

**Course Structure**  
**Class M. Sc. II ZOOLOGY**

M. Sc. II		Semester - III	
Sr. No.	Subject Title	Theory (TH)	
		No. Of Lecture	Credits
1	MZT301Paper- IX Genetics	04	04
2	MZT 302 Paper- X Enzymology	04	04
3	MZT 303 Cell Biology Elective paper-I Paper- XI Computational Molecular Biology	04	04
4	MZT 304Cell Biology Elective paper-II Paper- XII- Molecular Biology of Gene	04	04
5	MZT 305Paper XIII Animal Cells in Biotechnology	04	04
6	MZP 306	04	04
7	MZP 307	04	04
	Total Of	28	28

M. Sc. II		Semester - IV	
Sr. No.	Subject Title	Theory (TH)	
		No. Of Lecture	Credits
1	MZT 401Paper- XIV Toxicology and Immunology	04	04
2	MZT 402 Paper- XV Cell in Differentiation, Development and Specialization	04	04
3	MZT 405 Paper- XVI Cell Pathology	04	04
4	MZP 403	04	04
5	MZP 404	04	04
	Total Of	20	20

**Proposed Syllabus for M.Sc. II Zoology**  
**Submitted to**  
**Yashavantrao Chavan Institute of Science, Satara**  
**(Autonomous)**  
**Under**  
**Choice Based Credit System (CBCS)**  
**(June 2019-2020)**  
**M.Sc.-II Sem.-III**  
**MZT 301 Genetics**

**Learning objectives:**

- This will provide understanding of the inheritance and expression of various genes .
- An understanding of the clinical relevance of genetic concepts.
- To understand the chromosome structure, chromatin organization and variation
- To analyse strategies of gene transfers
- To learn the concepts of Linkage concept of sex determination and sexlinked inheritance
- This syllabus will provide the student with knowledge and understanding of the role and application of genetics with learning difficulties and the implications to other family members

**Unit- I Chromosomal variations**

1. Human Karyotypic analysis- normal and abnormal chromosomes, banding, nomenclature
2. Genetics basis of sex determination in human beings Y linked genes, X linked genes, Dosage compensation, and testicular feminization Syndrome.
3. Numerical abnormalities of human chromosomes and related syndrome Nondisjunction, Aneuploidy, Patau syndrome, Edward syndrome, Down syndrome, Turner syndrome and Klinefelter syndrome
4. Structural abnormalities of human chromosomes and related syndromes Robertsonian Translocation
5. Linkage groups, genetic maps, crossing over, genetic recombination.
6. Chromosome painting

**Unit- II- Population and Evolutionary Genetics**

1. Genetic variation in natural population, phenotypic variation
2. Hardy- Weinberg principle, Genetic drift, Genetic pool
3. Models of Speciation Measurement of Genetic variations
4. Use of Molecular techniques to study genetic evolution.
5. Human Behavioral genetics

### **Unit- III- Mutations**

1. Introduction to the mutation, mutation and environment, Spontaneous versus induced mutation.
2. Phenotypic effects of mutations.
3. Somatic and germinal mutation.
4. Pleiotropy,
5. Back mutation and suppressor mutation
6. Molecular basis of genetic mutation
7. Chemical induced mutation
8. Mutation and DNA repair mechanism
9. Mutation frequency
10. Practical application of genetic mutations
11. Mutagenicity and carcinogenicity.
12. Mutations and human welfare

### **Unit- IV- Basis of genetic counseling and developmental genetics**

1. Ethical and psychological approach of genetic counseling
2. Avoidance of risk factor with genetic diseases, Prenatal genetic counseling and diagnosis.
3. Family pedigree, Genetic inheritance and investigations
4. Developmental genetics –Developmental anomalies in case of human –Inborn errors of metabolism
5. Socio-economic importance of developmental genetics

### **Learning outcomes –**

1. Students will be able to define genetic terms and explain their clinical relevance
2. They will be able to Describe the inheritance and expression of human blood groups
3. The significance of a knowledge of genetics in medical field related to anomalies of inborn errors
4. They will know the importance of inheritance of genetic characters in any individual and will be able to interpret the factors responsible for that
5. They will understand the role of genetic counselor in life.
6. They will explore the changes in genes caused due to different types of mutations taking place in body due to environmental and evolutionary changes .

