

**Shree Manibhai Virani and Smt. Navalben Virani Science College  
(Autonomous), Rajkot  
Affiliated to Saurashtra University, Rajkot**

**Syllabus – B. Voc. Medical Laboratory and Molecular Diagnostic  
Technology**

**Semester I-II**

**For Students Admitted from A.Y. 2017-2018 & Onwards**

## B. Voc. Medical Laboratory and Molecular Diagnostic Technology

### SEMESTER - I

17VMLGC01	Core 1: Human Physiology	04 hrs/wk	04 Credits
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#### Objectives:

To enable the students to

1. Use anatomical terminology to identify and describe locations of major organs of each system covered and understand the basic organization of human body
2. Understand the basic structure and functions of various systems of human body
3. Explain interrelationships among molecular, cellular, tissue and organ functions in each system
4. Describe the interdependency and interactions of the systems
5. Explain contributions of organs and systems to the maintenance of homeostasis

#### Unit -1 Functional Organization of Human Body (09hrs)

- Introduction to Human Body
- Cells, Tissues and Body Organization
- Tissues – different types, functions and its importance
- Musculo-Skeleton System and Body Cavity - Appendicular and Axial Skeleton
- Properties and Function of different types of Muscles – Smooth, Cardiac and Skeletal Muscle

#### Unit -2 Circulatory system (10hrs)

- Blood – Composition, function, types of Blood Cells and its role in Human Physiology
- Cardiovascular System – Blood Vessels, anatomy of Heart, types of Blood Circulation, Cardiac Cycle, BP and Pulse
- Lymphatic System – Functional anatomy of Lymph and Lymph Vessels, Lymphatic Organs and Tissues – Lymph Node, Spleen, Thymus Gland, MALT

#### Unit – 3 Respiratory, Digestive and Renal system (10hrs)

- Respiratory System - Functional anatomy of different parts, types of Respiration, Gaseous Exchange of CO<sub>2</sub> and O<sub>2</sub>
- Digestive System – Functional anatomy of Alimentary Tract, Organs of Digestion and their functions, Food metabolism, Digestion, Absorption and Transport
- Renal System - Functional anatomy of different parts of renal system, Urine Formation and Elimination, Regulation
- Water, acid-base and electrolyte balance.

**Unit – 4 Nervous system and Special Senses (10hrs)**

- Nervous System – Organization, basic functions, Neurons, Synapse, Neurotransmitter, Central Nervous System, Peripheral Nervous System and Autonomous Nervous System, Brain and Spinal Cord
- Integumentary system – Functional anatomy of Skin
- Special senses – Eye – optic of Vision, Sense of Hearing – Ear, Chemical senses – Taste and Smell.

**Unit – 5 Reproductive System and Growth (09hrs)**

- Female Reproductive System – functional anatomy of External and Internal parts, Puberty, Oogenesis, Menstruation Cycle
- Male Reproductive System - functional anatomy of various parts, Puberty, Spermatogenesis, Fertilization and Embryo Development
- Endocrine System – Introduction, basic functions of different Glands and their Secretions

**Text Books**

1. Sujit Chaudhari, **Concise Medical Physiology**; Central publishing company limited.
2. Wilson Katheen, Anne Waugh, **Anatomy and Physiology in Health and Illness**; Churchill livingstone
3. Arthur Guyton and Hall, **Textbook of Medical Physiology**; W.B. Saunders publishing company limited.

**Reference Books**

1. R. L. Bijlani, **Understanding Medical Physiology**; Jaypee publishing company limited.
2. Gerard Tortora, Bryan Derrcikson, **Principles of Anatomy and Physiology**; Wiley publication

17VMLGC02	<b>Core 2: Basic Biochemistry</b>	<b>04 hrs/wk</b>	<b>04 Credits</b>
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### Objectives:

To enable the students to

1. Identify the major classes of polymeric biomolecules and their monomeric building blocks
2. Understand the basic chemistry and importance of biomolecules
3. Explain the specificity of enzymes (biochemical catalysts), and the chemistry involved in enzyme action.
4. Describe the structure of DNA, and explain how it carries genetic information in its base sequence.

