | **K4** |
| **1.4** | Haemoglobin content | • Estimate the amount of heaemoglobin in blood | |
| **1.5** | RBC count | • To assess the total count of RBC in human blood | **K5** |
| **1.6** | Spotters – Haemoglobinometer, Haemocytometer and Sphygmomanometer | • Classisfy the various apparatus for blood count and blood pressure | **K4** |
| **II** | **DEVELOPMENTAL BIOLOGY** | | |
| **2.1** | Observation of sperm motility in Bull's semen | • Examine the movement of sperm in compound microscope | **K4** |
| **2.2** | Mounting of developmental stages in chick embryo | • Identify the various stages of chick embryo | **K4** |

| | | | |
|---|---|---|---|
| **2.3** | Frog – Egg, 2 cell stage, 4 cell stage, blastula, gastrula and yolk plug stage | • Examine the different stages of developmental stages of frog in prepared microslides | **K4** |
| **2.4** | Developmental stages of chick – 24hrs, 48hrs, 72hrs | • Examine the different stages of chick embryo in prepared microslides | **K4** |
| **III** | **IMMUNOLOGY** | | |
| **3.1** | WBC count | • Inspect the WBC differential count | **K4** |
| **3.2** | ABO blood grouping | • Identify the blood grouping in man | **K3** |
| **3.3** | Lymphoid organs in mouse | • Demonstrate the lymphoid organs in mouse | **K2** |
| **3.4** | Spotters – T. S of thymus, T.S of Spleen, T.S of Lymph node, Bone marrow | • Explain about the major immunological organs through a permanent slide | **K2** |
| **IV** | **BIOTECHNOLOGY** | | |
| **4.1** | Electrophoretic separation of proteins | • Apply the biotechnological process for the separation of proteins | **K3** |
| **4.2** | Spotters – PCR, Western blotting, Southern blotting, Vector pBR 322 | • Explain the important techniques and probes in biotechnology | **K2** |
| **V** | **BIOINFORMATICS** | | |
| **5.1** | Basic sequence retrieval – NCBI | • Evaluate the functions of different bioinformatics tools | **K5** |
| **5.2** | Literature Data Base – PubMed | | |
| **5.3** | Basic alignment – BLAST, FASTA | | |
| **5.4** | Pairwise and Multiple alignment – Clustal X | | |
| **5.5** | Amino acid sequences | • Evaluate the importance of diverse sequences in bioinformatics platform | **K5** |
| **5.6** | Nucleotide sequences | | |

| | | | |
|---|---|---|---|
| **5.7** | Multiple sequence alignment | | |
| **5.8** | Dot Plot | | |
| **5.9** | Phylogenetic tree | | |

## 4. MAPPING (CO, PO, PSO)

| U19ZY6P6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | - | H | - | H | H | - | - | M | - | H | - | H |
| **CO2** | H | - | - | - | H | - | - | - | M | - | H | - | H |
| **CO3** | M | - | H | - | H | H | - | - | M | - | H | - | H |
| **CO4** | H | - | H | - | H | H | - | - | M | - | H | - | H |
| **CO5** | H | - | H | - | H | H | - | M | H | H | H | - | H |
| **CO6** | H | H | H | - | H | H | - | M | H | H | H | - | H |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT METHODS

| **DIRECT** |
|---|
| 1. Continuous Assessment Test I, II<br>2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc.(as applicable)<br>3. End Semester Examination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinators:**

**1. 2Dr. Priscilla Suresh**
**2. Dr. Faridha Banu**

**Allied Zoology Courses offered to students of Under Graduate Programme in**

**Allied Zoology Courses offered to students of Under Graduate Programme in Botany (Shift I, Shift,II) chemistry (Shift II)**

# ALLIED ZOOLOGY – I: BIOLOGY OF INVERTEBRATES AND CHORDATES

**SEMESTER :I** **CODE: U19BYY1P1**
**CREDITS: 3 (Bot), 3 (Chem)** **HOURS/WEEK: 4**

## 1. COURSE OUTCOMES:

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

| CO. No. | COURSE OUTCOMES | LEVEL | UNIT |
|---|---|---|---|
| CO1 | Classify the levels of biodiversity and adaptations of Invertebrates and Chordates. | K4 | I |
| CO2 | Analyze the various organ systems of animals through type study. | K4 | I |
| CO3 | Compare the organization and taxonomic status of Invertebrates and Chordates and apply it in various fields and focus on conservatory techniques | K5 | II |
| CO4 | Distinguish the characters and classify the organisms belonging to different taxa. | K4 | III |
| CO5 | Assess the relative position of individual organs and associated structures through dissection of the invertebrate representatives. | K4 | IV |
| CO6 | Categorize the lower order animals with similar physiological mechanisms with that of the higher order chordates | K4 | V |

## 2. A. Syllabus

### INVERTEBRATES

**UNIT I** Phylum Protozoa, Porifera and Coelenterata
General characters of the Phyla Protozoa, Porifera and Coelenterata.
Type study: Paramecium – Polymorphism in hydrozoa

**UNIT II** Phylum Platyhelminthes, Phylum Aschelminthes and Phylum Annelida

General characters of the Phyla Platyhelminthus, Aschelminthus and Annelida
Type study: Fasciola hepatica- Host parasitic interaction of Tapeworm

**UNIT III** Phylum Arthropoda, Mollusca and Echinodermata
General characters of the Phyla Arthropoda, Mollusca and Echinodermata
Type study: Star fish- Cephalopodes an advanced molluscs

**CHORDATES**

**UNIT IV** Class Pisces and Amphibians
General characters of the Class Pisces and Amphibia
Type study:
Shark (all systems excludingendoskeleton)
Parental care inamphibians

**UNIT V** Class Reptilia, Aves and Mammalia
General characters of the Class Reptilia, Aves and Mammalia
Type study:
1. Rabbit (all systems excluding endoskeleton)

**B. Topics for Self-Study**

| Sl.No. | Topics | Web Links |
|---|---|---|
| 1. | Classificationo f invertebrates<br><br>Conjugation in Paramecium | https://www.kullabs.com/class-miscellaneous/miscellaneous-subject/miscellaneous-topics/classification-of-invertebrates<br><br>https://www.allamaiqbalcollege.edu.in/uploads/download_20040511 31.pdf |
| 2. | Life cycle of fasciola hepatica | https://www.scops.org.uk/internal-parasites/liver-fluke/lifecycle/ |
| 3 | Water vascular system in Echinodermata | https://www.biologydiscussion.com/invertebrate-zoology/phylum-echinodermata/water-vascular-system-of-echinoderms/33754 |
| 4. | Modes of respiration in amphibians | https://www.britannica.com/science/respiratory-system/Amphibians |
| 5. | Evolution of mammals | https://www.nationalgeographic.com/science/prehistoric-world/rise-mammals/ |

**C. Text Book**

1. Ayyar E.K. Ananthakrishnan, T.N. Invertebrata, Outlines of Zoology, Vol-I,Viswanathan Pvt.Ltd.,1993.

**D. References Books**


1. Jordan E.L. and Verma P.S., Invertebrate Zoology, 12th edn., S. Chand & Co.,1995.
2. Kotpal R.L., Agarwal, R.P.R., Khertarpa. I., Modern **Text Book** of Zoology,Rastogi Publications,1989.
3. Kotpal R.L, Protozoa, Porifera, Coelenterata, Annelida, Arthropoda, Mollusca, Echinodermata, Rastogi Publication, 1988,1992
4. Dhami D.S and Dhami J.K.R, Chordate Zoology, Chand & Co.,1978


**E. Web Links**

1. https://www.who.int/news-room/fact-sheets/detail/zoonoses
2. http://www.fao.org/fishery/countrysector/naso_india/en#:~:text=India%20is%20also%20an%20important,about%209.06%20million%20metric%20tonnes
3. https://www.acs.edu.au/courses/invertebrate-animals-730.aspx

