**DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,**
**CHHATRAPATI SAMBHAJINAGAR.**

**CIRCULAR NO.SU/M.Sc./Deptt./NEP/110/2024**

It is hereby inform to all concerned that, the syllabi prepared by the Departmental Committee and recommended by the Dean, Faculty of Science & Technology, **Academic Council at its meeting held on 08 April 2024 has accepted the following Syllabi under the Faculty of Science & Technology as per National Education Policy-2020** run at the University Department, Dr.Babasaheb Ambedkar Marathwada University as appended herewith.

| Sr.No. | Courses | Semester |
|---|---|---|
| 1. | M.Sc.Physics | IIIrd & IVth semester |
| 2. | M.Sc.Chemistry with Specializations Inorganic Chemistry, Organic Chemistry & Physical Chemistry. | IIIrd & IVth semester |
| 3. | M.Sc.Zoology | IIIrd & IVth semester |

This is effective from the Academic Year 2024-25 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
Ref.No.SU/2024/100-108
Date:- 01.06.2024

* * * * *

Deputy Registrar,
Academic Section

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1] **Head of the Department, Department of Physics, Chemistry and Zoology Dr.Babasaheb Ambedkar Marathwada University,Chhatrapati Sambhajinagar.**

2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

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1] **The Director, Board of Examinations & Evaluation,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
2] The Section Officer,[B.Sc.Unit] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
3] The Programmer [Computer Unit-1] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
4] The Programmer [Computer Unit-2] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
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7] The Record Keeper, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

# DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHHATRAPATI SAMBHAJINAGAR, MAHARASHTRA, INDIA

## FACULTY OF SCIENCE AND TECHNOLOGY

## 2 YEARS P.G. PROGRAMME

## COURSE STRUCTURE AND CURRICULUM

As Per National Education Policy 2020

Subject - ZOOLOGY
Course Structure and Curriculum for M.Sc. 2nd year
(IIIrd and IVth Semester)

**FOR UNIVERSITY DEPARTMENT**

Department of Zoology (Autonomous)
Dr. Babasaheb Ambedkar Marathwada University,
Chhatrapati Sambhajinagar-431004.
(Effective from 2024-25)

24/6/24.

6/7/2024

**As per NEP 2020**

**Credit distribution structure for Two Years PG Program with Multiple Entry and Exit Options**

**Class: M.Sc. First Year Semester: I[st] Semester**
**Subject: Zoology Theory + Practical**

| Course type | Course Code | Course name | Teaching Scheme (Hrs/week) | | Credits Assigned | | Total Credits |
|---|---|---|---|---|---|---|---|
| | | | Theory | Practical | Theory | Practical | |
| DSC Core Course | ZOO/DSC/520 | Biosystematics and animal diversity | 3 | - | 3 | - | 14 |
| | ZOO/DSC/521 | Biochemistry | 3 | - | 3 | | |
| | ZOO/DSC/522 | Ecology (Principles and Practices) | 3 | | 3 | | |
| | ZOO/DSC/523 | Practical based on ZOO/DSC/520 | | 2 | - | 1 | |
| | ZOO/DSC/524 | Practical based on ZOO/DSC/521 | - | 2 | - | 1 | |
| | ZOO/DSC/525 | Practical based on ZOO/DSC/522 | - | 2 | - | 1 | |
| | ZOO/DSC/526 | Practical Skill/advanced technique | - | 4 | - | 2 | |
| DSE (Choose any one from pool) | ZOO/DSE/527 | Helminthology - I | 3 | - | 3 | - | 04 |
| | ZOO/DSE/528 | Protozoology – I | 3 | - | 3 | | |
| | ZOO/DSE/529 | Entomology – I | 3 | - | 3 | | |
| | ZOO/DSE/530 | Endocrinology – I | 3 | - | 3 | | |
| | ZOO/DSE/531 | Marine Biology -I | 3 | - | 3 | | |
| | ZOO/DSE/532 | Practical based on ZOO/DSE/527 | - | 2 | - | 1 | |
| | ZOO/DSE/533 | Practical based on ZOO/DSE/528 | - | 2 | - | 1 | |
| | ZOO/DSE/534 | Practical based on ZOO/DSE/529 | - | 2 | - | 1 | |
| | ZOO/DSE/535 | Practical based on ZOO/DSE/530 | - | 2 | - | 1 | |
| | ZOO/DSE/536 | Practical based on ZOO/DSE/531 | | | | | |
| RM | ZOO/RM/535 | Research Methodology I | 4 | - | 4 | - | 04 |
| | | | | | **16** | **06** | **Total credits 22** |

**Class: M.Sc. First Year Semester: II$^{nd}$Semester**

**Subject: Zoology Theory + Practical**

| Course type | Course Code | Course name | Teaching Scheme (Hrs/week) | | Credits Assigned | | Total Credits |
|---|---|---|---|---|---|---|---|
| | | | Theory | Practical | Theory | Practical | |
| DSC Core Course | ZOO/DSC/570 | Genetics and Bioinformatics | 3 | - | 3 | - | 14 |
| | ZOO/DSC/571 | Cell and Molecular Biology | 3 | - | 3 | - | |
| | ZOO/DSC/572 | Biophysics | 3 | - | 3 | - | |
| | ZOO/DSC/573 | Practical based on ZOO/DSC/570 | - | 2 | - | 1 | |
| | ZOO/DSC/574 | Practical based on ZOO/DSC/571 | - | 2 | - | 1 | |
| | ZOO/DSC/575 | Practical based on ZOO/DSC/572 | - | 2 | - | 1 | |
| | ZOO/DSC/576 | Practical Skill/advanced technique | | 4 | | 2 | |
| DSE (Choose any one from pool) | ZOO/DSE/577 | Helminthology - II | 3 | - | 3 | | 04 |
| | ZOO/DSE/578 | Protozoology – II | 3 | - | 3 | | |
| | ZOO/DSE/579 | Entomology – II | 3 | - | 3 | - | |
| | ZOO/DSE/580 | Endocrinology – II | 3 | - | 3 | - | |
| | ZOO/DSE/581 | Marine Biology -II | | | | | |
| | ZOO/DSE/581 | Practical based on ZOO/DSE/577 | - | 2 | - | 1 | |
| | ZOO/DSE/582 | Practical based on ZOO/DSE/578 | - | 2 | - | 1 | |
| | ZOO/DSE/583 | Practical based on ZOO/DSE/579 | - | 2 | - | 1 | |
| | ZOO/DSE/584 | Practical based on ZOO/DSE/580 | - | 2 | - | 1 | |
| RM | ZOO/OJT/FP/585 | OJT/FP | - | 8 | - | 4 | 04 |
| | | | | | **12** | **10** | **Total credits 22** |

**For Practical – 1 Credit = 30 clock Hrs. (For 13 Practical compulsory – 3 Hours each)**
**Total credits for theory = 16 credits**
**Total credits for practical = 6 credits**

**As per NEP 2020**

**Credit distribution structure for Two Years PG Program with Multiple Entry and Exit Options**

**Class: M.Sc. Second Year Semester: III[rd] Semester**
**Subject: Zoology Theory + Practical**

| Course type | Course Code | Course name | Teaching Scheme (Hrs/week) | | Credits Assigned | | Total Credits |
|---|---|---|---|---|---|---|---|
| | | | Theory | Practical | Theory | Practical | |
| DSC Core Course | ZOO/DSC/620 | Developmental biology | 3 | - | 3 | - | 14 |
| | ZOO/DSC/621 | Immuno-biology | 3 | - | 3 | | |
| | ZOO/DSC622 | Applied Biotechnology -I | 3 | | 3 | | |
| | ZOO/DSC/623 | Practical based on ZOO/DSC/620 | | 2 | - | 1 | |
| | ZOO/DSC/624 | Practical based on ZOO/DSC/621 | - | 2 | - | 1 | |
| | ZOO/DSC625 | Practical based on ZOO/DSC/622 | - | 2 | - | 1 | |
| | ZOO/DSC/626 | Practical Skill/advanced technique | - | 4 | - | 2 | |
| DSE (Choose any one from pool) | ZOO/DSE/627 | Applied Parasitology - I | 3 | - | 3 | - | 04 |
| | ZOO/DSE/628 | Animal Physiology– I | 3 | - | 3 | | |
| | ZOO/DSE/629 | Molecular Biology -I | 3 | - | 3 | | |
| | ZOO/DSE/630 | Endocrinology – I | 3 | - | 3 | | |
| | | | | | | | |
| | ZOO/DSE/631 | Practical based on ZOO/DSE/627 | - | 2 | - | 1 | |
| | ZOO/DSE/632 | Practical based on ZOO/DSE/628 | - | 2 | - | 1 | |
| | ZOO/DSE/633 | Practical based on ZOO/DSE/629 | - | 2 | - | 1 | |
| | ZOO/DSE/634 | Practical based on ZOO/DSE/630 | - | 2 | - | 1 | |
| | | | | | | | |
| RM | ZOO/RP/635 | Research Project -I | 04 | - | 04 | - | 04 |
| | | | | | **16** | **06** | **Total credits 22** |

