

# **GAUHATI UNIVERSITY**



**SYLLABUS FOR**  
**BACHELOR IN MEDICAL LABORATORY TECHNICIAN**  
**AND**  
**BACHELOR IN MEDICAL LAB & MOLECULAR DIAGNOSTICS TECHNOLOGY**  
**(VOCATIONAL)**

**FYUGP STRUCTURE UNDER NEP**

**GAUHATI UNIVERSITY**

**About the Course:** The Bachelors course in Medical Laboratory Technician and Medical Lab & Molecular Diagnostics Technology (known as B. Voc. MLT/ML&DT), is a 3 years course, **currently** and will have 6 semesters. The course will have 21 papers, with 84 credits in total for the 3-year course. Each paper will have 4 credits. The first 3 semesters will have 3 papers each semester while the last 3 semesters will have 4 papers per semester.

**Objective of the Course:**

- To train competent and skillful Lab Technologists of Skills, Competence and Integrity.
- To train the students to carry out laboratory investigations accurately and provide reliable reports to facilitate proper diagnosis and prognosis of diseases.
- To be competent to undertake routine as well as special investigative procedures in various Medical Laboratory Technology.
- To develop knowledge and skill in accordance with the demand in the field of Medical Laboratory Technology.
- To enable to operate and maintain all equipment used in the Laboratory diagnosis.
- To apply bio-statistical concepts to data to draw conclusions and evaluate significance of research results.
- To enable to work as Supervisor/Trainer/Teacher in the field of Medical Laboratory Technology, as per norms.
- To create awareness on the principles underlying the organization of a Clinical Laboratory.

**Entry Criteria:** The entry criteria for B. Voc. MLT/ML & MDT are HS Science passed with Biology as one of the subjects. It is based on marks and/or interview.

**Pass:** The students of the course should pass both theory, practical and internals, individually as per University norms. There shall be both theory and practical exams at the end of each semester.

# SEMESTER I

## PAPER-I

### HUMAN ANATOMY AND PHYSIOLOGY (4 CREDITS)

**Theory: 60**

**Practical: 20**

**Internal Assessment: 20**

**Theory: 3 Credits**

**Practical: 1 Credit**

**Overview and key learning outcomes:** This paper will help the students to understand the basics and fundamentals of cells, tissues, different systems of the body including Musculo-skeletal system, GI system, Respiratory system, Cardiovascular system, Genitourinary system etc.. Further the students have to learn about the medical terminology used in human anatomy, functions of different systems of humans.

| Unit | Topics  | Credits & Marks              |
|------|---|------------------------------|
| I    | <b>Introduction to Human Anatomy and Physiology</b> <ul style="list-style-type: none"><li>○ Basic Anatomy and Physiology</li></ul> <b>Anatomical planes, location and terminology</b> <ul style="list-style-type: none"><li>○ Anatomical position</li><li>○ Anatomical planes</li><li>○ Important anatomical terminology</li><li>○ Different anatomical regions of the body</li></ul>                                     | <b>1 Credit<br/>20 marks</b> |
| II   | <b>Cells and Tissues</b> <ul style="list-style-type: none"><li>○ Introduction, composition of cell</li><li>○ Function of cell</li><li>○ Movement through cell membrane</li><li>○ Cell cycle, cell division and control of cell division</li><li>○ Different types and various functions of tissue</li><li>○ Epithelial tissues</li><li>○ Connective tissue</li><li>○ Muscular tissues</li><li>○ Nervous tissues</li></ul> |                              |
| III  | <b>Musculo-skeletal System</b> <ul style="list-style-type: none"><li>○ Introduction and basic terminology</li><li>○ Bone structure, types of bones</li><li>○ Bone development, function of bones</li><li>○ Organization of the skeleton</li><li>○ Different type of joints and cartilage</li><li>○ Structure and functions of a Skeletal Muscle, smooth muscle and cardiac muscle</li><li>○ Muscular response</li></ul>   |                              |
| IV   | <b>Gastro-intestinal System</b> <ul style="list-style-type: none"><li>○ Physiology &amp; anatomy of mouth, Oral cavity (lip, tongue with histology, tonsil, dentition, pharynx, salivary glands, Waldeyer's ring)</li></ul> Oesophagus, stomach, small and large intestine, liver, gallbladder, pancreas.   |                              |

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|------|---|--|
| V    | <p><b>Respiratory System</b></p> <ul style="list-style-type: none"> <li>○ Parts of Respiratory System, nose, nasal cavity, larynx, trachea, lungs, bronchopulmonary segments, names of paranasal air sinuses, Physiology of respiration, control of respiration</li> </ul>  | <p><b>1 Credit</b><br/><b>20 marks</b></p> |
| VI   | <p><b>Cardiovascular System and Lymphatic System</b></p> <ul style="list-style-type: none"> <li>○ Anatomy and physiology of heart, Heart size, location, chambers, exterior &amp; interior, blood supply to the heart, Systemic and pulmonary circulation, Branches of aorta, common carotid artery, axillary artery, brachial artery, superficial palmar arch, femoral artery, internal iliac artery.</li> <li>○ Blood pressure and peripheral pulse</li> <li>○ Inferior vena cava, portal vein, portosystemic anastomosis, Great saphenous vein, Dural venous sinuses,</li> <li>○ Lymphatic system – Cisterna chyli &amp; thoracic duct, histology of lymphatic tissue, Names of regional lymphatics, axillary and inguinal lymph nodes in brief</li> </ul> |  |
| VII  | <p><b>Genito-urinary System</b></p> <ul style="list-style-type: none"> <li>○ Anatomy of Kidney, Ureter, Urinary bladder, male and female urethra.</li> <li>○ Histology of Kidney, ureter and urinary bladder.</li> <li>○ Formation of Urine</li> <li>○ Micturition</li> <li>○ Parts of male reproductive system, testis, vas deferens, epididymis, prostate. Spermatogenesis.</li> <li>○ Parts of female reproductive system – uterus, fallopian tubes, ovary, mammary glands – gross.</li> <li>○ Oogenesis, Ovulation, Menstrual cycle.</li> </ul>   | <p><b>1 Credit</b><br/><b>20 Marks</b></p> |
| VIII | <p><b>Nervous System</b></p> <ul style="list-style-type: none"> <li>○ Basic structure and function</li> <li>○ General function of the Nervous system</li> <li>○ Nervous tissue</li> <li>○ Cell membrane potential</li> <li>○ The synapse</li> <li>○ Processing impulses</li> <li>○ Classification of Neurons and Nerve fibers</li> </ul> <p><b>Basics of sensory, Somatic and Enteric nervous system.</b></p> <ul style="list-style-type: none"> <li>○ Introduction, meninges, ventricles and CSF</li> <li>○ Central Nervous system - Brain and its parts, Spinal cord</li> <li>○ Peripheral Nervous System - Spinal Nerves, Cranial nerves &amp; autonomic Nervous System</li> </ul>   |  |
| IX   | <p><b>Endocrine System</b></p> <ul style="list-style-type: none"> <li>○ Name of all endocrine glands</li> </ul> <p>Detail on (gross and histology).</p> <ul style="list-style-type: none"> <li>○ Pituitary gland</li> <li>○ Thyroid gland</li> <li>○ Parathyroid gland</li> <li>○ Adrenal gland</li> </ul>  |  |

| Sl. No. | Experiments   |
|---------|---|
| I       | Histology of types of epithelium, Histology of serous, mucous & mixed salivary gland.   |
| II      | Demonstration of parts of the respiratory system.   |
| III     | Demonstration of heart and vessels in body, Histology of lymph node, spleen, tonsil & thymus, Normal chest radiography showing heart shadows. |
| IV      | Demonstration of reflections  |
| V       | Histology of three types of cartilages.   |
| VI      | Demonstration of parts of urinary systems.  |
| VII     | Demonstration of the glands.  |
| VIII    | Demonstration of blood pressure with sphygmomanometer, demonstration of peripheral pulse  |

#### Reference Books:

| Sl. No. | Title  | Authors                               | Publisher         |
|---------|--|---------------------------------------|-------------------|
| 1       | Ross and Wilson Anatomy and Physiology in Health and Illness | Anne Waugh<br>Allison Grant           | Elsevier          |
| 2       | Textbook of Medical Physiology                               | Guyton                                | Jaypee            |
| 3       | BD Chaurasia's Human Anatomy                                 | BD Chaurasia's                        | CBS<br>Publishers |
| 4       | Understanding Medical Physiology                             | L. Bijlani                            | Jaypee            |
| 5       | Principles of Anatomy and Physiology                         | Gerard J. Tortora<br>Bryan Derrickson | Wiley             |

## PAPER-II

### INTRODUCTION TO BIOMOLECULES, INSTRUMENTATION AND REAGENTS (4 CREDITS)

Theory: 60

Practical: 20

Internal Assessment: 20

Theory: 3 Credits

Practical: 1 Credit

**Overview and key learning outcomes:** This paper will assist students in learning fundamental principles of macromolecular function and structure. Additionally, able to identify various laboratory glassware, plastic ware, and instruments, as well as care and maintenance of laboratory equipment and Biomedical waste management.

| Unit | Topics   | Credits & Marks        |
|------|--|------------------------|
| I    | <p><b>Introduction to Biomolecules</b></p> <p><b>Carbohydrates &amp; Lipids:</b></p> <ul style="list-style-type: none"><li>○ Carbohydrates: Introduction, classification into mono, oligo and polysaccharides. Classification of monosaccharides, based on no. of C-atoms. Functional groups- aldoses and ketoses. Biochemical reactions of monosaccharide, Isomerism of Carbohydrates.</li><li>○ Lipids: Introduction, classification of lipids, Important saturated &amp; unsaturated fatty acids. Properties &amp; functions. Derived lipids: Phospholipids, glycolipids, Waxes, Biological role of cholesterol.</li></ul> <p><b>Amino acid and Proteins:</b></p> <ul style="list-style-type: none"><li>○ Introduction, classification, optical isomerism, Optical properties, Acid – Base properties. Peptide bond formation and properties. Composition and primary, secondary and tertiary structures of proteins.</li></ul> <p><b>Nucleic acids:</b></p> <ul style="list-style-type: none"><li>○ Structures of purine and pyrimidine bases, nucleosides, nucleotides, RNA and DNA (differences), helical structure of DNA (Watson &amp; Crick model), Types of RNA- mRNA, rRNA &amp; tRNA</li></ul> | 1 Credit<br>(20 Marks) |
| II   | <p><b>Instruments (theory and demonstration) Diagrams to be drawn.</b></p> <ul style="list-style-type: none"><li>○ Use, care and maintenance of water bath, water distillation plant, refrigerators, cold box and deep freezer</li><li>○ Centrifuges: Principle, Svedberg unit, centrifugal force.</li><li>○ Different types of centrifuges: Use, care and maintenance of a centrifuge.</li><li>○ Laboratory balances use, care and maintenance of manual balances and electrical balances.</li><li>○ Colorimeter and spectrophotometer, principle and different parts of colorimeter. Cuvettes, significance of cuvettes in colorimeter, cuvette</li></ul>  | 1 Credit<br>(20 Marks) |