## 3. SPECIFIC LEARNING OUTCOMES (SLO)

| Unit/ Section | Course Contents | Specific Learning outcomes | Highest Bloom's taxonomic Level of transaction |
|---|---|---|---|
| **I** | **PHYLUM PROTOZOA, PORIFERA AND COELENTERATA** | | |
| **1.1** | **General Characters** | • Identify the differences of characters in eachphylum<br>• Classify the phylum on the basis of theircharacters | **K3**<br>**K4** |
| **1.2** | **Type study: Paramecium** | • Relate the various systems in Paramecium and its functions | **K2** |
| **1.3** | **Polymorphism in Hydrozoa** | • Analyze the mechanism of polymorphism in hydrozoa | **K4** |
| **II** | **PHYLUM PLATYHELMINTHES, PHYLUM ASCHELMINTHES AND PHYLUM ANNELIDA** | | |

| | | | |
|---|---|---|---|
| **2.1** | **General Characters** | •List out the differences of characters in eachphylum<br>•Classify the phylum on the basis of theircharacters | **K4** |
| **2.2** | **Type study: Fasciola hepatica** | •Analyze thevarious<br>• systems and their functions | **K4** |
| **2.3** | **Host parasitic interaction of tapeworm** | •Illustrate theparasitic<br>• characters of tapeworm | **K2** |
| **III** | **PHYLUM ARTHROPODA, MOLLUSCA AND ECHINODERMATA** | | |
| **3.1** | **General Characters** | • Identify and classify the characters in eachphylum | **K4** |
| **3.2** | **Type study: Star fish** | • Elaborate each systems of Star fish andits<br>• Significance | **K6** |
| **3.3** | **Cephalopods – an advanced molluscs** | • Justify that cephalopods are known as“advanced<br>• molluscs” | **K5** |
| | **CHORDATES** | | |
| **IV** | **CLASS PISCES AND AMPHIBIANS** | | |
| **4.1** | **General Characters of Class Pisces and Amphibians** | •Classify the general characters of Pisces and<br>• Amphibians | **K4** |
| **4.2** | **Type study : Shark** | •Explain the various systems andtheir<br>• Functions | **K5** |
| **4.3** | **Parental care in Amphibians** | •Interpret the mechanism of parental care in amphibians andtheir<br>• importance with examples | **K5** |
| **V** | **CLASS REPTILIA, AVES AND MAMMALIA** | | |
| **5.1** | **General Characters** | •Classify each class onthe<br>• basis of their characters | **K4** |
| **5.2** | **Type Study: Rabbit** | •Elaborate themechanism<br>• and functions of the various systems of Rabbit. | **K5** |

## 4. MAPPING (CO, PO, PSO)

| U19ZYY1P1 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | M | H | H | H | H | H | - | H | M | H | H |
| CO2 | H | - | - | H | H | M | H | H | - | H | - | H | M |
| CO3 | H | M | H | - | - | - | H | H | - | H | - | H | - |
| CO4 | H | H | H | H | H | H | H | H | H | H | H | H | H |
| CO5 | H | M | M | - | H | M | M | H | H | H | - | - | - |
| CO6 | H | H | M | H | H | M | H | H | - | H | - | M | H |

L-Low M-Moderate H-High

## 5. COURSE ASSESSMENT METHODS

| DIRECT |
|---|
| 1. Continuous Assessment Test I, II<br>2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc.(as applicable)<br>3. End Semester Examination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinators:**

**1. Ms. Hadline Kiruba**
**2. Dr. R. Sudha**

**Allied Zoology Courses offered to students of Under**
**Graduate Programme in Botany (Shift I, Shift II)**
**Chemistry (Shift II)**

**ALLIED ZOOLOGY - II: HUMAN PHYSIOLOGY AND ECONOMIC ZOOLOGY**

**SEMESTER: II** **CODE: U19BYY22**
**CREDITS: 4** **HOURS/WEEK: 4**

## 1. COURSE OUTCOMES

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

| CO.No. | COURSE OUTCOMES | LEVEL | UNIT |
|---|---|---|---|
| CO1 | Explain the structural and functional aspects of organ systems in human beings | K5 | I |
| CO2 | Relate the coordinated functioning of complex human body machine and also the abnormalities and diseases | K2 | II |
| CO3 | Develop skills in Vermiculture, Apiculture, Sericulture and Pisciculture | K6 | III |
| CO4 | Ascertain the commercial importance of animals and apply the knowledge to become entrepreneurs. | K3 | III |
| CO5 | Interpret the significance of pollination, pollinators and the modes of pollination | K5 | IV |
| CO6 | Apply the acquired skills in pest management and apply the Integrated farming system to start a small scale unit. | K3 | V |

## 2. A. Syllabus

### HUMAN PHYSIOLOGY

**UNIT I** **12 Hrs**

Physiology of Digestion and Circulation
Nutrition types - Physiology of digestion, Physiology of respiration - Structure and function of Human heart, Composition and functions of blood- Muscle: Types, structure and function

**UNIT II** **12 Hrs**

Mechanism of excretion in man, sensory organs and endocrine glands
Structure and function of mammalian kidney: urine formation in man-Photo and phono receptors in man- Endocrine glands: Hormones secretion.

**ECONOMIC ZOOLOGY**

**UNIT III** **12 Hrs**

Vermiculture and Apiculture
Vermiculture: Introduction –Ecological classification of earthworm - Preparation of vermibed– management - vermiwash - Economic Importance
Apiculture: Introduction - species of honeybees - bee colony – Newton's beehive - care and management- extraction of honey - nutritive and medicinal value of honey

**UNIT IV** **12 Hrs**

Sericulture and Pisciculture
Sericulture: Introduction - types of silkworm - life cycle of silkworm (Bombyxmori) Species of Mulberry -rearing – reeling - Economic importance of silk
Pisciculture: types of ponds: Nursery, stocking - management of a pond- Freshwater cultivable fishes:Major carps: *Catlacatla, Rohu, Mrigala*- induced breeding.

**UNIT V** **12 Hrs**

Significance of green resources and Common pests of agriculture and maintenance Pollination, Pollinators and Pollination modes – Conservation of pollinators: Agriculture, forestry and Nature. Plants and their dispersers: Ants, Birds and mammals. Insects as pest in Agriculture (Rice and Coconut) – Integrated farming of Fish, Crop and Livestock.

## B. Topics for Self-Study

| Sl.No. | Topics | Web Links |
|---|---|---|
| **1.** | Mechanism of blood clotting | https://www.ncbi.nlm.nih.gov/books/NBK507795/ |
| **2.** | Mechanismof Muscleaction | https://pubmed.ncbi.nlm.nih.gov/2959261/ |
| **3** | Various types of hormones and its related diseases | https://www.webmd.com/diabetes/endocrine-system-disorders |
| **4.** | Kidney disorders and treatment | https://www.kidneyfund.org/kidney-disease/chronic-kidney-disease-ckd/ |
| **5.** | Economic importance of sericulture | https://www.slideshare.net/venkateshagri/importance-of-sericulture-118876575 |
| **6.** | Ornamental fish culture | https://www.ncdc.in/documents/downloads/161804052015.-Sample_DPR-Ornamental-Fish-Culturchange.pdf |
| **7.** | Common insect pests and its control | https://www.agric.wa.gov.au/pest-insects/insect-pests-vegetables |

## C. Text Books


1. Goyal A, Sasthry KV, Animal Physiology, Rastogi Publications,2004.
2. Shukla G.S and Upadhay, Economic Zoology, V.B. Rastogi Publications, 2004.
3. Ravikiran Vasant Mane, Integrated Farming System, Scitus Academics,2015


## D. References Books


1. Jordon E.L and Verma P.S., Chordate Zoology and Elements of Animal Physiology, 1995.
2. FAO Sericulture Training Manual, Oxford and IBH,1992.
3. David Ward Roubik, The Pollination of Cultivated Plants, FAO Publishers,2018.
4. Srinivasaulu Reddy M, Sambasiva Rao, A Text Book of Aquaculture, KRS, DPH,1994
5. Little D.C, Integrated Livestock fish farming systems, FAO Publishers, 2003.