**As per NEP 2020**

**Credit distribution structure for Two Years PG Program with Multiple Entry and Exit Options**

**Class: M.Sc. Second Year Semester: IV$^{th}$ Semester**
**Subject: Zoology Theory + Practical**

| Course type | Course Code | Course name | Teaching Scheme (Hrs/week) | | Credits Assigned | | Total Credits |
|---|---|---|---|---|---|---|---|
| | | | Theory | Practical | Theory | Practical | |
| DSC Core Course | ZOO/DSC/650 | Evolution And Behavior | 3 | - | 3 | - | 12 |
| | ZOO/DSC/651 | General and Comparative Physiology | 3 | - | 3 | | |
| | ZOO/DSC/652 | Animal Biotechnology II | 3 | | 3 | | |
| | ZOO/DSC/653 | Practical based on ZOO/DSC/650 | | 2 | - | 1 | |
| | ZOO/DSC/654 | Practical based on ZOO/DSC651 | - | 2 | - | 1 | |
| | ZOO/DSC/655 | Practical based on ZOO/DSC652 | - | 2 | - | 1 | |
| | | | | | | | |
| DSE (Choose any one from pool) | ZOO/DSE656/ | Applied Parasitology- II | 3 | - | 3 | - | 04 |
| | ZOO/DSE/657 | Animal physiology – II | 3 | - | 3 | | |
| | ZOO/DSE/658 | Molecular biology – II | 3 | - | 3 | | |
| | ZOO/DSE/659 | Endocrinology – II | 3 | - | 3 | | |
| | | | | | | | |
| | ZOO/DSE/660 | Practical based on ZOO/DSE/656 | - | 2 | - | 1 | |
| | ZOO/DSE/661 | Practical based on ZOO/DSE/657 | - | 2 | - | 1 | |
| | ZOO/DSE/662 | Practical based on ZOO/DSE/658 | - | 2 | - | 1 | |
| | ZOO/DSE/663 | Practical based on ZOO/DSE/659 | - | 2 | - | 1 | |
| | | | | | | | |
| RM | ZOO/RP/664 | Research Project | | 12 | | 06 | 06 |
| | | | | | 16 | 06 | Total credits 22 |

## Class: M.Sc. Second Year Zoology Third Semester

| | | |
|---|---|---|
| **1: DSC -** | **ZOO/DSC/620** | Developmental biology |
| | **ZOO/DSC/621** | Immuno-biology |
| | **ZOO/DSC/622** | Applied Biotechnology -I |
| | **ZOO/DSC/623** | Practical based on Developmental biology |
| | **ZOO/DSC/624** | Practical based on Immuno-biology |
| | **ZOO/DSC/625** | Practical based on Applied Biotechnology -I |
| | **ZOO/DSC/626** | Practical Skill/Advanced Technique |

**2: DSE -** (Choose any one from Pool/Basket)

| | |
|---|---|
| **ZOO/DSE/627** | Applied Parasitology -I |
| **ZOO/DSE/628** | Animal Physiology -I |
| **ZOO/DSE/629** | Molecular Biology -I |
| **ZOO/DSE/630** | Fishery Science -I |
| **ZOO/DSE/631** | Practical based on Applied Parasitology -I |
| **ZOO/DSE/632** | Practical based on Animal Physiology -I |
| **ZOO/DSE/633** | Practical based on Molecular Biology -I |
| **ZOO/DSE/634** | Practical based on Fishery Science -I |

**3: RM - ZOO/RP/635** Research Project

## Fourth Semester

| | | |
|---|---|---|
| **1: DSC -** | **ZOO/DSC/650** | Evolution and Behavior |
| | **ZOO/DSC/651** | General and Comparative Physiology |
| | **ZOO/DSC/652** | Applied Biotechnology -II |
| | **ZOO/DSC/653** | Practical based on Evolution and Behavior |
| | **ZOO/DSC/654** | Practical based on General and Comparative Physiology |
| | **ZOO/DSC/655** | Practical based on Applied Biotechnology -II |

**2: DSE -** (Choose any one from Pool/Basket)

| | |
|---|---|
| **ZOO/DSE/656** | Applied Parasitology -II |
| **ZOO/DSE/657** | Animal Physiology -II |
| **ZOO/DSE/658** | Molecular Biology -II |
| **ZOO/DSE/659** | Fishery Science -II |
| **ZOO/DSE/660** | Practical based on Applied Parasitology -II |
| **ZOO/DSE/661** | Practical based on Animal Physiology -II |
| **ZOO/DSE/662** | Practical based on Molecular Biology -II |
| **ZOO/DSE/663** | Practical based on Fishery Science -II |

**3: RM - ZOO/RP/664** Research Project

# Dr. Babasaheb Ambedkar Marathwada University
# Chhatrapati Sambhajinagar
## Department of Zoology
## M.Sc. Second Year (Semester -III)

### Paper No. ZOO/DSC/620 - DEVELOPMENTAL BIOLOGY

Contact Hours: 45 Credits- 3

**Learning Objectives:**

- To impart knowledge in evolving areas of biological science with respect to developmental biology.
- To impart an understanding of fundamental processes governing development of life.
- To inculcate interest in research in developmental biology and to create manpower for this region.

**Learning Outcomes:**

By the end of the course students will be able to:

- Explain basic concepts of developmental biology.
- Gain detailed knowledge about developmental biology and organogenesis.
- Learn about gametogenesis, embryological development, cleavage mechanisms, gastrulation and role of hormones in metamorphosis and regeneration.

**Unit I: Theories of Development**

1. Preformation and epigenesis
2. **Gametogenesis** (i) Spermatogenesis. Growth of Spermatocytes and acrosome formation spermiogenesis, Capacitation (ii) Oogenesis. (a) Growth of Oocyte and vitellogenesis. (b) Organization of Egg cytoplasm: role of egg cortex, (c) Morphogenic determination in egg cytoplasm.
3. **Fertilization:** Block to polyspermy (Fast and Slow);
4. Significance of fertilization in development and the essence of activation of the egg (Molecular mechanism)

**Unit II**

1. Early embryonic development, Patterns of cleavage; Morulation and Blastulation.
2. Gametogenesis in chordates (tunicates to mammals); (a) Fate maps (b) Mechanism of gastrulation (c) Morphogenic movements (d) Significance of gastrulation.
3. Primary embryonic induction: (a) concepts of potencies; prospective fates; Progressive determination, Totipoteney and pluripotency.
4. Nuclear transfer experiment (b) Induction of the primitive nervous system (Spemann's primary organizers) (c) Nature and regionally-specific properties of inductors, (d) Competence (e) Abnormal inductors (f) chemistry and mechanism of action of inducing substances.

**Unit III**

1. Cell differentiation and differential activity.

## Paper No. ZOO/DSC/621 - IMMUNO-BIOLOGY

Contact Hours: 45 Credits- 3

**Learning Objectives:**

- To inculcate knowledge about Immunobiology.
- To understand the aspects of human immunology such as antigens, antibodies, B- and T-lymphocytes and different cells of the immune system.
- To extend the knowledge about immune systems of the body and immune system in invertebrates and their association with vertebrate system.

**Learning Outcomes:**

By the end of the course students will be able to:

- Explain the tissues, cells and molecules involved in host defense mechanisms.
- Understand of types of immunity, Interactions of antigens, antibodies, complements and other immune components.
- Describe concepts of B-cell, T-cell, Toll-like receptors, hypersensitivity reactions and autoimmune diseases.

**Unit I: Introduction to immune-biology and innate immunity**

1. Different types of first defence barriers against pathogens, Anatomic and chemical basis of inflammatory Inducers.

2. **Innate immunity:** Cells involved in innate immunity, PAMPs and DAMPs, Microbial recognition and tissue damage initiates an inflammatory response.