### Unit - 1 Chemistry of Carbohydrates (10hrs)

- Introduction-  
Definition and functions
- Classification-  
Monosaccharide, disaccharide, oligosaccharide, Polysaccharide
- Chemical and  
physical properties (Stereoisomerism, Racemic mixture, Epimers, Enantiomers, Structure of glucose-pyranose and furanose, Mutarotation)  
(Tautomerization, Reduction properties, oxidation, reduction, dehydration, osazone formation, formation of esters)

### Unit - 2 Chemistry of Protein (10hrs)

- Introduction-Definition and functions
- Structure and classification of amino acids (Standard amino acids and non standard amino acids)
- Properties of amino acids in brief (Physical- Solubility, Melting points, taste, optical properties, Zwitterion, Isoelectric pH, titration)  
(Chemical- Reactions due to -COOH group, Reactions due to -NH<sub>2</sub> group)
- Protein- Definition, classification
- Structure- Primary, secondary, tertiary, quaternary
- Properties (Solubility, Molecular weight, Shape, pI, acidic and basic proteins, precipitation of proteins, denaturation)

### Unit - 3 Chemistry of Lipids (09hrs)

- Lipids- Introduction, Definition and functions
- Classification (Simple lipids, complex lipids, derived lipids)
- Properties of lipids (Hydrolysis, Saponification, Rancidity, Lipid peroxidation)

- Fatty acid (saturated and unsaturated, Essential Fatty Acids)
- TAG, Phospholipids, lipoprotein and glycolipids- structure and functions
- Sterols and its role (ergosterol, Cholesterol)

#### **Unit - 4 Chemistry of Nucleic acids**

**(09hrs)**

- Nucleic acid- Functions
- Nucleotides- Purines, Pyrimidines,
- Chargaff's rule, Structure of DNA
- Watson and Crick Model, Types of DNA, A-DNA, B-DNA, Z-DNA
- Structure of RNA molecule and its types (mRNA, rRNA, tRNA)

#### **Unit – 5 Enzymes**

**(10 hrs)**

- Introduction- Definition, Nomenclature and Classification, Properties
- Coenzymes, Iso-enzymes-Definition, Examples, Importance
- Mechanism of action of enzymes (Enzyme-substrate complex formation, Lock and key model or Fischer's template theory, Induced fit theory or Koshland's model, Substrate strain theory)
- Factors affecting enzyme action
- Enzyme inhibition and regulation (Reversible, Irreversible, Allosteric)

#### **Text Books:**

1. D M Vasudevan. **Text book of Biochemistry for Medical Students**; Jaypee Publications
2. D Voet, J Voet. **Biochemistry**; Wiley Publications
3. U. Satyanarayan. **Basics of Biochemistry**; Books and Allied Ltd

#### **Reference Books:**

1. G P Talwar. **TB of Biochemistry and Human Biology**; Prentice Hall publications
2. J L Jain. **Fundamentals of Biochemistry**; S Chand publications
3. D L Nelson, **Lehninger Principles of Biochemistry**; W H Freeman Publications

17VMLSC01	<b>Core Skill 1: Human Physiology</b>	<b>06 hrs/wk</b>	<b>06 Credits</b>
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**Objectives:**

The course will enable the student to

1. Identify various types of tissues of the body
2. Operate the BP instrument
3. Collect venous and capillary blood for analysis
4. Identify different cells present in blood

**List of Practical**

1. Cell structure
2. Epithelial Tissue
3. Connective tissue
4. Muscle tissue
5. Anatomical terms and Skeletal system
6. Cavities of the body
7. Study of body organs through a visit to anatomy department of medical college
8. Blood Pressure measurement
9. Pulse rate measurement
10. Phlebotomy- Venous blood and Capillary blood collection technique
11. Blood smear preparation and differential staining
12. Identification of blood cells through microscope

**Reference Books:**

1. Tortora, Gerard J.; Derrickson, Bryan. **Anatomy & physiology: Workbook**; Wiley India Pvt. Ltd.
2. Singh, A. K. **Anatomy and Physiology for Paramedicals**; Jaypee Brothers Medical Publishers (P) Ltd.
3. Prasad, S. R.; Sinha, Aruna (Foreword). **Practical Histology for Medical Students**; Jaypee Brothers Medical Publishers (P) Ltd.