## E. Weblink

1. https://extension.psu.edu/insects-pests-and-diseases/pest-disease-and-weed-identification/insect-identification-and-control

## 3. SPECIFIC LEARNING OUTCOMES (SLO)

| Unit/ Section | Course Contents | Specific Learning outcomes | Highest Bloom's taxonomic Level of transaction |
|---|---|---|---|
| **I** | **MECHANISM OF DIGESTION, RESPIRATION, CIRCULATION, MUSCLE AND ITS TYPES** | | |
| **1.1** | **Nutrition**: and its types | • Classify the various types of nutrition and the levels of nutrition requirements in various agegroups<br>• and malnutrition | **K4** |
| **1.2** | Physiology of **digestion** | • Explain the mechanism of digestion and the organs and components which aidsin<br>• Digestion | **K5** |
| **1.3** | Physiology of **Respiration** | •Elaborate the mechanism of the respiratory process and the organs involved in respiration andthe<br>• imbalance in respiration and related diseases | **K6** |
| **1.4** | **Cirlcuation**: Structure and function of **Human heart** | •Analyze the various structural components and understand its functions | **K4** |
| **1.5** | Composition and functions of **blood** | •Classify the various components of blood and its rolein<br>•transporting the chemical components | **K4** |
| **1.6** | **Muscle**: Types, structure and function | •Compare the types of muscles its structure and understand the functions | **K5** |
| **II** | **EXCRETORY, SENSORY AND ENDOCRINE SYSTEM** | | |
| **2.1** | Structure and function of mammalian **kidney: urine formation in man** | •**Evaluate** the structure of kidney and the process of urine formation and the imbalance inexcretion | **K5** |
| **2.2** | **Photo and phono** receptors in man | •Explain the structure of eye and ear. To elaborate the defects in vision and hearing andthe | **K5** |

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|---|---|---|---|
| | | •methods to rectify it | |
| **2.3** | Endocrine glands: **Hormones secretion** | • Distinguish the various types of hormones and its role in the normal functioning ofbody. | **K4** |
| **III** | **VERMICULTURE AND APICULTURE** | | |
| **3.1** | **Vermiculture**: Introduction –Ecological classification of earthworm | • Classify the species ofearthworm | **K4** |
| **3.2** | Preparation ofvermibed– management - vermiwash -Economic Importance | • Design the methods in Vermibedmanagement and its economic importance | **K6** |
| **3.3** | **Apiculture**: Introduction - species of honeybees | • Classify and distinguish the characters of the various species ofhoneybees | **K4** |
| **3.4** | **Bee colony** – Newton's beehive - care and management | • Explain the method or process of the construction, care and maintenance of a beehive | **K5** |
| **3.5** | **Extraction of honey** - nutritive and medicinal value of honey | • Formulate the method of honey extraction | **K6** |
| **IV** | **SERICULTURE AND PISCICULTURE** | | |
| **4.1** | **Sericulture**: Introduction - types of silkworm | • Classify the characters and types ofSilkworm | **K4** |
| **4.2** | **Life cycle of silkworm** (Bombyxmori) | • Explain the life cycle of Silkworm and the time taken for its development | **K5** |
| **4.3** | **Species of Mulberry** - rearing – reeling - Economic importance of silk | • Distinguish the various species of mulberry and the uses ofsilk | **K4** |

| | | | |
|---|---|---|---|
| **4.4** | **Pisciculture**: types of ponds: Nursery,stocking - management of apond | • Construct and manage the various types ofponds | **K6** |
| **4.5** | **Freshwater cultivable fishes:**Major carps: *Catlacatla, Rohu, Mrigala*- induced breeding. | • Select the species of fishes on the basis of their characters for cultivation | **K5** |
| **V** | **POLLINATION – IMPORTANCE AND INTEGRATED FARMING PRACTICES** | | |
| **5.1** | **Pollination**, **Pollinators and Pollination modes** – Conservation of pollinators: Agriculture, forestry and Nature. Plants and their dispersers: Ants, Birds and mammals | • Evaluate the significance of Pollination, Pollinators and its conservation | **K5** |
| **5.2** | **Insects as pest in Agriculture** (Rice and Coconut) | • Analyze and create a plan to manage the majoragricultural pests | **K4** |
| **5.3** | **Integrated farming of Fish**, Crop and Livestock. | • Construct an integrated farming system with crops and livestock and balancing theecosystem | **K6** |

## 4. MAPPING (CO, PO, PSO)

| U19ZYY2P2 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | H | M | M | H | M | H | M | M | H | H | H |
| **CO2** | H | - | - | H | H | M | H | H | - | H | - | M | M |
| **CO3** | M | M | - | H | - | - | H | M | H | H | - | H | - |
| **CO4** | H | H | H | H | H | H | H | M | M | M | M | M | H |
| **CO5** | - | H | H | - | H | M | M | H | H | H | - | - | - |
| **CO6** | M | M | M | H | H | M | H | H | - | H | - | H | H |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT METHODS

| **DIRECT** |
|---|
| 1. Continuous Assessment Test I, II<br>2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc.(as applicable)<br>3. End Semester Examination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinators:**

**1. Ms. Hadline Kiruba**

**2. Dr. R. Sudha**

**BIOLOGY OF INVERTEBRATES, CHORDATES, HUMAN PHYSIOLOGY AND ECONOMIC ZOOLOGY**
**ALLIED ZOOLOGY PRACTICAL I**

**SEMESTER: 2** **Code: U19BYYP1**
**CREDITS: 3** **HOURS/WEEK: 3**

## 1. COURSE OUTCOMES

On completion of this course, the students will be able to:

| CO.No. | COURSE OUTCOME | LEVEL | EXPERIMENTS |
|---|---|---|---|
| CO1 | Analyse the structural organization of the different systems in Earthworm, Cockroach and Frog | K4 | I |
| CO2 | Assess the organ systems of insects through dissection and virtual labs. | K6 | I |
| CO3 | Explain the structural organization of mouthparts | K4 | I |
| CO4 | Identify the body setae in a muscle squash of earthworm and show under the compound microscope<br>Create a mount on Placoid scale | K4<br>K5 | I |
| CO5 | Identify the specimen and write their classification and its significance | K3, K4 | II |
| CO6 | Analyse the antigen and antibody reaction and identified the blood group | K4 | II |

## 2. A. Syllabus

**BIOLOGY OF INVERTEBRATES AND CHORDATES**

**DISSECTION**

Earthworm : Digestive system and Nervous system

**VIRTUAL DISSECTION**

Frog :Digestive system, respiratory system, arterial system, venous system, Nervous system male and female reproductive systems

**MOUNTINGS**

Housefly and Mosquito: Mouth parts
Earthworm : Body setae
Shark : Placoid scale

**SPOTTERS**

Amoeba, Paramecium, Paramecium conjugation, Obelia colony, Tapeworm, Scolex of tape worm, Ascaris, Leech, Millipede, Centipede, Pila, Freshwater mussel, Starfish, Shark, Calotes, Pigeon, Rabbit.

