

**RAJARSHI SHAHU MAHAVIDYALAYA, LATUR**  
**(Autonomous)**  
**(BoS in ZOOLOGY)**

**CHOICE BASED CREDIT SYSTEM (CBCS)**  
**SEMESTER PATTERN**  
**(W.e.f. Academic Year 2022-23)**



**SYLLABUS FOR B.Sc.-II EXAMINATION**  
**SUB: ZOOLOGY**

**June-2022**

**RAJARSHI SHAHU MAHAVIDYALAYA, LATUR.**  
**(Autonomous)**

SEMESTER PATTERN CURRICULUM UNDER  
CHOICE BASED CREDIT SYSTEM (CBCS)

Faculty of Science

B.Sc. S.Y. Under Graduate (UG) Programmes

SUBJECT: ZOOLOGY

(w. e. f. June -2022)

Semester	Course Number		Paper No. and Title	Total period/week	Marks		Credits
					Internal ESE	External CA	
SEM-III	CCZ-III	A	Animal Physiology and Immunology	45 3/week	20	30	2
		B	Genetics	45 3/week	20	30	2
	CCZP-III	A	Animal Physiology and Immunology	45 3/week	20	30	2
	CCZP-IV	B	Genetics	45 3/week	20	30	2
	SECZ-I		Clinical Haematology	3/Week	20	30	2
SEM-IV	CCZ-IV	A	Biochemistry	45 3/week	20	30	2
		B	Molecular Biology and Genetic Engineering	45 3/week	20	30	2
	CCZP-V	A	Biochemistry	45 3/week	20	30	2
	CCZP-IV	B	Molecular Biology and Genetic Engineering	45 3/week	20	30	2
	SECZ-II		Microtechniques	3/Week	20	30	2

## B. Sc. II ZOOLOGY (SEM-III)

Course Code: U-ZOO-382

Course: Animal Physiology and Immunology (CCZ-III-A)

Credits: 02

Marks: 50

Lectures: 45

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### Learning Objectives

- To make the students to understand the physiological process of animals
- To understand the importance of physiology and Immunology
- To understand concepts and different types of immunity.
- To have basic knowledge of functions of different organs and organ system
- To introduce the concepts of physiology of digestion excretion and Osmoregulation
- To introduce the concepts of physiology of respiration and circulation

### Course Outcome

- Learners would understand the different physiological process of animals
  - Learners would be able to correlate the habit and habitat with nutritional, excretory and osmoregulatory structures
  - Learners would be able describe the concepts and different types of immunity.
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### Unit – I (Digestion Physiology and Respiration physiology)

- Intracellular and Extracellular digestion
- Mechanical process in digestion
- Chemical process of digestion
- Absorption of food
- External and Internal respiration
- Respiratory organs of man
- Mechanism of respiration
- O<sub>2</sub> and Co<sub>2</sub> transportation
- Control of respiration and Respiratory quotient

### Unit –II (Circulation physiology)

- Open and closed type of circulation
- Circulatory organs (Heart and Blood vessels)
- Typical pattern of circulation
- Composition and function of blood
- Level of blood Cholesterol, urea and sugar.
- Erythropoiesis and Its regulation
- Blood pressure, ECG, Heart beat and Cardiac cycle.
- Lymphatic system (Lymph, Lymph vessels and Lymph node)

### Unit –III ( Excretion physiology and Neurophysiology)

- Mode up of Excretion
- Structure of nephron (Uriferous tubule)
- Physiology of Urine formation Composition of urine and Osmoregulation
- Structure of Neuron
- Structure of Synapse and reflex action
- Conduction of nerve impulses and Neurotransmitter

## **UNIT:-IV (Muscle physiology , Reproductive Physiology and Immunology)**

- Structure and types of muscles
  - Ultra structure of skeletal muscle fibre
  - Sliding filament theory
  - Hormonal control of testicular and ovarian functions , Menstrual cycle, Estrous cycle, and Homeostasis.
  - Types of Immunity ii) The immune system
  - Immune response (Antigen, Antibody, Humoral and cell mediated immunity)
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### **Reference Books**