### **Reference Books:**

1. Genetics of population by Philip Hedrick (Unit I & IV)
2. Principles of Population Genetics By Hartl and Clark (Unit II)
3. Gene Clones by Ernst Winnacker (Unit I)
4. Fundamentals of genetics by B. D. Singh. (Unit I)

5. Principles of genetics 8<sup>th</sup> edition by Gardner, Simmons and Snustad. (Unit III)
6. Molecular Biology by David Clark (Unit I & IV)
7. Concepts of Genetics By Klug and Cummings (Unit I, II, III & IV)
8. Principles of Genetics By Tamarin (Unit I, II & III)
9. Genetics By Strickberger (Unit I & IV)
10. Facts of Genetics By Robert Edger (Unit I & IV)
11. Introduction to biochemical genetics By Mather and Jinks (Unit I & II)
12. Molecular Genetics By Gunther Stint (Unit I, II, III & IV)

**M.Sc.-Zoology**  
**Academic Flexibility, Credit System**  
**M.Sc.-II Sem.-III**

**MZT 302 - Enzymology**

**Learning objectives -**

- To provide knowledge of different enzymatic reactions occurring in the body which is beneficial.
- To classify the enzymes and investigate the structure and role of enzymes in body.
- To know the importance of various enzymes in fundamental life processes and its kinetics.
- To deal with current applications and future potential of **enzymes** process.

**Unit- I: Classification and Nomenclature of Enzymes, Isoenzymes, Multienzyme Complexes.**

1 Cofactors.

2 Inorganic.

3 Organic: PyridoxylPhosphate, Biotin, Lipoic acid, Thiamindiphosphate, Flavin nucleotides, Nicotinamide.

**Unit- II: Extraction and Purification of Enzymes.**

1. The extraction of soluble enzymes.

2. Extraction of membrane bound enzymes.

3. The nature of the extraction medium.

4 Preliminary purification procedures

5 Further purification procedures.

6 Criteria of purity.

7 Determination of molecular weight of enzymes.

**Unit- III: Enzyme Kinetics.**

1. Relationship between initial velocity and substrate concentration.

2. Michaelis-Menten equation.

3. Briggs Haldane Hypothesis.
4. The Line Weaver Burk Plot.
5. The Halden relationship for reversible reaction
6. Effect of Modifiers on enzyme Kinetics.
7. Effect of temperate.
8. Thermal denaturation.
9. Effect of pH.
10. Enzyme Actions of-
11. Chymotrypsin.
12. Fructose bisphosphate aldolase

**Unit- IV: The control of Enzyme Activities by Non Genetic Mechanism.**

1. Enzymes in Organised System.
2. RNA nucleotidyl transferase.
3. The Pyruvate dehydrogenase.
4. Enzyme Technology.
5. Use of isolated enzymes in industrial processes.
6. Immobilized enzyme.

**Learning outcomes –**

1. Student will be able to classify the enzymes according to nomenclature
2. They will be to explain the function of various enzymes and their factors related to it
3. They will learn the and understand the enzyme kinetics and effect of different factors on enzyme action ,
4. They will know the different processes of extraction and purification of enzymes .
5. They will explore the recent advances in the enzyme technology in the industrial process.

**Reference book–**

1. Methods in Enzymology all volumes.(Unit I, II, III & IV)
2. Scopes, R.K. Protein Purification, Principles and Practice. (Unit II)
3. Ferdinand, W. (1976) fundamentals of enzyme kinetics, Butterworths, London. Enzyme by Palmer.(Unit III)
4. Fundamentals of Enzymology: Price N.C. and L. Stevens e.. Oxford, New York. Dixon, M., Webb, E.C; et al. (3rd Ed.) Longman, London.(Unit I)
5. Niggins, I.J. Best D.J. and Jones, J. Biotechnology – Principles and applications, Black well, scientific oxford (1985).(Unit IV)
6. Bullock, J. and Kristiansen, B- (1987) Basic biotechnology.(Unit IV)
7. Palmer and Bonner- Enzyme biochemistry, biotechnology and clinical chemistry 2<sup>nd</sup> edition.(Unit I, II, III & IV)

