School of Paramedical Sciences

Department of Medical Laboratory Technology

B Sc in Medical Laboratory Technology

FLEXILEARN

-Freedom to design your degree

STAREX UNIVERSITY

GURUGRAM

HARYANA

2021-2022

School of Paramedical Sciences

Department of Medical Laboratory Technology

B Sc (Medical Laboratory Technology)

FLEXILEARN

-Freedom to design your degree

STAREX UNIVERSITY
GURUGRAM
HARYANA
2018-2019

Updated
B Sc in Medical Laboratory Technology
(B Sc MLT)
3- Years Course
(VI Semester)

REGULATIONS OF B.SC (MLT) COURSE:

1. SHORT TITLE AND COMMENCEMENT

These regulations shall be called "THE REGULATIONS FOR THE BACHELOR OF SCIENCE IN MEDICAL LABORATORY TECHNOLOGY STAREX UNIVERSITY

They shall come into force from the academic year 2018-19 Session.

The regulation and syllabus are subject to modifications by the standing Board of studies for paramedical courses from time to time.

II. REGULATIONS

1. ELIGIBILITY FOR ADMISSION

Candidates should have pass in the **10+2 with PCB/PCM (min. 45%**) from any Recognized Education Board.

Later entry: Passed two years Diploma in MLT after 12th standard or three years Diploma in MLT after 10th standard.

2. DURATION OF THE COURSE AND COURSE OF STUDY

The period of certified study and training of the B Sc MLT degree course shall be of three academic years.

3. MEDIUM OF INSTRUCTION

English shall be the medium of instruction for all the subjects of study and for examinations of the course.

4. MINIMUM WORKING DAYS IN AN ACADEMIC YEAR

Each academic year shall consist of not less than 180 days with a minimum of 90 days working days per semester.

5. ATTENDANCE REQUIRED FOR APPEARING EXAMINATION

a) Examination will be conducted in both theory and practical as prescribed. Candidates will be permitted to appear for the Examinations in the subject, only if they secure not less than >70 % of attendance in each subject of the respective semester/year.

b) A student who does not meet the minimum attendance requirement in a semester or year must repeat the course work along with the next batch of students.

6. CONDONATION FOR LACK OF ATTENDANCE

Condonation of shortage of attendance in aggregate up to 10 % (between 60 % and 70%) in each semester may be granted by the Institute's Academic Committee and as per the regulations of Starex University, under extraordinary circumstances on payment of extra one year tuition fee as penal fees.

7. INTERNAL ASSESSMENT (IA):

Internal assessment will be done in each subject of study and the marks will be awarded to the candidates as detailed in the scheme of examinations. The marks awarded will be done on the basis of the candidate's performance in the assignments, class tests –written / practical, laboratory work, preparation and presentation of Project work/ seminars or any other accepted tools of assessment, as assessed by the teachers. Candidate should have scored a minimum of 40% in Theory (IA) and 40% in Practical (IA) separately to be allowed to appear for the Summative / Final Examination.

8. EXAMINATIONS:

a) The Summative/Final Examination will be conducted in the suggested pattern for all the three years (Six Semester).

b) The particulars of subjects for various examinations and distribution of marks are detailed in the Scheme of Examination.

9. ELIGIBILITY / MAXIMUM DURATION FOR THE AWARD OF THE DEGREE:

a) The candidates shall be eligible for the Degree of Bachelor of Science in Medical Laboratory Technology when they have undergone the prescribed course of study for a period of not less than three years in Starex University and have passed the prescribed examinations in all subjects.

b) The maximum period to complete the course successfully should not exceed the period of 6 years.

10. MARKS QUALIFYING FOR A PASS

a) Candidate must pass separately in Theory +Viva voce and Practical by getting a minimum of 45 % marks in the aggregate marks obtained in internal assessment and Summative/Final Examination. It is further subject to the condition that candidate should obtain minimum of 45% marks Summative/Final Examination and, 45% marks in Final Practical and 40% marks in internal assessment.

b) If a candidate fails in either theory or practical, he / she has to reappear for both theory and practical.

11. DECLARATION OF CLASS

Letter Grade	Grade Point
O (Outstanding)	10
A^+(Excellent)	9
A (Very Good)	8
B^+(Good)	7
B (Above Average)	6
C (Pass)	5
F (Fail)	4
Ab (Absent)	0

Schedule of Examination-2018-19 (Total Credits-150)

SUMMARY OF PROGRAMME STRUCTURE				
Semesters	**Lecture(L) Hours Per Week**	**Tutorial (T) Hours Per Week**	**Practical (P) Hours Per Week**	**Total Credits**
First semester	15	5	10	25
Second semester	15	5	10	25
Third semester	15	5	10	25
Fourth semester	15	5	10	25
Fifth semester	15	5	10	25
Sixth semester	-	-	-	25
Total				150

I Semester

Sn	**Nomenclature of paper/course**	**Paper Code**	**Course type**	**Scheme**				**Credits** C(L-T-P)
				T	I	P	TM	
1	General Pathology	1001101	Core	75	25	50	150	5(3-1-2)
2	Human Anatomy and physiology I	1001102	Core	75	25	50	150	5(3-1-2)
3	Basics of Biochemistry	1001103	Core	75	25	50	150	5(3-1-2)
4	General Microbiology-I	1001104	Core	75	25	50	150	5(3-1-2)
5	Microbial Technology	1001105	Core	75	25	50	150	5(3-1-2)
6	Computer Science-I (Subsidiary Subject)	1001106	Non-credit	75	_	25	100	5(3-1-2)

II Semester

Sn	**Nomenclature of paper/course**	**Paper Code**	**Course type**	**Scheme**				**Credits** C(L-T-P)
				T	**I**	**P**	**TM**	
1	Human Anatomy and physiology-II	1001201	Core	75	25	50	150	5(3-1-2)
2	Biochemistry (Metabolism-I)	1001202	Core	75	25	50	150	5(3-1-2)
3	General Microbiology-II	1001203	Core	75	25	50	150	5(3-1-2)
4	Hematology and Disorders	1001204	Core	75	25	50	150	5(3-1-2)
5	Clinical Pathology	1001205	Core	75	25	50	150	5(3-1-2)
6	Computer Science-II (Subsidiary Subject)	1001206	Non-credit	75	_	25	100	5(3-1-2)

III Semester

Sn	Nomenclature of paper/course	Paper Code	Course type	Scheme				Credits
				T	I	P	TM	C(L-T-P)
1	Biochemistry (Metabolism-II)	1001301	Core	75	25	50	150	5(3-1-2)
2	Hematology & coagulation	1001302	Core	75	25	50	150	5(3-1-2)
3	Systematic Bacteriology	1001303	Core	75	25	50	150	5(3-1-2)
4	Histopathology & Cytology-I	1001304	Core	75	25	50	150	5(3-1-2)
5	Immunohematology, Blood bank and Transfusion Technology	1001305	Core	75	25	50	150	5(3-1-2)

IV Semester

Sn	Nomenclature of paper/course	Paper Code	Course type	Scheme				Credits
				T	I	P	TM	C(L-T-P)
1	Enzymology	1001401	Core	75	25	50	150	5(3-1-2)
2	Medical Parasitology	1001402	Core	75	25	50	150	5(3-1-2)
3	Medical Mycology & Virology	1001403	Core	75	25	50	150	5(3-1-2)
4	Histopathology & Cytology-II	1001404	Core	75	25	50	150	5(3-1-2)
5	Immunology & Serology	1001405	Core	75	25	50	150	5(3-1-2)

V Semester

Sn	Nomenclature of paper/course	Paper Code	Course type	Scheme				Credits
				T	I	P	TM	C(L-T-P)
1	Toxicology & Biostatistics	1001501	Core	75	25	50	150	5(3-1-2)
2	Applied Medical Microbiology	1001502	Core	75	25	50	150	5(3-1-2)
3	Applied Histology and Cytology	1001503	Core	75	25	50	150	5(3-1-2)
4	Transplant Technology	1001504	Core	75	25	50	150	5(3-1-2)
5	Clinical Microbiology	1001505	Core	75	25	50	150	5(3-1-2)

VI Semester

Sn	Nomenclature of paper/course	Paper Code	Course type	Scheme				Credits
				T	I	P	TM	
1	Assignment (Project Work)	1001603	Core	-	-	-	100	20

Note: The Internship program is of 6-months duration. A student doing internship has to work under supervision of experienced staff in the following areas (1) Clinical Pathology (2) Microbiology & Serology (3) Hematology (4) Clinical Biochemistry (5) Histopathology & Cytology (6) Transfusion Medicine and (7) Phlebotomy.