17VMLSC02	<b>Core Skill 2 : Basic Biochemistry</b>	<b>09 hrs/wk</b>	<b>09 Credits</b>
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### Objectives:

The course will enable the student to

1. Understand responsibilities of Laboratory Technologist
2. Prepare solutions and reagents
3. Analyze the biochemical compound qualitatively and quantitatively
4. Operate basic instruments in the laboratory

### List of Practical

1. Introduction to Medical Laboratory Technology
2. The Responsibilities of Laboratory Technologist
3. Laboratory Safety
4. Laboratory first aid measures
5. Introduction to Microscope and its working
6. Introduction to Spectrophotometer and flame photometer
7. Introduction to common laboratory instruments
8. Preparation of solutions and reagents
9. Qualitative analysis of carbohydrates
10. Estimation of glucose by GOD POD method
11. Qualitative analysis of amino acids and proteins
12. Estimation of protein by Biuret method
13. Estimation of serum total cholesterol
14. Estimation of DNA by DPA method
15. Estimation of RNA by Orcinol method
16. Estimation of serum SGPT/SGOT enzyme level
17. Assay of salivary Amylase
18. Enzyme assay of Acid phosphatase
19. Study the effect of substrate concentration on the activity of enzyme and calculate  $K_m$  and  $V_{max}$
20. Study the effect of temperature on the activity of enzyme
21. Study the effect of pH on the activity of enzyme

### Reference Books:

1. Praful Godkar, **A Textbook of Medical Laboratory Technology**; Bhalani Publication
2. Shankara, YM Shivaraja; Ganesh, MK; Shivashankara, A R, **Laboratory Manual For Practical Biochemistry**; Jaypee Brothers Medical Publishers (P) Ltd.
3. Jones, Evangeline. **Manual of Practical Medical Biochemistry**; Jaypee Brothers Medical Publishers (P) Ltd.
4. Sawhney S.K., Singh, R. (2005). **Introductory Practical Biochemistry**: Alpha Science International.

## SEMESTER – II

17VMLGC03	<b>Core 3: Clinical Pathology and Parasitology</b>	<b>03 hrs/wk</b>	<b>03 Credits</b>
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### Objectives:

To enable the students to

1. Understand life cycle of various parasites and their disease pathogenesis
2. Understand clinical significance of altered physiological parameters
3. Understand the clinical manifestation of diseases

### Unit - 1 Urine analysis (10hrs)

- Composition of normal urine
- Collection and preservation of urine
- Physical, Chemical and Microscopic examination of urine
- Clinical significance of urine analysis

### Unit - 2 Cerebrospinal fluid and Semen analysis (09 hrs)

- Composition of CSF and semen
- Collection and preservation of CSF and semen
- Physical, chemical and Microscopic examination of CSF and semen
- Clinical significance of CSF and semen analysis

### Unit – 3 Sputum analysis and Cavity fluids (09hrs)

- Composition of sputum, Collection and preservation of sputum
- Physical, chemical and Microscopic examination of sputum
- Clinical significance of sputum analysis
- Transudates and exudates
- Synovial fluid analysis, Peritoneal fluid analysis, Pericardial fluid analysis

### Unit - 4 Introduction to parasitology and protozoa (10hrs)

- Definition of important terms of Parasitology
- Classification of Parasites
- Intestinal Amoebae  
*E. Histolytica* and *E. coli* : Life cycle, Morphology, Disease & Lab Diagnosis
- Flagellates of intestine/genitalia  
*Giardia lamblia* and *Trichomonas vaginalis* : Life cycle, Morphology, Disease & Lab Diagnosis
- Malaria Parasite
  - a. *Plasmodium vivax* : Life cycle, Morphology, disease & lab diagnosis
  - b. Differences between *P. vivax*, *P. malaria*, *P. falciparum* & *P. ovale*.