3. PRRs, Types of Toll- like receptors (TLRs)
   - NOD-like rceeptors as sensors and bacterial infection and cellular damage.
   - NLRP in Cell death and inflammation,
   - RIG -1 like receptor in type – I interferon production and proinflammatory cytokines.

4. **Adaptive immunity**: Antigen-antibody receptor interactions, the strueture of antibodies and receptors. Arrangement of genes and maturity in the bone marrow. Secondary lymphoid tissues role in adaptive immunity/response

**Unit II : Antigen recognition by B cell and T cell receptor :**

Structure of typical antibody molecules, Interaction with the antibody molecule with Spceific antigen, Antigen recognition by T- cells, Primary immunoglobulin gene Rearrangement, T- Cell receptor gene rearrangement, Structural variations in immunoglobulin complex and its function.

**Unit III : The development of mature lymphocyte receptor responses**

Myeloid lineage Lymphocyte receptors signalling. Antigen receptor signalling

## Paper No. ZOO/DSC/622 - APPLIED BIOTECHNOLOGY -I

Contact Hours: 45 Credits- 3

**Learning Objectives:**

- To create interest in technological advancements in biological sciences and its application to mankind.
- To familiarize the students with different diagnostic techniques with applications.
- To develop critical thinking about emerging techniques of biology, including nano-biotechnology and marine biotechnology.

**Learning Outcomes:**

By the end of the course students will be able to:

- Understand the applications of Biotechnology in Agriculture and waste-recycling.
- State principles and applications of various diagnostic techniques.
- Learn about the marine biotechnology and nano-biotechnology in detail.

**Unit I: Biotechnology in Agriculture and waste recycling**

Waste management: Definition, Solid waste suitable for composting, Methods of composting: Vermi-composting. Mineralization process in composting, Biochemistry of composting, factors involved, the infrastructure required –maturity parameters, value-added application methods.

**Unit II: Biotechnology in Diagnosis and Molecular diagnosis**

1. Introduction to molecular diagnosis, significance, scope rise of diagnostic industry, Biomarkers in disease diagnostics, Role of markers in disease diagnosis with examples.
2. Immunodiagnostic techniques: DNA reporter, Fluorogenic reporters, electro-chemiluminescent tags, and label-free immunoassays. PCR in molecular diagnosis, cellular and fundamental genomics in diagnostics.
3. Principles, techniques and application of Protein Sequencing, DNA Sequencing, CRISPR-CAS technology.

Family Genetic Inheritance for identifying rare and common genetic variants: NGS platforms, Illumina, ion Torrent, complete Genomics technology, Third generation sequencing (3GS); Pac bio –Single Molecule Real Time (SMRT) sequencing and Oxford Nanopore Technologies (ONT), Heliocose Single molecule sequencing, Complete genome Advanced sequencing.

**Unit III: Marine Biotechnology**

Significance, Marine-derived pharmaceuticals, Marine bioresources, Secondary metabolites, Marine action-bacterial metabolites and their pharmacological potential, Barophilic organisms and their applications, Seaweeds for removal of metal pollutants. Green fluorescence proteins, red fluorescence proteins, characteristics, and applications.

**Paper No. ZOO/DSC/626 - PRACTICAL SKILL/ADVANCED TECHNIQUE**

1. Elution of protein from Gel filtration and determine the molecular mass.
2. Determination of given amino acid by Thin layer chromatography (TLC)
3. Standard procedure for cell separation by centrifugal elutriation
4. Separation of DNA by Agarose gel electrophoresis and determine molecular mass.
5. SDS-PAGE electrophoresis of protein and determine molecular mass.
6. Study of Beer Lambert's Law for spectrophotometry.
7. Estimation of protein by Lowry's method or Micro Lowry method or dye binding technique.
8. Estimation of carbohydrate by Anthrone method.
9. Plasma separation from given blood sample
10. Serum separation from given blood sample and its electrophoresis.
11. Blood group analysis and clinical correlations.
12. Estimation of blood glucose by DuBois method or enzyme method.
13. Estimation of blood lipids.
14. Isolation of erythrocytes
15. Estimation of ESR of given blood sample.
16. Total RBC count from human blood
17. Identification of defective RBC's from given blood sample for Thalassemia/Sickle cell anemia/ Protozoan parasite.
18. Total WBC count from human blood
19. Differential count on WBC from human blood
20. Precipitation reaction: the ring test
21. Agglutination reaction: The febrile antibody test
22. IgG purification
23. Widal Test
24. ELISA test (Indirect/Sandwich/Dot)
25. Antibiotic potency test –Plate diffusion method (Minimum Inhibitory Concentration)
26. Study of cell viability by Trypan blue exclusion
27. Isolation of DNA from E. coli by mini prep method
28. Isolation of plasmid from bacteria
29. To observe Bacteriophage growth.
30. To isolate DNA from Bacteriophage.

31. Bacterial DNA amplification using PCR
32. Restriction digestion of DNA using nuclease
33. Transformation of DNA in bacteria
34. Gene expression by Gal-x
35. Visit to Food/Pharmaceutical industry

**Elective Courses**

## Paper No. ZOO/DSE/627 - APPLIED PARASITOLOGY -I

Contact Hours: 45 Credits- 3

**Learning Objectives:**

- To understand the basic and general concepts of Parasitology.
- To study major types of parasites of medical and veterinary importance.
- To develop understanding of food and water borne diseases.

**Learning Outcomes:**

By the end of the course students will be able to:

- Enlist types of parasites and hosts along with their relationship.
- State the advantages and disadvantages of parasite in life.
- Explain Inter-specific biological relationships.

**Unit I: Introduction to Parasitology**

Inter-specific biological relationships phoresis, symbiosis, commensalism and parasitism. Parasitism-Definition and concept, Origin and evolution of parasites, Adaptation in parasites. Advantages and disadvantages in parasitic life, Types of Types of hosts - definitive and intermediate, primary secondary specific host, paratenic, carrier, Susceptible, Resistant, accidental, Vectors parasites

**Unit II: Systematics and taxonomy**

1.Systematics and taxonomy: Host as an environment, parasites ecological niche, infectious site, Parasitic populations: Quantitative descriptors- Macro and micro parasites, population structure, trophic relationships, multiple species interaction, Adaptations for transmission: parasitic reproduction, behavioral adaptations, Epidemiology: Macro-epidemiology, Micro-epidemiology.

2. Mathematical models: Host-switching or host capture, phylo-geography, apomorphic, ingroup and outgroup. Synapomorphies, monophyletic, paraphyletic, polyphyletic, cladogram, parasitism and sexual selection, evolution and virulence.

**UNIT III: Immunology and pathology**

1.Susceptibility and resistance, Innate defense mechanisms, cell signaling, cytokines and cytokine receptors, antimicrobial molecules and pattern recognition receptors (PRR), pathogen associated molecular pattern (PAMPs), complement, alternative pathways, classical pathways, Toll-like receptors, Glycosylphosphatidylinositol, other chemical defenses – interferons, tumor necrosis factors, cellular defense phagocytosis-phagocytes.

2.Adaptive immune receptors: Self and non-self-recognition in adaptive responses, antibodies, functions of antibody in host-defense, lymphocytes. Generation of humoral response, cell mediated response; inflammation.

**Unit IV: Habitat and Environment**

Habitat and environment of different parasites. Host parasite system, Host reaction to parasites, pathogenicity of Endo and Ectoparasites. General control of ecto and endoparasites, chemical, biological, physical, mechanical, cultural and legislative.

Economic importance of parasites, direct or indirect effect on human, animal, farm animals and Agriculture, poultry and fisheries pathogenicity. Major taxa of parasites of Medical and veterinary importance

Factors influencing parasitism; influence of season, host age and other phonological factor on parasitic population (prevalence and intensity)

**Unit V: Biochemistry and Molecular biology**

Energy metabolism, Energy stores, regulation of energy, energy metabolism in parasitic protozoa, lipid metabolism, metabolism of nitrogenous compound, Amino acid metabolism.

Gene expression, - telomeric gene expression, Discontinuous transcription of mRNA Editing in kinetoplastids flagellates, Transfection success in kinetoplastid flagellates. Homologous gene recombination, Genetic exchange in malaria parasites and trypanosomes, chromosome and gene mapping.