Paper Code	Nomenclature of paper/course	Credit C(L-T-P)
	I Semester	
	General pathology (1001101)	5(3-1-2)
	UNIT I Introduction to Pathology & Hematology. Formation, Composition and function of Blood. Haemopoisis (Erythropoiesis, Leucopoiesis & Thrombopoisis), Anticoagulant, Mode of Action, Uses, Advantages & Disadvantages. Collection, Preservation, Transportation & Handling and disposable of Blood Sample. Standard& Universal Precautions in Hematology. Hematological Stain, Principle, Composition & procedure of Staining. Preparation of Blood Smear and their significance. Hem cytometer, principle, working procedure Care & Maintenance. **Unit-II** Haemoglobin, its synthesis and types, normal and abnormal hemoglobins, extravasccular and intravascular hemolysis. Anaemia and its classification, Morphological and etiological, pathogenesis, laboratory investigations and management, Iron deficiency anaemia, metabolism of iron, pathogenesis, laboratory investigations and management, principle and procedure of special test Megaloblastic anaemia, pernicious anaemia, pathogenesis, laboratory investigations Cell Injury and Cellular Adaptations- Normal Cell**,** Cell Injury- types of cell injury, etiology of cell injury, and morphology of cell injury, cellular swelling, and Cell death: types- autolysis, necrosis, and apoptosis. Inflammation- Acute inflammation - vascular event, cellular event, inflammatory cells Chronic Inflammation - general features, granulomatous inflammation **Unit III** Tissue Renewal and Repair, healing and fibrosis, cirrhosis, introduction of oedema, hyperaemia, congestion, hemorrhage, haemostasis, thrombosis, embolism, infarction, shock and hypertension. Neoplasia: Definition, how does it differ from hyperplasia, difference between benign tumor and malignant tumor. Healing- Definition, different phases of healing, factors influencing wound healing. **Unit IV**	

Infectious Diseases: pathogenesis & overview of modes of infections, prevention and control with suitable examples like Typhoid, Dengue
Cancer: Definitions, nomenclature, characteristics of benign and malignant neoplasm, metastasis, Carcinogens and cancer, concept of oncogenes, tumour suppressor genes, DNA repair genes and cancers stem cells.

PRACTICALS

1. Collection of blood Sample by Venous & Capillary Method
2. Estimation of Hb By Sahli 's & CMG Method
3. Determination of RBC, WBC & Platelet Counts By Hem cytometer
4. Preparations of EDT & Sodium Citrate Vials
5. Preparation of thin & thick blood smear
6. Separation of Buffy Coat
7. Determination of ESR by Win Trobe& Western Green Method
8. Any other practical's based on theory paper
9. Blood group

RECOMMENDED BOOKS

1. Harse Mohan, Text Book of Pathology 7th Edition 2015, Jaypee & Brothers Medical Publishers LTD.
2. Richard A. McPherson, Henry's Clinical Diagnosis and Management by Laboratory Methods, 22 Edition 2014 Elsevier.
3. E M Keohane, L Smith, J Walenga, Rodak's Hematology: Clinical Principle and Application, 5th Edition 2015, Elseivier.
4. John P. Greer ,Daniel A. Arber , Bertil E. Glader , Alan F. List , Robert T. Means, Frixos Paraskevas, George M. Rodgers , John Foerster, Wintrobe's Clinical Hematology 13th Edition 2013, Wolters Kluwer.
5. Bernadette F. Rodak, George A. Fritsma, Kathryn Doig, Hematology: Clinical Principles and Applications, 4th Edition 2012. Saunders & Elseviers.

5(3-1-2)

Human Anatomy & Physiology-I (1001102)

Unit I

Introduction to medical sciences. Organization of human body and integrated physiology:- Cell, Tissue, Organ, Organ system & body. Anatomical terms: - Body position, Section, Cavity & their related term.

Unit II

Respiratory system: - Anatomy & physiology of nose and nasal cavity, pharynx, larynx, trachea, lungs. Mechanism of respiration. Lungs capacity. Lobes of lungs, layers of lungs

Integumentary system: - Anatomy & physiology of skin & its layer, nails, hairs, structure and function of skin, care of skin.

Unit III

Digestive system: - Anatomy & physiology of mouths, pharynx, esophagus, stomach: parts , structure function, blood supply. Intestine: parts, structure, function and blood supply. Pancreas: parts, structure, ducts, functions. Liver: structure, lobes, quadrants, blood supply and function. gall bladder: bile, duct, Mechanism of digestion.

Skeletal system:- Anatomy & physiology of bones, structure of bone, parts of bone ,types of bone ,blood supply of bone, Joints and its types with eg., .Upper limb, Lower limb, Vertebral column, Thorax/chest, skull.

Unit IV

Muscular system:-skeletal muscle cardiac muscle, smooth muscle, Physiology of muscular contraction and controlling them various types of Joints and their physiology, neuromuscular junction

Cardiovascular system: - Anatomy & physiology of blood vessels, heart structure, chambers of heart, function of heart, systematic circulation, valves, pressure, circulation in adults & fetal, blood, artery, vein, capillary.

PRACTICALS

1. Demonstration of Human cell, Cell division Mitosis & meiosis - from chart& slides.
2. Demonstration of various tissue- Epithelial, Connective, Muscular & Nervous.
3. Demonstration of Individual Bones & Respiratory System from Chart
4. Measurement of Blood Pressure, Respiration & Heart Beat
5. Demonstration of Body Organ like Eye, Nose, Tongue etc.
6. Any other practicals based on theory paper

RECOMMENDED BOOKS

		5(3-1-2)

1. B. D. Chaurasia, BD Chaurasia's Human Anatomy Regional and Applied Dissection and Clinical: Lower Limb Abdomen and Pelvis, Vol I, II and III, 7th Edition 2016, CBS Publishers & Distributors.
2. K Simbulingam & P Simbulingam, Essential Medical Physiology, 6th Edition 2012, Jaypee Brothers Medical publishers (P) LTD.
3. N Murgesh, Basic Anatomy and Physiology, 6th Edition 2011, Satya Publishers.
4. Anne Waugh, Kathleen and J W Wilson, Ross and Wilson Anatomy and Physiology, 12th Edition 2014, Churchill Living Stone.
5. H. G. Q. Rowett, Basic Anatomy and Physiology, 3rd Edition 1996, Murray Publishers Ltd.
6. Gerard J. Tortora, Bryan H. Derrickson, Principle of anatomy and physiology, 14th Edition 2014, Wiley Publication.
7. R S Winwood, Sears Anatomy & Physiology, 6th Edition, 1985, CRC Press.

Elaine N. Marie, Essentials of Human Anatomy and Physiology, 11th Edition 2015, Pearsons Benjamin Cummings.

Basics of Biochemistry (1001103)

Unit I

Introduction to Clinical Biochemistry and role of Medical Lab Technologist, ethics, responsibility, safely measure and hazards in clinical biochemistry lab and first aid in laboratory accidents. Basic awareness of laboratory in respect to equipments & glassware (Unit of Measurements, and calibration of volumetric apparatus. Colorimetry, spectrophotometery, flame photometry, analytical balance etc, (principles instrumentations & applications) Preparation and storage of reagents standard solutions, buffer solutions and pH determination. Biophysics, techniques- osmosis, dialysis, surface tension, sedimentation and viscosity – principles & applicatons.

Unit II

Henderson – Hassalbach equation and its clinical applications. Acid base disturbances and their clinical significance Acid –base –buffer and pH-simple calculations. Concept of clinical sensitivity and specificity and factors affecting the clinical results. Collection of blood specimens avoiding Haemolysis, de- proteinization& separation of serum/plasmas.