|            |  |                                |
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|            | for visible and UV range.  |                                |
| <b>III</b> | <p><b>Standard solutions</b></p> <ul style="list-style-type: none"> <li>○ Technique for preparations of standard solutions. Significance of volumetric flasks in preparing standard solutions.</li> <li>○ Preparations of standard solutions of deliquescent compounds (CaCl<sub>2</sub>, Potassium carbonate, sodium hydroxide etc.)</li> </ul>   | <b>1 Credit<br/>(20 Marks)</b> |
| <b>IV</b>  | <p><b>Laboratory Apparatus and Preparation of solutions</b></p> <ul style="list-style-type: none"> <li>○ Pipettes – different types (Graduated, volumetric, Pasteur, automatic etc.), calibration of glass pipettes, Burettes, beakers, Petri dishes, depression plates.</li> <li>○ Flasks – different types, volumetric, round bottomed, conical etc.</li> <li>○ Significance of borosilicate glass; care and cleaning of glassware, different cleaning solutions of glass.</li> <li>○ Preparation of Molar, Normal, and Percentage solutions.</li> <li>○ Preparation of different dilutions</li> </ul> |                                |
| <b>V</b>   | <p><b>Bio Medical Waste Management</b></p> <ul style="list-style-type: none"> <li>○ To gain understanding of importance of proper and safe disposal of bio-medical waste &amp; treatment.</li> <li>○ To gain understanding of categories of biomedical waste.</li> <li>○ To learn about disposal of bio-medical waste colour coding, types of containers, transportation of waste, etc.</li> <li>○ To gain broad understanding of standards for bio-medical waste disposal</li> <li>○ To gain broad understanding of means of biomedical waste treatment.</li> </ul>                                     |                                |

### Practical Biochemistry (1 Credit)

| Sl. No. | Experiments   |
|---------|---|
| I       | Identification of different laboratory glasswares (Pipettes, Funnels, Measuring cylinders, Test tubes, Centrifuge tubes, test tube draining rack Tripod stand, wire gauze, Bunsen burner etc) |
| II      | Cleaning and maintenance of glassware.  |
| III     | Demonstration of instruments and appliances (Centrifuge, Weighing balance, colorimeter etc.)  |
| IV      | Demonstration of weighing various types of chemicals, liquids, hygroscopic substances   |
| V       | Preparation of discard solutions.   |
| VI      | Calculation and preparation of Percentage solution, Molar solution. Normality solution.   |
| VII     | Estimation of blood glucose (Fasting, Random and Postprandial)  |

### Reference Books:

| Sl. No. | Title | Authors | Publisher |
|---------|-------|---------|-----------|
|         |       |         |           |

|   |  |  |          |
|---|--|--|----------|
| 1 | Textbook of biochemistry for medical students          | D M Vasudevan                          | Jaypee   |
| 2 | Fundamentals of biochemistry                           | J L Jain                               | S Chand  |
| 3 | Biochemistry   | D Voet, J Voet                         | Wiley    |
| 4 | Medical Laboratory Technology Methods & interpretation | Ramnik Sood                            | Jaypee   |
| 5 | Textbook of Medical Lab Technology                     | Praful B. Godkar,<br>Darshan P. Godkar | Bhalani  |
| 6 | Biochemistry   | U. Satyanarayana<br>C. Chakrapani      | Elsevier |

**PAPER-III**

**INTRODUCTION TO PATHOLOGY (4 CREDITS)**

**Theory: 60**

**Practical: 20**

**Internal Assessment: 20**

**Theory: 3 Credits**

**Practical: 1 Credit**

**Overview and key learning outcomes:** In this paper the students have to know about various blood collection equipment, different types of blood sample collections, need to know about color coded vacutainers, anticoagulants, further the students has to know basics about blood and other samples with suitable collections and various tests. The students have to learn about various laboratory hazards, safety and first-aid and personal hygiene.

| <b>Unit</b> | <b>Topics</b>  | <b>Credits &amp; Marks</b>   |
|-------------|--|------------------------------|
| <b>I</b>    | <p><b>Introduction to pathology</b></p> <ul style="list-style-type: none"> <li>○ Evolution of pathology</li> <li>○ Different branches of pathology</li> </ul> <p><b>Cell injury</b></p> <ul style="list-style-type: none"> <li>○ Etiology of Cell injury</li> <li>○ Pathogenesis of cell injury</li> <li>○ Reversible and irreversible cell injury</li> <li>○ Cellular adaptations (Atrophy, Hypertrophy, hyperplasia, metaplasia, dysplasia etc)</li> </ul> | <b>1 Credit<br/>20 marks</b> |
| <b>II</b>   | <p><b>Inflammation</b></p> <ul style="list-style-type: none"> <li>○ Definition, causes and types</li> <li>○ Acute inflammation and chronic inflammation</li> <li>○ Cells involved in inflammation</li> <li>○ General features of chronic inflammation</li> <li>○ Systemic effects of chronic inflammation</li> </ul>   |                              |



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|-----|--|----------------------|
| III | <p><b>Basic Hematology</b></p> <ul style="list-style-type: none"> <li>○ Hematopoiesis - Erythropoiesis, Leukopoiesis and Thrombopoiesis</li> <li>○ Blood and its composition (Structure and functions of red blood cells, white blood cells, platelets and related pathologic conditions)</li> </ul> <p><b>Anaemia</b></p> <ul style="list-style-type: none"> <li>○ Introduction and classifications (Morphological and etiological), effects of anemia on body.</li> <li>○ Haematocrit</li> <li>○ Red cell indices (MCV, MCH, MCHC, RDW)</li> </ul> <p><b>Methods and types of various sample collection</b></p> <ul style="list-style-type: none"> <li>○ Collection of blood (Capillary, venous and arterial blood)</li> <li>○ Anticoagulants</li> <li>○ Interpretation of test request form</li> <li>○ Different types of vacutainers and order of blood draw</li> <li>○ Collection of CSF &amp; other body cavity fluids</li> <li>○ Urine collection &amp; use of preservatives</li> </ul> | 1 Credit<br>20marks  |
| IV  | <p><b>Introduction to Laboratory</b></p> <ul style="list-style-type: none"> <li>○ Types of laboratories</li> <li>○ Laboratory set up</li> <li>○ Physical aspect of laboratory</li> <li>○ Medico-logical aspects of clinical practice</li> </ul>  |                      |
| V   | <p><b>Introduction to Immuno-hematology</b></p> <ul style="list-style-type: none"> <li>○ History of blood group</li> <li>○ Biochemistry and genetics of ABO and RH blood Group individuals</li> <li>○ Different blood group systems</li> <li>○ Methods of blood grouping (ABO and Rh)</li> <li>○ Universal donor and recipient concepts</li> </ul>   | 1 Credit<br>20 marks |
| VI  | <p><b>Personnel Hygiene</b></p> <ul style="list-style-type: none"> <li>○ To develop understanding of the concept of Healthy Living</li> <li>○ To develop understanding &amp; procedures of Hand Hygiene</li> <li>○ To be equipped with Techniques of Use of PPE</li> </ul>   |                      |
| VII | <p><b>Safety &amp; First Aid</b></p> <ul style="list-style-type: none"> <li>○ To develop understanding and precautions to ensure Patient's Safety</li> <li>○ To develop basic understanding and precautions to ensure sample preservation while transporting</li> <li>○ Describe common emergency conditions and what to do in medical emergencies</li> <li>○ Describe basics of first aid</li> <li>○ Different types of Laboratory Hazards</li> <li>○ Accidents in the laboratory</li> </ul>  |                      |

**Practical Pathology: (1 Credit)**

| Sl. No. | Experiments  |
|---------|--|
| I       | Collection of Blood sample (capillary blood and Venous blood) using correct techniques (Vacutainer and syringe based blood collection) |

|     |  |
|-----|--|
| II  | Haemoglobin Estimation (Sahli's method and Cyanmethemoglobin method)     |
| III | Haematocrit (PCV)  |
| IV  | Erythrocyte Sedimentation Rate (ESR)(Wintrobe's and Westergren's method) |
| V   | Preparation of peripheral blood film and stain with Romanowsky stain.    |
| VI  | Blood grouping and Rh typing (Slide method and tube method)              |
| VII | Serum typing or reverse blood typing                                     |

**Reference Books:**

| Sl. No. | Title   | Authors                                | Publisher                   |
|---------|---|--|-----------------------------|
| 1       | Textbook of Pathology                         | Harsh Mohan                            | Jaypee                      |
| 2       | Clinical Pathology hematology & Blood Banking | Nanda Maheswari                        | Jaypee                      |
| 3       | Essentials of Clinical Pathology              | Shirish M Kawthalkar                   | Jaypee                      |
| 4       | Practical Pathology                           | Harsh Mohan                            | Jaypee                      |
| 5       | Textbook of Medical Laboratory Technology     | Darshan P. Godkar,<br>Praful B. Godkar | Bhalani<br>Publishing House |

**SEMESTER II**  
**PAPER-I**  
**PAPER CODE: MHS0200104**  
**BASIC BIOCHEMISTRY AND NUTRITION (4 CREDITS)**

**Theory: 75**

**Practical: 25**

**Theory: 3 Credits**

**Practical: 1 Credit**

**Overview and key learning outcomes:** In this paper the students will learn about the basic biochemistry like acid base balance in the human body, role of vitamins and minerals in health and disease, different types of enzymes and how it works. Further the students will know about the basic nutrition and related terminology.

| UNIT | Details   | Credits & Marks |
|------|---|-----------------|
| I    | <b>Acid base balance and disturbance</b><br>Basic concept of acid and base, pH, buffers, mechanism of buffer action<br>Acid base balance, Various mechanism for maintenance of blood pH<br>Disorders of acid base balance, Acidosis and alkalosis, anion gap.<br>Importance of blood gas measurement.   |                 |
| II   | <b>Vitamins</b><br>Definition and classification, Fats soluble vitamins and water-soluble vitamins<br>Biochemical functions, Dietary sources, Recommended dietary allowance, deficiency and toxic manifestations.   |                 |
| III  | <b>Mineral Metabolism</b><br>Calcium, phosphorous, iron, copper, zinc, sodium, potassium  |                 |
| IV   | <b>Enzymes</b><br>Introduction- definition<br>Nomenclature & classification, chemical nature and properties<br>Coenzymes, isoenzymes, properties<br>Enzyme specificity<br>Mechanism of action of enzymes<br>Factors affecting enzyme activity<br>Enzyme inhibition and regulation<br>Diagnostic value of serum enzymes – Creatinine kinase, alkaline phosphatase, Acid phosphatase, LDH, SGOT, SGPT, Amylase, Lipase. |                 |
| V    | <b>Nutrition</b><br>Study of Human Nutrition – Ideal nutrition, under nutrition and over nutrition<br>Nutrition and Energy – Energy content of foods, Respiratory quotient of foodstuffs<br>Utilization of energy by man –Basal metabolic rate, specific dynamic action, Physical activity<br>Energy requirement of man.<br>Nutritional importance of carbohydrates, lipids, proteins, vitamins and minerals.         |                 |