**References:**


1. Infectious Disease Epidemiology: theory and practice. 2nd edition. Nelson & Williams (Eds.). 2007.
2. A good additional online text: Global Burden of Disease and Risk Factors. Disease Control Priorities Project. It is available at: http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=gbd.TOC&depth=2
3. Medical Parasitology by Markell, Voge and John, 8th ed. W.B. Saunders Co.
4. Reingold, A.L. Outbreak Investigations – A Perspective. Emerging Infectious Diseases 1998; 4(1): 21-27.
5. Modern Parasitology Ed FEG Cox, Blackwell Science
6. Foundations of parasitological (2009): GD Schmidt and LS Roberts. McGraw Hill Higher Education.
7. Jones, K.E., Patel, N.G., Levy, M.A., Storeygard, A., Balk, D., Gittleman, J.L. and P. Daszak. Global trends in emerging infectious diseases. Nature 2008; 451(21): 990-993.

## Paper No. ZOO/DSE/628 - ANIMAL PHYSIOLOGY -I (INVERTEBRATE PHYSIOLOGY)

Contact Hours: 45 Credits- 3

**Learning Objectives:**

- To understand the basic physiological processes in invertebrates and their use in medical, non-medical and veterinary sciences.

**Learning Outcomes:**

By the end of the course students will be able to:

- Explain osmoregulation and hormonal regulation in various invertebrates.
- Describe physiological processes like digestion, respiration, excretion and reproduction in invertebrates.

**Part A: Physiology of Arthropods**

**Unit I: Crustacea**

1. Osmotic and ionic regulation, mechanism of regulation, hormonal control of osmoregulation.
2. Structure and functions of heart: Significance of pericardial organs in heartbeat, blood Sugars in crustacean and its hormonal control.
3. Types of reproduction, genetic sex determination, sex reversals, factors affecting reproduction, hormonal control of reproduction

**Unit II: Insecta I**

1. Nutrition and choice of food, functional morphology of alimentary canal and associated glands, role of digestive enzymes.
2. Functional morphology of respiratory organs in insects, physiology and factors affecting respiration.
3. Structure and functions of photoreceptors, mechano-receptors and chemoreceptors, mechanism of reception.
4. Gametogenesis and factors affecting reproduction, hormonal control of reproduction.
5. Types of metamorphosis in insects and hormonal regulation of metamorphosis.

**Part B: physiology of non-arthropods**

**Unit III: Annelida**

1. Digestive system, transport of food through alimentary canal, regulation of digestion.
2. Types of reproduction, sexual development and maturation, factors affecting reproduction.
3. Growth and regeneration in polychaeta and its hormonal regulation.

**Unit IV: Mollusca**

1. Osmotic equilibrium, osmotic and ionic regulation in freshwater and Marine forms.
2. Respiratory organs, structural properties and functions of respiratory pigments.
3. Nitrogenous end products, urine formation and excretion.
4. Reproduction pattern (Gonochorium, Hermaphroditism, self-fertilization, parthenogenesis).
5. Factors influencing reproduction, formation control of reproduction, sex reversal.

**Unit V: Echinodermata**

1. Coelomic fluids and coelomocytes.
2. Respiratory organs, role of Perivisceral coelomic fluid in respiration, factors affecting respiration.
3. Types of reproduction, breeding behavior, factors influencing reproduction, regeneration in echinoderms.

**Reference Books:**


1. Comparative animal physiology by Prosser C.L.
2. General and comparative physiology by - Florey W.A.
3. General and comparative physiology by Hoar W.B.
4. Animal physiology by Neilsen K.S.
5. Cell Biology by Ambrose and Fastly.
6. Principle of animal physiology by Wilson J.A.
7. Neural and integrative physiology by Prosser C.L.
8. Animal physiology by Gordon G.S.
9. Modern physiology by Strang F.L.

## Paper No. ZOO/DSE/629 - MOLECULAR BIOLOGY -I

Contact Hours: 45 Credits- 3

**Learning Objectives:**

- To impart knowledge in evolving biological science at a molecular level.
- To impart an understanding of the fundamental process governing life and information flow.
- To inculcate interest in research molecular biology and creating a human resource for this region.

**Learning Outcomes:**

By the end of the course students will be able to:

- Explain chemical components of nucleic acids, structure of DNA, structure and types of RNA.
- Have a proper understanding of prokaryotic replication.
- Understand DNA damage and various genetic disorders.

**UNIT I:**

**The Central dogma** - Flow of information in biological system; Historical perspective, composition of RNA and DNA. Bases, Chargaff's rule Relationship between genes and proteins; Structure of DNA - Watson & Crick model – different forms of DNA (A,B,Z) - nearest neighbor base frequency (anti parallel nature) analysis. RNA – structure and functions; mRNA, rRNA & tRNA – structures and functions. Variation in size and shape of genomes; ultracentrifugation and electron microscopic methods to study the shape and size of genomes and genetic capacity; C-value paradox, Organelle genomes.

**UNIT II:**

**Clusters and repeats:** tandem repeats, mini- micro- satellites and interspersed genome-wide repeats and their significance. Pseudo genes and transposable elements. Globin gene clusters, gene duplication and gene evolution, gene conversion and codon usage.

**Prokaryotic DNA Replication:** Replicon, single and multi-copy replicons, linear and circular replicons, unidirectional and bidirectional replication, experimental methods, mapping origin of replication,

semi-conservative (Meselson and Stahl's experiment) and semi-discontinuous replication; experimental demonstrations.

Topological problems in DNA replication; topoisomerases, helicase and gyrase. Mechanism and classification of topoisomerases, assay of topoisomerases.

Priming DNA synthesis in bacteria; experimental evidence, components of primosome. Initiation at origin (oriC) of *E. Coli.* Creation of replication forks. Regulation of initiation at origins, sequestration of origins after replication, role of helicase, assay of helicase.

**UNIT III:**

**Enzymology of DNA replication;**

DNA polymerases, chemistry of nucleotide polymerization and in vitro assay.

Properties and functions of DNA polymerase-I, Kornberg enzyme. Subunit composition of polymerase –III holoenzyme, identification of functions of individual subunits by complementation and mutational studies.

mechanism of replication of *E. coli* DNA-trombone model, termination of replication. Hand-palm structure of DNA polymerases.

Processivity and fidelity of replication. Bacterial replication and its connection to cell cycle

**UNIT IV:**

**Transcription in prokaryotes**: The transcriptome, prokaryotic RNA polymerase; molecular composition, and

mechanism of transcription. Initiation of prokaryotic transcription; Structure of bacterial promoters. Effect of sigma factor on binding of RNA pol. to promoters. Structure and function of sigma factor, reuse of sigma factor (sigma cycle). Sigma movement relative to DNA: FRET assay. DNA melting at promoters, promoter clearance. Role of α-subunit in upstream element recognition.

Foot-printing of upstream elements with α-subunit. Elongation: Role of β-subunit in phosphodiester bond formation. Structure of elongation complex and core polymerase. Termination of transcription: Rho- dependent and independent, termination, RNA product under Rho dependent termination.

**UNIT V:**

**Translation-** Genetic code, feature of genetic code triplet codon, degeneracy, wobble hypothesis, variation in codon usage, structure of ribosome - A, P, E sites of ribosomes,

## Paper No. ZOO/DSE/630 – FISHERY SCIENCE -I

Contact Hours: 45 Credits- 3

**Learning Objectives:**

- To develop the scientific outlook and awareness in Inland water bodies and its great potential for fish and fish seed production.
- To familiarize the students with phylogeny of fish.
- Application of the fishery science for the biological productivity of inland waters.
- The commercial fish species exploitation by sharing ecological niches.

**Learning Outcomes:**

By the end of the course students will be able to:

- Identify the fish from both, marine and fresh water.
- Explain characters, classification and techniques related to fish.
- Develop knowledge about fisheries, conventional and non-conventional fishing methods.

**Unit I:**

General Characters and classification of fresh and marine water fish, Identification of larval stages of major carps, Identification of fish up to species level, General characters of bony and cartilaginous fish and phylogeny of fish.

**Unit II:**

Aquatic ecosystems, Fresh, brackish and marine water ecosystems, Productivity of ponds and its nutrient circulations, Identification of plankton, nekton and benthos, Role of plankton in fish culture.

**Unit III:**

Culture techniques of major carps, Breeding techniques, Induced breeding bundh breeding, breeding in happa, Types of fish culture-Cage culture, Pen culture, Monoculture, Polyculture, Types of hatcheries, hatching happa, Chinese hatchery, Maintenance and management of hatcheries. Hybridization

**Unit IV:**

Types of fish-ponds in fresh water fish culture, Layout and construction of ponds. Fertilization and management of various ponds. Fish diseases and their control measures. Setting up of home aquarium and maintenance of aquarium fish.