**M.Sc.-II Sem.-III**  
**MZP 306**  
**Practical based on MZT 301 &302**

- 1 Human lymphocyte culture.
2. Preparation of metaphasicchromosomesfromhuman lymphocyte culture.
3. Study of human chromosomes explainingaspects of chromosome structure.
4. Study of human normal karyotype.
5. Manual preparation of human karyotype from metaphasic chromosomes.
6. Assessing quality and quantity of metaphases.
7. Harvesting of mitotic chromosomes fromrat bone marrow.
9. Study of X chromosome heterochromatinization by Barr body staining .
10. G banding of rat chromosomes/Human chromosomes.
11. Preparation of chromosome ideogram.
12. Karyotype identification with reference to Patau syndrome, Edward Syndrome, Down syndrome, Klinefelter syndrome and Turner syndrome (fromphotographs).
13. Identification of cases of Patau syndrome, Edward Syndrome, Down syndrome Klinefelter syndrome and Turner syndrome fromphotographs by morphological/ symptomatic features
14. Principle of Fluorescence In Situ Hybridization, Interpretation of results FISH for Patau syndrome, Edward Syndrome,Downsyndrome,Klinefelter syndrome and Turner syndrome (fromphotographs).
15. Drosophila culture
16. Sexual dimorphism in Drosophila
17. Study of heritable characters in Drosophila
18. Examples based on Hardy-Weinberg Equilibrium
19. Symbols used in Pedigree analysis
20. Studies of Human pedigrees concerned with autosomal recessive disorders, autosomal dominant disorders, X linked dominant disorders and X linked recessive disorders.
21. Clinical test for Phenylketonuria by Guthrie test /Ferric chloride test
- 24.Estimationofproteins.
- 25.EstimationofAmylase/anyothersuitableenzyme.
- 26.Effectof pHonAmylaseactivity/anyother suitableenzyme.
- 27.Effectof temperatureonAmylaseactivity/anyother suitableenzyme.
- 28.Michaelis– MentenconstantdeterminationforAmylase/ anyothersuitable enzyme.
- 29.Effectof modifiersonenzymeactivity/ Thermolabilityofenzyme.
- 30.IsolationofAmylaseoranyother enzyme.
- 31.Anyother practicalsetbythe Department.
- 32. Catalase estimation using H<sub>2</sub>O<sub>2</sub> as substrate**
- 33. SDS-PAGE Electrophoresis**

AT LEAST 12 EXPERIMENTS TO BE COVERED IN THE SEMISTER FROM GENETICS.

**M.Sc. Zoology**  
**Academic Flexibility, Credit System**  
**M.Sc.-II Sem.-III**  
**Cell biology – Elective Paper- I**  
**MZT 303 Computational Molecular Biology**

**Learning objectives –**

- To impart knowledge to students to develop keen interest in molecular biology and genetics, information technologies and computer science.
- This syllabus will provide students the information of sequences of DNA which will help in the research
- This will help them to understand diagnosis of diseases with the help of new emerging technique in the bioinformatics.
  
- knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics
- to improve the problem-solving skills, including the ability to develop new algorithms and analysis methods

**Unit –I: Advanced molecular techniques**

- 1 DNA physical, chemical, biological properties
- 2 DNA sequencing, whole genome analysis techniques, next gen sequencing method, PCR, Nucleic acid hybridization technology, DNA libraries
- 3 RNA sequencing and Protein sequencing
- 4 Gene Structure Prediction of openreadingFrame,6frametranslation
- 5 Genomic markers- RAPD, RFLP, SNP, EST.

**Unit –II: Sequence comparison methods & search algorithms:**

1. Searching sequence databases by sequence similarity. (Nucleic acid and proteins).
2. Pairwise alignment techniques – local and global sequence alignment Needleman-Wunsch algorithm, Smith-Waterman algorithm.
3. Multiple sequence alignment, consensus sequences.

**Unit –III: Phylogenetics and Sequence annotation**

1. Phylogenetics, Cladistics and Ontology
2. Building Phylogenetic trees
3. Evolution of macromolecular sequences
4. Principles of genome annotation
5. Annotation tools and sequences

**Unit –IV: Structural bioinformatics.**

1. Conceptual models of protein structure
2. The evolution of protein structure and function
3. Obtaining and viewing and analyzing structural data
4. Structural alignment
5. Classification of protein to known CATH and SCOP
6. Structure prediction by comparative modeling
7. Secondary structure prediction

## 8. Advanced structure prediction and prediction strategies

### Learning outcomes –

- They will gain the insight of advanced molecular techniques of DNA sequencing .
- They will be able to describe various sequence comparison methods and related algorithms.
- Students will be able to use online tools and software for various molecular sequence analysis and investigate the phylogenetic relationship also .
- They can explain the various and analyse the structure and function of protein structure with the help of proteomics through softwares related to it .
- They will gain the knowledge of structural and functional relationships, and molecular evolution.

### Reference Books:

1. Introduction to Bioinformatics (2002) – AM Lesk Pub. By oxford University Press.(Unit I, II, III & IV)
2. Bioinformatics – A practical guide to the analysis of genes & proteins (2001) = Ed by A.D. Baxevanis & B.F, Francis Ouelletele pub. By A JahnWiley&sons publication, New York.(Unit I, II, III & IV)
3. Introduction to Bioinformatics (2002) – AM Lesk Pub. By oxford University Press.(Unit I, II, III & IV)
4. Bioinformatics – A practical guide to the analysis of genes & proteins (2001) = Ed by Baxevanis & B.F, Francis Ouelletele pub. By A JahnWiley&sons publication, New York. (Unit I, II, III & IV)
6. Introduction to Bioinformatics (2003) T.K. Atwood & D.J. Parry smith.(Unit I, II, III & IV)
7. Instant notes :Bioinformatics (2003) West head D.R. Parish J.H. & Twyman R.M. Pearson Education (Cell & Molecular biology in action series).