Unit-III

Preparation of solution and reagents, normal solution, molar solutions, percent solution, buffer solution, dilutions, w/v, v/v, standard solution, aqueous solutions, concepts of acid and base

	Units of measurement: SI unit, reference range, conversion factor, units for measurement of bio metabolite, enzymes, protein, drugs, hormones, vitamins **Unit-IV** Specimen collection and processing of blood, urine & CSF, separation of serum and plasma, deproteinization of sample, Handling of specimens for testing, preservation of specimen, transport of specimen, factors affecting the clinical results, effect of storage on sample Physical, chemical and microscopic examination of urine, Bence Jones Proteinuria and its clinical significance, qualitative test of urine for reducing sugars, protein, ketone bodies, bile Salt, bile pigments, urobilinogen, occult blood, uric acid, urea and Creatinine, quantitative estimation of 24 hrs urine for protein and their clinical significance. **PRACTICALS** 1. Cleaning of Laboratory Glass wares. 2. Preparation of distilled Water. 3. Care and maintenance of the biochemistry lab. 4. Preparation of Hypertonic, Hypotonic & Norm tonic Solution & their Clinical Significance. 5. Collection of Blood Sample, serum & plasma separation. 6. Physical, chemical and microscopic examination of urine. 7. Any other practical's based on theory paper **RECOMMENDED BOOKS** 1. U Satyanarayan and U Chakrapani, Text book of Biochemistry, 4th Edition 2013, Elsevier. 2. M N Chatterjea and Rana Shinde, Text book of Medical Biochemistry , 8th Edition 2012, Jaypee & Brothers Medical Publishers (P) Ltd. 3. D M Vasudevan, Sreekumari S, Kannan Vidhyanathan,Textbook of Biochemistry for Medical students, 8th Edition 2016, Jaypee & Brothers Medical Publishers (P) Ltd. 4. S Ramakrishana, Test Book of Medical Biochemistry, 3rd Illustrated Edition 2004, Orient Longman 5. S Chitiprol, Biochemistry: Instant Notes for Medical students, 1st Edition 2006, Jaypee & Brothers Medical Publishers. 6. DM Vasudevan, Subir Kumar Das, Practical Textbook of Biochemistry for Medical Students, 2nd Edition 2013, Jaypee & Brothers Medical Publishers (P) Ltd. 7. P K Godkar, Text Book of Medical Laboratory Technology, 3rd Edition 2014, Bhalani Publication.	5(3-1-2)

8. Ranjna Chawla, Practical Clinical Biochemistry: Methods and Interpretations, 4th Edition 2014, Jaypee & Brothers Medical Publishers (P) Ltd.
9. David T Punmmer, An introduction to practical biochemistry, 3rd Edition 2004, Tata McGrew Hill.
10. Shivaraja Shankara YM, Shankara, Ganesh MK, Laboratory Manual for Practical Biochemistry, 2nd Edition 2013, Jaypee & Brothers Medical Publishers (P) Ltd.
11. Carl A Buttis, David E. Bruns, Teitz fundamental of clinical chemistry and molecular diagnosis,7th Edition 2015, Elsevier.
12. Albert L Lehninger, Michel M Cox, David L Nension, Lehninger Principle of Biochemistry, 6th Edition 2013, W H Freeman & Co.
13. Robert Kincaid Murray, David Bender, Kathleen M. Botham, Peter J. Kennelly, Harpers Illustrated Biochemistry, 30th Edition 2015, McGraw Hill Professional.
14. Michael Lieberman, Allan D. Marks, Colleen M. Smith, Dawn B. Marks, Marks' Essential Medical Biochemistry, 2nd Edition 2007, Lippincott Williams & Wilkins.
15. Donald Voet, Judith G. Voet, Charlotte W. Pratt, Fundamentals Of Biochemistry: Life At The Molecular Level, 5th Edition 2016, John Wiley and Sons.

5(3-1-2)

General Microbiology-I (1001104)

Unit I

History & Introduction of Medical Microbiology. Importance of Medical Microbiology. Discovery of Microorganism. Contribution of Robert Koch, Bordet, Paul Ehrlich, Alexander Flaming, etc. Scope& Relevance of Safety Measures of Medical Microbiology. Bacterial Structure- Cell wall, Outer membrane, Lipo polysaccharide, Cytoplasmic membrane, Nucleus and Morphology Shape, Capsule, Flagella, fimbriae, capsule, spore.

Unit II

Growth and Nutrition requirement (Oxygen, Carbon dioxide, Temperature, Moisture and drying, Hydrogen Ion concentration and Light) of Bacteria, Autotrophs, Heterotrophs.Bacterial Growth (Lag phase, Log phase, Stationary phase and Phase of Decline) Curve. Products of Bacterial growth and Bacterial enzymes.
Different types of staining: Simple stains, Negative stain, Impregnation Method, Differential stain. Gram's stain- preparation of stain and staining methods. Ziehl–Neelsen stain.

Unit-III

	General safety measures used in Microbiology laboratory, Sterilization and disinfection: Various physical methods of sterilization – heat, UV radiation, ionizing radiation, filtration, characters affecting sterilization, auto clave control and sterilization indicators. Biomedical waste management in a Medical Microbiology laboratory: Types of the waste generated, Segregation, Treatment, Disposal **Unit-IV** Antiseptics & Disinfectants: Definition, types and properties, mode of action, use, qualities of good disinfectants. Chemical disinfectants – phenol and its compounds, alcohol, halogen, heavy metals and quaternary ammonium compounds, aldehyde, gaseous compound. Use and abuse of disinfectants. Precautions while using the disinfectants. **PRACTICALS** 1. Preparation of smear. 2. Perform Ziehl-Neelsen staining. 3. Perform Gram's staining 4. Perform Geimsa stain. 5. Perform Leishman staining. 6. Perform spore staining 7. Any other practical's based on theory paper 8. Perform Negative Staining 9. To perform simple stainng 10. To prepare good smear . **RECOMMENDED BOOKS** 1. Text book of medical laboratory technology by Praful B C P Baveja, Text book of Microbiology, 4th Edition 2010, Arya Publication. 2. Arti Kapil, Ananthanarayan and Paniker's Textbook of Microbiology, 9th Edition 2013, Orient Black Swan. 3. Mark Gladwin , Trattler William , C. Scott, Mahan, Clinical Microbiology Made Ridiculously Simple. 6th Edition 2013, Medmaster. 4. D.R.Arora / Brij Bala Arora, Textbook of Microbiology, 5th Edition 2016, CBS Publishers & Distributors. 5. Eds J. G. Collee, J. P. Duguid, A. G. Fraser & B. P. Marmio, Mackie and McCartney: Practical medical microbiology, 14th Edition 2007, Church New Delhi (India): Elsevierill Livingston. 6. R C Dubay & D.K.Maheshwari, Practical Microbiology, Revised edition 2014, S Chand & Company Ltd.	5(3-1-2)

	7. Dr. C.P. Baveja, Dr. V. Baveja, Textbook of Microbiology for MLT, 2nd Edition, Arya Publication. 8. Joanne Willey, Linda Sherwood, Christopher J. Woolverton, Presscot's Microbiology, 9th Edition 2014, McGraw-Hill Education. 9. Gary W Procop & Elmer W. Koneman Koneman's Color Atlas and Textbook of Diagnostic Microbiology, 7th Edition 2016, Wolters Kluwer Health. 10. F. H. Kayser, K. A. Bienz, J. Eckert, Medical Microbiology, 10th German Edition 2005, Thieme Stuttgart, New York. 11. Michael Ford, Medical Microbiology, 2nd Edition 2014, Oxford university press.	5(3-1-2)
	Microbial Technology (1001105) **Unit 1** Microscope: History, Introduction, different types of microscope (Compound Microscope, Phase contrast Microscope, Florescent Microscope, Electron Microscope) - Principle, components, uses and functions. **Unit II** Magnification, Numerical Aperture, Resolution, Care and maintenance of microscope. Safety Measures in Microbiology Laboratory. Occurrence of Infection, Route of lab infection, Safety Measures & precaution in microbiology lab. **Unit-III** General Instruments: Use of Distillation plant, Centrifuge Machine and Analytical Balance. Uses of Hotplate, Magnetic Stirrer and Water Bath. Microbiological Instruments: Use of Autoclave Incubator, Hot air oven and Laminar Air flow. Use of Colony Counter and Gas pack anaerobic jar. **Unit-IV** Sterilization and Disinfection: Physical method, Chemical method, Mechanical method. Sterilization by heat, dry heat, moist heat. Sterilize by filtration, Merits and demerits of heat sterilization. Temperature less than 100^0C, Temperature at 100^0C, Temperature above 100^0C. **PRACTICALS** 1. Demonstration of Compound Microscope. 2. Demonstration of Centrifuge 3. Demonstration of Analytical Balance 4. Demonstration of Incubator 5. Demonstration of Hot Air Oven 6. Demonstration of Autoclave	

7. Demonstration of Water Bath
8. Demonstration of Colony Counter
9. Demonstration ofLaminar Air flow
10. Any other practical's based on theory paper

RECOMMENDED BOOKS

1. C P Baveja, Text book of Microbiology, 4th Edition 2010, Arya Publication.
2. Arti Kapil, Ananthanarayan and Paniker's Textbook of Microbiology, 9th Edition 2013, Orient Black Swan.
3. Mark Gladwin , Trattler William , C. Scott, Mahan, Clinical Microbiology Made Ridiculously Simple. 6th Edition 2013, Medmaster.
4. D.R.Arora / Brij Bala Arora, Textbook of Microbiology, 5th Edition 2016, CBS Publishers & Distributors.
5. Eds J. G. Collee, J. P. Duguid, A. G. Fraser & B. P. Marmio, Mackie and McCartney: Practical medical microbiology, 14th Edition 2007, Church New Delhi (India): Elsevierill Livingston.
6. R C Dubay & D.K.Maheshwari, Practical Microbiology, Revised edition 2014, S Chand & Company Ltd.
7. Dr. C.P. Baveja, Dr. V. Baveja, Textbook of Microbiology for MLT, 2nd Edition, Arya Publication.
8. Joanne Willey, Linda Sherwood, Christopher J. Woolverton, Presscot's Microbiology, 9th Edition 2014, McGraw-Hill Education.
9. Gary W Procop & Elmer W. Koneman Koneman's Color Atlas and Textbook of Diagnostic Microbiology, 7th Edition 2016, Wolters Kluwer Health.
10. F. H. Kayser, K. A. Bienz, J. Eckert, Medical Microbiology, 10th German Edition 2005, Thieme Stuttgart, New York.
11. Michael Ford, Medical Microbiology, 2nd Edition 2014, Oxford university press.