**HUMAN PHYSIOLOGY AND ECONOMIC ZOOLOGY**

1. WBC Differential count
2. ABO blood grouping in man

**SPOTTERS**

Hemoglobinometer, Haemocytometer, *Eudriluseugeniae*,Vermicasts, Honey Bee, Honey, Silk moth, Silk gland, Silk threads, *Catlacatla*, Rohu. Seed dispersers : Ant, Birds, mammals. Slides : Nerve cell, Striated muscle

**B. Topics for Self- Study**

| Sl.No. | Topics | Web Links |
|---|---|---|
| 1. | Calotes | https://www.notesonzoology.com/phylum-chordata/garden-lizard/external-morphology-of-garden-lizard-with-diagram-chordata-zoology/8383 |
| 2. | Sphygmomonometer | https://www.practicalclinicalskills.com/sphygmomanometer |
| 3. | Lampitomaurutii | http://www.brainkart.com/article/Earthworm---Lampito-mauritii_33172/ |
| 4. | Placoid scale | https://australian.museum/learn/animals/fishes/placoid-scales/ |

**C. Text Books**

1. Lal S.S., A Textbook of Practical Zoology Invertebrate, Rastogi Publication, 2004
2. Lal S.S., A Textbook of Practical Zoology Vertebrate, Rastogi Publication, 2004

**D. Reference Book**

1. Sinha J.,Chatterjee A.K., Chattopadhyay., Advanced Practical Zoology, Books and Allied (P) Ltd., 2011.

**E. Web Links**

1. https://doi.org/10.1016/B978-0-12-374144-8.00241-1
2. https://krishijagran.com/agripedia/sericulture-an-introduction-to-silk-cultivation-and-production-in-india-along-with-its-policy-initiatives/
3. https://www.youtube.com/watch?v=_y1CHEytZr0

## 4. SPECIFIC LEARNING OUTCOMES (SLO)

| Experiments | Course Contents | Specific Learning Outcomes | Highest Bloom's Taxonomic Level of Transaction |
|---|---|---|---|
| **I** | **BIOLOGY OF INVERTEBRATES AND CHORDATES DISSECTION** | | |
| **1.1** | Earthworm-Digestive system | • Identify the morphological characters of the animal<br>• 2. To Illustrate the digestive system the animal. | **K4**<br>**K3** |
| **1.2** | Earthworm-Nervous system | • Cut open the animal and show the nervous system of Earthworm. | **K3** |
| **1.3** | Cockroach - Digestive system | • Find and locate the digestive system of cockroach | **K1** |
| **1.4** | Cockroach - Nervous system | • Construct the nervous system and Propose its parts | **K5** |
| **1.5** | Frog : Virtual Dissection of Digestive system | • Construct the dissection using virtual softwatein the various systems in frog | **K5** |
| **1.6** | Frog - Virtual Dissection of Reproductive system | • Construct the dissection using virtual software in your computer | **K5** |
| **1.7** | Mouth parts- Housefly | • Examine the mouthparts and distinguish the types | **K3** |
| **1.8** | Mouth parts- Mosquito | • Examine the mouthparts and distinguish the types | **K3** |
| **1.9** | Earthworm – Body setae | • Mount the body setae of earthworm and analyse under the microscope | **K4** |
| **1.10** | Shark - Placoid scale | • Make a slide of placoid scale by analysing the given sample | **K4** |
| | **SPOTTERS** | | |
| **1.11** | Amoeba, Paramecium, Paramecium conjugation | • Classify the given animal and discuss its characters | **K3** |
| **1.12** | Obelia colony, Tapeworm, Scolex of tape worm, | • Discuss the significance of the animal | **K2** |
| **1.13** | Ascaris, Leech | • Identify and describe the structure | **K4** |
| **1.14** | Millipede, Centipede | • Compare the given animal | **K3** |
| **1.15** | Pila, Freshwater mussel | • Classify the given animal and discuss its characters | **K3** |

| | | | |
|---|---|---|---|
| **1.16** | Starfish, Shark, | • Discuss the significance of the animal | **K2** |
| **1.17** | Calotes, Pigeon, Rabbit. | • Classify the animal and discuss the characters. | **K3** |
| **II** | **HUMAN PHYSIOLOGY AND ECONOMIC ZOOLOGY** | | |
| **2.1** | WBC Differential count | • Distinguish the different types of blood group | **K4** |
| **2.2** | ABO blood grouping in man | • Analyse the antigen and antibody reaction | **K4** |
| | **SPOTTERS** | | |
| **2.3** | Hemoglobinometer Haemocytometer | Explain the importance of the instruments | **K4** |
| **2.4** | *Eudriluseugeniae*,Vermicasts Honey Bee, Honey | Identify the animals and explain their economic importance | **K4** |
| **2.5** | Silk moth, Silk gland, Silk threads | Explain their economic importance. | **K4** |
| **2.6** | *Catlacatla*, Rohu, | Distinguish the types of fishes | **K4** |
| **2.7** | Slides : Nerve cell, Striated muscle | Distinguish between the different types of cells | **K4** |

## 4. MAPPING (CO, PO, PSO)

| U19ZYYP1 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | M | H | H | H | L | - | H | H | - | - | H |
| **CO2** | H | H | M | H | H | M | - | L | H | H | M | - | H |
| **CO3** | H | M | M | M | H | H | - | L | H | H | M | - | H |
| **CO4** | H | L | L | H | H | H | - | - | H | M | - | - | M |
| **CO5** | H | H | M | H | - | H | - | - | H | H | M | - | H |
| **CO6** | H | M | H | L | H | H | M | - | M | - | H | - | H |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT METHODS

| **DIRECT** |
|---|
| 1. Continuous Assessment Test I, II<br>2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc.(as applicable)<br>3. End Semester Examination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinators:**

**1. Ms. Hadline Kiruba**

**2. Dr. R. Sudha**

## Allied – II ENVIRONMENTAL ZOOLOGY

**SEMESTER: 2** **CODE: U19ESZY2**
**CREDITS: 3** **HOURS/WEEK: 4**

### 1. COURSE OUTCOMES:

On Completion of this course, the students will be able to:

| CO.No. | COURSE OUTCOME | LEVEL | UNIT |
|---|---|---|---|
| CO1 | Determine the salient features of Kingdom Animalia and the levels of organization at cellular, tissue and organ grade level of organization | K6 | I |
| CO2 | Classifying the major Phylum Invertebrata and Chordata with its distinctive characters and suitable examples | K3 | II |
| CO3 | Compare the major process of mechanism of migration and flight adaptations in animals. | K4 | III |
| CO4 | Explaining the types of animal behaviour and distinguishing between stereotyped and Acquired behaviour in animals | K4 | IV |
| CO5 | Discuss the process of communication in birds and mammals | K6 | V |
| CO6 | compare the external morphology of invertebrates and chordates | K4 | II |

### 2. A. Syllabus

**Unit I DIVERSITY OF INVERTEBRATES AND CHORDATES 12 Hrs**

Kingdom Animalia: Salient features - levels of organization: cellular, tissue, organ and organ system; Classification of major Invertebrata Phyla and Phylum Chordata up to classes - General characters and diversity of Major Invertebrata Phyla and Phylum Chordata with suitable examples.

**Unit II BENEFICIAL INSECTS, VERMICULTURE AND PARASITOLOGY 12 Hrs**

Detailed study: Earthworm –Cockroach- Pigeon. Economic importance of beneficial insects - Social life of honey bees. Brief study of Vermiculture, vermicomposting and its applications. Parasitology-Vector borne diseases–Malaria, Dengue.

**Unit III ADAPTIVE RADIATION IN CHORDATES 12 Hrs**

Biological significance of Migratory animals: Fishes, Birds and Mammals. Flight adaptations in vertebrates - Aquatic adaptations in birds and mammals; embryonic adaptation: Extra embryonic membrane structure in Reptiles and Birds. Adaptive radiations in chordates: Aquatic, terrestrial and arboreal. Bio indicators- microbes.

**Unit IV ANIMAL BEHAVIOUR AND PHEROMONES 12 Hrs**

Animal Behaviour: Stereotyped behaviour- instincts and motivation; Acquired behaviour: Pavlovian learning, trial and error learning. Pheromones and behaviour: types, significance – Pheromones with reference to insects and rodents.

**Unit V SOCIAL BEHAVIOUR IN ANIMALS 12 Hrs**

Social behaviour: Birds, primates. Biological rhythms: circadian, tidal, lunar, circannual rhythms. Types of communication in animals: visual, olfactory, tactile, verbal and non-verbal- Communication in bees and birds. mimicry and animal colorations.