**Unit V:**

Major fisheries in India and fishing methods. Important Inland, cold water, Brackish, estuarine and marine fisheries of India. Conventional and non-conventional fishing methods.

translation in prokaryotes - activation of amino acids, initiation: shine dalgarno complex, initiation factors, effect of GTP hydrolysis by IF2. exchange of ribosomal subunits. Elongation: elongation factors, peptide bond formation, termination: release factors.

**Concept of gene:** Fine structure of gene, Beadle and Tatum's One gene one enzyme concept, One gene one polypeptide concept, Complementation test, Intragenic complementation, Cistron, Recon and Muton, Split gene, Jumping gene, Overlapping gene & multiple genes. Operon concept- lac operon, Arabinose and tryptophan operon.

**Reference Books:**


1. Molecular Biology of gene, 5th edition (2004), James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick, Publisher – Pearson Education, Inc. and Dorling Kindersley Publishing Inc.
2. Molecular Biology, 4th edition (2007), Weaver R., Publisher – McGrew Hill Science.
3. Molecular Biology of Cell, 4th Edition (2004), Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts and James D. Publisher: Garland Publishing.
4. Essential Cell Biology, 2nd edition (2003), Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, Publisher: Garland Publishing.
5. Fundamentals of Molecular Biology, (2009), Pal J.K. and Saroj Ghaskadbi, Publisher: Oxford University Press.
6. Genes X, (2010), Benjamin Lewin, Publishers – Jones and Barlett Inc.

**Practical Paper No. ZOO/DSC/631 – (Practical based on ZOO/DSC/627)**
**Applied Parasitology -I**

1. Study of different types of animal associations with suitable examples.
2. Study of different types of parasites, vectors etc.
3. Study of different/important ecto/endoparasites of poultry, fish, animal and human.
4. Study of hemoflagellates from vertebrate blood.
5. Preparation of blood smear, staining and identification of Haemosporina.
6. Study of different mosquito vectors of protozoan parasites.
7. Submission of permanent slides at the time of examination.

**Practical Paper No. ZOO/DSC/632 – (Practical based on ZOO/DSC/628)**
**Animal Physiology -I**

1. Effect of salinity on blood chloride content of crab.
2. Effect of temperature on Heartbeat. $Q_{10}$ measurements in bivalve/crabs.
3. Estimation of glycogen from hepatopancreas and gonads of bivalve/crabs.
4. Estimation of protein from hepatopancreas and gonads of bivalve/crabs.
5. Estimation of lipid from hepatopancreas and gonads of bivalve/crabs.
6. Estimation of cholesterol from hepatopancreas and gonads of bivalve/crabs.
7. Oxygen consumption in relation to sex and size/temperature of bivalve/leech/crabs.
8. Acid phosphatase activity in hepatopancreas of crab/bivalve.
9. Alkaline phosphatase activity in hepatopancreas of crab/bivalve.
10. Estimation of ascorbic acid from hepatopancreas and gonad of crab/bivalve.
11. Chromatophores in crustaceans and effect of background on color change.

**Practical Paper No. ZOO/DSC/633 – (Practical based on ZOO/DSC/629)**
**Molecular Biology -I**

1. Extraction of genomic DNA from bacterial DNA
2. Determination of Molecular size of DNA.
3. Restriction digestion of DNA.
4. Determination of molecular weight of different DNA fragments by running a standard marker on agarose gel electrophoresis.
5. To isolate and clearing of the DNA fragment of interest from the agarose gel.
6. To perform transformation of DNA into bacterial cells.
7. To isolate DNA of bacteriophage lambda
8. To separate immunological proteins (alpha, beta and gamma) from serum by Sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE).
9. To prepare master plate and carry out its replica plating.
10. Extraction of RNA from *E coli.*

**Practical Paper No. ZOO/DSC/634 – (Practical based on ZOO/DSC/630)**
**Fishery Science -I**

1. Identification of fish up to species level with suitable examples from each class.
2. Analysis of water: Turbidity, pH, dissolved oxygen, carbon dioxide, alkalinity, chlorinity.
3. Identification of plankton, nekton and benthos.
4. Fishing crafts and gears, hatching happa.
5. Identification fish parasites.
6. Identification of fish food (at least twenty)
7. Visit to fish breeding center.

# FOURTH SEMESTER

## Paper No. ZOO/DSC/650 - EVOLUTION AND BEHAVIOR

Contact Hours: 45 Credits- 3

**Learning Objectives:**

- To study the origin of various animal groups.
- To study the mechanism involved in evolution.
- To study the significance and pattern of evolution.
- To study the behavioral mechanisms.

**Learning Outcomes:**

By the end of the course students will be able to:

- Explain various theories of evolution.
- Describe the origin of biomolecules and their metabolism.
- State the evolutionary time scale and evolution of organisms.

**Unit I**

1. Geological time scale. Concept of evolution and theories of organic evolution.
2. Lamarckism, Darwinism, Neo-Darwinism and Modern Synthetic Theory. New concepts regarding Lamarckism and Darwinism.
3. Evolutionary forces (i) Natural selection (ii) Mutation (iii) isolation and its role in species formation (iv) genetic drift (v) Migration (vi) Meiotic drive, Hardy-Weinberg law of genetic equilibrium

**Unit II**

1. Molecular population genetics, patterns of change in nucleotides and amino acid sequences, Ecological significance of molecular variations, Emergence of Non-Darwinism hypothesis.
2. Genetic of quantitative traits in population, Genotype-environment interaction, inbreeding depression and heterosis, Molecular analysis of quantitative traits, phenotypic plasticity.
3. Genetics and speciation, biological concept of species, evolutionary species concept, phylogenetic species concept,
4. Speciation: patterns and mechanism of reproductive isolation, models of speciation (Allopatric, Sympatric, Parapatric).

**Unit III**

1. Molecular evolution: Genetic evolution, Evolution of gene families, Molecular drive, Assessment of molecular variation, origin of higher categories: Micro and macroevolution, Trends in Human evolution.
2. Characteristics of evolution, Extinction, replacement, irreversibility of specialization, etc.
3. Adaptive diversity and nature of adaptation; Adaptive radiations and recent views, occupation of new environment and niche, mimicry and coloration.

**Unit IV**

1. Introduction to animal behavior, definition, concept of ethology, scope and limitations. Orientation, classification of various types of taxis and kinesis.
2. Social behavior in primates (a) Primate societies (b) Social sounds, olfactory, tactile, visual, vocal and acoustic (c) Status: Dominance and hierarchy, territorial behavior, courtship and mating, aggregation

**Unit V**

1. Reproductive behavior in fish (Stickle back or any other fish).
2. Behavior in insects: courtship behavior in Drosophila, Social behavior, Communications, Concealment behavior, Pheromones in behavior.
3. Human behavior: Learning, Habituation, conditioned reflex: Trial and error; Latent learning, learning and discrimination, imprinting, neural mechanism of learning, Molecular mechanism of memory, Altruism.
4. Instinctive behavior: concept, Phyletic decent, and physiology
5. Methods of studying behavior: Brain lesions, electrical stimulation, drug administration.

**Reference Books:**


1. Varma and Agrawal - Genetics and Evolution
2. Dobzhansky, Genetics and Origin of Species. 3rd Ed. Columbia Univ. Press.
3. Dobzhansky, Th., F.J. Ayala, G.L. Stebbins and J.M. Valentine.
4. Futuyama, D.J. Evolution. Surjeet Publication, Delhi.
5. Jha, A.P. Genes and Evolution. John Wiley Publication, New Delhi.
6. Savage J.M Evolution. Amerind Publishing Co. New Delhi.
7. Varma and Agrawal – Evolution
8. Animal behavior and Evolutionary Approach by Alcock
9. Perspectives in animal behavior Goodenough, Wiley 1993
10. An introduction to animal behavior 5$^{th}$ed. Cambridge Univ Press. By Manning

## Paper No. ZOO/DSC/651 - GENERAL AND COMPARATIVE PHYSIOLOGY

Contact Hours: 45 Credits- 3

**Learning Objectives:**

- To study the physiological processes in detail for medical, non-medical and veterinary science purposes.
- To gain knowledge about various biological systems.

**Learning Outcomes:**

By the end of the course students will be able to:

- Explain various biological systems and their regulation in detail.
- Describe the origin of biomolecules and their metabolism.