## Unit-5 Nematodes, Cestode and trematodes

(10hrs)

- Intestinal Nematodes:  
Life cycle, Morphology, disease & lab diagnosis of *Ascaris lumbricoides*, *Enterobius vermicularis* (Thread worm) and *Ancylostoma duodenale* (Hook worm)
- Tissue Nematodes:  
*W. Bancrofti* - Life cycle, Morphology, Disease & Lab Diagnosis  
Cestodes - *T. solium*, *T. saginata* & *E. granulosus*.  
Trematodes - *S. haematobium* & *F. hepatica*

### Text Books:

1. S.S. Kelkar, **A Textbook of Parasitology**; Bombay Popular P.
2. P. Chakraborty, **Parasitology**;
3. Praful Godkar, **Text Book of Medical Laboratory Technology**; Bhalani

### Reference Books:

1. Bernard Henry, **Clinical Diagnosis and Management By Laboratory Methods**, W B Saunders
2. Rajesh Karyakarte, **Medical Parasitology**; Books & Allied ltd

17VMLGC04	<b>Core 4: Hematology</b>	<b>03 hrs/wk</b>	<b>03 Credits</b>
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### Objectives:

To enable the students to

1. Understand the functions of blood
2. Identify the different types of formed elements of blood and their synthesis
3. Learn the different disorders of blood cells
4. Understand blood coagulation mechanism and its disorders

### Unit - 1 Blood cell formation (09 hrs)

- Formation of blood- Haemopoiesis, Definition
- Site of Haemopoiesis
- Hematopoetic stem cells and progenitor cells
- Overview of Erythropoiesis, leucopoiesis and thrombopoiesis

### Unit - 2 General aspects of Anemia (10 hrs)

- Classification of anemia- Morphological and etiological. Iron deficiency anemia- mechanism of iron absorption, causes of iron deficiency, signs and symptoms and laboratory findings
- Megaloblastic anemia- Causes, signs and symptoms and laboratory findings
- Hemolytic anemia- Classification, causes, signs and symptoms and lab findings
- Genetic defects of haemoglobin- Sickle cell anemia and thalassaemia(causes, signs and symptoms and laboratory findings in brief)

### Unit - 3 General aspects of White cell disorders (09 hrs)

- Granulocytes and their disorders such as Neutrophil leucocytosis, disorders of neutrophils function, neutropenia, eosinophil and basophil leucocytosis, Monocytes and their disorders such as monocytosis, disorders of monocyte function
- Lymphocytes and their disorders such as lymphocytosis and immunodeficiency
- Some genetic and acquired WBC disorders- Chediak-Higashi syndrome, May-Hegglin anomaly, Pelger-Huet anomaly, Lysosomal storage disorders, toxic granulation

### Unit – 4 Hematological Malignancies (10 hrs)

- Classification of leukemia: Overview of Acute leukemia and Chronic leukemia, Clinical features, Laboratory findings

- Malignant lymphoma, types, Clinical features
- Multiple myeloma: Pathogenesis, smouldering myeloma, diagnosis and clinical features
- Myeloproliferative disorders: Polycythaemia vera (PV); Essential thrombocythaemia (ET); and Primary myelofibrosis

#### **Unit – 5 Platelets**

**(10 hrs)**

- Definition of Homeostasis. Platelets- structure and function
- Blood coagulation- Factors involved in blood coagulation, Mechanism of Intrinsic and extrinsic pathway
- Bleeding disorders due to vascular abnormalities (Inherited: Hereditary haemorrhagic telangiectasia, Ehlers-Danlos syndrome. Acquired: Definitions of Senile purpura, vascular abnormality due to vit C deficiency, Henoch–Schönlein)
- Bleeding disorders due to decreased platelet production (Autoimmune (idiopathic) thrombocytopenic purpura, (WAS), increased platelet destruction (Autoimmune (idiopathic) thrombocytopenic purpura), disorders of platelet function (Glanzmann's disease, acquired disorder)
- Coagulation disorders(Hemophilia, Von willebrand disease, Disseminated intravascular coagulation)

#### **Text Books:**

1. Peter Haen. **Principles of Haematology**; WCB Publications
2. A.V.Hoffbrand. **Essential Hematology**; Black well publications
3. Kawthalkar, Shirish M. **Essentials of Hematology**;Jaypee Brothers Medical Publishers (P) Ltd.

#### **Reference Books:**

1. Emmanuel Besa. **Haematology**. Harwal publications
2. Frank Firkin, C Chester man. **De Gruchy's Clinical Haematology in Medical Practice**; Black well Publications
3. Saxene, Renu; Pati, H. P.; Mahapatra, Manoranjan.**Recent Advances in Hematology**; Jaypee Brothers Medical Publishers (P) Ltd.