**B. Topics for Self-Study**

| Sl.No. | Topics | Web Links |
|---|---|---|
| 1. | Calotes | https://www.notesonzoology.com/phylum-chordata/garden-lizard/external-morphology-of-garden-lizard-with-diagram-chordata-zoology/8383 |
| 2. | Vector borne diseases | https://www.who.int/news-room/fact-sheets/detail/vector-borne-diseases |
| 3. | Apiculture | https://www.sciencedirect.com/topics/earth-and-planetary-sciences/apiculture |

**C. Text Books**


1. Jordan E.L. and Verma P.S., Invertebrate Zoology,12$^{th}$edn. Schand& Co. 1995.
2. Kotpal R.L., Agarwal, R.P.R., Khertarpa,Modern**Text Book** of Zoology-I –Rastogi Publications.1989.


**D. References Books**


1. Ayyar E.K. Ananthakrishnan, T.N., **Outlines of Zoology**: **Invertebrata**, Vol-I and Vol-II Viswanathan Pvt. Ltd.1993.
2. Hoshang. S, Gundevia and Hare Govind Singh, **A textbook of Animal Behaviour**, Chand & Co., 1997.
3. Shukla G.S and Upadhay V.B., **Economic Zoology**, Rastogi Publications, 2004.
4. Jordan, E.L. and Verma P.S., **Invertebrate Zoology,** 12$^{th}$edn. S.Chand& Co., 1995.
5. Kotpal, R.L., Agarwal, R.P.R., Khertarpa. I., **Modern Text Book of Zoology,** Rastogi Publications, 1989.
6. Dhami, D.S and Dhami, J.K.R., **Chordate Zoology,** Chand & Co., 1978.
7. Ismail,S.A., **Vermicology: The Biology of Earthworm**, Orient Longman, London,1970.


**E. Web Links**

1.https://www.who.int/news-room/fact-sheets/detail/zoonoses
2.https://www.acs.edu.au/courses/invertebrate-animals-730.aspx
3.https://www.khanacademy.org/science/biology/crash-course-bio-ecology/crash-course-biology-science/v/crash-course-biology-123
4. https://courses.lumenlearning.com/suny-biology2xmaster/chapter/chordates/

**3. SPECIFIC LEARNING OUTCOMES (SLO)**

| Unit/ Section | Course Content | Specific Learning outcome | Highest Bloom's Taxonomic Level of Transaction |
|---|---|---|---|
| **I** | **DIVERSITY OF INVERTEBRATES AND CHORDATES** | | |

| | | | |
|---|---|---|---|
| **1.1** | Salient features of Animalia | • Discus the salient features of animals | **K6** |
| **1.2** | Levels of organization | • Classify the different levels of organization | **K3** |
| **1.3** | Classification-Invertebrates & Chordates | • Explain the characteristics features of invertebrates &Chordates | **K4** |
| **II** | **BENEFICIAL INSECTS, VERMICULTURE AND PARASITOLOGY** | | |
| **2.1** | Type study-Earthworm | • Identify the morphological characters of the animal.<br>• Explain the different system of animal. | **K4**<br>**K4** |
| **2.2** | Cockroach | • Identify the morphological characters of the animal | **K4** |
| **2.3** | Pigeon | • Identify the morphological characters of the animal | **K4** |
| **2.4** | Social life of honey bee | • Predict the social life of honey bee | **K5** |
| **2.5** | Vermiculture | • Explain vermiculture.<br>• Compare the different types of vermicomposting | **K4**<br>**K4** |
| **2.6** | Vectorborne diseases- Malaria, Dengue | • To identify and examine the epidemiology of viral diseases | **K4** |
| **III** | **MIGRATION IN ANIMALS AND ADAPTIVE RADIATION IN CHORDATES** | | |
| **3.1** | Migratory animals-Fish, Birds, Mammals | • Explain the types of migration in fishes, birds & mammals | **K4** |
| **3.2** | Flight adaptations | • Classify the adaptations in birds | **K3** |
| **3.3** | Aquatic adaptations | • Devise/Formulae the aquatic adaptations | **K5** |
| **3.4** | Extra embryonic membrane | • Describe the extra embryonic membrane<br>• To study the characteristics of extra embryonic membranes | **K1** |
| **3.5** | Adaptive radiation | • Explain radiation.<br>• Explain the types of adaptive radiation | **K4** |
| **IV** | **ANIMAL BEHAVIOUR AND PHEROMONES** | | |
| **4.1** | Animal behaviour | • Discuss the various behaviour of animal | **K6** |
| **4.2** | Acquired behaviour | • Discuss the various behaviour of animal | **K6** |
| **4.3** | Pheromones & Social behaviour | • Relate the Effect of pheromones in various social behaviours of animals | **K1** |
| **V** | **SOCIAL BEHAVIOUR IN ANIMALS** | | |
| **5.1** | Biological rhythms | • Compare various behaviours of animal based on different biological rhythms | **K4** |
| **5.2** | Types of communication- | • Explain various communication | **K4** |

| | | | |
|---|---|---|---|
| | Animals, Birds | mechanisms of animals and birds | |
| **5.3** | Mimicry and colouration | • Distinguish various patterns of mimicry and colouration | **K4** |

## 4. MAPPING (CO, PO, PSO)

| U19ESZY2 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | L | H | H | L | M | - | - | H | H | - | H |
| **CO2** | H | H | L | H | H | L | M | - | - | H | H | - | H |
| **CO3** | H | H | L | H | H | L | M | M | - | H | H | - | M |
| **CO4** | H | H | L | H | H | L | M | - | - | H | H | - | M |
| **CO5** | H | H | L | H | H | L | H | - | - | H | H | - | H |
| **CO6** | H | H | - | H | H | - | M | - | - | H | H | - | H |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT METHODS

| **DIRECT** |
|---|
| 1. Continuous Assessment Test I,II<br>2. Assignment Group Presentation, Poster preparation,<br>3. End Semester Examination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinator:**

**Dr. Susan. G. Suganya**

## Allied Practical – II: ENVIRONMENTAL ZOOLOGY LAB

**SEMESTER: II** **Code: U19ESYP2**
**CREDITS: 4** **HOURS/WEEK: 3**

### 1. COURSE OUTCOMES

At the end of this course, the students will be able to:

| CO.No. | COURSE OUTCOMES | LEVEL | EXPERIMENTS |
|---|---|---|---|
| CO1 | Conversant with organ systems of Earthworm and cockroach. | K4 | I |
| CO2 | Isolate body setae of Earthworm and observe under the microscope. | K5 | II |
| CO3 | Study and distinguish various mouthparts of insects under the microscope. | K5 | II |
| CO4 | Analyze the process of Biological rhythms and communication in bees. | K4 | III |
| CO5 | Investigate the necessity of various adaptation in animals | K4 | III |
| CO6 | Study the biological significance of the given spotters | K4 | III |

### 2. A. Syllabus

**I VIRTUAL DISSECTION OF COCKROACH**

Digestive system, Nervous system, male and female reproductive systems

**DISSECTION**

Earthworm : Digestive system and Nervous system

**II MOUNTINGS**

1. Mosquito : Mouth parts
2. House fly : Mouth parts
3. Earthworm : Body setae
4. Shark : Placoid scale

**III. SPOTTERS**

- Amoeba, Paramecium, Obelia colony, Tapeworm, Ascaris, Leech, Millipede, Centipede, Freshwater mussel, Starfish, Shark, Calotes, Pigeon, Rabbit,
    - *Eudriluseugeniae*, vermicasts,
- Biological rhythms and communication in bees.

### B. Topics for Self-Study

| Sl.No. | Topics | Web Links |
|---|---|---|
| 1. | Earthworm | https://biologywise.com/earthworm-classification-taxonomy |
| 2. | Shark | https://www.britannica.com/animal/Shark |

**C. Text Book**

1. Advanced practical zoology by S. Chand & company LTD.1995

**D. Reference Books**


1. Lal S.S., A Textbook of Practical Zoology Invertebrate, Rastogi Publication, 2004
2. Sinha J. Chatterjee A.K., Chattopadhyay., Advanced Practical Zoology, Books and Allied (P) Ltd., 2011.