## MZT 304 MOLECULAR BIOLOGY OF GENE

### Learning objective:

- This syllabus will improve knowledge of basic concept in genetics along with advanced techniques in molecular biology.
- This will impart basic understanding of fundamental molecular processes
- Student will gain knowledge of genes and their expression at nuclear level .
- Students will gain -depth knowledge of biological and/or medicinal processes through the investigation of the underlying molecular mechanisms.

### Unit I: Fundamentals of Molecular Biology

1. Chromosome as a carrier of genes
2. DNA replication (Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons) and recombination (Homologous and site specific recombination)
3. Replication error and repair.

### Unit II: Genes, Genomics and Chromosome.

2. Transposable DNA elements
  - a) DNA Transposones
  - b) LTR Retrotransposons
  - c) Non LTR Retrotransposons (SINES and LINES)
3. Organelles DNA
  - a) Mitochondrial DNA
  - b) Chloroplast DNA
4. Genomics- Genome wide Analysis of Gene Structure and Expression (With model organism as example, organization structure and mapping of genome)
5. Morphology and Functional Elements of Eukaryotic Chromosomes
  - a) Chromosomenumber, size and shape at metaphase

### Unit III:

1. Gene and its expression:
  - a) Concept of gene
  - b) Transcriptional control of gene expression in prokaryote (Lac, trp operon).
2. Transcriptional control of gene expression in eukaryotes:
  - a) RNA polymerases and gene control.
  - b) Regulatory sequences in protein coding gene.
  - c) Activators & Repressors of Transcription.
  - d) Regulation of transcription factor activity.
  - e) Regulation of elongation and termination of transcription.
  - f) DNA binding motifs in gene regulatory proteins.

## **2. Post transcriptional gene control and nuclear transport:**

- a) Processing of pre m-RNA.
- b) Regulation of prem-RNA processing.
- c) Macromolecular transport across the nuclear envelope.
- d) Cytoplasmic mechanisms of post transcriptional control.
- e) RNAs in gene regulation (RNA interference, siRNA, miRNA mechanism)

## **Unit IV: Signaling pathway that control gene activity.**

1. TGF  $\beta$  receptors and the direct activation of smuds.
2. Cytokine receptors and the JAK-STAT pathway.
3. Receptor tyrosine kinase and activation of Ras.
4. MAP kinase pathways

## **Learnig outcome –**

1. Student will gain an understanding of chemical and molecular processes that occur in and between cell
2. Student understanding will become such that you will be able to describe and explain processes and their meaning for the characteristics of living organisms
3. They will be able to explain signaling pathways undergone by different cell
4. They will learn about the role of gene regulation in the proper working of the organ system of the body .

## **Reference books:**

An introduction to genetic engineering By Desmond S.T. Nicholl (Unit I, II, III & IV)

Genes by Benjamin Lewin.(Unit I, II, III & IV)

Molecular Biology of the gene by Watson(Unit I, II, III & IV)

## **M.Sc.Zoology**

### **Academic Flexibility, Credit System**

### **M.Sc.-II Sem.-III**

### **MZT 305 Animal Cells in Biotechnology**

## **Learning objectives –**

- Student are introduced with the different animal cells used for tissue culture
- To Understand the use and limitations of in vitro cell analysis
- To Understand the basic requirements for a tissue culture laboratory
- To Understand the basic techniques of tissue culture, sterile technique, contamination analysis, bio-waste, cell storage
- 

## **Unit I:**

### **1. Laboratory design and introduction of cells:**

- 1.Design of Tissue Culture Laboratory

2. Equipments: Laminar Flow Hoods, CO<sub>2</sub> incubator, Microscopes, centrifuge, Refrigerators and Freezers, pipetting aids, Miscellaneous Equipments.