5(3-1-2)

COMPUTER SCIENCE-I (1001106)

Unit 1

Introduction to Computer**:** Meaning or Definition of Computer**,** Evolution of computer**,** Features of Computer**,** Main Operation of the Computer**,** Main Elements of Computer System**,** Bits, Bytes and Words**,** Device in Computer**,** Various Input & output Device.

Unit II

Applications of computer**:** advantages and limitations of computers.

	Memory**:** overview of storage devices .main memory, storage evaluation criteria, random access memory, read only memory, secondary storage devices. **Unit-III** Generation of Computers and their Classification Generation of Computers**,** Classification of Computers. **Unit-IV** Operating System Meaning of Operating System**,** Function of Operating System**,** Language Translators Database Meaning Of Database**,** Data Processing System**,** Function of Data Processing**,** Objectives of Database**,** Type of Database**,** Functions of Database Management System (DBMS)**,** and Advantages & Disadvantages of DBMS**,** Various Database Structures or database models. **II Semester** **Human Anatomy & Physiology-II (1001201)** **Unit I** Lymphatic system: Lymphatic organs, lymphocytes, Spleen, Bone marrow etc. primary & secondary immune response, Immunity. Primary defense mechanism of human body against pathogenic microbes. Physiology of various body fluids: CSF, peritoneal, Pericardial, Pleural and synovial fluids. Cartilage, ligaments, tendons. **Unit II** Excretory system: Anatomy & physiology of Kidney, Ureters, Bladder & Urethra. Mechanism of urine formation, GFR, mechanism of GFR, Nephrons diagram and its function. Sense organ: Anatomy & physiology of eye, diagram of eye, ear, diagram of ear, nose & tongue. **Unit-III** Nervous system: Anatomy& physiology of Neurons structure and function, Brain and its parts, Spinal cord, Central & Peripheral nervous system. Endocrine system: Anatomy & physiology of hormones, glands, Pituitary gland & hypothalamus, thyroid gland, parathyroid glands, adrenal glands, pancreas, pineal gland & mechanism of action.	5(3-1-2)

Unit-IV

Reproductive system: Male- Anatomy & physiology of Primary & secondary reproductive organs, sperm diagram and its function, spermatogenesis, testis, prostate gland,

Female-Anatomy & physiology of Primary & secondary reproductive organs, ovary, ovum, uterus, Oogenesis, mensturation cycle.

PRACTICALS

1. Collection of body Fluids
2. Estimation of sugar in CSF fluid
3. Demonstration of Semen
4. Analysis of Semen
5. Estimation of Insulin Hormone
6. Examination of Urine
7. Demonstration of Reproductive System by Chart
8. Demonstration of Glands in chart in human body
9. Demonstration of Sense Organ
10. Demonstration of spinal & Cranial Nerve
11. Any other practical's based on theory paper

RECOMMENDED BOOKS

1. B. D. Chaurasia, BD Chaurasia's Human Anatomy Regional and Applied Dissection and Clinical: Lower Limb Abdomen and Pelvis, Vol I, II and III, 7th Edition 2016, CBS Publishers & Distributors.
2. K Simbulingam & P Simbulingam, Essential Medical Physiology, 6th Edition 2012, Jaypee Brothers Medical publishers (P) LTD.
3. N Murgesh, Basic Anatomy and Physiology, 6th Edition 2011, Satya Publishers.
4. Anne Waugh, Kathleen and J W Wilson, Ross and Wilson Anatomy and Physiology, 12th Edition 2014, Churchill Living Stone.
5. H. G. Q. Rowett, Basic Anatomy and Physiology, 3rd Edition 1996, Murray Publishers Ltd.
6. Gerard J. Tortora, Bryan H. Derrickson, Principle of anatomy and physiology, 14th Edition 2014, Wiley Publication.
7. R S Winwood, Sears Anatomy & Physiology, 6th Edition, 1985, CRC Press.

Elaine N. Marie, Essentials of Human Anatomy and Physiology, 11th Edition 2015, Pearsons Benjamin Cummings.

5(3-1-2)

Biochemistry (Metabolism-I) (1001202)

	Unit I Metabolism: Introduction to metabolism, concept of catabolism and anabolism. Metabolic pathways and their significance in the living system. Metabolites: Introduction, clinical significance, physiological variation in various body fluids, pathological aspects. **Unit II** Carbohydrates: Introduction, general and structural classification, biological functions. Metabolism of carbohydrates (Glycolysis, TCA, ETS and oxidative phosphorylation). Genetic disorders related to carbohydrate metabolism, Blood glucose and its regulation, hyperglycemia, hypoglycemia and glucosuria. Vitamins: Types and their roles, deficiency related diseases. **Unit III** Amino acids: Introduction, classification, structural properties, biological functions. Proteins: Introduction, general and structural classification, biological functions. Metabolism of proteins (Digestion of proteins, General reactions of amino acids, Regulations of amino acid biosynthesis). Disorders related to proteins and amino acids metabolism. Enzymes: Introduction, properties and biological significance, structure and mechanism of action, enzyme inhibition (competitive and non competitive inhibition), concept of co-factors, prosthetic groups, apoenzyme, holoenzyme and co-enzymes (with examples) and enzyme excess or deficiency related disorders. **Unit IV** Fatty acids and fats: Introduction and biological significance, classification of fatty acids, structure of fats and fatty acids. Lipids: Introduction, classification, biological significance, metabolism of lipids. Nucleic acid: Historical prospective, types and their functions, role of nucleic acid in protein synthesis (central dogma) , double helical model of DNA, nucleic acid mutations and its related disorders. Miscellaneous – urea cycle, formation and breakdown of hemoglobin, iron metabolism. **PRACTICALS** **Qualitative test**: i. Carbohydrate a. Molisch's Test b. Fehling's Test c. Benedict's Test d. Barfoed's Test e. Seliwanoff's Test f. Iodine Test g. Osazone Test, ii. Qualitative test of urine for Ketone bodies	5(3-1-2)

iii. Any other practical's based on theory paper

RECOMMENDED BOOKS

1. U Satyanarayan and U Chakrapani, Text book of Biochemistry, 4th Edition 2013, Elsevier.
2. M N Chatterjea and Rana Shinde, Text book of Medical Biochemistry , 8th Edition 2012, Jaypee & Brothers Medical Publishers (P) Ltd.
3. D M Vasudevan, Sreekumari S, Kannan Vidhyanathan,Textbook of Biochemistry for Medical students, 8th Edition 2016, Jaypee & Brothers Medical Publishers (P) Ltd.
4. S Ramakrishana, Test Book of Medical Biochemistry, 3rd Illustrated Edition 2004, Orient Longman
5. S Chitiprol, Biochemistry: Instant Notes for Medical students, 1st Edition 2006, Jaypee & Brothers Medical Publishers.
6. DM Vasudevan, Subir Kumar Das, Practical Textbook of Biochemistry for Medical Students, 2nd Edition 2013, Jaypee & Brothers Medical Publishers (P) Ltd.
7. P K Godkar, Text Book of Medical Laboratory Technology, 3rd Edition 2014, Bhalani Publication.
8. Ranjna Chawla, Practical Clinical Biochemistry: Methods and Interpretations, 4th Edition 2014, Jaypee & Brothers Medical Publishers (P) Ltd.
9. David T Punmmer, An introduction to practical biochemistry, 3rd Edition 2004, Tata McGrew Hill.
10. Shivaraja Shankara YM, Shankara, Ganesh MK, Laboratory Manual for Practical Biochemistry, 2nd Edition 2013, Jaypee & Brothers Medical Publishers (P) Ltd.
11. Carl A Buttis, David E. Bruns, Teitz fundamental of clinical chemistry and molecular diagnosis,7th Edition 2015, Elsevier.
12. Albert L Lehninger, Michel M Cox, David L Nension, Lehninger Principle of Biochemistry, 6th Edition 2013, W H Freeman & Co.
13. Robert Kincaid Murray, David Bender, Kathleen M. Botham, Peter J. Kennelly, Harpers Illustrated Biochemistry, 30th Edition 2015, McGraw Hill Professional.
14. Michael Lieberman, Allan D. Marks, Colleen M. Smith, Dawn B. Marks, Marks' Essential Medical Biochemistry, 2nd Edition 2007, Lippincott Williams & Wilkins.
15. Donald Voet, Judith G. Voet, Charlotte W. Pratt, Fundamentals Of Biochemistry: Life At The Molecular Level, 5th Edition 2016, John Wiley and Sons.