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|--|---|--|
|  | Importance of fibre in nutrition<br>Recommended dietary allowance and balance diet. |  |
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### **PRACTICALS:**

1. Estimation of SGOT
2. Estimation of SGPT
3. Estimation of Alkaline Phosphatase
4. Estimation of Amylase
5. Estimation of LDH

### **Reference Books:**

| <b>Sl No.</b> | <b>Title</b>                         | <b>Authors</b>          | <b>Publisher</b> |
|---------------|--------------------------------------|-------------------------|------------------|
| 1             | Clinical biochemistry                | Nessar Ahmed            | Oxford           |
| 2             | Textbook of medical biochemistry     | M N Chatterjea          | Jaypee           |
| 3             | Clinical Chemistry                   | M N Chatterjea          | Jaypee           |
| 4             | Lehninger Principles of Biochemistry | Nelson LD and Cox<br>MM |                  |

**SEMESTER II**  
**PAPER-II**  
**PAPER CODE: MHS0200204**  
**GENERAL MICROBIOLOGY (4 CREDITS)**

**Theory: 75**

**Practical: 25**

**Theory: 3 Credits**

**Practical: 1 Credit**

**Overview and key learning outcomes:** In this paper the student will have basic knowledge about bacteria and its structure, growth & nutrition, preparation of culture medium to grow bacteria. Further the students will be able to perform various sterilization methods.

| UNIT | Details  | Credits & Marks |
|------|--|-----------------|
| I    | <p><b>Introduction to Microbiology</b></p> <ul style="list-style-type: none"> <li>○ The history and scope of microbiology, characterization, classification of Micro-organisms.</li> </ul> <p><b>Morphology of bacteria</b></p> <ul style="list-style-type: none"> <li>○ Size, shape, structure of bacteria.</li> <li>○ Gram's characteristics of bacteria</li> </ul>  |                 |
| II   | <p><b>Growth and Nutrition:</b></p> <ul style="list-style-type: none"> <li>○ Nutrition requirements of bacteria,</li> <li>○ Growth and multiplications of bacteria</li> <li>○ Bacterial division,</li> <li>○ Batch Culture</li> <li>○ Continuous culture</li> <li>○ bacterial growth</li> <li>○ Total and viable count</li> </ul>  |                 |
| III  | <p><b>Sterilization and Disinfection</b></p> <ul style="list-style-type: none"> <li>○ Definition</li> <li>○ Methods of sterilization and disinfection.</li> <li>○ Frequently used terms</li> <li>○ Anti septic and disinfectants</li> <li>○ Principles and use of equipment's of sterilization namely Hot air Oven, Autoclave. Pasteurization.</li> </ul>  |                 |
| IV   | <p><b>Culture Media and Culture Methods</b></p> <ul style="list-style-type: none"> <li>○ Common ingredients of culture media, Classification of media</li> <li>○ Selective, differential, transport, indicator media</li> <li>○ Maintenance media</li> <li>○ Anaerobic Cultivation,</li> <li>○ Preparation of media, Forms of Media</li> <li>○ Use of culture media in diagnostic bacteriology.</li> <li>○ Methods of bacterial culture: Streak culture, lawn culture, stroke culture, stab culture, pour-plate culture, shake culture and liquid culture. Anaerobic culture methods.</li> </ul> |                 |

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| V  | <b>Pure culture and cultural characteristics</b> <ul style="list-style-type: none"> <li>○ Natural microbial population</li> <li>○ Selective methods</li> <li>○ Pure culture- methods of isolating pure culture</li> <li>○ Maintenance and preservation of pure culture</li> <li>○ Cultural characteristics</li> </ul> |  |
| VI | <b>Identification of Bacteria</b> <ul style="list-style-type: none"> <li>○ Microscopic Morphology</li> <li>○ Staining reactions – Gram’s stain, Ziehl Neelsen stain, Capsule stain, metachromatic stain.</li> </ul>   |  |

**PRACTICALS:**

1. Demonstration and sterilization of equipment’s- Hot Air Oven, Autoclave, Laminar Air Flow
2. Demonstration of commonly used culture media, nutrient broth, nutrient agar, blood agar, chocolate agar, MacConkey agar media etc.
3. Demonstration of pure culture techniques
4. Perform Grams Staining
5. Perform Acid Fast Staining
6. Negative Staining

**Reference book:**

| Sl. No. | Title  | Authors                    | Publisher                                  |
|---------|--|----------------------------|--|
| 1       | Text book of Microbiology                              | Ananthanarayan and Paniker | Universities Press (India) Private Limited |
| 2       | Textbook of Microbiology                               | Sunindar Kumar             | Jaypee                                     |
| 3       | Medical Laboratory Technology Methods & interpretation | Ramnik Sood                | Jaypee                                     |
| 4       | Microbiology   | Prescott                   | Tata McGraw Hill                           |
| 5       | Principles of microbiology                             | R M Atlas                  | Tata McGraw Hill                           |

**SEMESTER II**  
**PAPER-III**  
**PAPER CODE: MHS0200304**  
**CLINICAL PATHOLOGY AND HAEMATOLOGY (4 CREDITS)**

**Theory: 75**

**Practical: 25**

**Theory: 3 Credits**

**Practical: 1 Credit**

**Overview and key learning outcomes:** Clinical pathology involves the diagnosis of disease through the analysis of bodily fluids and tissues. Hematology, a subset of clinical pathology, focuses on blood-related disorders. Both fields play crucial roles in understanding and treating various medical conditions.

| UNIT | Details  | Credits & Marks |
|------|--|-----------------|
| I    | <b>Urine analysis</b><br>Formation and Composition of urine<br>Collection and preservation of urine<br>Physical and chemical examination of urine<br>Microscopic examination of urine<br>Clinical significance of urine analysis     |                 |
| II   | <b>Cerebrospinal fluid analysis</b><br>Formation and composition of CSF<br>Collection and preservation of CSF<br>Physical and chemical examination of CSF<br>Microscopic examination of CSF<br>Clinical significance of CSF analysis |                 |
| III  | <b>Semen analysis</b><br>Composition of semen<br>Collection and preservation of semen<br>Physical and chemical examination of semen<br>Microscopic examination of semen<br>Clinical significance of semen analysis                   |                 |
| IV   | <b>Sputum analysis</b><br>Composition of sputum<br>Collection and preservation of sputum<br>Physical and chemical examination of sputum<br>Microscopic examination of sputum<br>Clinical significance of sputum analysis             |                 |
| V    | <b>Introduction to cavity fluids</b><br>Transudates and exudates<br>Synovial fluid analysis<br>Peritoneal fluid analysis<br>Pericardial fluid analysis<br>Pleural fluid analysis   |                 |

|      |   |  |
|------|---|--|
| VI   | <p><b>Examination of Stool</b><br/> Collection of stools<br/> Physical Examination<br/> Chemical examination<br/> Microscopic examination</p>   |  |
| VII  | <p><b>Basic Haematology</b><br/> Haemoglobinometry: Principles and various methods of quantitating HB. Errors and quality control in various methods.<br/> Erythrocyte Sedimentation Rate (ERS): Principles and methods of determining ESR, increasing and decreasing conditions of ESR, factors affecting ESR.<br/> Haemocytometry: RBC count, WBC count, Platelets count, Absolute eosinophil count. Different types of diluting fluids, errors in sampling.<br/> Romanowsky stains: Categorization, advantage and disadvantages. Peripheral blood film preparation and staining with Leishman's stain and description of normal and abnormal cells.<br/> Total leucocyte count (TLC) and Differential leucocyte count (DLC)<br/> Sickling tests<br/> Osmotic fragility test<br/> Investigation of G<sub>6</sub>PD Deficiency<br/> Bone marrow aspiration and biopsy.<br/> Understanding Complete blood count and Blood R/E<br/> Automation and recent advances in haematological techniques.</p> |  |
| VIII | <p><b>Haemoglobin</b><br/> Different forms of haemoglobin, synthesis, functions, abnormal haemoglobin variants.</p>   |  |

**PRACTICALS:**

1. Urine Examination
  - a. Collection methods
  - b. Urine preservation
  - c. Physical Examination
  - d. Chemical Examinations
  - e. Microscopic examination
2. Semen Analysis
3. CSF Analysis
4. Determination of Hemoglobin.
5. Complete Blood Counts
6. RBC Count by Hemocytometers.
7. TLC by Hemocytometer.



8. Differential Leukocyte count.
9. Determination of Platelet Count.
10. Determination of ESR by Wintrob's method.
11. Determination of ESR by Westergren's method.
12. Determination of PCV by Wintrob's.
13. Erythrocyte Indices- MCV, MCH, MCHC.
14. Reticulocyte Count.
15. Absolute Eosinophil Count.
16. PBF preparation, stain and observe morphology of Red Blood Cells.

**References book:**

| <b>Sl. No.</b> | <b>Title</b>  | <b>Authors</b> | <b>Publisher</b> |
|----------------|---|----------------|------------------|
| 1              | Text book of medical laboratory technology              | Praful Godkar  | Bhalani          |
| 2              | Clinical diagnosis and management by laboratory methods | Bernard Henry  | W B Saunders     |
| 3              | Essential haematology                                   | A.V. Hoffbrand | Black well       |
| 4              | Principles of haematology                               | Peter Haen     | WCB              |

**SEMESTER III**  
**PAPER-I**  
**PAPER CODE: MHS0300104**  
**IMMUNOLOGY AND SEROLOGY (4 CREDITS)**

**Theory: 75**

**Practical: 25**

**Theory: 3 Credits**

**Practical: 1 Credit**

**Overview and key learning outcomes:** In this paper the students will understand about body defence system and types, vaccines and immunization, infection that can be transmitted from hospital, prevention and control of hospital infection. Further the students will have idea about various serological tests. These outcomes collectively empower individuals to make meaningful contributions to healthcare through their understanding and application of immunology and serology.