- A textbook of Animal Physiology – K.A. Goel and K.V. Shastri (Rastogi Pub.)
- A textbook of Practical Physiology – V.G. Ranade (P.V.G. Prakashan Pune.)
- Clinical Pathology and Haematology – Nanda Baheti (Kanhaiya Pub.)
- Comparative animal physiology C. Ladd Prosser.
- Text book of animal Physiology – A.K. Berry (Emkay Pub.Delhi)
- Animal Physiology – A. Mariakuttikan N. Arumugam (Saras Publication)
- Principles of animal Physiology – Wood D.W
- Physiology – Guyton and Hall
- Doby-Immunology (W.H. Freeman)

## B. Sc. II ZOOLOGY (SEM-III)

Course Code: U-ZOO-382

Course: Genetics (CCZ-III-B)

Marks: 50

Credits: 02

Lectures: 45

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### Learning Objectives:

- To make the students to understand the structure and functions of gene
- To understand the importance of Genetics
- To have basic knowledge of mutation
- To understand the inheritance pattern.

### Course Outcome

- Understand and apply the principles of inheritance.
- Understand the concept of multiple alleles, linkage and crossing over.
- Learner able to introduce the concept of sex determination and its types, sex influenced and sex limited genes.
- Learners would understand mechanisms of sex determination.
- Learners would be able to correlate the disorders linked to a particular sex chromosome.

### Unit – I (Mendelian genetics and Modifications)

- Mendelism
- Monohybrid cross and Dihybrid cross
- Interaction of gene (9:3:4, 9:7, 13:3, 15:1)
- Incomplete dominance.
- Back cross and test cross.

### Unit – II (Multiple Alleles and Multiple Gene)

- Multiple alleles – Eg. Coat colour in Rabbit .and ABO Blood groups in Man.
- Rh factor and Erythroblastosis foetalis in man.
- Multiple genes - Eg. Skin colour in Man.
- Linkage – definition, Types and significance
- Crossing over –Mechanism, Factor affecting on crossing over, and Its Significance

### Unit – III (Sex determination, sex linked inheritance and Gene Mutations)

- Chromosomal methods of sex determination.
- Bridge's ratio theory of genic balance.
- Sex linked inheritance in Drosophila.
- Sex linked inheritance in man – colorblindness, haemophilia, Hypertrichosis and baldness.
- Chromosomal Mutations – Structural and numerical mutations
- Mutagenic agents
- Sickle cell anemia.

### Unit – IV (Human genetics)

- Syndromes – Turner's, Klinefelter's, Down's, Cat – Cry, Patau's, and Edwards.
- Inborn errors of metabolism – Phenylketonuria (PKU), Alkaptonuria, Albinism.
- Human Pedigree analysis with Symbols use and Eugenics and Euphenics

## Reference Books

- Gupta, P.K. (1996) "Genetics" Rastogi Publications.
- Ranga, M.M. "Animal Biotechnology (Agrobios), Published by Agrobios (India).
- Rastogi, Sharma, V.N. and Anuradha Tandon (1993). "Concepts in Molecular Biology". Wiley Eastern Ltd. N. Delhi.
- Smustad, Simmons, Jenkins (1999). "Principles of Genetics" John Wiley and sons. Inc.
- Genetics – P.K. Gupta (Rastogi pub. Meerut)
- Genetics – Verma P.S. and Agarwal V.K. (S. Chand pub. Delhi.)
- Genetics – Winchester (Oxford LBH Pub.)
- Genetics and Evolution – A.P. Jha (Macmillon India)
- Concepts of genetics – W.S. Clug (Pearson Education ISBN)
- Genetics – Strickberger (Prentice – Hall)
- Principle of genetics – R.H. Tamarin (Tata Mc Graw Hill Pub. India)
- Concepts of Genetics – R. L. Kotpal (Rastogi Pub.)
- Genetics and Genetic Engineering – Dr. R.P. Meyyan (Saras Pub.)
- Foundations of Genetics – Pai A.C. (Mc Graw Hill Pu b.)
- Molecular Genetics – Gunther, S. Stent, (Macmillon)
- Principles of Genetcs – Sinnott, Dunn and Dobzansky (Tata McGraw Hill Pub. Delhi).
- Genetics – M.P. Arora (Himalaya).
- Genetics and Evolution – N. Armugam (Saras Pub.)
- Genetic – Veer Bala (Rastogi Pub.)