**E. Web Link**

1. https://www.acs.edu.au/courses/invertebrate-animals-730.aspx

## 3. SPECIFIC LEARNING OUTCOMES (SLO)

| Experiments | Course contents | Specific Learning outcomes | Bloom's Taxonomy Level of Transaction |
|---|---|---|---|
| **I** | **VIRTUAL DISSECTION** | | |
| **1.1** | Dissection of Earthworm Digestive system and Nervous system | • To understand the basic organization of earthworm systems | **K2, K4** |
| **1.2** | Virtual dissection of cockroach Digestive system, nervous systems and reproductive system | • To study insect system using in silico platform. | **K4** |
| **II** | **MOUNTING & DISPLAY** | | |
| | Mountings of<br>Mosquito : Mouth parts<br>House fly : Mouth parts<br>Earthworm : Body setae<br>Shark : Placoid scale | • To evaluate various mouth parts of insects by mounting | **K4, K5** |
| **III** | **SPOTTERS** | | |
| **3.1** | **Spotters:** Amoeba, Paramecium, Obelia colony, Tapeworm, Ascaris, Leech, Millipede, Centipede, Freshwater mussel, Starfish, Shark, Calotes, Pigeon, Rabbit, Eudriluseugeniae, vermicasts, Biological rhythms and communication in bees. | • To discuss the biological significance and adaptations. | **K4** |

## 4. MAPPING (CO, PO, PSO)

| U19ESYP2 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | L | L | H | M | M | H | M | H | H | M | L |
| **CO2** | H | H | M | M | H | M | M | H | M | H | H | M | M |
| **CO3** | H | H | L | L | H | M | M | H | M | H | H | M | L |
| **CO4** | H | H | L | L | H | M | M | H | M | H | H | M | M |
| **CO5** | H | H | M | L | H | M | M | H | M | H | H | M | L |
| **CO6** | H | H | L | L | H | M | M | H | M | H | H | M | L |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT METHODS

| **DIRECT** |
|---|
| 1. Continuous Assessment Test I, II<br>2. Assignment, Group Presentation, Poster preparation,<br>3. End Semester Examination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinator:**

**Dr. Susan. G. Suganya**

**UG – NON-MAJOR ELECTIVE COURSES (NMEC)**
**(OFFERED TO STUDENTS OF OTHER DISCIPLINES)**

**NMEC-I: PUBLIC HEALTH AND HYGIENE**

**SEMESTER: III** **Code: U19ZY3E1**
**CREDITS: 2** **HOURS/WEEK: 2**

## 1. COURSE OUTCOMES

On completion of the course, the student will be able to:

| CO.No. | COURSE OUTCOMES | LEVEL | UNIT |
|---|---|---|---|
| CO1 | Compare the spectrum of health | K2 | I |
| CO2 | Classify the nutrients in food and assess the importance of balanced diet | K4 | II |
| CO3 | Explain the effects of malnutrition | K5 | II |
| CO4 | Interpret the maternal and child health | K5 | III |
| CO5 | Inspect about mentalilleness and its causes | K4 | IV |
| CO6 | Appraise the practices of health education | K5 | V |

## 2. A. Syllabus

### UNIT I - HEALTH

Health: Definition and concepts, spectrum, indicators:morbidity and mortality - determinants of health.

### UNIT II - NUTRITION

Nutrition: major nutrients - food types - balanced diet- malnutrition and its effects - hypertension - cardio vascular diseases, obesity and diabetes.

### UNIT III - MATERNAL AND CHILD HEALTH

Maternal and child health: Maternity - MCH problems- antenatal, intra natal – Post natal care

### UNIT IV - MENTAL HEALTH

Mental health: Types, causes of mental illness and prevention of mental health- crucial points in the life of humanbeings- Addiction: Alcoholism, Smoking-deaddiction and rehabilitation

### UNIT V - HEALTH EDUCATION

Health education: Definition- objectives - practices of health education. Methods of family welfare.

**B. Topics for Self-Study**

| Sl. No. | Topics | Web Links |
|---|---|---|
| 1. | Stress Management | https://www.verywellmind.com/stress-management-4157211 |
| 2. | Health Programs in India | http://nhp.gov.in/healthprogramme/national-health-programmes |
| 3. | Hospital waste Management | https://www.medprodisposal.com/medical-waste-disposal/what-is-medical-waste-medical-waste-definition-types-examples-and-more/ |
| 4. | Epidemiology of Communicable diseases | https://www.ncbi.nlm.nih.gov/books/NBK470303/ |
| 5. | Screening of diseases | https://www.who.int/ionizing_radiation/medical_radiation_exposure/munich-WHO-1968-Screening-Disease.pdf |

**C. Text Book**

1. Park, J.E and Park.K, **Text Book** of preventive and social medicine, 13thEdn- Banarsidas. Bhanot, Jabalpur -1990.

**D. References Books**

1. Swaminathan.M, Bappco, Hand book of food and Nutrition, Bangalore -1989.
2. Swaminathan, M., Essentials of food and Nutrition. Vol.I and II 1989

**E. Web Links**

1. https://www.who.int/health-topics/nutrition
2. https://jamanetwork.com/journals/jama/article-abstract/289200
3. https://www.sciencedirect.com/topics/social-sciences/health-education
4. https://www.cdc.gov/healthyschools/sher/characteristics/index.htm

## 3. SPECIFIC LEARNING OUTCOMES (SLO)

| Unit/ Section | Course Contents | Specific Learning outcomes | Highest Bloom's Taxonomic Level of Transaction |
|---|---|---|---|
| **I** | **HEALTH** | | |
| **1.1** | Health - definition and concepts | • Explain the importance of health and the various concepts involved in it | **K2** |
| **1.2** | Spectrum | • Determine the illness – wellness concept | **K5** |
| **1.3** | Health indicators | • Explain the various health indicators of human beings | **K5** |
| **1.4** | Determinants of health | • List out the concepts that determine the health | **K4** |
| **II** | **NUTRITION & DISEASES** | | |
| **2.1** | Nutrients | • Assess the role of nutrients to maintain ideal health | **K5** |
| **2.2** | Balanced diet | • Categorize the significance of essential food and its proportions in daily life | **K4** |
| **2.3** | Malnutrition | • Deduct the deficiency of nutrients and its supplements in food | **K5** |
| **2.4** | Hypertention, Cardiovascular diseases, Obesity and diabetes | • Explain the ill effects and disease caused due to malnutrition | **K5** |
| **III** | **MATERNAL CHILD HEALTH** | | |
| **3.1** | Maternal and child health | • Assess about the health of a women and her | **K5** |

| | | | |
|---|---|---|---|
| | | child during pregnancy | |
| **3.2** | Maternity and MCH problems | • Analyzethe motherhood qualities and problems of maternal and child health | **K4** |
| **IV** | **MENTAL HEALTH & ADDICTION** | | |
| **4.1** | Mental health | • Assess the emotional and behavioural health of an individual | **K5** |
| **4.2** | Crucial points in Human's life (Addiction) | • Test for the root cause of addiction and the types of additives and the rehabilitation for such addiction | **K4** |
| **V** | **HEALTH EDUCATION** | | |
| **5.1** | Health education | • Explain the principles of health through group of people to maintain proper health | **K5** |
| **5.2** | Family welfare | • Make use of family planning concepts for better health | **K3** |