| UNIT | Details  | Credits & Marks |
|------|--|-----------------|
| I    | <b>Introduction to immune system</b><br>Innate and adaptive immunity,<br>Cells and tissues of immune system,<br>Functions of lymphoid tissue<br>Antigen: Immunogenicity versus antigenicity<br>Properties of immunogen, Hapten, adjuvants, epitopes  |                 |
| II   | <b>Antibody and MHC</b><br>Basic structure of antibody<br>Major classes and their biological activity<br>Antigenic determinants<br>Structure, function relationships in antibody<br>Major histocompatibility complex-MHC<br>Structure and properties of class I and II MHC<br>Expression of MHC molecule<br>Overview of monoclonal antibody            |                 |
| III  | <b>Immune response</b><br>Antigen processing and presentation<br>Cytosolic pathway for exogenous antigen<br>Endocytic pathway for exogenous antigen<br>Cell mediated immune response<br>T-cell activation and differentiation<br>Cytotoxic T cells and its functions<br>Humoral response<br>B-cell activation and differentiation<br>Complement system |                 |
| IV   | <b>Immune system in health and disease</b><br>Dysfunctional immunity<br>Hypersensitivity reactions-<br>Immediate hypersensitivity and delayed hypersensitivity reactions   |                 |

|    |  |  |
|----|--|--|
|    | Immunodeficiency diseases<br>Autoimmune diseases<br>Transplantation immunology   |  |
| V  | <b>Vaccine</b><br>Different types of immunizing agents – Vaccines and immunoglobulins<br>Active and passive immunization<br>Designing of vaccine for active immunization<br>Live attenuated vaccine, Inactivated vaccine<br>DNA vaccine, Recombinant |  |
| VI | <b>Serological reactions</b><br>Antigen antibody reactions<br>Precipitation reactions<br>Agglutination reactions<br>Radioimmunoassay and ELISA<br>Western blotting reactions<br>Immunofluorescence Flowcytometry                                     |  |

**Practical:**

1. WIDAL Test
2. VDRL Test
3. RF Test
4. CRP Test
5. ASO Test
6. Pregnancy Test
7. Rapid test for HIV Test

**Reference Books:**

| Sl. No. | Title                                       | Authors          | Publisher  |
|---------|---|------------------|------------|
| 1       | Textbook of microbiology                    | Suninder Kumar   | Jaypee     |
| 2       | Serology and immunology-A clinical approach | William Stanford | MacMillan  |
| 3       | Immunology                                  | Immunology       | WH Freeman |
| 4.      | Cellular and Molecular Immunology           | Abul Abbas       | Saunders   |
| 4.      | Basic and clinical immunology               | Daniel Stites    | Lange      |

**SEMESTER III**  
**PAPER-II**  
**PAPER CODE: MHS0300204**  
**INTRODUCTION TO METABOLISM (4 CREDITS)**

**Theory: 75**

**Practical: 25**

**Theory: 3 Credits**

**Practical: 1 Credit**

**Overview and key learning outcomes:** In this paper the students will learn about various metabolism related to carbohydrate, protein and lipids and nucleic acids and related diseases.

**Outcomes:** Energy Understanding, Metabolic Pathway Proficiency, Nutrient Utilization, Anabolic Processes, Regulation and Enzymes, by achieving these outcomes, student can apply their knowledge to fields like medicine, nutrition, and biochemistry, contributing to advancements in healthcare and understanding the intricacies of life processes.

| UNIT | Details  | Credits & Marks |
|------|--|-----------------|
| I    | <b>Chemistry of carbohydrates &amp; their related metabolism</b><br>Introduction-Definition and Classification<br>Biomedical importance & properties<br>Metabolism: Glycogenesis & glycogenolysis,<br>Glycolysis, Citric acid cycle & its significance HMP shunt & Gluconeogenesis<br>Regulation of blood glucose level<br>Hyperglycemia & hypoglycemia<br>Diabetes mellitus - definition, types, features Gestation diabetes mellitus<br>Glucose Tolerance test, glycosuria Hypoglycemia & its causes |                 |
| II   | <b>Chemistry of Proteins&amp; their related metabolism</b><br>Introduction-Definition and Classification of proteins<br>Biomedical importance<br>Metabolism: Catabolism of amino acids<br>Removal of NH <sub>2</sub> group<br>Transformation, Deamination Decarboxylation- Ammonia formation & transport<br>Urea cycle, Metabolic disorders in urea cycle<br>Fate of some important amino acids- Phenylalanine, Tyrosine & Tryptophan<br>Creatine, Creatinine  |                 |
| III  | <b>Chemistry of Lipids &amp; their related metabolism</b><br>Introduction-Definition and Classification of lipids<br>Biomedical importance, essential fatty acids<br>Metabolism: Beta oxidation of fatty acids<br>Fatty liver<br>Ketosis<br>Cholesterol & its clinical significance<br>Lipoproteins in the blood & their functions<br>Atherosclerosis  |                 |
| IV   | <b>Chemistry of Nucleic acid metabolism</b>  |                 |

|  |   |  |
|--|---|--|
|  | Elementary chemistry of DNA and RNA<br>Structure of nucleotide DNA and RNA molecule and its structure<br>Functions of nucleic acids<br>Nucleotide metabolism- purines and pyrimidines |  |
|--|---|--|

**Practical (1 Credit)**

1. Blood glucose estimation.
2. Estimation of serum urea
3. Estimation of serum creatinine
4. Estimation of uric acid
5. Determination of glucose in urine (Benedict's Test)
6. Determination of ketone bodies in urine (Rothera's Test)
7. Determination of protein in urine (Heat and Acetic Acid test, Sulphosalicylic acid test)
8. Determination of Bile pigment and Uribilinogen in urine (Fouchet's test and Ehrlich's test)
9. Determination of Bile salts in urine (Hay's Test)

**Reference Books:**

| Sl No. | Title                                | Authors                 | Publisher |
|--------|--------------------------------------|-------------------------|-----------|
| 1      | Clinical biochemistry                | Nessar Ahmed            | Oxford    |
| 2      | Textbook of medical biochemistry     | M N Chatterjea          | Jaypee    |
| 3      | Clinical Chemistry                   | M N Chatterjea          | Jaypee    |
| 4      | Lehninger Principles of Biochemistry | Nelson LD and Cox<br>MM |           |

**SEMESTER III  
PAPER-III  
PAPER CODE: MHS0300304  
SYSTEMIC BACTERIOLOGY (4 CREDITS)**

**Theory: 75**

**Practical: 25**

**Theory: 3 Credits**

**Practical: 1 Credit**

**Overview and key learning outcomes:** In this paper the students will be able to understand about various bacteria and related diseases caused by bacteria, how they cause disease and lab diagnosis. Further the students will be able to learn about the principles and applications of various microscopes.

| Unit | Details   | Credits & Marks |
|------|---|-----------------|
| I    | <b>Gram positive and gram-negative cocci</b><br>Morphology, cultural characteristics, biochemical reaction, pathogenesis/disease caused & lab diagnosis - Staphylococci, Pneumococci, Streptococci<br>N. gonorrhoeae, N. meningitides |                 |
| II   | <b>Gram positive bacilli</b><br>Morphology, cultural characteristics, biochemical reaction, pathogenesis/disease caused & lab diagnosis of Corynebacteria, Mycobacteria, Clostridia, Actinomycetes, Bacillus                          |                 |
| III  | <b>Gram negative bacilli</b><br>Morphology, cultural characteristics, biochemical reaction, pathogenesis/disease caused & lab diagnosis of Enterobacteriaceae, Pseudomonas, Vibrio, Brucella, Bordetella, Haemophilus.                |                 |
| IV   | <b>Miscellaneous bacteria</b><br>Morphology, cultural characteristics, biochemical reaction, pathogenesis/disease caused & lab diagnosis of Spirochetes – Treponema, Leptospira   |                 |
| V    | <b>Microscopy</b><br>Working principle and applications of Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope, Polarised Microscope, Scanning Electron Microscope and Transmission Electron Microscope.        |                 |

**Practical:**

1. Culture Techniques
2. Composition of culture media
3. Preparation of media
4. Identification of media & their uses
5. Culture methods & identification of common bacteria on media.
6. Antibiotic sensitivity testing.

**Reference Books:**

| <b>Sl. No.</b> | <b>Title</b>                       | <b>Authors</b>  | <b>Publisher</b> |
|----------------|------------------------------------|-----------------|------------------|
| 1              | Medical microbiology               | David Greenwood | ELBS             |
| 2              | Medical microbiology               | Michel Ford     | IBMS             |
| 3              | Diagnostic microbiology            | Ellen Baron     | Mosby            |
| 4.             | Medical Microbiology               | Anant Narayan   | Jaypee           |
| 5.             | Essentials of medical microbiology | Rajesh Bhatia   | Jaypee           |

**SEMESTER IV**  
**PAPER-I**  
**PAPER CODE: MHS0400104**  
**CLINICAL BIOCHEMISTRY (4 CREDITS)**

**Theory: 75**

**Practical: 25**

**Theory: 3 Credits**

**Practical: 1 Credit**

**Overview and key learning outcomes:** In this paper the students will learn about metabolic disorders of carbohydrates, lipids and protein. Further the students will know about the Liver Function Test, Kidney function Test and clinical enzymology.

| UNIT | Details   | Credits & Marks |
|------|---|-----------------|
| I    | <p><b>Metabolic disorders of carbohydrates</b><br/>           Overview of carbohydrate metabolism<br/>           Hyperglycemia- metabolic defect<br/>           Type I and II Diabetes mellitus<br/>           Causes, incidence, risk factors, biochemical basis and diagnosis, Complications<br/>           Hypoglycemia- metabolic defect<br/>           Diabetes profile</p>  |                 |
| II   | <p><b>Metabolic disorders of lipid</b><br/>           Hypercholesterolemia, hypertriglyceridaemia<br/>           Atheroma and heart disease, coronary artery disease<br/>           Causes, incidence, risk factors, biochemical basis and diagnosis.<br/>           Lipid profile test</p>   |                 |
| III  | <p><b>Metabolic disorders of protein and nucleic acid</b><br/>           Phenylketonuria and alkaptonuria<br/>           Maple syrup urine disease<br/>           Hyperuricemia<br/>           Gout- Metabolism defect, symptoms and diagnosis</p>  |                 |
| IV   | <p><b>Organ function test:</b><br/> <b>Liver function test</b><br/>           Functions of liver and diseases of liver, Jaundice, hepatitis, cirrhosis<br/>           Bilirubin metabolism,<br/>           Liver function test - plasma proteins, bilirubin (Direct, indirect and total bilirubin)<br/>           SGPT, SGOT, Alkaline phosphatase, gamma glutamyltransferase.<br/> <b>Kidney Function Test</b><br/>           Functions of kidney, Renal threshold of substances, Clearance test (Urea and creatinine clearance test) for glomerular function, Urine concentration and dilution test for tubular function.</p> |                 |



|   |  |  |
|---|--|--|
| V | <b>Clinical enzymology</b><br>Introduction to enzymes<br>Clinical significance of enzyme assays<br>Significance of isoenzymes<br>Different isoenzymes.<br>SGOT, SGPT, Alkaline Phosphatase, GGT, Amylase, Acid Phosphatase,<br>LDH, CPK, Troponin, Acid Phosphatase etc. |  |
|---|--|--|

**Practical:**

1. Estimation of Cholesterol
2. Estimation of HDL/LDL Cholesterol
3. Estimation of Triglycerides
4. Estimation of LDH
5. Estimation of Glucose
6. Estimation of Bilirubin (Total, Direct, Total + Direct)
7. Estimation of SGPT/SGOT
8. Estimation of Acid Phosphatase
9. Estimation of Alkaline Phosphatase
10. Estimation of Creatinine
11. Estimation of Urea
12. Estimation of Uric acid
13. Estimation of Blood Urea Nitrogen

**Reference Books:**

| Sl No. | Title                                | Authors                 | Publisher |
|--------|--------------------------------------|-------------------------|-----------|
| 1      | Clinical biochemistry                | Nessar Ahmed            | Oxford    |
| 2      | Textbook of medical biochemistry     | M N Chatterjea          | Jaypee    |
| 3      | Clinical Chemistry                   | M N Chatterjea          | Jaypee    |
| 4      | Lehninger Principles of Biochemistry | Nelson LD and Cox<br>MM |           |

**SEMESTER IV**  
**PAPER-II**  
**PAPER CODE: MHS0400204**  
**IMMUNOHEMATOLOGY AND BLOOD BANKING (4 CREDITS)**

**Theory: 75**

**Practical: 25**

**Theory: 3 Credits**

**Practical: 1 Credit**

**Overview and key learning outcomes:** In this paper the students will understand about blood groups, blood transfusion, different methods to identify blood groups, matching donor's blood with patient's blood, various screening procedures for donors.