General Microbiology-II (1001203)

Unit I

	General Characteristics (Margin, surface, texture, color) and Classification. Bacterial classification Based on Shape, Based on Oxygen requirement, Based on their size, Based on Host Resistance or Pathogencity, Based on Staining reaction. Bacteriological Culture media, Composition, Classification- Depending on the consistency, depending upon the oxygen requirement of organisms, their preparation and uses. **Unit II** Basic requirements of culture media. Biochemical test: Principle, method and importance of various test like- Indole, Motility, Citrate, Urease, Catalase, Coagulase, Oxidase, Nitrate Reduction, Triple sugar iron, Voges-Proskauer/Methyl red, H_2S production, Gas production. Bacitracin test. Growth and nutrition of Bacteria: Oxygen, carbon dioxide, temperature, moisture and drying, hydrogen ion concentration and light. **Unit-III** Principle, working, use, care & maintenance of Laminar air flow, Centrifuge, Autoclave, hot air Oven, Incubator, Mac-intos Field-jar etc. Collection and transportation of the specimen. **Unit-IV** Antimicrobial agents and Antibiotics: Antibiotic susceptibility testing in bacteriology, Culture medium used for Antibiotic susceptibility testing, Control, morphology, cultural characteristics, Pathogencity, lab diagnosis of Staphylococcus, Streptococcus, Pneumococcus, Neisseria, Methods of the ABST, Stokes and Kirby-baur method. **PRACTICALS** 1. Preparation of Nutrient Agar 2. Preparation of Mc Conkey Agar 3. Preparation of Blood Agar 4. Preparation of Chocolate Agar 5. Preparation of Muller Hinton Agar 6. Preparation of Nutrients Broth 7. Preparation of Slop Medium 8. Preparation of Solid Liquid Medium 9. Any other practical's based on theory paper **RECOMMENDED BOOKS** 8. C P Baveja, Text book of Microbiology, 4th Edition 2010, Arya Publication. 9. Arti Kapil, Ananthanarayan and Paniker's Textbook of Microbiology, 9th Edition 2013, Orient Black Swan. 10. Mark Gladwin , Trattler William , C. Scott, Mahan, Clinical Microbiology Made Ridiculously Simple. 6th Edition 2013, Medmaster.	0(0-0-0) 5(3-1-2)

11. D.R.Arora / Brij Bala Arora, Textbook of Microbiology, 5th Edition 2016, CBS Publishers & Distributors.
12. Eds J. G. Collee, J. P. Duguid, A. G. Fraser & B. P. Marmio, Mackie and McCartney: Practical medical microbiology, 14th Edition 2007, Church New Delhi (India): Elsevierill Livingston.
13. R C Dubay & D.K.Maheshwari, Practical Microbiology, Revised edition 2014, S Chand & Company Ltd.
14. Dr. C.P. Baveja, Dr. V. Baveja, Textbook of Microbiology for MLT, 2nd Edition, Arya Publication.
12. Joanne Willey, Linda Sherwood, Christopher J. Woolverton, Presscot's Microbiology, 9th Edition 2014, McGraw-Hill Education.
13. Gary W Procop & Elmer W. Koneman Koneman's Color Atlas and Textbook of Diagnostic Microbiology, 7th Edition 2016, Wolters Kluwer Health.
14. F. H. Kayser, K. A. Bienz, J. Eckert, Medical Microbiology, 10th German Edition 2005, Thieme Stuttgart, New York.
15. Michael Ford, Medical Microbiology, 2nd Edition 2014, Oxford university press.

Hematology & Disorders (1001204)

Unit I

Hb & Hemoglobinopathies-Definition, types, characteristics, sign & symptoms. Leucomoid reaction: definition, types, causes. Leukocytosis, Leukopenia, Erythrocytosis, Anemia, Thrombocytosis, Thrombocytopenia, Pancytopenia & Normal range their conditions. Physiological changes of RBC, WBC &Platelets. Morphological abnormalities of WBC, RBC & Platelets.

Unit II

Anemia:-Definition, types, Sign & Symptoms, causes & laboratory diagnosis, Prevention & control. Leukemia:-Definition, classification, Sign & Symptoms laboratory diagnosis. Prevention & Control (FAB classification of leukemia-Acute & Chronic, AML, ALL, CML, CLL, Multiple Myeloma)

Unit-III

Haemoglobin, its synthesis and types, normal and abnormal hemoglobins, extravasccular and intravascular hemolysis.
Haemolytic anaemia, pathogenesis and laboratory investigations, principle and procedure of special test, G-6-PD

5(3-1-2)

Unit –-IV

Leukopoiesis , Stages of Leukocyte Maturation, Features of Cell Identification, leucocytosis and leukocytopenia , neutrophilia , eosinophilia, basophilia, monocities, lymphocytosis,

neutropenia, lymphopenia, causes and significance, toxic granulation, Morphological alterations in neutrophil, effect of HIV on blood

PRACTICALS

1. Preparation of Leishman, Write &Giemsa stain.
2. Staining of blood Smear by leishman stain & Field stain
3. Determination of AEC, ANC & ALC.
4. Demonstration of PBS.
5. Determination of PCV, MCV, MCH, MCHC
6. Any other practical's based on theory paper

RECOMMENDED BOOKS

1. Shrish M. Kawthalkar, Essential Hematology, 2nd Edition 2013, Jaypee Publication.
2. Bain, Decie & Lewis Practical Hematology, 11th Edition 2016, Churchill Livingstone.
3. J Ochei and A Kolhatkar, Medical Laboratory Science- Theory and Practice, 1st Edition 2000, Tata Mcgraw Hill Publishing Co Ltd.
4. Praful B. Godkar, Darshan P. Gidkar, Text book of Medical Laboratory Technology, 3rd Edition 2014, Bhalani Publishing House.
5. Harse Mohan, Text Book of Pathology 7th Edition 2015, Jaypee & Brothers Medical Publishers LTD.
6. Richard A. McPherson, Henry's Clinical Diagnosis and Management by Laboratory Methods, 22 Edition 2014 Elsevier.

Clinical Pathology (1001205)

5(3-1-2)

Unit I

Examination of Urine: Composition of Urine, Collection of Urine, Preservatives used in Urine samples. Routine examination of Urine- Physical analysis, Chemical analysis, Quantitative test for albumin, Disorder causing albuminuria, Qualitative test for sugar, Quantitative determination of sugar in Urine, Ketone body test, causes of Ketonuria, Blood in urine, Test for Bile salt, Bile pigment and Urobilinogen. Microscopic examination of urine.

Unit II

	Examination of Feces: Routine examination of Feces, Gross examination and Physical examination of Stool. Determination of pH and Reducing substance and Occult blood in the Stool. Microscopic examination of stool specimen. Brief discussion on Protozoa and Metazoa examination in Stool. Semen Examination: Sample collection methods, Physical, Chemical and Microscopically Examination and their Clinical Significance. **Unit-III** Mechanism of coagulation, coagulation factors, Bleeding time, clotting time, platelet count, protamine sulphate test, clot retraction test Introduction to immuno hematology and blood banking technology, antigen, antibody, complements, ABO & Rh blood group system, method of determination, other blood group system, Donor selection, blood collection, anticoagulants, additive systems, blood bags, its labelling , storage and transportation **Unit-IV** Uses, care & maintenance and calibration of Coulter counter, coagulometer, automatic ESR analyzer, urine analyzer, point of care testing. Pre and Post analytical variables, automation in hematology **PRACTICAL** 1. Urine-collection, preservation and physical examination 2. Chemical examinations (Protein, sugar and ketone) 3. Chemical examinations (Bile salt, bile pigment and urobilinogen) 4. Urine microscopic examination- RBCs, pus, epithelial, crystal and casts 5. Collection, preservation and physical examination of stool 6. Occult blood examination in stool 7. Wet mount of stool, normal saline and iodine method 8. Concentrated method of stool examination for ova and cyst 9. Analysis and examination of semen-physical examination, sperm motility, morphological study of sperms. 10. Any other practical's based on theory paper **RECOMMENDED BOOKS** 1. Medical Laboratory Technology Vol. 1 by KL Mukherjee; Tata McGraw Hill Publishing Company, New Delhi 2. An Introduction to Medical Laboratory Technology by FJ Baker; ButterworthsHeinenmann, Oxford 3. Medical Laboratory Manual for Tropical Countries by Monica Cheesberg; Cambridge University Press; UK	5(3-1-2)