**Unit I: Energy sources and their Distribution:**

1. Anaerobic stages in Terrestrial evolution, Origin of aerobic world (Photosynthesis) and animal and its environment.
2. Regulatory mechanisms: Factors at enzyme activity, at organ system level, Autonomic nervous system, endocrine system, coordinated regulations
3. Nutrition: Nutritive requirement, collection of food, Digestion, Absorption, Correlation of digestive activities, energy balance, BMR.

**Unit II: Exchange of gases, cardiovascular system and excretory system**

1. Integumentary, Bronchial respiration, Aquatic to aerial breathing (Lungs, Trachea and Respiratory mechanisms).
2. Transporting of oxygen, $Co_2$, Regulation of fluid volume, Phagocytosis, the reticulo-endothelial system, coagulation of blood, energy-producing reactions and energy utilizing reactions, Comparative physiology of excretion, kidney, nitrogenous waste in mammals, and in animals, formation of urine, urine concentration, waste elimination, regulation of water balance, electrolyte balance and acid base balance.
3. Competitive anatomy of heart structure, myogenic heart, specialized tissue, neural and chemical regulation of all above.

**Unit III: Environmental reactions:**

1. Temperature and rates of biological activities, Temperature compensation in poikilotherms and homeotherms.
2. Water and electrolyte problems of terrestrial living, Regulatory mechanisms, Oxygen as limiting factor in the environment, effect of environment on oxygen demand, effect of hydrostatic pressure, buoyancy and biological clocks.
3. Comfort zone, Body temperature – Physical, chemical, neural, acclimatization and Acclimation.

**Unit IV: Various interactions and Animal activities:**

1. Molecular basis of cellular irritability and pain, Chemoreception, Mechanoreception, Temperature receptors, Mechanism producing movement, amoeboid movement, electric organ, Luminescent organs, Pigment cells, Interneural transmission, Integrative systems of neurons, Physiology of behavior.
2. Neurons, Gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscles, bone and posture.

**Unit V: Reproduction and Development:**

Reproductive mechanisms, Invertebrate hormones of reproduction, Vertebrate control, regeneration, metamorphosis, Stolonization andepitoky in polychaete worms, Arthropod growth and metamorphosis, Growth, molting and metamorphosis in the vertebrates.

**Reference Books:**


1. Comparative Animal Physiology by Prosser C.L.
2. General and Comparative Physiology by Floren W.A.
3. General and Comparative Physiology by Hoar W. B.
4. Animal Physiology by Neilsen K.S.
5. Principles of Animal Physiology by Wilson J.A.
6. Animal Physiology by Gordon G.L.
7. Modern Physiology by Strang F.L.
8. Animal Physiology by Mohan and Arora

## Paper No. ZOO/DSC/652 – APPLIED BIOTECHNOLOGY -II

Contact Hours: 45 Credits- 3

**Learning Objectives:**

- To create interest in Biotechnology.
- To familiarize the students with different diagnostic techniques with applications.
- To develop critical thinking about immerging techniques of biology, including nano-biotechnology and marine biotechnology.

**Learning Outcomes:**

By the end of the course students will be able to:

- Explain biofuels, biotransformation of reclaimant metabolites and green technologies.
- Describe principles and applications of DNA finger printing, Human genome project etc.
- Understand stem cells, policies, storage and applications.

**Unit I: Biotechnology in environment: Generation of plant origin alternative fuels**

1.First-generation biofuels: Bio-alcohol (Corn, Sugarcane), Syngas, Biodiesel, Biogas; Second-generation biofuels: Cellulose biofuels, biohydrogen, bioethanol; Third-generation biofuels: Algae fuel.

2.Biotransformation of reclaimant Metabolite (with examples), the ecological impact of microbes, green technology; Definition, concept and implication, the role of green technologies towards sustainable development.

**Unit II: Biotechnology in Human Welfare**

Application to forensic science: Principle of DNA fingerprinting, application of DNA profiling in forensic medicine for solving crimes and paternity disputes. Genetically modified crops and food; Health concerns, Human genome project: Its implication in health and diseases. GUaRDIAN; Genomics for precision medicine in India.

**NGS Strategies for Family based Genetic analysis** –Family based Genome Wide Association Studies (GWAS), advantages and disadvantages. Target specific sequencing- Panel gene sequencing; Whole Exome Sequencing (WES), Whole Genome Sequencing; Linkage analyses in Era of NGS.

**Unit III: Bioinformatics Pipelines for Variants:**

General variants calling workflow using WS and WGS data, Specialized Pipelines for family Based Variants analysis: Genetic resources for variant analysis, classification of Genetic variants. Cloud based bioinformatics services for Analysis of Genomic Data , Selecting an NGS and Bioinformatics Strategies; Common sequencing errors a with NGS Analysis, Analytical, Ethical and regulating challenges in analysis of NGS.

associated factors (TAFs). Phosphorylation of CTD of RNA pol-II, Mediator complex and RNA polymerase.

**UNIT IV:**

Transcription in eukaryotes: Separation of nuclear RNA polymerases- rat liver RNA pol. Roles of the RNA polymerases. Sensitivity to α-amanitin. Subunits of RNA pol-II (yeast pol-II). Heterogeneity of Rpb1 subunit. Formation and maintenance of transcription bubble. Elongation factors: Effect of TFIIS, reversal of transcription arrest, proof reading of transcripts. Composition and working of transcription units at class-I and class-III promoters.

**UNIT V:**

Eukaryotic translation: Eukaryotic translation initiation-scanning model, eukaryotic initiation factors, role of eIF4E, F, and G. Formation of stable 48S initiation complex, role of eIF1 and eIF1A, toeprint assay, direction of polypeptide synthesis and mRNA translation. Control of translation in bacteria and eukaryotes. Amino acyl-tRNA synthetases, formation of ternary complex among amino- acyl tRNA, EF-T, and GTP, three site model of ribosome, peptide bond formation, G- protein and translation, stop codon suppression, release factors, aberrant termination, non-stop mRNAs, termination of transcription, termination codon, no-go-decay of mRNA. Inhibitors of prokaryotic and eukaryotic translation. Post-translational modifications of proteins. Mechanism of translational control.

**References**

1. Cooper G. M. 1996. The Cell A Molecular Approach, Sinauer Associates, Inc.,
2. Molecular Biology of the Cell. B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Garland Publishing, New York and London.
3. Harvy F. Lodish (Editor) Arnold Berk, Paul Matsudaira, Chris A. Kaiser, Monty Krieger,Matthew P. Scott, S. Lawrence Zipursky, James Darnell: Authors. Molecular Cell Biology. W. H. Freeman and Co., Publishers
4. Alberts, B., Bray, D., Lewis, J., Raff, M, Roberts, K, and Watson, J. D. Molecular biology of cell. Garland Publishing Inc., New York.
5. Freifelder D. Molecular Biology. A Comprehensive Introduction to Prokaryotes and Eukaryotes. Jones and Bartlett, USA.

6. Watson, J. D., T. A. Baker, S. P. Bell, A. Gann, M. Levine, R. Losick. 2004. Molecular Biology of the Gene. 5th Edition. Pearson Education Pte. Ltd., New Delhi, India.

7. Voet D, Voet JG. Biochemistry. Ed. John Wiley & Sons. New York.

8. Benjamin Lewin. Gene VIII

9. E.D. and P.D. DeRobertis Cell and Molecular Biology

**Practical Paper No. ZOO/DSC/653 – (Practical based on ZOO/DSC/650)**
**Evolution and Behavior**

1. Practical based on Hardy-Weinberg law.
2. Lederberg experiment.
3. Courtship behavior in *Drosophila*.
4. Wing beat and song produced.
5. Duration intervals of courtship songs (wing buzzing).
6. Reading behavior of praying Mantis.
7. Schooling behavior of fish.
8. Field visit to an animal husbandry centre.
9. Visit to NCCS, NCL, NIV, NARI Pune.

**Practical Paper No. ZOO/DSC/654 – (Practical based on ZOO/DSC/651)**
**General and Comparative Physiology**

1. Qualitative survey of digestive enzymes in any vertebrate.
2. Estimation of salivary amylase activity.
3. Determination of abnormal and normal constituents of urine.
4. Estimation of chloride from haemolymph/ urine of cow.
5. Estimation of uric acid from serum.
6. Total count of R.B.C from human blood.
7. Differential count of W.B.C from human blood.
8. Estimation of Haemoglobin and carrying capacity of blood.
9. Measurement of blood pressure.
10. Hematin crystal formation.
11. Effect of temperature on the heart beat and Q10 measurement.
12. Effect of temperature on the rate of oxygen consumption
13. Measurement of respiratory quotients.