Outcome: Blood Typing Proficiency, Antibody Detection, Transfusion Medicine Knowledge, Compatibility Testing, Blood Component Separation, Emergency Response by achieving these outcomes, individuals in immunohematology and blood banking contribute significantly to the safety of blood transfusions, public health, and emergency medical response efforts.

| UNIT | Details   | Credits & Marks |
|------|---|-----------------|
| I    | <b>Concept of immunohematology</b><br>Definition of immunohematology<br>Antigens and antibodies in the blood<br>Antigen-antibody reaction in vitro<br>Complement fixation test  |                 |
| II   | <b>Blood group system</b><br>ABO blood group system and ABO variant<br>Genetics and inheritance of blood groups<br>Rh blood group system and other blood group systems<br>Laboratory detection of antibodies and antigen-<br>Blood grouping techniques- Cell grouping and<br>Serum grouping<br>Antiserum used in ABO test procedures, Anti ---A,<br>Anti-B Anti- AB Antiserum                   |                 |
| III  | <b>Blood transfusion practice</b><br>Types of transfusion, main objective of blood transfusion, Special transfusion practice<br>Hazards of transfusion –transfusion transmitted diseases, Haemolytic transfusion reaction<br>Investigation of a Transfusion reaction<br>Actions to take when transfusion reaction occurs<br>Haemolytic disease of new born<br>Coomb's test and its significance |                 |
| IV   | <b>Blood banking</b><br>Functions of blood bank, Design, components of blood bank   |                 |

|    |  |  |
|----|--|--|
|    | Blood donor- screening criteria, collection of blood and post collection processing<br>Blood donation record book, Blood donor card<br>Storage, preservation- various anticoagulants<br>Cross matching techniques<br>Issue of blood in emergency lifesaving situation<br>Issue of blood in neonate and infants |  |
| V  | <b>Blood component separation and use</b><br>Apheresis procedure<br>Blood components-red cells, white cells, platelets, coagulation factors, FFP, Cryoprecipitate etc.<br>Advantages of blood component therapy  |  |
| VI | <b>HLA system</b><br>Historical perspective<br>Antigen and antibodies<br>HLA gene products<br>Techniques of histocompatibility testing<br>Clinical significance of HLA system  |  |

### Practical (1 Credit)

1. Preparation of 5% and 10% red cell suspension
2. Blood grouping and Rh typing (Slide and tube method)
3. Serum typing
4. Cross Matching (Major and Minor cross matching)
5. Screening of Donor's blood for infective agents
6. Preparation of blood components.

### Reference Books:

| Sl. No. | Title  | Authors          | Publisher |
|---------|--|------------------|-----------|
| 1       | Modern blood banking and transfusion practice        | Denise Harmening | Jaypee    |
| 2       | Blood transfusion a basic text                       | Anthony Britten  | AITBS     |
| 3       | A textbook of blood banking and transfusion medicine | VH Talib         | CBS       |
| 4.      | A textbook of blood bank and transfusion medicine    | Satish Gupte     | Jaypee    |

**SEMESTER IV**  
**PAPER-III**  
**PAPER CODE: MHS0400304**  
**INTRODUCTION TO MYCOLOGY & VIROLOGY (4 CREDITS)**

**Theory: 75**

**Practical: 25**

**Theory: 3 Credits**

**Practical: 1 Credit**

**Overview and key learning outcomes:** In this paper the students will learn about properties of fungus and virus. The students will know about the medically important fungus and virus. By achieving these outcomes, individuals in mycology and virology contribute to medical research, public health, and clinical practice, playing vital roles in disease diagnosis, treatment, and prevention.

| UNIT | Details  | Credits & Marks |
|------|--|-----------------|
| I    | <b>Introduction to Mycology</b><br>General properties of fungi, classification of fungi, reproduction and sporulation, cultivation methods, laboratory methods of diagnosing fungal infection.   |                 |
| II   | <b>Mycoses</b><br>Classification of mycoses, Superficial and deep fungal infections, opportunistic fungal infection. Mycotoxins pathogenesis and lab diagnosis - <i>Malassezia furfur</i> , <i>T. nigra</i> , <i>T. Pidera</i> , Mycetoma, Rhinosporidium, Sporotrichosis, Dermatophytes, <i>Candida albicans</i> , Histoplasmosis, Blastomycosis, Coccidiosis |                 |
| III  | <b>Introduction to Virology</b><br>Classification and general properties of viruses – interferon, inclusion bodies<br>Structure and chemical composition of viruses<br>Viral replication, Cultivation of viruses and laboratory diagnostic methods of viral diseases   |                 |
| IV   | <b>Viral diseases</b><br>Pox virus, Herpes virus, Myxoviruses, Enteroviruses<br>Rabies, Arbo viruses, hepatitis, HIV, viruses causing gastro enteritis, miscellaneous viruses  |                 |

**Practical (1 credit)**

1. Skin scrapping and KOH mount
2. Culture Media used for fungus.
3. Preparation of fungal culture – SDA, BHI
4. LPCB
5. Methods of lab diagnosis & virus.

**Reference Books:**

| <b>Sl. No.</b> | <b>Title</b>                       | <b>Authors</b>  | <b>Publisher</b> |
|----------------|------------------------------------|-----------------|------------------|
| 1              | Medical microbiology               | David Greenwood | ELBS             |
| 2              | Medical microbiology               | Michel Ford     | IBMS             |
| 3              | Diagnostic microbiology            | Ellen Baron     | Mosby            |
| 4              | Medical Microbiology               | Anant Narayan   | Jaypee           |
| 5              | Essentials of medical microbiology | Rajesh Bhatia   | Jaypee           |

**SEMESTER IV**  
**PAPER-IV**  
**PAPER CODE: MHS0400404**  
**MEDICAL PARASITOLOGY (4 CREDITS)**

**Theory: 75**

**Practical: 25**

**Theory: 3 Credits**

**Practical: 1 Credit**

**Overview and key learning outcomes:** In this paper the students will learn about various parasites and its types and the disease caused and various virus its transmission lab diagnosis etc. further the students will be able to identify different blood and stool parasites by various diagnostic techniques.

**Outcomes:** Parasite Identification, Pathogenicity, Epidemiology, Diagnostic Techniques. By achieving these outcomes, students in medical parasitology play crucial roles in disease diagnosis, treatment, and prevention, contributing to global health initiatives and improving the well-being of affected populations.

| UNIT | Details  | Credits & Marks |
|------|--|-----------------|
| I    | <p><b>Introduction to Parasitology</b></p> <ul style="list-style-type: none"> <li>○ Common terms employed in Parasitology</li> <li>○ Classes of parasites and hosts</li> <li>○ Host-Parasite relationship</li> <li>○ Different routes of transmission of parasites</li> <li>○ Basic classification and characteristics of Protozoa and Helminths</li> </ul>  |                 |
| II   | <p><b>Protozoa</b><br/> Describe the morphology, life-cycle, pathogenicity, disease caused, laboratory diagnosis and prophylaxis of</p> <ul style="list-style-type: none"> <li>○ <i>Entamoeba histolytica</i></li> <li>○ <i>Giardia lamblia</i></li> <li>○ <i>Balantidium coli</i></li> <li>○ <i>Toxoplasma gondi</i></li> <li>○ Trichomonas</li> <li>○ Plasmodium species</li> <li>○ <i>Leishmania donovani</i></li> </ul>  |                 |
| III  | <p><b>Helminths</b><br/> Describe the morphology, life-cycle, pathogenicity, disease caused, laboratory diagnosis and prophylaxis of Platyhelminthes</p> <ul style="list-style-type: none"> <li>○ <b>Cestoda (Tape worms):</b> <i>Taenia solium</i>, <i>Taenia saginata</i>, <i>Echinococcus granulosus</i></li> <li>○ <b>Trematodes (Flukes):</b> <i>Schistosoma haematobium</i>, <i>Fasciola hepatica</i>,</li> </ul> <p><b>Nemathelminthes</b></p> <ul style="list-style-type: none"> <li>○ <b>Nematoda (Round Worm):</b> <i>Ascaris lumbricoides</i>, <i>Enterobius</i></li> </ul> |                 |

|    |  |  |
|----|--|--|
|    | <i>vermicularis, Strongyloides stercoralis, Trichiuris trichiura, Anchylostoma duodenale, Dracunculus medinensis, Wuchereria bancrofti.</i>  |  |
| IV | <b>Diagnostic Techniques</b> <ul style="list-style-type: none"> <li>○ Collection and preservation of sample for parasitological examination.</li> <li>○ <b>Examination of stool for parasites:</b> Staining techniques, Concentration techniques.</li> <li>○ <b>Examination of blood for parasites:</b> Thin and thick blood film for malaria and microfilaria, different staining techniques,</li> <li>○ <b>Examination of Biopsy material:</b> Brief account of splenic puncture for diagnosis of Kala-azar, lymph node puncture, bone marrow biopsy and skin biopsy.</li> </ul> |  |

### PRACTICALS (1 Credit)

1. Saline preparation and iodine preparation from stool specimen.
2. Saline concentration techniques for faecal parasite.
3. Zinc sulphate flotation technique.
4. Preparation of thin and thick blood film for malarial parasite.
5. Buffy coat smear preparation.
6. Blood film preparation for microfilaria.