	4. Textbook of Medical Laboratory Technology by Praful B Godkar; Bhalani Publishing House, Mumbai 5. Cellular Pathology Techniques by CFA Culling, Butterworths Co, London **Computer Science-II** **(1001206)** **Subsidiary subject** **Unit I** Windows Graphical User Interface, Windows, Features of Windows, Control Button of windows, Various Icons on Desktop Microsoft Word(INTRODUCTION) **Unit II** Microsoft Excel (INTRODUCTION) Microsoft PowerPoint (INTRODUCTION) Internet – Features, Different type of network, Internet, **Unit-III** Patient Management Medical Establishments using Computer, One or More Computer, Network, Software, Training, Service Operators of System Computerization in Hospitals and Nursing Homes, Features of a Hospital Software Packages, Password Protection ,Various Application of Different Medical ,Software and Support **Unit-IV** Picture archiving communicating system, DICOM,RIS,HIS, Uses of computer in hospitals in different department Online reporting system, different types of software used in medical fields.	5(3-1-2)

III Semester

Biochemistry (Metabolism-II)
(1001301)

Unit I

Glycolysis, TCA and their clinical importance, Glucose tolerance test (GTT, GCT).Protein metabolism-urea cycle and Lipid metabolism, ketone bodies, lipid profile.

Thyroid function test: T3, T4, TSH Free T3, Free T4, Infertility profile: TSH, FSH, LH, Testosterone, estrogen, prolactin.

Unit II

Principle, assay procedures and clinical significance of following; Glucose, urea, uric acid, creatinine cholesterol, Billirubin (Direct & Indirect)

Electrolytes: sodium, potassium, calcium.

Acid – base (handerson hasselbach equation) balance test, creatinine clearance tests Renal function tests and their clinical interpretation. Glycosylated Hb& Liver function tests. Principle technique and clinical significance.

Unit-III

Basic concepts of principles of nutrition and nutrients macro and micro nutrients.

Fundamental concepts of biophysical phenomena like osmosis, dialysis, colloidal state, viscosity, absorption, osmotic pressure, surface tension and their application in relation to the human body.

Principal Procedure and Application of analyzer, Enzyme Linked Immunosorbent Assay (ELISA). Introduction of diabetes and its types and clinical significance.

Unit-IV

Dilution, serial dilution, blood glucose regulation, BMR. Quality control and Assurance, accuracy and precession. Clinical significance of LFT, RFT, HBA1C , lipid profile.

PRACTICALS

1. Estimation of Serum / Plasma Glucose Level by different Method.
2. Estimation of Total Protein.
3. Estimation of Serum Urea & Creatinine Level.
4. Estimation of Serum Cholesterol & Triglyceride Level
5. Estimation of Serum Uric acid Level
6. Any other practical's based on theory paper

5(3-1-2)

RECOMMENDED BOOKS

1. U Satyanarayan and U Chakrapani, Text book of Biochemistry, 4th Edition 2013, Elsevier.
2. M N Chatterjea and Rana Shinde, Text book of Medical Biochemistry , 8th Edition 2012, Jaypee & Brothers Medical Publishers (P) LTD.
3. D M Vasudevan, Sreekumari S, Kannan Vidhyanathan,Textbook of Biochemistry for Medical students, 8thEdition 2016, Jaypee & Brothers Medical Publishers (P) Ltd.
4. S Ramakrishana, Test Book of Medical Biochemistry, 3rd Illustrated Edition 2004, Orient Longman.
5. S Chitiprol, Biochemistry: Instant Notes for Medical students, 1st Edition 2006, Jaypee & Brothers Medical Publishers.
6. DM Vasudevan, Subir Kumar Das, Practical Textbook of Biochemistry for Medical Students, 2nd Edition 2013, Jaypee & Brothers Medical Publishers (P) LTD.
7. P K Godkar, Text Book of Medical Laboratory Technology, 3rd Edition 2014, Bhalani Publication.

Hematology & Coagulation (1001302)

Unit I

Coagulation: Mechanism of coagulation, clotting factor coagulation disorders (Disseminated Intravascular Coagulation, Von Willebrand Disease, Hemophilia etc) Role of Platelets in Coagulation & haemostatic mechanism. Bleeding Disorders (perpura, Idiopathic thrombocytopenic Perpura Bleeding disorders: Various types, vascular abnormalities, platelet disorders, thrombosis and thrombohaemorrhagic disorders.

Unit II

Sample collection, Preparation & storage of Sample, Abnormalities of RBC, WBC and platelets clinical significance & Lab diagnosis. Improved neubaur's chamber and its principle and its application. Introduction of Le Cell and its Preparation, Collection, preservation and transportation sample for coagulation testing

Unit III

Overview of hemostasis and coagulation, Stages of platelets development, Primary and Secondary hemostasis, Role of platelets, Role of coagulation factors, Coagulation inhibitory system, Fibrinolysis. ESR principle and procedure.

Unit-IV

General blood picture, introduction of iron, TIBC, Transferrin, Ferritin, Folic acid Schilin test, ,G-6-PD, Osmotic fragility test, Perls Prussian staining, Platelet count, PT, INR APTT. Various

5(3-1-2)

method of the BT, CT.

PRACTICALS

1. Anticoagulation.
2. PBS.
3. Staining of PBS.
4. Determination of bleeding time & clotting time.
5. Determination of ESR.
6. Any other practical's based on theory paper

RECOMMENDED BOOKS

1. J. Ochei and A. Kolhatkar, Medical Laboratory Science-Theory and Practice, 1st Edition 2000, Tata Mcgraw Hill Publishing Co. Ltd.
2. Praful B. Godkar, Darshan P. Godkar, Text book of Medical Laboratory Technology, 3rd Edition 2014, Bhalani Publishing House.
3. Bain, Decie & Lewis Practical Hematology, 11th Edition 2016, Churchill Livingstone.
4. Mannual of Basic Technique for Health Laboratory, 2nd Edition 2003, WHO Geneva.
5. Sood, Textbook of Medical Laboratory Technology,1st Edition 2006, Jaypee Brothers Publishers, 2006.

Systematic Bacteriology (1001303)

Unit I

Morphology, classification, culture characteristics, biochemical reaction and sensitivity of gram positive bacteria: Streptococcus, Staphylococcus, pneumococcus, Corynebacterium diphtheria, Clostridium Tetani and Mycobacterium Tuberculosis. Principle of ZN stains.

Unit II

Pathogenesis, clinical importance and lab diagnosis of gram positive bacteria: Streptococcus, Staphylococcus, pneumococcus, Corynebacterium diphtheria, Clostridium Tetani and Mycobacterium Tuberculosis. Procedure of ZN stains and alternative stains used in ZN stains.

5(3-1-2)

Unit III

Morphology, classification, culture characteristics, biochemical reaction and sensitivity of gram negative bacteria: Escherichia coli, Klebsiella, Proteus, Salmonella, Shigella, Pseudomonas aeroginosa, Neisseria gonorrhoeae and Neisseria meningitides. Principle of

Gram stains.

Unit-IV

Pathogenesis, clinical importance and lab diagnosis of gram negative bacteria: Escherichia coli, Klebsiella, Proteus, Salmonella, Shigella, Pseudomonas aeroginosa, Neisseria gonorrhoeae and Neisseria meningitides. Procedure of Gram stains and alternative stains used in gram stains.

PRACTICALS

1. Sample collection for Bacteriology Study.
2. Preparation of smear for gram stains.
3. Gram stains.
4. Perform ZN stains.
5. Perform the Catalase test
6. Perform the coagulase test
7. Any other practical's based on theory paper

RECOMMENDED BOOKS

1. C P Baveja, Text book of Microbiology, 4th Edition 2010, Arya Publication.
2. Arti Kapil, Ananthanarayan and Paniker's Textbook of Microbiology, 9th Edition 2013, Orient BlackSwan.
3. Mark Gladwin , Trattler William , C. Scott, Mahan, Clinical Microbiology Made Ridiculously Simple. 6th Edition 2013, Medmaster.
4. D.R.Arora / Brij Bala Arora, Textbook of Microbiology, 5th Edition 2016, CBS Publishers & Distributors.
5. Eds J. G. Collee, J. P. Duguid, A. G. Fraser & B. P. Marmio, Mackie and McCartney: Practical medical microbiology, 14th Edition 2007, Church New Delhi (India): Elsevierill Livingston.
6. R C Dubay & D.K.Maheshwari, Practical Microbiology, Revised edition 2014, S Chand & Company LTD.
7. Dr. C.P. Baveja, Dr. V. Baveja, Textbook of Microbiology for MLT, 2nd Edition, Arya Publication.
8. Joanne Willey, Linda Sherwood, Christopher J. Woolverton, Presscot's Microbiology, 9th Edition 2014, McGraw-Hill Education.
9. Gary W Procop & Elmer W. Koneman Koneman's Color Atlas and Textbook of Diagnostic Microbiology, 7th Edition 2016,Wolters Kluwer Health.
10. F. H. Kayser, K. A. Bienz, J. Eckert, Medical Microbiology,10th German Edition 2005, Thieme Stuttgart, New York.
11. Michael Ford, Medical Microbiology, 2nd Edition 2014, Oxford university press.
12. Neal Chamberlain, Medical Microbiology: The Big Picture, 1st Edition 2008, Mc Grew Hill Medical.