## 4. MAPPING (CO, PO, PSO)

| U19ZY3E1 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | H | - | M | H | H | M | H | - | H | - | H |
| CO2 | H | - | H | - | M | H | H | M | H | - | H | - | H |
| CO3 | H | - | H | - | M | H | H | M | H | - | H | - | H |
| CO4 | H | - | H | - | M | H | H | M | H | - | H | - | H |
| CO5 | H | - | H | - | M | H | H | M | H | - | H | - | H |
| CO6 | H | - | H | - | M | H | H | M | H | - | H | - | H |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT METHODS

| **DIRECT** |
| --- |
| 1. Continuous Assessment Test I, II<br>2. Assignment Group Presentation, Poster preparation,<br>3. End Semester Examination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinators:**

**1. Mr. K. Jeremiah Kirubananth**
**2. Dr. S. Bhuvaneshwari**

## NMEC- II: INDUSTRIAL ZOOLOGY

**SEMESTER: IV** **Code: U19ZY4E2**
**CREDITS: 2** **HOURS/WEEK: 2**

### 1. COURSE OUTCOMES

On completion of this course, the students will be able to:

| CO.No. | COURSE OUTCOMES | LEVEL | UNIT |
|---|---|---|---|
| CO1 | Analyse the economic importance of earthworms, apiculture, sericulture, Poultry and Pisciculture | K4 | I |
| CO2 | Classify the earthworms,honey bees, silkworms, fowls and fishes based on ecological and morphological concepts. | K4 | II |
| CO3 | Importance of vermicompost,honey,silk,fowls and fishes and agriculture. | K5 | III |
| CO4 | Construct vermicompost, Apiculture, Sericulture, Poultry, Pisciculture unit based on the gained expertise. | K4 | IV |
| CO5 | Develop the skills in establishing a above mention unit through field visit. | K3 | V |
| CO6 | Identify the various diseases of various forming organisms | K3 | V |

### 2. A. Syllabus

**UNIT IINTEGRATED FARMING SYSTEM** **6 Hrs**

**Introduction**: scope and economics of Industrial zoology - Integrated Farming System. Vermiculture: Ecological classification of earthworm: Preparation of vermibed - management: vermiwash - Economic Importance

**UNIT IIAPICULTURE** **6 Hrs**

**Apiculture:** - species of honeybees - bee colony – Newton's beehive - care and management extraction of honey - nutritive and medicinal value of honey

**UNIT III SERICULTURE** **6 Hrs**

**Sericulture:** Introduction - types of silkworm - life cycle of silkworm (Bombyx mori) Species of Mulberry- rearing – reeling - Economic importance of silk

**UNIT IV POULTRY FARMING** **6 Hrs**

**Poultry farming:** Classes of poultry: Desi: Aseel,Gagus, Exotic: leghorn. Rhode Island - housing ofchicken: deep litter system, cage system, brooder housings, and grower housings - poultry equipments: feeder, waterer, brooder, cages.

**UNIT V PISCICULTURE** **6 Hrs**

**Pisciculture:** types of ponds: Nursery, stocking -management of a pond- Freshwater cultivable fishes:Major carps: Catlacatla, Rohu, Mrigala - induced breeding

B. **Topics for Self-Study**

| Sl.No. | Topics | Web Links |
|---|---|---|
| 1 | **Vermiculture**: Monitoring and harvesting of vermicompost | https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/E-Learning/Moocs/Solid_Waste/W4/Manual_On_Farm_Vermicomposting_Vermiculture.pdf |
| 2 | **Pisciculture:** Fish feed preparation, fish culture system & water quality management | http://www.ipublishing.co.in/ijesarticles/thirteen/articles/volthree/EIJES31197.pdf<br><br>http://www.fao.org/fileadmin/templates/SEC/docs/Fishery/SSFF/Preparation_en.pdf |
| 3 | **Sericulture:** silkworm pest preventive and control measures | http://egyankosh.ac.in/bitstream/123456789/9091/1/Unit-2.pdf |
| 4 | **Apiculture:** Bee dancing | https://home.uni-leipzig.de/muellerg/1001/tarpy.pdf |
| 5 | **Poultry farming:** Poultry diseases | http://www.poultryhub.org/health/disease/types-of-disease/ |

**C. Text Books**

1. Shukla G.S and UpadhayV.B.,Economic Zoology ,Rastogi Publications 2004.
2. Jordon E.L and Verma, P.S.,Chordate zoology and elements of Animal Physiology, 1995.

**D. Reference Books**

1. FAO Sericulture Training Manual, Oxford and IBH,1992
2. Gnanamani M.R, Poultry Keeping ,Deepam Publication, 1978
3. SrinivasauluReddy.M ,A**Text Book** of Aquaculture, Sambasiva Rao KRS.,DPH 1994

**E. Web Links**

1. https://www.sciencedirect.com/topics/nursing-and-health-professions/pisciculture
2. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/apiculture

## 3.SPECIFIC LEARNING OUTCOMES (SLO)

| Unit/ Section | Course Contents | Learning Outcomes | Highest Bloom's Taxonomic Level of Transaction |
|---|---|---|---|
| **I** | **INTRODUCTION, VERMICULTURE** | | |
| **1.1** | Scope and Economics of Vermiculture | • Discuss the importance of and scope of vermiculture | **K6** |
| **1.2** | Ecological classification of earthworm | • List out the characteristic features of earthworms | **K4** |
| **1.3** | Morphology and earthworm | • explain the external structure and the complete lifecycle of the Eudrilus | **K5** |
| **1.4** | Organic waste resources | • Analyze the importance and uses of organic wastes | **K4** |
| **1.5** | Vermicomposting methods | • Discuss the various methods followed in vermicomposting | **K5** |
| **1.6** | Vermiwash | • Explain the process of vermiwash | **K5** |
| **II** | **APICULTURE** | | |
| **2.1** | Scope and Economics of apiculture | • Elaborate the importance and scope of apiculture | **K3** |
| **2.2** | classification of honeybees and methods | • Examine the morphology and characteristic features of honeybees | **K4** |
| **2.3** | extraction of honey | • Explain the process of vermiwash | **K5** |
| **2.4** | medicinal value of honey | • know the importance and value of honey | **K3** |
| **III** | **SERICULTURE** | | |
| **3.1** | Scope and economics of sericulture | • Discuss the economic importance and the scope of sericulture | **K5** |
| **3.2** | Types of silkworm | • Compare and classify the different types of silkworm | **K5** |
| **3.2** | Lifecycle of *Bombyx mori* | • Explain the life cycle of silkworm | **K4** |
| **3.4** | Varieties of mulberries Harvesting and preservation | • Categorize the various varieties of mulberries | **K4** |

| | | | |
|---|---|---|---|
| | | • Elaborate the silk harvesting and preservation techniques | **K3** |
| **3.5** | Rearing and rearing appliances | • Examine the process of rearing and the appliances used for rearing | **K4** |
| **3.6** | Methods of mounting cocoons | • Discuss the diverse methods of mounting the cocoons | **K5** |
| **3.7** | Commercial characters of cocoons | • Evaluate the commercial values of cocoons | **K5** |
| **3.8** | Diseases of silkworm | • Identify the various diseases of silkworm | **K3** |
| **IV** | **POULTRY FARMING** | | |
| **4.1** | Scope and economics of poultry | • Discuss the economic importance and the scope of poultry forming | **K6** |
| **4.2** | Ecological classification of fowls | • List out the characteristic features of poultry birds | **K4** |
| **4.3** | Cage and deep litter methods | • Learn the rearing methods | **K5** |
| **4.4** | Equipments | • Know how to operate the various equipments | **K3** |
| **V** | **PISCICULTURE** | | |
| **5.1** | Field Visit To Pisciculture Unit | • Inspect the process | **K5** |
| **5.2** | Commercial value of fishes | • Evaluate the commercial values of fishes | **K5** |
| **5.3** | Harvesting methods | • Learn the different type of Harvesting methods | **K4** |

## 4. MAPPING (CO, PO, PSO)

| U19ZY4E2 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | H | H | H | H | H | H | H | H | M | H | H |
| CO2 | H | H | H | H | H | H | H | H | H | H | H | H | H |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO3** | H | H | H | H | H | H | H | H | H | H | H | H | H |
| **CO4** | M | H | H | H | H | H | H | H | M | H | - | H | H |
| **CO5** | H | H | H | H | H | H | H | H | M | H | H | H | H |
| **CO6** | M | H | H | H | H | H | H | H | M | H | H | H | H |