### Reference Books:

| Sl. No. | Title  | Authors                    | Publisher                                  |
|---------|--|----------------------------|--|
| 1       | Text book of Microbiology                              | Ananthanarayan and Paniker | Universities Press (India) Private Limited |
| 2       | Textbook of Microbiology                               | Sunindar Kumar             | Jaypee                                     |
| 3       | Medical Laboratory Technology Methods & interpretation | Ramnik Sood                | Jaypee                                     |
| 4       | Microbiology   | Prescott                   | Tata McGraw Hill                           |
| 5       | Principles of microbiology                             | R M Atlas                  | Tata McGraw Hill                           |

**SEMESTER V**  
**PAPER-I**  
**PAPER CODE: MHS0500104**  
**BASICS OF MOLECULAR BIOLOGY (4 CREDITS)**

**Theory: 75**

**Practical: 25**

**Theory: 3 Credits**

**Practical: 1 Credit**

**Overview and key learning outcomes:** In this paper the students will learn about various genetic code, DNA replication, Transcription, translation gene regulation. Basic molecular biology study covers DNA and RNA processes, gene expression regulation, protein structure, and essential laboratory techniques. Students explore genome organization, cell signalling, and applications in genetic engineering and medicine. This foundational knowledge underpins advances in biotechnology and contributes to understanding life at the molecular level.

| UNIT | Details   | Credits & Marks |
|------|---|-----------------|
| I    | <p><b>Genetic code and Chromatin structure</b><br/>           Biochemical elucidation of codon, properties of genetic code, Wobble hypothesis, cracking of genetic code.<br/>           DNA binding protein – Histones and non- histones proteins, structure and types of binding motifs with example, Supercoiling of DNA, positive and negative supercoiling.</p>   |                 |
| II   | <p><b>Replication of DNA</b><br/>           Concept of replication, uni- and bi- directional replication, rolling circle model and D-loop model for replication.<br/>           Initiation, elongation and termination of replication. Enzymes and accessory proteins; Fidelity. Telomerases: mechanism, maintenance of integrity and role in cancer</p>  |                 |
| III  | <p><b>Transcription</b><br/>           Definition, Initiation, Elongation, termination post transcriptional modifications<br/>           Processing of hn RNA, tRNA, rRNA; 5'Cap formation; 3'-end processing and polyadenylation; Splicing; RNA editing; mRNA stability.</p>   |                 |
| IV   | <p><b>Translation</b><br/>           Translation machinery; Ribosomes, ER, composition and assembly; termination codons; Mechanism of initiation, elongation and termination; Co- and post-translational modifications.<br/>           Transport: Transport of proteins and molecular chaperones; Protein stability; Protein turnover and degradation.</p>  |                 |
| V    | <p><b>Gene regulation and Mutation</b><br/>           Operator, promoter, regulator, terminator, TATA box, CAT box.<br/>           Operator concept- Lactose and Tryptophan operons.<br/>           Introduction and Types of Mutation, Suppression of Mutation.<br/>           Mutagens: Introduction, types and properties.<br/>           DNA Damage, Repair, and Recombination. Transposable elements and Retrotransposons.</p> |                 |



|     |   |
|-----|---|
| I   | <p><b>Introduction and Application of rDNA technology</b></p> <p>Steps involved in rDNA technology, isolation of DNA from different sources, concept of restriction modification, restriction endonucleases, Introduction of vector and host. Introduction to generation of genomic and cDNA libraries.</p> <p>Gene therapy, pharmaceutical products and molecular diagnostics,</p>   |
| II  | <p><b>Gene amplification through PCR and Types</b></p> <p>Polymerase Chain Reaction: Principle, methodology, primer designing, types of polymerase and factors affecting PCR, advantages, limitations and application PCR. Variants of PCR: Reverse Transcriptase PCR, Real Time PCR, Inverse PCR, anchored PCR, nested PCR, hot start PCR, multiplex PCR, touchdown PCR, ARMS (amplification refractive mutation system) PCR</p> |
| III | <p><b>DNA fingerprinting methods</b></p> <p>Methodology and application of DNA fingerprinting methods (RFLP with probe introduction, RAPD, AFLP).</p> <p>Principle methodology and types of DNA sequencing (Sanger Coulson method, Maxam-Gilbert method, Pyrosequencing)</p>  |

**Reference Books:**

| Sl. No. | Title                                | Authors        | Publisher       |
|---------|--------------------------------------|----------------|-----------------|
| 1       | Gene VIII (2004) and Gene IX (2008). | B. Lewin       | Oxford          |
| 2       | Molecular biology of The Cell        | Alberts et al. | Garland science |
| 3       | Molecular Biology of the Cell        | Lodish et al., | WH Freeman      |
| 4       | Recombinant DNA                      | Watson et. al. | WH Freeman      |

**Practical:**

1. Demonstrate DNA extraction methods.
2. Demonstrate the PCR process and its role in DNA amplification.
3. Demonstrate the Gel Electrophoresis.
4. Demonstrate Agarose gel electrophoresis
5. Visualize and analyze the separated DNA bands.
6. Isolation of DNA from blood sample.

**SEMESTER V**  
**PAPER-II**  
**PAPER CODE: MHS0500204**  
**HISTOPATHOLOGICAL TECHNIQUES (4 CREDITS)**

**Theory: 75**

**Practical: 25**

**Theory: 3 Credits**

**Practical: 1 Credit**

**Overview and key learning outcomes:** Histopathological techniques studies result in adept tissue processing, microscopic evaluation, and staining proficiency for accurate disease diagnoses. The application of quality control measures ensures reliability, contributing to effective communication with clinicians and enhancing patient care. Furthermore, individuals in this field contribute to scientific research, investigating disease mechanisms and treatment responses, thereby advancing our understanding of various medical conditions. This expertise plays a crucial role in both pathology and medical research.

| UNIT | Details  | Credits & Marks |
|------|--|-----------------|
| I    | <b>Introduction to Histopathology</b><br>Fundamentals of normal histology and histopathology<br>Overview of tissue seen in normal histology<br>Epithelium, muscle, nervous and connective tissue<br>Basic histopathology- non tumor pathology<br>Tumor pathology   |                 |
| II   | <b>Specimen receiving, labelling and registration in the laboratory</b><br>Mention proper label with patient information and avoid cross contamination of the specimen.<br>Mention unique specimen identification to the specimen  |                 |
| II   | <b>Basic steps for Tissue Processing</b><br>Fixing of tissues, classification, mode of action, buffered fixative, preparation of various fixatives<br>Grossing technique<br>Dehydration, clearing, infiltration and embedding in wax, Chemicals involved in tissue processing, different moulds used in embedding<br>Post fixation treatment.<br>Microtomy - Tissue sectioning technique using microtome.<br>Methods of decalcifications: Chemical involved, end point of decalcification. |                 |
| III  | <b>Equipment for histopathological techniques</b><br>Microscope, Microtome -Types, Uses, Parts, different types of microtome knives, care & maintenance, honing and stropping.<br>Automated tissue processor - components, working & precautions during use, Tissue floating bath, slide warming table.  |                 |
| IV   | <b>Staining Methods</b><br>Basic structure of a dye, mechanism of staining, progressive and regressive staining, mordant, accentuators, dye classification.<br>Haematoxylin & Eosin stain, Haematoxylin - Types, methods of preparation, staining,<br>Eosin - method of preparation  |                 |

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|    | <b>Special stains</b> – stain for collagen fibre, reticular fibre, elastic fibre<br>Staining of glycogen and mucin   |  |
| V  | <b>Enzyme histochemistry</b><br>Immunohistochemistry and the various immunohistochemical stains in the diagnosis of various disorders Tissues of special interest – nervous system, Hard tissue, Endocrine cells |  |
| VI | Frozen sections and cryostat sections – working principle, applications,   |  |

**Practical:**

1. Demonstration of instruments used in histopathology laboratory.
2. Labelling of histopathological specimen and filling of requisition form.
3. Receiving and registering of specimen.
4. Preparation of various chemicals in laboratory
5. Grossing and role of laboratory technologist
6. Tissue processing, blocking, section cutting, staining with H&E stain , mounting and labelling.
7. Decalcification of bone and other hard tissue.
8. Preservation and museum techniques.

**Reference Books:**

| Sl. No. | Title   | Authors            | Publisher            |
|---------|---|--------------------|----------------------|
| 1       | Manual of histological techniques and their diagnostic application        | John Bancroft      | Churchill livinstone |
| 2       | Concise book of medical laboratory technology-Methods and interpretations | Ramnik Sood        | Jaypee               |
| 3       | Clinical diagnosis and management by laboratory methods                   | John Bernard henry | Saunders             |
| 4       | Textbook of medical laboratory technology                                 | Praful Godkar      | Bhalani              |

**SEMESTER V**  
**PAPER-III**  
**PAPER CODE: MHS0500304**  
**ENDOCRINOLOGY, TUMOR AND CANCER MARKERS (4 CREDITS)**

**Theory: 75**

**Practical: 25**

**Theory: 3 Credits**

**Practical: 1 Credit**

**Overview and key learning outcomes:** Endocrinology and tumor/cancer markers studies provide insights into hormonal regulation, neoplastic conditions, and specific molecular indicators. Students learn to identify hormonal imbalances and understand their role in diseases like diabetes and thyroid disorders. Proficiency in detecting tumor and cancer markers equips individuals for early diagnosis and targeted therapeutic interventions, contributing to advancements in personalized medicine and improving patient care in endocrine and oncological settings.

| UNIT | Details  | Credits & Marks |
|------|--|-----------------|
| I    | <b>Introduction to Endocrinology</b><br>Definition of hormone,<br>Endocrine gland, Exocrine and paracrine glands<br>Chemical nature of hormones<br>Classification<br>Mode of hormone action-receptors, secondary<br>Messengers-cAMP, GMP<br>Hormone assay and analysis   |                 |
| II   | <b>Hypothalamus and pituitary gland</b><br>Anatomy, Chemistry and functions of hypothalamus<br>Regulations and diseases related to hormones of these gland<br>TRH, GHRH, GnRH, CRH, Somatostatin, dopamine<br>Pituitary gland- Anatomy, Chemistry and functions-GH, Prolactin, FSH, LH, ADH<br>Neuro hypophyseal hormones<br>Pineal gland- Morphology and hormones |                 |
| III  | <b>Thyroid and parathyroid glands</b><br>Anatomy, Chemistry and functions, secretion and metabolism of thyroid and parathormones<br>Regulation of thyroid hormones<br>Pathophysiology of the thyroid hormones-<br>Diseases related to these glands   |                 |
| IV   | <b>Adrenal gland</b><br>Anatomy, Chemistry and functions and regulations of Adrenocortical hormones<br>Adrenal medulla hormones  |                 |

|     |  |  |
|-----|--|--|
|     | Pathophysiology of these hormones<br>Addison's disease, Cushing's syndrome   |  |
| V   | <b>Gastrointestinal and pancreatic hormones</b><br>Structure and cell types of islets of Langerhans of pancreas<br>Secretion of insulin, glucagon and other hormones- Functions and Pathophysiology of these hormones- Diabetes mellitus<br>Gastrointestinal hormones- Gastrin, CCK, Secretin- Functions and regulation  |  |
| VI  | <b>Reproductive hormones</b><br>Male and female reproductive hormones<br>Testosterone, Estrogen, Progesterone and others synthesis and functions<br>Human chorionic gonadotropin<br>Functions, regulation and Pathophysiology related to reproductive hormones   |  |
| VII | <b>Tumor and cancer markers</b><br>Concept of benign and malignant neoplasms, Categories of neoplasia<br>Oncogene-definition-<br>Mechanism of action of Oncogenes (outline)<br>Characteristics of growing tumor cells-general and morphological changes, biochemical changes<br><b>Tumor Markers-</b><br>Introduction and definition<br>Clinical applications of tumor markers.<br>Enzymes as tumor markers<br>Prostate specific antigens (PSA)<br>Oncofetal antigens, Alpha feto protein (AFP)<br>Carcino embryonic antigen (CEA)<br>Squamous cell carcinoma (SCC) antigen. |  |