## B. Sc. II ZOOLOGY (SEM-III)

Course Code: U-ZOO-382

Lab. Course-III: Animal Physiology and Immunology (CCZP-III-A)

Credits: 02

Marks: 50

Lectures: 45

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### Learning Objectives

- To make the students to understand the hematological and immunological techniques.
- To make the students to understand the hematological techniques conducted in laboratories including, complete blood count, blood grouping, blood films, and differential count.
- To make the students to understand the process of digestion by qualitative detection of digestive enzymes.
- To make the students to understand the analytical techniques know the functional status of different organ.

### Course Outcome

- Learners would understand the different physiological process of animals
- Learners would be able to understand functional status of organ
- Learners would be able to understand complete blood count, blood grouping, blood films, and differential count.
- Learners would understand the respiratory status of animals

1. Qualitative detection of digestive enzymes (protease, Amylase and Lipase) in cockroach/ Crab.
2. Detection of human salivary amylase.
3. Estimation of oxygen consumption in fish/ Crab or any other suitable aquatic animal.
4. R.B.C. Counting.
5. W.B.C. counting.
6. Differential leucocyte count of blood.
7. Measurement of blood pressure by sphygmomanometer.
8. Estimation of Haemoglobin.
9. Estimation of urine / serum creatinine from blood
10. Estimation of urine / serum urea by diacetyl monoxime method
11. Colorimetric estimation of blood/serum cholesterol.
12. ESR of blood.
13. Determination of clotting time of blood by capillary tube method.
14. Estimation of glucose by Benedict quantitative method.
15. Determination of bilirubin in serum
16. Qualitative detection of Nitrogenous waste products (Ammonia, Urea and Uric acid)
17. Preparation of Haematin crystals.
18. Types of nerves – Unipolar, Bipolar, Multipolar. (Chart/slides)
19. Antibody and antigen reaction

**B. Sc.II ZOOLOGY (SEM-III)**

**Course Code: U-ZOO-382**

**Lab. Course-IV: Genetics (CCZP-IV-B)**

**Credits: 02**

**Marks: 50**

**Lectures: 45**

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**Learning Objectives:**

- To make the students to understand the Mendel's Laws of inheritance.
- To understand the importance modification in Mendelian laws like complementary factor to Blood group.
- To understand the problems based on sex linked inheritance.
- To understand the chromosomal abnormalities.

**Course Outcome**

- Learner will be able to do the problems based Mendel's laws.
  - Understand and apply the concept of multiple alleles, linkage and crossing over.
  - Learner able to do the problems based on sex linked inheritance and blood groups etc.
  - Learners would understand mechanisms of sex determination.
  - Learners would be able to understand the Human pedigree analysis and symbols.
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**PRACTICALS**

1. Problems based on monohybrid and dihybrid cross (Explain with the help of plastic beads.)
2. Problems on modification in ratio due to interaction of genes– complementary factors, supplementary factors, inhibitory factors, duplicate genes (explain with the help of plastic beads).
3. Problems on blood group inheritance in man.
4. Problems based on sex linked inheritance
5. Culture of Drosophila and observation of genetic characters in Drosophila (eye & wings)
6. Preparation of temporary slides of salivary gland chromosomes from chironomous larva.
7. Study of slide of sickle cell anemia.
8. Study of chromosomes abnormalities in man, Down's syndrome, Klinefelter Syndrome, and Turner Syndrome with the help of Photograph / Charts / Karyotype.
9. Drosophila culture techniques.
10. Study of phenotypic characters in Drosophila (Body colour, Wing pattern and Eye colour).
11. Buccal smear – Identification of Barr Body
12. Human pedigree analysis- Various symbols used and problems



## B. Sc.II ZOOLOGY (SEM-III)

Course Code: U-ZOO-382

Course: Clinical Haematology (SECZ-I)

Credits: 02

Marks: 50

Lectures: 45

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### Learning Objective:

- To understand Perform staining and counting technique for identification of different type of blood cells.
- To understand collection methods of blood sample.
- To understand separation techniques of blood sample components.
- To understand diagnosis of different blood related diseases.