3. Glass wares/plastic wares and filters for tissue culture.

4. Basic Aseptic Techniques

### **5. Cryopreservation for Storage and shipment**

6. Primary cell culture, Established cell line, transformed cell line

## **Unit II:**

### **2. Growth media**

1. Physical requirements and Nutritional Requirements of Cells

Natural media

Basal salt solution (BSS)- Various types

Minimum Essential Medium (MEM)

Antibiotics in media

Serum dependent defined media

Serum independent defined media – Cell specific media

### **3 Basic Techniques of mammalian cell culture**

1. Primary Cell culture – Isolation and separation of cells, viable cell count, maintenance of cell culture, maintenance of stock culture, Antibiotic free stock cultures

2. Types of cell cultures – Monolayer, Suspension, Clonal culture, Mass culture- micro carrier culture (monolayer), **Stem cell cultures (ESC)**

## **Unit III:**

### **5. Biology and Characterization of cultured cells**

Karyotyping

Contamination Testing of Culture

Viability measurement and cytotoxicity, **MTT assay**

Measurement of growth parameters

Cell cycle analysis and Synchronization of cultures

### **6. Uses of Animal Cells in Culture**

Evaluation of Chemical carcinogenicity, Cell malignancy Testing

Uses of Embryonic stem cells and Pluripotent stem cells

## **Unit IV:**

### **7. Cell surgery and Cell Fusion Methods**

Surgical manipulation of *in vitro* fertilization

Cell fusion by Sendai virus and Polyethylene glycol

Hybridoma cell preparations and their properties

### **Tissue Engineering**

Capillary culture Units

Techniques for culturing differentiated cells: Use of Reconstituted basement membrane rafts and use of feeder layers.

## **Learning outcomes -**

- Student will be able to explain the differences between primary and cell line cultures
- Student will get Brief understanding of cell growth requirements

- Brief understanding of analytical techniques
- They will be able to know the cell fusion techniques and different methods of maintaining the contamination free culture .

**Reference:**

Freshney, R.I. Culture of Animal Cells: A Manual of Basic Technique, 1994, John Wiley & Sons Inc. Pub. USA. (Unit I)

Butler, M. Mammalian Cell Biotechnology.: A practical Approach 1991 IRL Press Oxford. (Unit I, II, III & IV)

Cell Culture: Methods in Enzymology, vol. 58 1979/recent volume. Academic Press.

Kuchler, R.J. Biochemical Methods in Cell Culture & Physiology 1977. Dowden, Hutchinson & Ross, Inc. Strousberg, USA (Unit I, II, III & IV)

Morgan, S.I. Animal Cell Culture 1993 Bio. Scientific Publishers Ltd Oxford.

Butler, M. Mammalian Cell Biotechnology.: A practical Approach 1991 IRL Press Oxford. (Unit I, II, III & IV)

Jenni P. Mather & David Barnes Eds: Animal Cell Culture Methods. Methods in Cell Biology Vol. 57 Academic Press. (Unit I, II, III & IV)

Ranga M.M.- Animal biotechnology 2<sup>nd</sup> edition. (Unit I, II, III & IV)

Dubey R.C.- Advanced biotechnology (Unit I, II, III & IV)

**M.Sc.Zoology**  
**Academic Flexibility, Credit System**  
**M.Sc.-II Sem.-III**  
**MZP 307**  
**Cell Biology Practical-I**  
**Practical based on MZT 303, 304 & 305**

1. Example based on DNA sequencing.
2. Example based on RNA sequencing.
3. Example based on Protein sequencing & SS bond prediction, transmembrane & signal peptide sequence prediction.
4. Examples based on Genetic code
- 6 frame translation at frames.
  - Codon preference base translation frames.
  - Open reading frame search.
5. Database search- NCBI, DDBJ, EMBL, BRENDA, KEGG, Uni Prot.
6. Primary sequence analysis of proteins- Prot PARAM
7. Secondary structure prediction
8. Tertiary structure analysis
9. Pairwise sequence alignment- FASTA, BLAST,
10. Multiple sequence alignment- Clustal **Omega**
11. Phylogenetic analysis- **by MEGA**.
11. Metaphasic chromosome preparation from bone marrow cells.
12. C-band of metaphasic chromosomes.
13. Isolation and estimation of DNA & RNA.
15. Demonstration of RNA (by RNase digestion & TBpH 3.5) & estimation.
18. Estimation of Histones.
9. Demonstration of Histones.
20. Estimation of phosphate from isolated nucleic acids.
21. **Visualization of isolated DNA on Agarose gel Electrophoresis.**
22. **Estimation of DNA using Gel – DOC.**
23. **Polymerase Chain Reaction.**
24. Any other experiments / practicals set by the Department.
25. Preparation of glassware for cell culture. Preparation of cells that do not need enzyme digestion ( RBC, Spleen lymph nodes, B.M.)
26. Isolation of cells by enzyme digestion
27. Separation of cells by suitable methods
28. Viable cell count (Trypan Blue)
29. **MTT assay**
30. Primary cell culture and its maintenance

**M.Sc. Zoology**  
**Academic Flexibility, Credit System**  
**M.Sc. II Sem. IV**  
**MZT 401 Toxicology & Immunology**

**Learning objectives –**

- To provide knowledge of how chemicals spread, accumulate and impact on Nature and people
- Introduces you to the principles of toxicology, with particular emphasis on the principles governing toxic responses to chemical exposures, including the disposition of toxicants, and the nature and effect of toxicity.
- Student will gain knowledge about the immunological techniques for the detection of various diseases .
- I will impart knowledge of antigens and structures of antibodies within body

**Unit I**

**Concept and Scope of Toxicology** :Definition, History, Recent development, Disciplines of toxicology. Classification of toxicants,toxic effects,principle aspects and importance of toxicology.