17VMLGC05	<b>Core 5: General Microbiology</b>	<b>03 hrs/wk</b>	<b>03 Credits</b>
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### **Objectives:**

To enable the students to

1. Differentiate between various micro and macroorganisms
2. Understand the bacterial structure
3. Learn the different techniques for the growth and maintenance of bacteria
4. Learn different techniques to grow the bacteria in laboratory

### **Unit 1- Major Groups of Microorganisms (10 hrs)**

- Difference between Eukaryotes, Prokaryotes and Archaea
- Major groups of Microorganisms
- Eukaryotic Microorganisms: Fungi, Algae and Protozoa
- Bacteria: General characteristics
- Viruses: Plant and Animal viruses, Bacteriophages
- Microbial Taxonomy: Introduction and overview
- Taxonomic ranks of microorganisms

### **Unit –2 Morphology and fine structure of bacteria (09 hrs)**

- Bacterial ultra structure, Size, shape and arrangement of bacteria
- Structures external to cell wall-Capsule, Flagella, Pili (Fimbriae), Sheath, Their structure and functions
- Cell wall structure, Functions, Gram nature of bacteria
- Structures internal to cell wall- Cytoplasmic membrane, Inclusion bodies, vacuoles, Nuclear material- Structure and function
- Spore and cyst- Definition, structure, importance and its formation

### **Unit – 3 Growth and Maintenance of bacteria (10 hrs)**

- Introduction and Definition of Growth, Modes of Cell division in prokaryotes
- Bacterial growth, Various phases of growth, Growth curve
- Batch Culture, Continuous culture
- Total count, viable count
- Bacterial nutrition- oxygen requirement, CO<sub>2</sub> requirement, temperature, pH, light

### **Unit – 4 Control of microbes (10 hrs)**

- Sterilization and Disinfection: Definition, Instruments used for sterilization, Autoclave, Hot air oven
- Control of microbes by physical agents, Definitions: Sterilization, Disinfection, Sanitization, Antisepsis, Microbiocidal & Microbiostasis, Thermal Death Time,

Thermal Death Point, D-Value, z-Value & F-value, High temperature, Low temperature, Radiation, Filtration

- Control of microbes by chemical agents, Phenol & Phenolic compounds, Alcohols
- Halogens – Iodine & Chlorine, Heavy Metals & Dyes, Detergents & Quaternary Ammonium Compounds, Aldehydes & Gaseous agents
- Phenol coefficient method
- Antibiotics, Definition, Classification, Mode of action and uses

#### **Unit – 5 Cultivation of Bacteria and Pure Culture Techniques**

**(09 hrs)**

- Nutritional requirements of Bacteria
- Chemical requirement of Growth – Bacteriological Media & their Types
- Physical Conditions required for growth – Air, pH & Temperature
- Cultivation of Anaerobes
- Selective methods to obtain pure culture
- Isolation techniques and preservation of pure culture, Cultural characteristics

#### **Text Books:**

1. Michael Pelczar. **Microbiology**; Tata McGraw Hill publications
2. Prescott. **Microbiology**; Tata McGraw Hill publications

#### **Reference Books:**

1. R M Atlas. **Principles of Microbiology**; Tata McGraw Hill publications
2. Tortora, Funke. **Microbiology an Introduction**; Pearson publications
3. Stanier, R.Y. **General Microbiology, 5<sup>th</sup> Edition**; Macmillan publication

17VMLSC04	<b>Core Skill 3: Clinical Pathology and General Microbiology Practical</b>	<b>10 hrs/wk</b>	<b>10 Credits</b>
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### Objectives:

The course will enable the student to

1. Perform the various body fluid analysis and interpret the results
2. To identify various parasites
3. Understand and perform the staining process and reagent preparation
4. Study the microbial cell morphology through microscopy
5. Learn the effects of various chemicals on the growth of bacteria.