### Learning Outcomes:

After completion of this course students should be able to:

- Perform staining and counting technique for identification of different type of blood cells.
  - Collect blood sample by different methods.
  - Separate different components of blood
  - Estimation of Hb from blood samples
  - Diagnosis of various blood diseases like anaemia
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## UNIT – I

### 1. The components of blood

- Plasma
- Red blood cells
- White blood cells
- Platelets

### 2. Collection of Blood

- Criteria for sample collection
- Collection of capillary blood (Peripheral Blood) blood by skin punctures
- Collection of venous blood by Venipuncture,
- Collection of arterial blood,

### 3. Practical:

- Collection Blood by Skin puncture and Venipuncture.
- Separation of Blood components Plasma, Serum and Corpuscles

## UNIT – II

### 1. Haemoglobin

- Structure and function of Haemoglobin

### 2. Anemia Causes, Effect and Control

- Types of anemia
- Causes and Symptoms of anemia
- Control measure of anemia
- Diagnosis of anemia

### 3. Practical

- Estimation of Haemoglobin

## UNIT – III.

### 1. Haemopoiesis, erythropoiesis and leucopoiesis

### 2. Practical: Complete Blood Count (CBC)

- RBC Counting

- WBC Counting
- Platelet count and Hamatocrit

#### **UNIT – IV**

- Blood Clotting,
- Mechanism of Clotting
- Extrinsic and Intrinsic Mechanism
- Blood cholesterol and Urea and Creatin

**3. Practical:** Clotting and bleeding time of blood.

#### **REFERENCE BOOKS:**

1. Medical Laboratory Technology - Ramnik Sood
2. Medical Lab Technology Vol. I, II & III – Kanai Mukherjee
3. Hand Book of Medical Technology - Mrs. Chitra
4. Medical Laboratory Technology – A. Ananthanarayan
5. Manual for Laboratory Technician of Primary Health by Minister of Health
6. Human Physiology Vol. I & II – C. C. Chatterjee

## B. Sc.II ZOOLOGY (SEM-IV)

Course Code: U-ZOO-382

Course: Biochemistry (CCZ-IV-A)

Credits: 02

Marks: 50

Lectures: 45

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### Learning Objectives:

- To make the students to understand chemistry of life
- To understand the importance of Biochemistry
- To have basic knowledge of metabolism
- To give learner insight into the structure of biomolecules, and their role in sustenance of life.

### Course Outcome:

- The learner will realize the importance of biomolecules and their clinical significance.
  - Able to demonstrate an understanding of fundamental biochemical principles, such as the structure/function of biomolecules, metabolic pathways, and the regulation of biological/biochemical processes.
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### Unit-I (Classification, Structural properties and biological functions)

- Introduction of Biochemistry
- Carbohydrates and lipids
- Proteins and Amino acids and peptides,

### Unit-II (Classification, Structural properties and biological functions)

- Vitamins (Discovery, types and their functional Significance.)
- Fat soluble (A, D, E, K, Q and U)
- Water soluble (B-complex family and Ascorbic Acid)
- Antioxidants

### Unit-III (Enzymology)

- Nomenclature of enzyme and chemistry of enzymes
- Classification, properties of enzyme
- Mechanism and factor affecting on enzyme action
- Enzyme inhibition and Biological function of enzymes
- Coenzymes

### Unit-VI (Metabolism)

- Metabolism of Carbohydrates
- (EMP, HMP pathway, Krebs cycle, Glycogenesis, Glyconeogenesis, Glycogenolysis.)
- Metabolism of lipid
- (Beta oxidation pathway, Ketogenesis, ketolysis, ketosis) iii) Metabolism of protein
- (Oxidation of amino acids. Urea cycle, Transamination Deamination)
- Biochemistry of Hormones

### Reference Books

- Lehninger Principles of Biochemistry
- Fundamentals of Biochemistry-J.L. Jain, Sunjay Jain, Nitin Jain, S. Chand & Company.
- Biomolecules-C.Kannan, MJP Publishers, Chennai-5.
- Laboratory manual in Biochemistry -Jayaraman.
- Biochemical methods -S.Sadasivan and Manickam.
- Introduction to Practical Biochemistry -David T. Plumme

## B. Sc. II ZOOLOGY (SEM-IV)

Course Code: U-ZOO-382

Course: Molecular Biology and Genetic Engineering (CCZ-IV-B)