**Practical:**

**ENDOCRINOLOGY**

1. Estimation of T3
2. Estimation of T4
3. Estimation of TSH
4. Estimation of FSH
5. Estimation of LH
6. Estimation of hCG
7. Estimation of Cortisol
8. Estimation of Progesterone
9. Estimation of Testosterone

**TUMOR & CANCER MARKERS:**

1. Estimation of Alpha feto proteins (AFP)

2. Estimation of Carcino embryonic antigen (CEA)

3. Estimation of CA- 125

4. Estimation of Prostate specific antigen (PSA)

**Reference Books:**

| <b>Sl. No.</b> | <b>Title</b>  | <b>Authors</b>    | <b>Publisher</b>  |
|----------------|---|-------------------|-------------------|
| 1              | Basic and clinical endocrinology  | Francis Greenspan | Prentice-Hall     |
| 2              | Textbook of medical biochemistry  | M N Chatterjea    | Jaypee            |
| 3              | Textbook of endocrinology   | Mala Dharmalingam | Mala Dharmalingam |
| 4              | Concise book of medical laboratory technology-Methods and interpretations | Ramnik Sood       | Jaypee            |

**SEMESTER V**  
**PAPER-IV**  
**PAPER CODE: MHS0500404**  
**SPECIAL HAEMATOLOGY (4 CREDITS)**

**Theory: 75**

**Practical: 25**

**Theory: 3 Credits**

**Practical: 1 Credit**

**Overview and key learning outcomes:** Special haematology is a branch of medical laboratory science that focuses on the analysis and diagnosis of haematological disorders beyond routine blood cell counts. It involves specialized tests to assess blood cell morphology, hemoglobinopathies, coagulation disorders, and various abnormalities related to blood cells and clotting factors.

| UNIT       | TOPICS  | Credits and Marks |
|------------|---|-------------------|
| <b>I</b>   | <p><b>Anaemia</b></p> <ul style="list-style-type: none"> <li>➤ General aspect of anaemia</li> <li>➤ Morphologic &amp; Etiologic classification of anaemia</li> <li>➤ Clinical features of anaemia and investigation of anaemia subject.</li> <li>➤ Iron Deficiency anaemia: Iron metabolism, etio-pathology of iron deficiency anaemia, clinical features and lab diagnosis.</li> <li>➤ Megaloblastic anaemia: Vitamin B12 and folate metabolism, biochemical basis of megaloblastic anaemia, etio-pathogenesis, clinical features and laboratory diagnosis.</li> <li>➤ Haemolytic anaemia: Definition and classification, features and laboratory investigation of haemolytic anaemia.</li> </ul> <p>Genetic defects of haemoglobin</p> <ul style="list-style-type: none"> <li>➤ Sickle cell anaemia and Thalassaemia</li> </ul> |                   |
| <b>II</b>  | <p><b>General aspects of white cell disorders</b></p> <ul style="list-style-type: none"> <li>➤ Granulocytes and their disorders</li> <li>➤ Monocytes and their disorders</li> <li>➤ Lymphocytes and their disorders</li> </ul>  |                   |
| <b>III</b> | <p><b>Platelets and haemostasis</b></p> <ul style="list-style-type: none"> <li>➤ Functions of platelets – primary haemostasis</li> <li>➤ Blood coagulation factors and extrinsic and intrinsic pathway</li> <li>➤ Bleeding disorders due to vascular, platelet abnormalities</li> <li>➤ Disorders of coagulation factors</li> </ul>   |                   |
| <b>IV</b>  | <p>Introduction to leukaemia</p> <ul style="list-style-type: none"> <li>➤ Definition and classification of leukaemia (FAB classification)</li> <li>➤ Lymphoid leukaemia</li> <li>➤ Myeloid leukaemia</li> </ul>   |                   |
| <b>V</b>   | <p><b>Introduction to Special Haematology:</b></p> <ul style="list-style-type: none"> <li>- Overview of specialized haematology</li> <li>- Importance in clinical practice and research</li> </ul>  |                   |

|           |   |  |
|-----------|---|--|
| <b>VI</b> | <b>Haematological Disorders:</b> <ul style="list-style-type: none"><li>- In-depth study of rare and complex haematological disorders</li><li>- Pathophysiology, clinical manifestations, and treatment approaches</li></ul> |  |
|-----------|---|--|



**SEMESTER VI**  
**PAPER-I**  
**PAPER CODE: MHS0600104**  
**CYTOPATHOLOGICAL TECHNIQUES (4 CREDITS)**

**Theory: 75**

**Practical: 25**

**Theory: 3 Credits**

**Practical: 1 Credit**

**Overview and key learning outcomes:** In this paper the students will learn in details about cytopathology and various branches, different types of specimens used in cytopathology lab, different normal and abnormal cells, Fine needle aspiration cytology along with different fixation and staining. Cytopathological studies yield expertise in precise disease diagnosis, particularly cancer, enabling effective screening and early detection. The outcomes play a crucial role in healthcare, impacting patient care and contributing to continuous advancements in medical science.

| UNIT       | TOPICS   | Credits and Marks |
|------------|--|-------------------|
| <b>I</b>   | Definition of cytology, Cells & tissues, Normal tissues of various systems of human body.  |                   |
| <b>II</b>  | <b>Classification of cytology</b> <ul style="list-style-type: none"> <li>○ Exfoliative and interventional cytology, Role of Cytology, Nuclear criteria of inflammation &amp; malignancy</li> </ul>   |                   |
| <b>III</b> | Collection of specimens from female genital tract specimen for routine screening. <ul style="list-style-type: none"> <li>○ Cervical smear</li> <li>○ Vaginal pool smear</li> <li>○ Lateral vaginal smear</li> <li>○ Combined (fast) smear</li> <li>○ Triple smear</li> <li>○ Endocervical and endometrial smear</li> </ul> |                   |
| <b>IV</b>  | <b>Urinary cytology</b> <ul style="list-style-type: none"> <li>○ Collection of urinary tract specimens</li> <li>○ Diagnostic utility of urinary cytology</li> </ul>  |                   |
| <b>V</b>   | <b>Progressive changes of the cells</b> <ul style="list-style-type: none"> <li>○ Changes in inflammation</li> <li>○ Dyskariotic Changes</li> <li>○ Changes in malignancy</li> </ul>  |                   |
| <b>VI</b>  | <b>Body cavity Fluids</b> <ul style="list-style-type: none"> <li>○ Effusions</li> <li>○ Collection and processing of body cavity fluid specimens</li> <li>○ Cyto-preparation and staining</li> <li>○ Processing of clotted and Bloody specimen.</li> </ul>   |                   |
| <b>VII</b> | <b>Fine Needle Aspiration Cytology</b> <ul style="list-style-type: none"> <li>○ Application of FNAC</li> <li>○ Advantages of FNAC</li> </ul>   |                   |

|             |   |  |
|-------------|---|--|
|             | <ul style="list-style-type: none"> <li>○ General procedure of FNAC</li> <li>○ Limitation of FNAC</li> <li>○ Wet and Dry fixed smear, its difference</li> </ul>  |  |
| <b>VIII</b> | Imprint cytology, Crush Smear cytology, Biopsy sediment cytology <ul style="list-style-type: none"> <li>○ Cell block preparation</li> <li>○ Cytological fixative and mailing Definition,</li> <li>○ Types/classification, Aims &amp; object</li> <li>○ Materials for establishments of cytological lab</li> </ul> |  |
| <b>IX</b>   | <b>Staining</b> <ul style="list-style-type: none"> <li>○ R/E stain types-Methods, Maintenance, Preparation of stain, Pap's stain</li> </ul> Special stains <ul style="list-style-type: none"> <li>○ MGG</li> <li>○ PAS</li> <li>○ ZN</li> <li>○ Mucicarmine</li> </ul> Mounting and Labelling                     |  |
| <b>X</b>    | <b>Establishments of lab</b> <ul style="list-style-type: none"> <li>○ Manpower, Space, Ventilation, Light, Water, working benches, Room arrangements, Reception of specimens, Instruments required</li> </ul>   |  |

**PRACTICALS: (1 CREDITS)**

- 1 Sample receiving labelling and entering
- 2 Preparation of Exfoliative cytological smears
- 3 Fixation – types and methods, Fixatives preparations
- 4 Preparation of smears in interventional cytology, Fixation and stains
- 5 Assist in FNAC  
Staining R/E -
  - Preparation of stains
- 6 Methods
  - MGG stain
  - PAP's Stain
- 7 Determination of sex chromatin

**Reference Books:**

| Sl. No. | Title   | Authors            | Publisher            |
|---------|---|--------------------|----------------------|
| 1       | Manual of histological techniques and their diagnostic application        | John Bancroft      | Churchill Livinstone |
| 2       | Concise book of medical laboratory technology-Methods and interpretations | Ramnik Sood        | Jaypee               |
| 3       | Clinical diagnosis and management by                                      | John Bernard Henry | Saunders             |

|   |   |               |         |
|---|---|---------------|---------|
|   | laboratory methods                        |               |         |
| 4 | Textbook of medical laboratory technology | Praful Godkar | Bhalani |

**SEMESTER VI**  
**PAPER-II**  
**PAER CODE: MHS0600204**  
**CLINICAL GENETICS (4 CREDITS)**

**Theory: 75**

**Practical: 25**

**Theory: 3 Credits**

**Practical: 1 Credit**

**Overview and key learning outcomes:** Clinical genetics students develop expertise in genetic counselling, test interpretation, and critical thinking for precision medicine. Their engagement in genetic research contributes to advancements in understanding the genetic basis of diseases. Ethical awareness guides responsible practice, and participation in public health initiatives addresses genetic factors impacting population health. Committed to continuous learning, students stay informed about genomic advancements and cultivate professionalism and effective communication skills for impactful contributions in personalized healthcare.