**Toxicity Tests:**Types of toxicity tests,acute,subacute and chronic toxicity tests and their objectives,experimental design,route of administration,doses and number. Bioassays i.e. determination LD<sub>50</sub> or LC 50 value using fish/mollusk/ insects graphical and statistical methods (**Probit analysis**).

**Unit- II**

**Insecticides and metals toxicity-** Synthetic organic insecticides, their classification, prospective effects, symptoms mechanism of toxic action of Organochlorine, Organophosphate, Carbamate and synthetic Pyrethroid insecticides, toxic metals-Arsenic, Lead, Mercury and Cadmium, their toxic effects on animals and toxic kinetics.

**Bio-accumulation and bio magnification toxicants-** Organochlorine insecticides and heavy metal mercury.

**Bio-transformation of toxicant-** Organochlorine and Organophosphate insecticides i.e. Metabolism of insecticides-DDT, BHC, Parathion and Malathion- Mechanism Phase I and Phase II reaction.

**Food Toxicants-** Food additives, Contaminants, adulterants, food poisoning due to bacterial fungal and algal toxins.

## Immunology

### Unit –III:

Antigens: Antigenicity and immunogenicity, Factors influencing immunogenicity, Epitopes, Antibody: Basic structure of antibodies, obstacles to antibody sequencing, Immunoglobulin fine structure, Antibody classes and biological activities. MHC molecules: Genomic map of MHC genes, Regulation of MHC expression, MHC and immune responsiveness, T cell, B cell antigenic properties, cytokines and therapeutic use of cytokines.

### Unit –IV:

Innate immunity: Anatomy, physiologic, phagocytic and inflammatory, Adaptive immunity: e played Antigenic specificity, diversity, immunologic memory, self and non-self-recognition, Hypersensitive reactions, IgE mediated (Type I) hypersensitivity, Antibody mediated cytotoxic (Type II) hypersensitivity, Immune complex mediated (Type III) hypersensitivity, Delayed type (Type IV) hypersensitivity. T cell mediated cytotoxicity, vaccine development (recombinant, combined, polyvalent vaccine), cancer immunology, immunological techniques- ELISA, RIA, Monoclonal antibodies, immunohistochemistry.

### Learning outcomes –

- Student will be able to understand the concept and scope of toxicology
- They will be able to define various toxicological terms
- They will understand different toxicity test and their lethal concentration and doses affecting various bodies
- They will be able to describe types of immunity and role played by immunological cells
- Student will have clear concepts of vaccines and their development ,and knowledge of various immunologic techniques for identification of diseases by Ag-Ab reaction .

### References Book

1. Clark W.R.. Experimental functions of Modern Immunology. Immunobiology - Charles A. Janeway and others – 2001.(Unit III & IV)
2. Pandey Kamleshwar. Shukla J.P. and Trivedi S.P.(2005): Fundamentals of Toxicology. New Central book agency PVT. LTD. Kolkata.(Unit I & II)
3. Thomas J.H. and William O.B. (1987): Handbook of Toxicology.(Unit I & II)
4. Roiff, I Brosfott, J and Male D – Immunology.(Unit III & IV)
5. Sharma, J.M. : Avian Cellular Immunology. Karger and Basel: The year of Immunology 1988.(Unit III & IV)
6. Zapata A.G. and Cooper, E.L. The immune system.(Unit III & IV)
7. Smialowicz R.J. and Holsapple Michael. Experimental Immunology toxicology. (Unit III & IV)

8. Laurie Hoffman – Goetz : Exercise and immune function(Unit III & IV)
9. Chris Kent (2001) : Basics of Toxicology(Unit I & II)
10. Devid J.K. and Kit A.K. (2006): Toxicological testing handbook 2nd Ed. (Unit I & II)
11. Gupta P.K. and Salunkhe D.K. (1985):Modern toxicology (Vol. I,II&III) Pandey, Shukla and Trevedi (2004): Fundamentals of Toxicology.(Unit I & II)
12. Kuby Immunology, WH Freeman, USA.(Unit III & IV)
13. W Paul Fundamentals of Immunology.(Unit III & IV)
14. I.M. Roitt, Essential Immunology, ELBS edition. (Unit III & IV)