L-Low M-Moderate H- High

## 5. COURSE ASSESSMENT STUDIES

| **DIRECT** |
|---|
| 1. Continuous Assessment Test I, II<br>2. Cooperative learning report, Assignment; Group Presentation, Project report, Poster preparation, Field Visit and Field Visit Report<br>**3.** End Semester Examination |
| **INDIRECT** |
| 1. Course-end survey |

**Course coordinators:**

**1. Dr.J. Nesarajan**
**2. Dr. R. Sudha**

**LIFE SKILLS**

**SEMESTER: IV** **COURSE CODE: U16LFS41**
**CREDITS: 1** **HOURS/WEEK: 1**

**General Objectives:**
1. To acquire skills and abilities for adaptive and positive behavior that helps to deal effectively with thedemands and challenges of everyday life.
2. To develop creative, communicative and critical thinking skills necessary for employability

**1. A. Syllabus**

**UNIT I**
Basics of Communication skills & Effective Communication
Features of Communication – Process of Communication Verbal, nonverbal,Body Language – Postures& Etiquette –Listening& speaking Skills- Communication Barriers – Listening & speaking Skills.

**Unit II**
Personal Effectiveness
Maslow's theory – Self-esteem- Role Conflict – Intra &Inter personal Skills – Efficiency Vs effectiveness – Team Building – Emotional Intelligence & Quotient

**Unit III**
Interview Skills
Types of Interviews – Resume Formats & preparation - Cover letters – Simple rules to face interviews –Dos &Don'ts in a an Interview – Telephonic Interview and Etiquette - Group Discussions – Types –Methods – Ingredients and Tips for a Successful Group Discussion.

**Unit IV**
Test of Reasoning & Numerical Ability
A. Numerical Ability: Problems related to Average – Percentage – Profit /Loss – Simple & Compound InterestTime& Work – Boats & Streams etc.
B. Logical reasoning: Logical Detection – Nonverbal reasoning – Problems related to seating arrangements –Relationship model – Assertion & Reasoning etc.
C. Online Tests:Aptitude – Logical Reasoning – Problem Solving –Time management in Online tests- Onlinetests on Language skills- Aptitude and technical rounds

**Unit V**
Outbound Learning, Physical, Mental, and emotional exercises

**B. Texts Books**
1. Barun.K.Mitra, Personality Development and Soft Skills, 6th edition, Oxford University pressNoida 2012.
2. M.Sarada, The complete Guide to Resume Writing, Sterling Publishers Pvt Ltd, New Delhi 2012.
3. Gloria J.Galances& Katherine Adams,Effective Group Disscussions,Theory& practice,12th Edition, Tata McGrawHillpvt Ltd 2012.
4. Francis Soundararaj, Basics of Communication in English, SoftSkills for Listening Speaking,Reading& Writing, Macmillan Publishers India Ltd. 2013.

## UG - PROGRAMME ARTICULATION MATRIX

| Sl.No. | COURSE NAME | COURSE CODE | CORRELATION WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO 1 | PSO 2 | PS O 3 | PSO 4 |
| 1 | Invertebrata | U19ZY101 | H | H | L | H | - | M | M | H | H | H | L | M | L |
| 2 | Core Practical – I | U19ZY1P1 | H | H | L | M | - | H | H | H | H | H | L | L | H |
| 3 | Chordata | U19ZY202 | H | H | L | H | - | M | H | H | H | H | M | L | L |
| 4 | Core Practical – II | U19ZY2P2 | H | H | L | H | - | H | H | H | H | H | H | M | H |
| 5 | Ecology and Evolution | U19ZY303 | H | H | - | H | - | L | M | H | H | H | H | L | L |
| 6 | Sericulture and Vermiculture | U19ZYPS1 | M | H | - | H | - | H | H | H | H | H | L | H | M |
| 7 | Core Practical – III | U19ZY3P3 | H | H | - | H | - | H | H | H | H | H | H | L | H |
| 8 | Cell and Molecular Biology | U19ZY404 | H | - | L | - | H | - | H | - | H | - | H | - | M |
| 9 | Pisciculture | U19ZYPS2 | M | H | - | H | - | H | H | H | H | H | L | H | M |
| 10 | Core Practical – | U19ZY4P4 | M | - | - | - | H | - | H | - | H | - | H | - | H |

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| | **IV** | | | | | | | | | | | | | | |
| **11** | **Genetics** | **U19ZY505** | **H** | **-** | **M** | **-** | **M** | **-** | **H** | **-** | **H** | **-** | **H** | **-** | **M** |
| **12** | **Microbiology** | **U19ZY506** | **H** | **-** | **H** | **-** | **M** | **-** | **H** | **-** | **H** | **H** | **H** | **-** | **M** |
| **13** | **Biophysics and Biochemistry** | **U19ZY5:1** | **H** | **-** | **M** | **-** | **M** | **-** | **H** | **-** | **H** | **-** | **H** | **-** | **M** |
| **14** | **Wild life ecology and Economic Entomology** | **U19ZYPS3** | **H** | **H** | **H** | **H** | **-** | **H** | **H** | **H** | **H** | **H** | **M** | **M** | **M** |
| **15** | **CorePractical – V** | **U19ZY5P5** | **H** | **-** | **H** | **-** | **H** | **-** | **H** | **-** | **H** | **H** | **H** | **-** | **H** |
| **16** | **Animal Physiology** | **U19ZY607** | **H** | **-** | **-** | **-** | **H** | **-** | **H** | **-** | **H** | **-** | **H** | **-** | **H** |
| **17** | **Developmental Biology and Immunology** | **U19ZY608** | **H** | **-** | **H** | **L** | **H** | **-** | **H** | **-** | **H** | **-** | **H** | **-** | **H** |
| **18** | **Biotechnology** | **U19ZY6:2** | **H** | **-** | **-** | **-** | **H** | **-** | **H** | **M** | **H** | **-** | **H** | **-** | **H** |
| **10** | **Biostatistics and Bioinformatics** | **U19ZY6:3** | **H** | **-** | **-** | **-** | **M** | **-** | **H** | **-** | **H** | **-** | **H** | **-** | **H** |
| **20** | **Core Practical – VI** | **U19ZY6P6** | **H** | **L** | **M** | **-** | **H** | **-** | **H** | **H** | **H** | **-** | **H** | **-** | **H** |
| **21** | **Allied Zoology I** | **U19ZYY11** | **H** | **H** | **L** | **H** | **-** | **M** | **M** | **H** | **H** | **H** | **L** | **M** | **L** |
| **22** | **Allied Zoology II** | **U19ZYY22** | **H** | **L** | **-** | **M** | **-** | **H** | **H** | **H** | **M** | **-** | **H** | **H** | **M** |
| **s23** | **Allied Zoology Practical** | **U19ZYYP 1** | **H** | **H** | **L** | **M** | **-** | **H** | **H** | **H** | **H** | **H** | **L** | **L** | **H** |

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| **24** | **Environmental Zoology** | **U19ESZY2** | **H** | **H** | **L** | **H** | **L** | **-** | **L** | **H** | **H** | **H** | **H** | **H** | **H** |
| **25** | **Environmental Zoology practical** | **U19 ESYP2** | **H** | **H** | **-** | **H** | **L** | **H** | **L** | **H** | **H** | **H** | **H** | **H** | **H** |
| **26** | **NMEC I** | **U19ZY3E1** | **M** | **L** | **H** | **-** | **-** | **-** | **L** | **-** | **H** | **-** | **M** | **-** | **H** |
| **27** | **NMEC II** | **U19ZY4 E2** | **M** | **H** | **-** | **H** | **-** | **H** | **H** | **H** | **H** | **H** | **L** | **H** | **M** |