5(3-1-2)

Histopathology & Cytology-I
(1001304)

Unit I

Introduction to Histopathology & Cytotechnology. Basic terminology-Adhesion, Autolysis, Biopsy, Fixation, Block, Cryostat, Clearing Agent, Decalcification, Dehydration, Exfoliative cytology, Freezing microtomy, Infiltration, Impregnation, Microtome, Mounting, Rehydration, Staining and Smear. Laboratory equipment for Histology and Cytology. Use and care of frequently used equipment: Microscope, Microtome, Care of Microtome, Paraffin Oven, Tissue Floating Bath, Vacuum Embedding Oven, Automated Tissue Processor and Slide Warmer. Preparation of Reagent Solution, Dilution from Stock Solutions.

Unit II

Laboratory Techniques in Histology: Receiving of Specimens, Logging of Specimens and Rejection Criteria of Specimens. Preparation of Tissue: Fixation, Preparation of Fixatives, Routine Fixative- Formalin, Storage of Specimen in Formalin, Special Fixatives, Deformalinization and Secondary Fixation. Different types of fixatives: Zenker's Fluid, Helly's Fluid, Removal of Mercuric Chloride Deposits, Bouin's Fluid and Carnoy's Fluid. Types and function of microtom.

Unit-III

H and E staining principle, tissue fixation, tissue processing, tissue staining. Advantages and disadvantages of formalin than other fixative. Alternate clearing agent than xylen.
Introduction of Cryostat and working step.

Unit- IV

Steps of tissue fixation, tissue processing and tissue staining. Commercially available fixatives. Points for the ideal fixatives.
Pap stain, FNAC.

PRACTICALS

1. Collection and labeling of histopathology and cytology specimen types
2. Preparation of different types of histopathology fixative
3. Demonstration of Microtome
4. Demonstration of Tissue floating bath
5. Any other practical's based on theory paper

RECOMMENDED BOOKS

	1. J Ochei and A Kolhatkar, Medical Laboratory Science- Theory and Practice, 1st Edition 2000, Tata Mcgraw Hill Publishing Co Ltd. 2. Praful B. Godkar, Darshan P. Godkar, Text book of Medical Laboratory Technology, 3rd Edition 2014, Bhalani Publishing House. 3. C F A Culling, Handbook of Histopathological and Histochemical Techniques, 3rd Edition 1974, Butterworth-Heinemann. 4. Bancroft J. D and Gamble M, Theory & Practice of Histological Techniques, 6thEdition 2008, Churchill livingstone. 5. H. Mohan, Text Book of Pathology 7th Edition 2015, Jaypee & Brothers Medical Publishers LTD. 6. Leopold G. Koss, Myron R. Melamed, Koss' Diagnostic Cytology and Its Histopathologic Bases, Volume 1, 5th Edition 2006, Lippincott Williams & Wilkins. 7. Edmund S. Cibas, Barbara S. Ducatman, Cytology: Diagnostic Principles and Clinical Correlates. 4th Edition 2014, Saurenders and Elseviers. 8. Gabrijela Kocjan, Fine Needle Aspiration Cytology: Diagnostic Principles and Dilemmas, 1st Edition 2005, Springer. 9. John A. Kiernan, Histological and Histochemical Methods: Theory and Practice, 4th Edition 2008, Scion Publishing Ltd.	5(3-1-2)
	Immunohematology, Blood Bank & Transfusion Technology **(1001305)** **Unit I** Basic Principles of Immunohematology, Application of Blood groups:- ABO Blood of Group Systems & Rh Blood Group System: History, Genetics, ABH antigens, Biochemical Synthesis of blood group antigens, Antigenic sites, weaker variants, Bombay Phenotype, ABO antibodies, Red cell serology techniques, their advantages and disadvantages, Cell and serum grouping, detection of weak A and B antigens. Pre transfusion testing, Different methods of cross matching, cross matching in special circumstances, emergency cross matching, electronic cross matching Principles of Direct and indirect ant globulin test, enzyme technique, albumins technique, Detection of blood group antibodies, identification of	

	their Specificity, clinical significance of antibody detection, differentiation between auto and allow-antibodies **UNIT II** Donor selection & screening and its various aspects. Collection, storage of blood and the guidelines for transfusion practice. Anticoagulants used in Blood Banking. Hemolytic transfusion reaction immediate and delayed; immune and non-immune reaction path physiology; Clinical signs and symptoms Laboratory invigilation for HTR Tests to defect bacterial Contamination in blood, Non- hemolytic transfusion reactions Immediate and delayed, febrile reaction, allergic reaction, clinical signs and symptoms. Acute transfusion related lung injury, Iron overload, Graft versus host disease. **Unit-III** Blood components and its preparation, preservation, storage and transportation Indications for different blood component transfusion, Blood transfusion reaction and its type, HDN Introduction of stem cell banking and bone marrow transplantation. **Unit-IV** Apheresis, indications of hemapheresis, plasmapheresis, plateletspheresis, plasmapheresis Quality control of reagents, equipments, blood components used in transfusion medicine. Role of NACO, Indian Red Cross Society, DGHS and blood transfusion services. **PRACTICALS** 1. Perform ABO Blood Grouping by Tube & Slide Method 2. Perform Rh Blood Grouping by Tube & Slide Method 3. Preparation of 5% & 10% Cell suspension 4. Test for 'D' Antigen 5. Perform the Major & Minor Cross Match 6. Perform the Direct & Indirect Coombs Test	5(3-1-2)

7. Screening of transmitting diseases
8. Screening of VDRL
9. Screening of HIV
10. Screening of HbsAg
11. Any other practical's based on theory paper

RECOMMENDED BOOKS

1. J Ochei and A Kolhatkar, Medical Laboratory Science-Theory and Practice, 1st Edition 2000, Tata Mcgraw Hill Publishing Co Ltd.
2. Praful B. Godkar, Darshan P. Godkar, Text book of Medical Laboratory Technology, 3rd Edition 2014, Bhalani Publishing House.
3. R N Makroo, Principle &Practice of transfussion medicine, 1st Edition 2014, Jain Books.
4. Christopher D Hillyer, Beth, James, Transfusion Medicine & hemostasis: Clinical & Laboratory aspect, 2ndEdition 2013, Elsevier Healths.
5. Richard A. McPherson, Henry's Clinical Diagnosis and Management by Laboratory Methods, 22nd Edition 2014, Elsevier.

5(3-1-2)

IV Semester

Enzymology (1001401)

Unit I

General Characteristics, Nomenclature & IUB Enzyme classification (Rational, Overview & specific Example). Holoenzyme, Apo enzyme, Co-Factors, Co-enzymes.

Units of Enzyme Activity, Factors Affecting's Enzyme activity, Derivations of michoulis maintain equations of unisubstrate reaction KM & its significance. Kcat / KM and its importance.

Unit-II

Coenzyme: Classification, various types and function, structure of NAD+, NADP+, FAD and FMN, PPP. Units for measuring enzyme activity, factors affecting enzyme level in serum/ plasma. Clinical assay & its type, kinetic assay and end point assay for the enzymes

Enzyme kinetics, the Michaelis-Menten equation and its physiological significances, Enzyme Inhibition, types of inhibitors of enzyme .Component of colorimeter/ spectrophotometer.

5(3-1-2)

Unit-III

Isoenzymes, and their clinical significance: SGOT,SGPT , ALP, , CPK, CK-MB, LDH,,Troponin-T&I, Myoglobin, Amylase, Lipase, ACP,

Basic Concepts of Automation, principle, working and maintenance of various clinical chemistry analyzers, point of care testing, Hospital Laboratory Management.

Priciple of spectrophotometer/ Colorimeter.

Unit- IV

Enzyme inhibition, its type- Reversible & Irreversible, competitive, Non Competitive Mechanism of action of Enzyme- Control of enzyme activity, Principle, clinical Significance

Normal Range of following Enzyme. CPK, CPK-MB,LDH, SGOT,SGPT, Cholinesterase, Amylase, Lipase, ALP , Troponin, Measurements of enzyme activity, Reaction type , Method of Estimation.