**M.Sc. Zoology**  
**Academic Flexibility, Credit System**  
**M.Sc.-II Sem.-IV**  
**MZP 404**  
**Practical based on MZT 401**

1. Measurements of growth parameters- DNA
2. Cell cycle analysis – mitotic cells.
3. Karyotype studies- Bone marrow peritoneal macrophages.
4. Evaluation of acute toxicity by using static renewal bioassay test ( In fish / Insect).
5. Determination of LC<sub>50</sub> of toxicant in fish / stored grain pest by employing probit analysis.
6. Effect of toxicant (sublethal dose) on fish gill and alimentary tract in fish and in insect on alimentary canal haemolymph (Mulberry silkworm)
7. Detection of heavy metal from animal issue by AAS (Lead/cadmium/chromium).
8. Detection of pesticide by TLC method from water sample (organochlorine/ organophosphate).
9. Paw edema test
10. Granulometry – Quantification by weight and differential cell count.
11. Splenectomy.
12. Study of spleen replica for germinal centers.
13. Separation of immunoglobulin by Electrophoresis.
14. Immuno diffusion technique of agar gel diffusion.
15. RBC rosette technique.
16. Haremagglutination inhibition test.
17. Blood group analysis.
18. Histology of lymphoid organs spleen, thymus, lymph node & Bone marrow.
19. Any other practical / experiments set by the Department.
20. **Antigen antibody reaction one of each type : precipitation (VDRL setup in tube or gels) WIDAL**



**M.Sc.Zoology**  
**Academic Flexibility, Credit System**  
**M.Sc.-II Sem.-IV**  
**Cell Biology Elective Paper- III**

**MZT 402: Cell In Differentiation, Development & specialization**

**Learning objectives –**

- To give deep knowledge of cell development and its differentiation at embryonic level .
- To impart basic understanding of molecular processes in the conversion of a specialized cell
- To clear the concepts of different developmental processes from the beginning of multicellular organisms ‘
- They will gain knowledge of structure and function of different cell types .

**Unit I: Differentiated cells and maintenance of tissues:**

1. Differentiated State
2. Tissues with Permanent cells (Eye lens, photoreceptor cells of retina)
3. Renewal of Cells by Mitosis (Liver cell, endothelial cells)
4. Renewal of Cells by Stemcells (Skin epithelium, intestinal epithelium)
5. Renewal of cells by pluripotent stemcells (Blood cell formation)

**Unit II Development of multicellular organism**

1. Universal mechanism of animal development.
2. Drosophila and the molecular genetics to pattern formation: Genesis of the body plan.
3. Homeotic selector genes and the pattern in of the anterior posterior axis.
4. Organogenesis and patterning of appendages.
5. Cell movement and the shaping of the vertebrate body.

### **Unit III:**

#### **1. Muscle as a cell and contraction unit:**

- a. Genesis, modulation and regeneration of skeletal muscle.
- b. Fibroblasts and their transformations- The connective tissue cell family.
- c. Bone remodeling.

#### **2. Mammalian neurons:**

- a) Neurons: Building Blocks of the nervous system
- b) Voltage-gated Ion Channels and the propagation of action potential in nerve cells
- c) Communication at synapses

### **Unit IV**

#### **1. Pancreatic Cells**

- a. Acinar Cells
- b. Islets of Langerhans
- c. Ductal Cells

#### **2. Pituitary Cell Type**

#### **3. Neurosecretary Cells**

#### **4. Corneal Endothelial cells**

#### **5. Hepatoparenchymal cells**

### **Learning outcomes –**

- Student will be able to get knowledge of stem cells and their renewal system .
- They will be able to describe the cell development processes in the multicellular organisms
- They can know the function of various cell by studying the mutation pattern in them
- They can explain and define various cell types ,their structure, location and function of cell .

### **Reference Books:**

1. Cell & Molecular Biology by Gerald Karp (2005) published by John Wiley & sons.(Unit I & II)
2. Molecular cellbiology by Lodish, Berk, Matsudaira, Kaiser, Krieger (2004) published by W. H. Freeman & company, New York.(Unit I, II, III & IV)
3. The Cell by Bruce Alberts, published by Garland publishing Inc. New York& London (Unit I, & II)
4. Developmental Biology By Gilbert(Unit II & III)
5. Cell & Molecular Biology by E.D.P. De Robertis.(Unit I, II, III & IV)
6. Human physiology- Guyton and Hall.(Unit III & IV)

**M.Sc.Zoology**  
**Academic Flexibility, Credit System**  
**M. Sc. II, Semester – IV**  
**MZT 403:Cell Pathology**

**Learning objective –**

- To provide deep knowledge of reasons of cellular stress and death process in body .
- To make them understand the programmed cell death and aging process in detail .
- To give them knowledge of cancer cells and factors responsible for it
- To impart the basic understanding of study of Viruses and damage caused by them and pathological changes caused due to them .
- To give them knowledge of effect of various antibodies at cellular level.