**Practical Paper No. ZOO/DSC/655 – (Practical based on ZOO/DSC/652)**
**Applied Biotechnology -II**

1. Use of biological database from Expasy and NCBI.
2. Retrieval of Nucleotide sequence from GenBank.
3. Retrieval of Protein sequence from GenBank.
4. Sequence similarity search by using BLASTN.
5. Sequence similarity search by using BLASTP.
6. Accessing structural database and download the protein structure.
7. Multiple Sequence Alignment.
8. Protein modelling based on DNA sequencing database/RNA sequencing database.
9. Protein modelling based on Amino acid sequencing database.

12. Nandini Shetty- Immunology. Introductory Textbook.
13. Karunasagar, I. -Aquaculture and Biotechnology. Oxford-IBH Publishers, New Delhi,
14. Govindan, T.K. -Fish Processing Technology, Oxford-IBH, 1985.
15. Shang, Y.C. -Aquaculture Economic Analysis – An Introduction. 1990.
16. Nikolsky, G.V. -Ecology of Fishes. Academic Press, NY, 1963.
17. Hoar, W.S. & D.J. Randal- Fish Physiology, Vols. 1–4, Academic Press, NY,1970.
18. Carl, B.E. Biology of Fishes- Saunders, 1979.
19. Turnor- Textbook of endocrinology
20. Day, F. -The fishes of India.

**Unit IV: Systems, synthetic biology and stem cell technology in biotechnology.**

Introduction to system biology; principles of system biology, modeling in systems biology, applications of system biology in biotechnology, Introduction to synthetic biology, principle and applications and scope of synthetic biology for the production of bioactive metabolite.

Introduction, what is a stem cell, types, Therapeutic applications of stem cells in human degenerative diseases (Examples). Stem cell policies and ethics, cord blood banking, and long-term storage of stem cells.

**Unit V: Pharmaceutical biotechnology**

Introduction, Use of Microbes in pharmaceutical industries, Microbial Drug Discovery, Screening at molecular level, Construction and design strategies. Rational drug discovery, Preclinical and clinical trials, Estimation of toxicity; LD 50 and ED 50.

**References:**


1. Satyanarayana,U (2010): Biotechnology , Books and Allied (P ) ltd, Kolkata
2. Rastogi, Sc (2009): Biotechnology, Principle and Applications, Narosa Publishing House, Mumbai.
3. Patnaik, B.K, Kara, TC, Gosh, SN, Dalai, AK (2012) Text book of Biotechnology. Tata McGraw Hill Education Private Limited.
4. Chanarayappa (2006): Molecular Biotechnology, Principles and Practices, University Press Pvt limited. Hyderabad
5. Frontier in Genetics –Reviews

**Elective Courses**

## Paper No. ZOO/DSE/656 - APPLIED PARASITOLOGY -II

Contact Hours: 45 Credits- 3

**Learning Objectives:**

- To know basic and general concepts of parasitology.
- To understand major types of parasites of medical and veterinary importance.
- To design and evaluate an intervention to control food and waterborne diseases.
- To prepare the experts in the field of medical and veterinary parasitology.

**Learning Outcomes:**

By the end of the course students will be able to:

- Explain parasite and its relation to global public health.
- Describe about parasites, host and their relationship.
- Have knowledge about various types of parasites and their life cycles.

**Unit I: Parasites and Health**

Parasite and Global Public Health, Global burden of infectious diseases, Biology, epidemiology and control of waterborne and foodborne parasites, Ecological changes and emerging diseases. General pattern of parasitic transmission,Parasitic zoonosis, Bioterrorism threats.

**Unit II: Clinical and pathological signs of parasite infection.**

1. Parasitic diseases of:
   a) Alimentary canal: GI tract, liver, abdominal cavity, protozoal entities, coccidiosis, Trematode infection, strongyloidiasis, Tricho-strongyloidiasis, Oxyurid infection.
   b) Urinary system: *Klossiella equi*, *Dioctophymerenale.*
2. Nervous system: Coenurosis, *Parastrongylus cantonensis*, *Stephanurus dentatus*.
3. In human: Giardiasis, Toxoplasmosis, Leishmaniasis, Trypanosomiasis, Malaria, Taeniasis, Echinococcosis, Fascioliasis, Trichuriasis, Hook worm diseases, Tick mites.

**Unit III: Strategies in the fight against parasites**

1.Approaches to control of parasitic diseases: Analysis of biological systems, Targets for intervention, Approaches, measures against parasitic diseases, water supplies, excreta disposals, Agricultural hygiene, personal hygiene, housing environmental management, control of vectors and intermediate hosts, trichinosis, treatment, immunization.

2.Strategies-planning and control: Malaria, Human Schistosomiasis, Guinea worm disease.

**Paper No. ZOO/DSE/657 – ANIMAL PHYSIOLOGY-II (VERTEBRATE PHYSIOLOGY)**

Contact Hours: 45 Credits- 3

**Learning Objectives:**

- To understand the basic mechanisms involved in physiological processes of vertebrates studied in animal, veterinary and medical sciences.

**Learning Outcomes:**

By the end of the course students will be able to:

- Explain cell transport, its types, cell growth and cell regulation.
- Describe hormonal mechanism and reproductive physiology.
- Knowledge about respiratory, nervous and excretory physiology.

**Unit I:**

1. Colloidal properties of cell; the cell as a polyphasic colloidal system.
2. Active transport, principles and mechanisms involved in transport: a) endocytosis - Pinocytosis, Phagocytosis, Phagotrophy, Autophagy b) exocytosis

**Unit II:**

1. Cell growth: Measurement of cell growth and regulation of growth; cell growth in tumors.
2. Bioluminescent organs in different vertebrates, physical properties of bioluminescence; chemistry of light production and functional significance of bioluminescence.

**Unit III:**

1. Structure of myofibrils; protein molecules in myofibrils; mechanism of muscle contraction, force and shortening velocity, role of calcium in cross Bridge attachment.
2. Nerve cell and their classification; how resting potential is maintained; origin and development of action potential; synapses and theories of synaptic transmission.

**Unit IV:**

1. Osmotic balance and ionic regulation in different vertebrates, role of hormones in osmoregulation.
2. Nitrogenous excretory products: Their detoxification, formation of ammonia, ornithine cycle, ammonia toxicity and detoxification, role of aldosterone, ADH hormone and renin-angiotensin system in Renal physiology.
3. Physiology of respiration: Structure of organs of respiration in air and water.
4. Respiratory pigments and Chemistry of oxygen transport. Factors affecting respiration, role of thyroid hormones in basal metabolic rate.

**Unit IV: Host finding: A Physiological effect and Role of Parasites and Hormones**

1. Miracidia of Trematodes: Dispersal, micro-habitat selection, Host-directed orientation, Attachment remaining on the host and penetration.
2. Cercaria of trematodes: Dispersal, micro-habitat selection, host-stimulated approach to the host, (Chemicals, water turbulence and). Attachment remaining in host, penetration into the host.
3. Parasitic Hormones – Ecdysteroids, Juvenile Hormones, Peptide hormones, Influence of parasites on the hosts endocrine systems. Importance of host hormone for parasites. Nematodes, Mosquitoes (Host seeking mechanism), Tse-tse flies, Ticks.

**Unit V:**

Parasitism in phylum apicomplexa.Coccodian parasites in vertebrates, *Theleria* and *Bibesia* of class Piroplasma. Parasitic Acanthocephala and Annelida (Any one example each), Parasitic Siphonoptera, Anupleura, Mallophaga,Dipteran, Diptera, Hemiptera and Pentatomidae.

**Reference Books:**


1. Infectious Disease Epidemiology: theory and practice. 2nd edition. Nelson & Williams (Eds.). 2007.
2. A good additional online text: Global Burden of Disease and Risk Factors. Disease Control PrioritiesProject. It is available at:http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=gbd.TOC&depth=2
3. Medical Parasitology by Markell, Voge and John, 8th ed. W.B. Saunders Co.
4. Reingold, A.L. Outbreak Investigations: A Perspective. Emerging Infectious Diseases 1998; 4(1): 21-27Jones, K.E., Patel, N.G., Levy, M.A., Storeygard, A., Balk, D., Gittleman, J.L. and P. Daszak. Globaltrends in emerging infectious diseases. Nature 2008; 451(21): 990-993.
5. Applied parasitology - Hiware, Jadhav and Mohekar
6. Helminth, Arthropod and Protozoa of domesticated animal -Solbsy E.J.W
7. Chatterjee K. D. (1969) -Parasitology (Protozoology and Helminthology)
8. Text book Medical Parasitology of Jaypee Brothers, - Panikar C.K.J (1988) Medical Publishers, New York.
9. Bio- Chemistry and physiology of protozoa -Hutner and Lwoff II Ed. Vols I and II
10. Prozoan Parasites of domestic animals and man – Levine

## Paper No. ZOO/DSE/658 – MOLECULAR BIOLOGY -II

Contact Hours: 45 Credits- 3

**Learning Objectives:**

- To impart knowledge in evolving biological science at molecular level.
- To impart understanding of the fundamental process governing life and information flow.
- To inculcate interest in research molecular biology and creating human resource for this region.