Credits: 02

Marks: 50

Lectures: 45

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### Course Outcomes:

- To make the students to understand biological tools for research
- To understand the importance of Molecular Biology and Genetic Engineering
- To have basic knowledge of cloning and Gene Expression

### Course Outcome:

- Students will able to use biological tools for research.
  - Learner will able to describe the importance of Molecular Biology and Genetic Engineering.
  - Learner will able to use vectors in cloning techniques and rDNA technology
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### UNIT- I

- Introduction to Molecular Biology
- Deoxyribonucleic acid (Structure, properties, function, and type of DNA)
- Ribonucleic acid (Structure and types)
- Replication and Genetic codes

### UNIT- II

- Protein synthesis
- Gene concept and molecular structure of gene
- Types of gene and Discontinuous genes (Exons and Introns)
- Gene Expression in prokaryotes (Lac operon) eukaryotes
- One gene one enzyme hypothesis and one polypeptide hypothesis

### UNIT- III

- Introduction to genetic engineering-Mendel's to Molecules
- Tools; - a) Enzymes: - i. lysing ii. Ligases
- iii Nucleases {Exonucleases, Endonucleases.,Restriction Endonucleases enzymes}
- iv. Synthesases{ DNA polymerase, Reverse transcriptase}
- b) Vectors:- Cloning vectors [plasmid -pBR322,Bacteriophage-Lambda phage, Viruses-SV40, Cosmids vectors] and Expression vectors {Shuttle vector }
- Techniques: - a) Southern, Northern and Western blotting b) PCR (Polymerase chain reaction)
- DNA Sequencing(Sanger)

### UNIT- IV

- Gene cloning
- Linking of desired gene with vector DNA
- Introduction of recombinant DNA into host Cell
- Identification of recombinant DNA
- c-DNA libraries and Genomic libraries
- Transgenesis and Transgenic animals [Transgenic cattle, sheep, pig and fish]
- Animal cloning and cloned animals [Dolly sheep]
- DNA fingerprinting

## Reference Books

1. Molecular Biology –David Friefelder –Narosa Publishing House, New Delhi.
2. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology –Verma, Agarwal –S. Chand& Co.
3. Molecular & Cell Biology –Bhamrah –Anmol Publ. Pvt. Ltd., New Delhi.
4. Molecular Biology of the Cell –Alberts, Bray, Lewis, Raff, Roberts, Watson –Garland Publishers, New York.
5. Molecular Biology of the gene –J. D. Watson, NH Hopkins, Roberts, Stertz, Weiner-Freeman. 6. Concepts in Biotechnology –
6. Editors-Balasubramanian, Bryee, Dharmalingam, Green, Jayraman – Sangam Books.
7. Molecular Biology of the Gene –Watson, Hopkins, Roberts, Steitz, Weiner –Benjamin Cummings Publishing Co.
8. Molecular Cell Biology –Baltimore, Zipursky, Matsudaria, Darnel –W. H. Freeman & Co., New York.
9. Outlines of Biochemistry –Conn & Stumpf.
10. Principles of Biochemistry –White, Handler, Smith –McGraw Hill Publ. 11. Cell & Molecular Biology –Phillip Sheller –Wiley Publ.
11. Molecular Biology -Robert F. Wiver

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**B. Sc. II ZOOLOGY (SEM-IV)**  
**Course Code: U-ZOO-382**  
**Lab Course-VI: Biochemistry (CCZP-IV-A)**

**Credits: 02**

**Marks: 50**

**Lectures: 45**

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**Course Objectives:**

- They should standardize their solutions individually.
- To make the students to understand the skills necessary to analyze chemicals and chemical reactions quantitatively and qualitatively;
- To make the students to understand the skills necessary to verify hypothesis.
- To make the students to understand skills of titrimetric, Colorimetric Iodometric analysis of vitamins, amino acid.