| UNIT | Details   | Credits & Marks |
|------|---|-----------------|
| I    | <b>Fundamentals of Genetics</b><br>Introduction, Significance of genetics, Mendel's principle of inheritance (Experimental material, Laws formulated with reference to Mono- and Dihybrid crosses, Test cross, Back cross) and Applications using Punnet square and Probability method, Mendel's principle in Human genetics  |                 |
| II   | <b>Cell cycle</b><br>Cell cycle and cell divisions<br>Mitosis, meiosis, errors in cell division   |                 |
| III  | <b>Linkage and crossing over</b><br>Introduction, Chromosome theory of Linkage<br>Crossing over - Introduction, Theories on the mechanism of crossing over and Types of Crossing over.<br>Quantitative genetics, Polygenic inheritance,<br>Gene and genotype frequency, Hardy-Weinberg law and its significance   |                 |
| IV   | <b>Human Chromosomes and Abnormalities</b><br>Chromosomal architecture and Karyotyping (Morphology, classification and organization, structural and functional gene). ISC Nomenclature system<br>Numerical chromosomal abnormalities (Aneuploidy, Euploidy and polyploidy)<br>Structural chromosomal abnormalities (Translocations, Inversions, Deletions, Insertions Duplications) |                 |
| V    | <b>Cytogenetics of Pregnancy, cancer and cell lines</b>   |                 |

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|-----|---|--|
|     | Prenatal diagnosis<br>Amniotic fluid cell culture<br>Chorionic villus sampling and culture<br>Establishing fibroblast culture<br>Chromosomal abnormalities in malignant disease (CML, AML, ALL etc.,)<br>Cytogenetic characterization of Various cell lines<br>Collection, transport and storage of samples for cytogenetic analysis,   |  |
| VI  | <b>Chromosomal staining, banding and FISH techniques</b><br>Giemsa banding<br>Quinacrine banding<br>Constitutive heterochromatin banding<br>Other banding Techniques<br>Applications of fluorescence <i>in situ</i> hybridization to chromosome analysis  |  |
| VII | <b>Microscopic and Image analysis system for Cytogenetic study</b><br>Light microscopy, Fluorescence microscopy and Phase contrast Microscopy<br>Charge-coupled device cameras, Image analysis systems<br>Interpretation and reporting of chromosomal analysis<br>Mode of Inheritance, Human pedigree analysis and genetic counselling. |  |

**Practical:**

1. Identification of different stages of mitosis.
2. **Genetic Pedigree Analysis:** To understand how to construct and analyze pedigrees to trace genetic traits within families.
3. **Polymerase Chain Reaction (PCR) for Genetic Testing:** Learn the application of PCR in genetic testing
4. **Karyotyping:** Demonstrate how to visualize and analyze chromosomal abnormalities.
5. Demonstrate how to perform southern blotting of DNA sample.
6. Preparation buccal smear for Barr body test.

**Reference Books:**

| Sl. No. | Title   | Authors         | Publisher                  |
|---------|---|-----------------|----------------------------|
| 1       | Essential of Human Genetics                                   | S. M. Bhatnagar | Orient longman             |
| 2       | Essential of Genetics   | Renu Chauhan    | Avichal Publishing Company |
| 3       | Genetics in clinical practice-Symptoms, diagnosis and therapy | Jayesh Sheth    | Jaypee                     |

**SEMESTER VI**  
**PAPER-III**  
**PAPER CODE: MHS0600304**  
**TOOLS AND TECHNIQUES IN FORENSIC SCIENCES AND RECOMBINANT DNA**  
**TECHNOLOGY (4 CREDITS)**

**Theory: 75**

**Practical: 25**

**Theory: 3 Credits**

**Practical: 1 Credit**

**Overview and key learning outcomes:** Forensic science and recombinant DNA technology students specialize in crime scene analysis, DNA profiling, and molecular techniques. Proficiency in forensic tools like fingerprint analysis and DNA sequencing enhances precision in criminal investigations. Their expertise in recombinant DNA technology allows applications in genetic engineering, medical research, and diagnostics. Adherence to ethical considerations ensures responsible use of these technologies, aligning with legal and privacy standards. These students are well-prepared for diverse careers in forensic science, biotechnology, and research, contributing significantly to law enforcement and scientific progress.

| UNIT | Details   | Credits & Marks |
|------|---|-----------------|
| I    | <p><b>Introduction and Application of rDNA technology</b><br/> Steps involved in rDNA technology, isolation of DNA from different sources, concept of restriction modification, restriction endonucleases,<br/> Introduction of vector and host. Introduction to generation of genomic and cDNA libraries.<br/> Gene therapy, pharmaceutical products and molecular diagnostics,</p>  |                 |
| II   | <p><b>Gene amplification through PCR and Types</b><br/> Polymerase Chain Reaction: Principle, methodology, primer designing, types of polymerase and factors affecting PCR, advantages, limitations and application PCR.<br/> Variants of PCR: Reverse Transcriptase PCR, Real Time PCR, Inverse PCR, anchored PCR, nested PCR, hot start PCR, multiplex PCR, touchdown PCR, ARMS (amplification refractive mutation system) PCR</p>                  |                 |
| III  | <p><b>Introduction to forensic science</b><br/> History and Development of Forensic Science, Definition of Forensic Science, Scope of Forensic Science, Need of Forensic Science, Basic Principles of Forensic Science,</p>   |                 |
| IV   | <p><b>Biologic evidence</b><br/> Importance, nature, location, collection, evaluation and tests for identification of Hair and Fibres, saliva, sweat, urine, blood, faecal matter, vaginal secretions and tests for their identification Blood grouping from stains of blood, semen, saliva and other body fluids by Absorption inhibition, Absorption-elution and mixed agglutination techniques, determination of secretor/non-secretor status.</p> |                 |

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| V  | <b>DNA Profiling</b><br>Introduction, History of DNA Typing DNA typing systems- RFLP analysis, sequence polymorphism. Analysis of SNP, Y- STR.   |  |
| VI | <b>Tolls in Forensic Techniques</b><br>Terminal Restriction Fragment Length Polymorphism (TRFLP),<br>Amplified Fragment Length Polymorphism (AFLP),<br>Single Stranded Conformation Polymorphism Analysis (SSCP),<br>Principle methodology and types of DNA sequencing<br>Thermal and Denaturation Gradient Gel<br>Electrophoresis (TGGE, DGGE),<br>Randomly Amplified Polymorphic DNA (RAPD).<br>Non-PCR DNA Fingerprinting Techniques with Applicability in Forensic Studies-<br>Restriction Fragment Length Polymorphisms (RFLP) and Ribotyping |  |

### Practical:

1. Demonstrate the process of isolating DNA from cells.
2. To learn the principles of DNA amplification.
3. Demonstrate the DNA separation based on size by Agarose Gel Electrophoresis
4. To study the specificity of restriction enzymes.
5. To understand the process of joining DNA fragments

### Reference Books:

| Sl. No. | Title                         | Authors            | Publisher                |
|---------|-------------------------------|--------------------|--------------------------|
| 1       | Molecular Biology of the Cell | Lodish et al.,     | WH Freeman               |
| 2       | Recombinant DNA               | Watson et. al.     | WH Freeman               |
| 3       | Methods of Forensic Science   | Curry, A. S.       | Inter science, New York  |
| 4       | Forensic Biology              | Chowdhari, S.      | B P R & D, Govt of India |
| 5       | Forensic Science Hand book    | Richard Saferstein | Prentice Hall            |

**SEMESTER V**  
**PAPER-IV**  
**PAPER CODE: MHS0600404**  
**INTRODUCTION TO BIOINFORMATICS AND BIOSTATISTICS (4 CREDITS)**

**Theory: 75**

**Practical: 25**

**Theory: 3 Credits**

**Practical: 1 Credit**

**Overview and key learning outcomes:** Introduction to Bioinformatics and Biostatistics provides an interdisciplinary approach to the analysis of biological data. It combines principles from biology, statistics, and computer science to extract meaningful insights from biological information, fostering a comprehensive understanding of computational tools in life sciences.

| <b>UNIT</b> | <b>Details</b>   | <b>Credits &amp; Marks</b> |
|-------------|--|----------------------------|
| I           | <b>Introduction</b><br>Definition and History of Bioinformatics, Computer fundamentals-different types of operating systems, Internet and Bioinformatics, Applications of Bioinformatics   |                            |
| II          | <b>Biological Databases</b><br>Introduction to biological databases- primary and secondary, Sequence and structural with special emphasis on NCBI, EBI, DDBJ, PDB and Swissport  |                            |
| III         | <b>Theoretical aspects of Sequence Analysis</b><br>Needlemen-Wunsch and Smith-Waterman methods of global and local alignments between sequences.   |                            |
| IV          | <b>Molecular Phylogeny</b><br>Properties and types of phylogenetic trees with special emphasis on tree building methods (UPGMA, Neighbouring joining, Maximum parsimony, Maximum likelihood)   |                            |
| V           | <b>Biocomputing in Genomics and Proteomics</b><br>Introduction to software's and tools for sequence analysis and assembly (BLAST, FASTA, CLUSTAL W, MEGA), 2D Gels.  |                            |
| VI          | <b>Descriptive and Relational Statistics</b><br>Data collection and tabulation, graphical representation of data, measures of central tendency (Mean, Median and Mode) with examples, measures of dispersion (range, quartile deviation, mean deviation, standard deviation, standard error and coefficient of variation) with examples, concept of skewness and kurtosis. |                            |
| VII         | <b>Sampling</b><br>Concept of dependent and independent variables, types of parametric and non-parametric tests, types of correlation, computation of Karl-Pearson correlation coefficient, Spearman's rank correlation coefficient and Simple linear regression analysis. Factor and discriminant analysis.   |                            |

**Practical's (1 credit)**



1. Understanding of different types of operating systems and requirements for Bioinformatics computing.
2. Understanding and use of various sequence information resources: GenBank, EMBL, Protein information resource (PIR)
3. Understanding and using: Swissport, TREMB, PDB.
4. Sequence retrieval (protein and gene) from NCBI.
5. Sequence alignment using BLAST and interpretation of results.
6. Multiple sequence alignment using Clustal W.
7. Generating phylogenetic tree using Standalone Software's and Online Tools.
8. Calculate mean, mode, median, standard error, standard deviation and variance from a given set of data using biostatistics.

**Reference Books:**

| Sl. No. | Title   | Authors                           | Publisher                 |
|---------|---|-----------------------------------|---------------------------|
| 1       | Bioinformatics for Beginners: Genes, Genomes, Molecular Evolution, Databases and Analytical Tools | Supratim Choudhuri                | Academic Press            |
| 2       | Introduction to Bioinformatics  | Arthur M. Lesk                    | Oxford University Press   |
| 3       | Bioinformatics: Databases and Algorithms  | Rashmi Tyagi and S. A. Chinnaiyan | McGraw-Hill Education     |
| 4       | Bioinformatics: Sequence Structure and Databanks: A Practical Approach                            | D. Deshmukh                       | Himalaya Publishing House |
| 5       | Sampling Techniques   | S. S. Kocher and S. D. Dubey      | Macmillan India Limited   |
| 6       | Fundamentals of Statistics  | S.C. Gupta and V.K. Kapoor        | Sultan Chand & Sons       |