**Unit I:Cell in stress and death**

1. Different types of stressful conditions on cell and cell response
2. Cell death and its regulation: Apoptosis-molecular mechanism and regulation
3. Cell organelles during cell degeneration/necrosis

**Unit II:Cancer Biology**

1. Tumor cells and onset of cancer
2. The genetic basis of cancer
3. Oncogenic mutations in growth promoting proteins
4. Mutations causing loss of growth-inhibiting and cell-cycle control
5. Carcinogens and caretaker genes
6. Cancer targeted treatment

**Unit III:Ageing**

1. Mechanism of ageing (Theories of ageing)
2. Cellular changes during ageing
3. Molecular changes during ageing

4. Immunological changes during ageing
5. Accumulation of toxins and chemical garbage, formation of lipofuscin granules
6. Ageing and cell cycle
7. Strategies against ageing
8. Antiaging treatment by medicinal plants

#### **Unit IV:**

##### **A. Effects of inhibitors**

1. DNA synthesis (Mitomycin)
2. RNA synthesis (Actinomycin and Rifampicin).
3. Protein synthesis (Cyclohexamide, Tetracyclins, Chloramphenicol, streptomycins).
4. Mitochondrial metabolism (CN, CO, Actinomycin –A, Azide etc.)

##### **B. Animal viruses:**

1. RNA viruses – Polio (+ strand RNA), VSV (-RNA), influenza (segmented RNA), HIV
2. DNA virus (SV40-ds DNA with circular genome), adenovirus (linear ds DNA genome), parvo virus (ssDNA virus), Ebola virus

#### **Learning outcomes –**

- 1) Student will be able to explain the reasons behind cellular stress and death .
- 2) They will be able to differentiate the normal and abnormal properties of cell
- 3) They will be able to explain the pathological changes in cell caused due to viral infections and understand the detailed structure and replication cycle of viruses .
- 4) They can describe the mode of action of various inhibitors on body at cellular level .

#### **Reference Books :**

1. Cell & Molecular Biology by Gerald Karp (2005) published by John Wiley & sons. (Unit I, II, III & IV)
2. Molecular cell biology by Lodish, Berk, Matsudaira, Kaiser, Krieger (2004) published by W. H. Freeman & company, New York. (Unit I, II, III & IV)
3. Lewin's cell 2<sup>nd</sup> edition by Lewin. (Unit I & II)
4. Metabolic Inhibitors Vol. I –IV. (Unit IV)
5. Molecular Biology of gene by James Watson (Unit I & II)
6. The Cell by Bruce Alberts, published by Garland publishing Inc. New York & London. (Unit I, II, III & IV)
7. Laboratory Investigation –Vol. 14, 1965. (Unit I, II, III & IV)
8. Inhibitors of nucleic acid synthesis by Kersen & Kersen. (Unit IV)
9. Inhibitors of Protein Synthesis FBI publication. (Unit IV)

**M.Sc.Zoology**  
**Academic Flexibility, Credit System**  
**M.Sc.-II Sem.-IV**  
**MZP 405**  
**Cell Biology Practical- II**  
**based on Paper MZT 402 & 403**

1. Mitosis in rat bone marrow.
2. Meiosis in rat & grass-hopper testis.
3. Meiotic non-disjunction in human (Identification based on pictures.)
4. Nervous system development in chick embryo.  
Study of Angiogenesis in chick embryo.
5. Demonstration of stem cells renewing by mitosis (liver cells Intestinal crypt cells. Bone marrow cells – demonstration of cell division by fulgure technique).
6. Demonstration of neurons in cerebral cortex of rat. Demonstration of pituitary cells.
7. Demonstration of pancreatic islet cells (L, B, Cell types).
  
8. Demonstrations of muscle striations (PAS method, phase contrast method) smooth muscle cells observations.
9. Demonstration of autochordia in striated & smooth muscle cells (Phase contrast & Janus green B staining).
10. In vitro cell degeneration of liver (histology – nuclear (E+H, Fulgure))

- a. alterations lysosomal by acid phosphatase alterations in rat).
11. In vivo cell degeneration– of kidney by Induced ischemia (histology, nuclear alterations – E+H, fulgure).
12. Age related lipid peroxidation in various organs of rat / mouse.
13. Demonstration of lipofuscin granules in brain of aged (natural & induced) rat / mouse.
14. Drug induced lipid peroxidation in liver & kidney (CCl<sub>4</sub> / any suitable drug).
15. Any other practical / experiments set by the Department. Project work / Review article.