**Course Outcome:**

- Learners would understand the qualitative and quantitative analytical skill of biomolecules.
  - Learners would understand skills of titrimetric, colorimetric, Iodometric analysis of biomolecules.
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1. Estimation of amino acids by formal titration.
2. Estimation of ascorbic acid by titrimetric method using 2, 6-dichlorophenol indophenol.
3. Estimation of Antioxidant by, 2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay
4. Estimation of reducing sugar from biological fluids by Benedict's titrimetric method.
5. Qualitative estimation of protein, Lipid and carbohydrates
- 6... Estimation of Protein by Biuret method/Bradford method/Lawry.
7. Estimation of amino acids by ninhydrin method
8. Isolation of glycogen from liver source and its estimation by anthrone method
9. Estimation of Lipids by Vanillin
10. Extraction of DNA by Phenol and Chloroform Method
11. Effect of temperature on enzyme action
12. Effect of pH on enzyme action
13. Effect of temperature on enzyme action
14. Effect of temperature on enzyme action

**B.Sc. II ZOOLOGY (SEM-IV)**

**Course Code: U-ZOO-382**

**Lab Course-VII: Molecular Biology and Genetic Engineering (CCZP-IV-B)**

**Credits: 02**

**Marks: 50**

**Lectures: 45**

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**Course Outcomes:**

- To make the students to understand knowledge restriction digestion and r-DNA.
- To understand the applications of Molecular Biology and Genetic Engineering
- To have basic knowledge of cloning and Gene Expression, gene transfer, Blotting techniques, Equipments used in genetic etc.

**Course Outcomes:**

- Learners will able to understand the blotting technique.
  - Learner will be able to use the agarose gel electrophoresis for DNA molecular size determination and will be able to estimate the DNA and RNA.
  - Learner will able to understand the vectors in cloning techniques and rDNA technology.
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**Practicals:**

1. Extraction of genomic DNA from Blood.
2. Estimation of Protein by Polyacrylamide Gel Electrophoresis
3. Estimation of DNA by Agarose gel electrophoresis
4. Estimation of RNA by Agarose gel electrophoresis
5. Demonstration DNA amplification by RT-PCR
6. Digestion of DNA with Restriction Enzymes
7. Demonstration Western Blotting
8. Demonstration of Southern / western blotting.
9. Estimation of DNA by DPA
10. Estimation of RNA by Orcinol reagent.
11. Extraction of proteins from tissues

**B. Sc. II ZOOLOGY (SEM-IV)**  
**Course Code: U-ZOO-382**  
**Course: Microtechnique (SECZ-II)**

**Credits: 02**

**Marks: 50**

**Lectures: 45**

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**Learning Objective:**

- To understand collection of tissues and fixation techniques
- To understand Methods of block preparation
- To understand Sectioning and staining techniques.

**Learning Outcomes:**

After completion of this course students should be able to:

- Perform preparation of paraffin block of different tissues
  - Perform fixation of tissues
  - Perform sectioning and staining.
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**UNIT - I**

- Introduction – Definition of Histotechnology
- Methods of examination of tissues and cells, Collection and labeling of specimens, Methods of preparation and examination of tissues (fresh and fixed tissue)

**UNIT - II**

- Fixation of tissue - Definition, Criteria for an ideal fixative, types (Simple and Compound), Properties of Simple and Compounds fixatives (Microanatomical, cytological and histochemical)
- Practical – Isolation and collection of tissue, fixing and block preparation.

**UNIT - III**

- Tissue processing - Manual and automatic tissue processing, Different embedding media, Steps of tissue processing (Dehydration, Clearing, and Impregnation).
- Embedding- Methods of Embedding, Embedding medium, names of medium and moulds, Automatic Tissue Processes (Structure and Working, Advantages and Disadvantages).
- Practical – Tissue processing of prepared blocks.

**UNIT - IV**

- Section Cutting - Types of Microtome, Rotary Microtome -Parts and their functions, Microtome Knives- Types, Care and Maintenance Techniques of sharpening; Technique of Section Cutting, Preparation of Adhesive Mixture, Mounting.
- Staining - Definition and Significance of Staining, Stain and Staining Types, Theory of Staining, Methods of Staining.
- Practical – Section Cutting, fixing, alcohol grading, staining and preparation of permanent slide.

**REFERENCE BOOKS:**

Histochemical Techniques – J. D. Bancroft.

Handbook of Histopathological and Histochemical Techniques - C.F.A. Culling.

Histological and Histochemical Methods 4th Edition – John Kier