**Learning Outcomes:**

By the end of the course students will be able to:

- Explain gene, heredity and DNA, RNA as a genetic material.
- Describe about DNA damage and types of repairs.
- Have knowledge about genomic organization, cot and rot values, gene families etc.

**UNIT I:**

Extra chromosomal replication: Replication of phage DNA φX174, T7, SV-40, rolling circle model of replication. Linear DNA-ends, terminal proteins, replication of plasmid DNA. Replication of RNA viruses and variations in them.

Structure and mechanism of reverse transcriptase and integrase (HIV), replication of tumor virus (RSV).

**UNIT II:**

Eukaryotic DNA replication: Replicative and repair enzymes of eukaryotes. Initiation, elongation by eukaryotic DNA polymerases. Isolation of ARS of yeast, ORC, Licensing factors and control of eukaryotic DNA replication, role of MCM proteins. Replication of organelle genomes, maintenance of ends of linear DNAs; telomeric DNA and telomerase. Regulation of eukaryotic DNA replication and inhibitors of DNA replication.

**UNIT III:**

Eukaryotic promoters: Class-II core promoter, modular organization, SV40 early promoter. Linker-scanning mutagenesis, TATA Box, downstream promoter elements, proximal promoter elements, TATA-less promoters and initiators. Class-I and Class-III promoters, Enhancers and silencers.

Class-II pre-initiation complex, foot-printing DAB. Structure and function of TFIID, TBP and

**Unit V:**

1. Sex determination and differentiation, differentiation of gonads in mammals.
2. Leydig cells, morphology, differentiation and its regulation.
3. Spermatogenesis, composition and formation of semen.
4. Ovarian follicular growth and differentiation, oogenesis, vitellogenesis, ovulation and ovum transport in mammals.
5. Hormonal mechanisms of implantation, pregnancy, parturition and lactation in mammals.

**Reference Books:**


1. EckertN Animal Physiology by David Randall.
2. Comparative animal physiology by Prosser C.L.
3. General and comparative physiology by - Florey W.A.
4. General and comparative physiology by Hoar W.B.
5. Animal physiology by Neilsen K.S.
6. Cell physiology by Giese A.C.
7. General physiology by Giese A.C.
8. A textbook of Biochemistry by West E.S. and Told W.R.
9. Cell Biology by Ambrose and Fastly.
10. Principle of animal physiology by Wilson J.A.
11. Animal physiology by Gordon G.S.
12. Modern physiology by Strang F.L.
13. Comparative physiology of animals by Hill R.W.
14. Medical physiology Guyton.
15. General endocrinology C.D. Turner
16. Endocrinology, Hadley, M.E. Pearson education (Singapore).

## Paper No. ZOO/DSE/659 – FISHERY SCIENCE -II

Contact Hours: 45 Credits- 3

**Learning Objectives:**

- To provide knowledge to the students about the recent trends and techniques of fishery.
- To impart knowledge about various physiological processes of fish.
- To inculcate knowledge about adaptations, migration, feeding etc. in fish.

**Learning Outcomes:**

By the end of the course students will be able to:

- Explain physiological processes including respiration, reproduction, digestion etc.
- Describe coloration, feeding habits, migration and bioluminescence.
- Develop knowledge about structure and functioning of endocrine glands of fish.
- Explain the hormonal control and mechanisms in physiological processes.

**Unit I:**

1. Digestive system and physiology of digestion, structure of heart, blood vascular and peripheral circulatory system.
2. Structure of kidney, ionic balance and osmoregulation and physiology of excretion in fish.
3. Reproductive system and physiology of reproduction, embryological development in fish.
4. Respiratory organs, physiology of respiration, swim bladder and Weberian ossicle.
5. Central nervous system (CNS) and cranial system, structure of eye and image formation in fish.

**Unit II:**

1. Coloration in fish, physiology of collaboration.
2. Types of migration, hill stream and deep-sea adaptations.
3. Bioluminescence and physiology of light production in fish.
4. Venom and Venomous gland, electric organ in fish.

**Unit III:**

1. Food and feeding habits, age and growth study, factors affecting growth.
2. Types of scales, fins, girdles in fish.
3. Lateral line system and its role in fish life, sensory organ in fish, parental care in fish.

**Unit IV:**

1. Structure and function of endocrine glands.
2. Pituitary gland: Hormones of adenohypophysis and neurohypophysis, Stainable and non-stainable fibers.
3. Adrenal gland: Adrenocortico-steroids, corpuscles of stannius, adrenal medullary hormones, pituitary-adrenal axis.
4. Urohypophysis: Role of Urotensin I and II.
5. Thyroid gland: Thyroid hormone synthesis, thyro-trophic hormones and their functions.
6. Pancreas: Pancreatic hormones, structure and their role in glucose metabolism, homeostasis.

**Unit V:**

1. Hormones and control mechanism.
2. General classification of hormones, principal, nature and functions of hormones, hormone receptor.
3. Sex hormones, Types of sex steroids and their biosynthesis pathway.
4. Prolactin cells and its hormones, functions, role of prolactin in osmoregulation and melanogenesis.
5. Calcium regulation in fish.
6. Gonadotropin-releasing hormones (GnRh), role of gonadotropins, biochemical nature.
7. Hormonal control of reproductive behavior, role of sex hormones in sex differentiation.

**References Books:**


1. Prosser & Brown- Comparative Physiology
2. Pillay,T.V.R.& M.A. Dill.- Advances in Aquaculture. Fishing News (Books)Ltd., England, 1979.
3. Stickney, R.R. -Principles of Warm water Aquaculture. John Wiley & Sons Inc.,1979.
4. Boyd, C.E. -Water Quality Management for Pond Fish Culture. Elsevier Scientific Publishing Company, 1982.
5. Jhingran, V.G. -Fish and Fisheries of India. Hindustan Publishing Corporation India, 1982
6. Bardach, et. al. -Aquaculture – The Farming and Husbandry of Freshwater and Marine Organisms. John Wiley & Sons, NY, 1972.
7. Santhanam, R. et. al. -A Manual of Freshwater Aquaculture. Oxford & IBH Publishing Co. Pvt. Ltd., 1987.
8. Cheng, T.C. -The Biology of Animal Parasites. Saunders, Philadelphia, 1964.
9. Ribelin, W.E. & G. Miguki- The Pathology of Fishes. The Univ. of Wisconsin Press Ltd., Great Russel st., London, 1975.
10. Schauperclaus- Fish Diseases. Vol. I & II.
11. Douglas P Anderson - Text Book of Fish Immunology

**Practical Paper No. ZOO/DSC/662 – (Practical based on ZOO/DSC/658)**
**Molecular Biology -II**

1. Transformation of DNA in yeast /plant /animal
2. Gene expression by Gal-x.
3. Detection/ determination of Auxotroph mutant.
4. Chromatin digestion with micrococcal nuclease.
5. Isolation of DNA from animal / plant cells by using kits.
6. Restriction digestion of DNA using nucleases.
7. DNA amplification using PCR.
8. Molecular weight determination using column chromatography and PAGE.
9. Isolation of plasmids from bacteria.

**Practical Paper No. ZOO/DSC/663 – (Practical based on ZOO/DSC/659)**
**Fishery Science -II**

1. Quantitative determination of glycogen, proteins and fats.
2. Dissections (any Bony fish)- digestive, reproductive, brain, pituitary gland and cranial Nerves.
3. Methods of food analysis with different feeding habits.
4. Study of different maturity stages and fecundity in fish.
5. Determination of growth in fish by scale or otolith method.
6. Determination of GSI and PI.
7. Histological preparation: Different glands and tissues.
8. Visiting CIFE, CIFA, FSI and CIFT etc.
9. Field work: Visit to fish production unit.