### List of practical:

1. Introduction to Body Fluids Analysis
2. Routine Urine Analysis
3. Semen Analysis
4. Sputum Analysis
5. CSF Examination
6. Synovial Fluid Examination
7. Pleural Fluid Examination
8. Stool examination
9. Permanent slides of cyst and eggs of various parasites
10. Preparation of glassware and disposal of laboratory media and cultures
11. Preparation of stains, staining reagents and standard solutions
12. Preparation of liquid and solid culture media
13. Study of bacterial motility by hanging drop method
14. Staining of bacteria
15. Differential staining- Gram staining
16. Acid fast staining
17. Special staining
  - Spirochete staining
  - Spore staining
  - Cell wall staining
  - Metachromatic granule staining
  - Capsule staining
18. Isolation of bacteria
19. Effect of chemicals on microbial growth
20. Effect of antibiotics on microbial growth
21. Viable count technique
22. Growth curve of bacteria by turbidometric method

### **Reference Books:**

1. Patel. R.J., Patel. K.R. (2009). **Experimental Microbiology, Vol-I**, Ahmedabad: Aditya Publications.
2. Patel. R.J., Patel. K.R. (2009). **Experimental Microbiology, Vol-II**, Ahmedabad: Aditya Publications.
3. Dubey, R.C., Maheshwari, D.K. (2005). **Practical Microbiology. New Delhi: S. Chand & Company Limited.**
4. Sharma, K. (2005). **Manual of Microbiology – Tools and Techniques.** New Delhi: Ane books.

17VMLSC05	<b>Core Skill 4:</b> Hematology Practical	<b>6 hrs/wk</b>	<b>06 Credits</b>
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**Objectives:**

The course will enable the student to

1. Observe and count the different types of blood cells
2. Interpret the results of the tests
3. Learn the coagulation tests
4. Learn various disorders of blood through blood cell count and morphology

**List of practical:**

1. Determination of Hemoglobin by Drabkin's method
2. Hemoglobin estimation by Sahli's method
3. Total RBC count
4. Total WBC count
5. Total Platelet count
6. Differential WBC count
7. Peripheral Smear Examination
8. Determination of Packed Cell Volume-PCV
9. Determination of Erythrocyte Indices
10. Determination of Erythrocyte Sedimentation Rate
11. Determination of Reticulocyte count
12. Determination of Prothrombin Time
13. Determination of Bleeding time
14. Determination of Clotting time- Capillary method
15. Determination of Clotting time- Lee White Method
16. Glucose-6-Phosphate Dehydrogenase Screening test
17. NESTROF test for thalassemia screening

**Reference Books:**

1. Praful Godkar, **Text Book of Medical Laboratory Technology**; Bhalani
2. Bernard Henry, **Clinical Diagnosis and Management By Laboratory Methods**, W B Saunders
3. Nageswari, K. Sri; Kothari, Anamika. **Practical Manual of Hematology**; Jaypee Brothers Medical Publishers (P) Ltd.
4. Lokwani, D. P.; Agarwal, M. B. (Foreword). **The ABC of CBC: Interpretation of Complete Blood Count and Histograms**; Jaypee Brothers Medical Publishers (P) Ltd.
5. Mehdi, S. R. **Laboratory Procedures in Hematology: Manual for DMLT, Undergraduate and Postgraduate Students of Pathology**; Jaypee Brothers Medical Publishers (P) Ltd.



17VMLSC06	<b>DSC- Allied Skill 2: Biostatistics Practical</b>	<b>2hrs/wk</b>	<b>02 Credits</b>
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### **Objectives:**

The course will enable the student to

1. To learn applications of mathematics for biological parameters
2. To learn about performing statistical analysis
3. To perform graphical presentation of the clinical data
4. To learn to validate the data scientifically using statistical tools

### **Practical:**

1. To introduce the applications of Biostatistics
2. To do the graphical presentation of the data- Pie chart, Bar graph, Line graph
3. To calculate mean, median and mode from the given data
4. To perform standard deviation and variance manually and using Microsoft Excel
5. Problems based on probability, Normal distribution and Binomial distribution
6. To perform the student's t- test
7. To perform Chi Square test
8. To perform ANOVA test
9. To perform correlation analysis
10. To perform regression analysis
11. Demonstration of common software for statistical analysis

### **Reference Books:**

1. Nsn Rao, Applied Statistics in Health Sciences; Jaypee
2. Khan and Khanum, Fundamentals of Biostatistics
3. Daniel, Biostatistics: Basic Concepts and Methodology For Health Science, Wiley
4. Parikh M N, Gogtay N, ABC of Research Methodology and Applied Biostatistics Premier of Clinician and Researchers, Jaypee