PRACTICALS

1. Estimation of SGOT Level in serum
2. Estimation of SGPT level in serum
3. Estimation of ALP Level in serum
4. Demonstration of Spectrophotometer/colorimeter
5. Estimation of CK-MB.
6. Any other practical's based on theory paper

RECOMMENDED BOOKS

1. U Satyanarayan and U Chakrapani, Text book of Biochemistry, 4th Edition 2013, Elsevier.
2. M N Chatterjea and Rana Shinde, Text book of Medical Biochemistry , 8th Edition 2012, Jaypee & Brothers Medical Publishers (P) LTD.
3. D M Vasudevan, Sreekumari S, Kannan Vidhyanathan,Textbook of Biochemistry for Medical students, 8thEdition 2016, Jaypee & Brothers Medical Publishers (P) Ltd.
4. S Ramakrishana, Test Book of Medical Biochemistry, 3rd Illustrated Edition 2004, Orient Longman.
5. S Chitiprol, Biochemistry: Instant Notes for Medical students, 1st Edition 2006, Jaypee & Brothers Medical Publishers.
6. DM Vasudevan, Subir Kumar Das, Practical Textbook of Biochemistry for Medical Students, 2nd Edition 2013, Jaypee & Brothers Medical Publishers (P) LTD.

5(3-1-2)

Medical Parasitology
(1001402)

Unit I

Introduction, Define Host, definitive host and intermediate host. Define Parasite, Ectoparasite, Endoparasite. Classification of Protozoa, explain the life cycle, mode of infection, habitat

pathogenesis and laboratory diagnosis of Entamoeba Histolytica and Entamoeba Coli, Giardia Lamblia, Leishmania Donovani Plasmodium- Plasmodium Vivax, Plasmodium Oval, Plasmodium Falciparum, and Plasmodium Malaria.

Unit II

Metazoa-Explain the mode of infection, pathogenesis and laboratory diagnosis of Taenia Saginata and Taenia Solium (Tapeworm), Trichuris Trichiura (Whipworm),
Ancylostoma Duodenale and Necator Americanus (Hookworm), Ascaris Lumbricoides (Roundworm), Enterobius Vermicularis and Strongyloides Stercoralis. Microfilaria- Wuchereria Bancrofti.
Toxoplasma gondii-clinical significance, lab diagnosis and profile

Unit III

Nature and Properties of Viruses
Introduction: definition of viruses. Structure of Viruses: Capsid symmetry, enveloped and non-enveloped viruses
Isolation, purification and cultivation of viruses
Viral taxonomy: Classification and nomenclature of different groups of viruses, Modes of viral transmission, Viral multiplication and replication strategies

Unit- IV

Poxviruses, Herpesviruses, hepaptitis viruses, retroviruses-HIV, Picorna viruses, rhabdoviruses, orthomyxoviruses and paramyxo viruses, TORCH profile, Symptoms, mode of transmission, prophylaxis and control of Polio, Herpes, Hepatitis, Rabies, Dengue, HIV, Influenza with brief description of swine flu, Ebola, Chikungunya, Japanese Encephalitis

PRACTICALS

1. Sample collection.
2. Preservative and compistion preperation
3. Saline iodine preparation.
4. Normal saline preparation
5. Preparation of stool smear
6. Preparation of concentration method
7. Identification of ova, cyst and trophozoit.
8. Any other practical's based on theory paper

5(3-1-2)

RECOMMENDED BOOKS

1. Arora & Arora, Text book of Medical parasitology, 4th Edition 2015, CBS Publishers.
2. Saugata Ghosh, Paniker's text book of medical parasitology, 7th Edition 2013, Jaypee Brothers Medical Publishers.
3. KD Chatterjee, Protozoology and Helminthology, 13th Edition 2009, CBS Publishers & Distributors pvt.
4. Subhash Chandra Parija, Textbook of Medical Parasitology: Protozoology & Helminthology, 4th Edition 2013, All India Publishers & Distributors.
5. T V Rajan, Textbook of Medical Parasitology, 1st Edition 2008, B I Publications.
6. World Health Organization, Basic laboratory methods in medical parasitology, World Health Organization 1991. WHO Geneva.
7. Mannual of Basic Technique for Health Laboratory, 2nd Edition 2003, WHO Geneva.
8. Lynne S. Garcia, Diagnostic Medical Parasitology, 6th Edition 2016, ASM Press.
9. David T. John, William A. Petri Jr., Markell and Voge's Medical Parasitology, 9th Edition 2006, Sunders Elseviers.

Medical Mycology & Virology (1001403)

Unit I

Introduction to Medical Mycology, Antifungal agents and Classification of Fungi. Aetology, Epidemiology, Morphology, Pathogenesis, Culture, Identification and Treatment of Cutaneous and Subcutaneous mycoses. Epidemiology, Morphology, Pathogenesis, Lab Diagnosis and mycosis. Classification, Epidemiology, Morphology, Diagnosis of Opportunistic mycoses.

Unit II

Introduction to Viruses, Morphology, Classification, Replication of Viruses. Antiviral susceptibility testing. Pathogenesis, Diagnosis and Control of Viruses. HIV structure, transmission, stages, lab diagnosis.

Unit III

Classification, Morphology, Antigenic classification, Epidemiology, Pathogenesis of Poxviruses, Herpesviruses, Nonenveloped DNA Viruses, Picornaviruses, Orthomyxoviruses, Paramyxoviruses,

	Arthropod and Rodent borne Viruses. Hepatitis Viruses (Hepatitis A, B, C, D, E & G) **Unit IV** Introduction to oncogenic viruses, Types of oncogenic DNA and RNA viruses, concepts of oncogenes and proto-oncogenes, prevention & control of viral diseases, antiviral compounds and their mode of action, interferon and their mode of action, General principles of viral vaccination **PRACTICALS** 1. Collection of Specimen for Fungal study 2. Morphological Examination Fungi by- KOH, Indian ink, Germ Test Tube 3. Fungal Culture method 4. Preparation of culture media 5. Identification of Fungi 6. Study of colony characteristics 7. Nail culture for Fungi. 8. Common identification of fungi 9. Any other practical's based on theory paper **RECOMMENDED BOOKS** 1. C P Baveja, Text book of Microbiology, 4th Edition 2010, Arya Publication. 2. Arti Kapil, Ananthanarayan and Paniker's Textbook of Microbiology, 9th Edition 2013, Orient BlackSwan. 3. Mark Gladwin , Trattler William , C. Scott, Mahan Clinical Microbiology Made Ridiculously Simple. 6th Edition 2013, Medmaster 4. D.R.Arora / Brij Bala Arora, Textbook of Microbiology, 5th Edition 2016, CBS Publishers & Distributors. 5. Eds J. G. Collee, J. P. Duguid, A. G. Fraser & B. P. Marmio, Mackie and McCartney: Practical medical microbiology, 14th Edition 2007, Church New Delhi (India): Elsevierill Livingston. 6. R C Dubay & D.K.Maheshwari, Practical Microbiology, Revised edition 2014, S Chand & Company LTD. 7. Dr. C.P. Baveja, Dr. V. Baveja, Textbook of Microbiology for MLT, 2nd Edition, Arya Publication. 8. Joanne Willey, Linda Sherwood, Christopher J. Woolverton, Presscot's Microbiology, 9th Edition 2014, McGraw-Hill Education. 9. Gary W Procop & Elmer W. Koneman Koneman's Color Atlas and Textbook of Diagnostic Microbiology, 7th Edition 2016, Wolters Kluwer Health.	5(3-1-2)

10. F. H. Kayser, K. A. Bienz, J. Eckert, Medical Microbiology,10th German Edition 2005, Thieme Stuttgart, New York.
11. Michael Ford, Medical Microbiology, 2nd Edition 2014, Oxford university press.
12. Neal Chamberlain, Medical Microbiology: The Big Picture, 1St Edition 2008, Mc Grew Hill Medical.

Histopathology & Cytology-II (1001404)

Unit-I

Decalcification: Acid method of Decalcification and Chemical testing for Decalcification. Tissue processing: Steps of Dehydration, Steps of Clearing, Steps of Infiltration and Impregnation. Manual Paraffin wax Technique. Manual and Automated Tissue Processing. Embedding: Types of molds. Preparation of Sections. Care and use of Microtome knife, Sharpening the Microtome Knife, Honing technique, Stropping technique.

5(3-1-2)

Unit II

Technique of Section Cutting: Trimming the Paraffin block, Attaching the Paraffin block to the Microtome, Orienting the block, Cutting the Sections.Technique of attaching Section to Micrscope Slide: Preparation of Slide and Procedure. Resealing blocks and Problems in Section Cutting. Routine Staining Procedure in Histotechnology: Basic Information about Staining- Staining Equipment, Preparation of Staining- Drying, Deparaffinizating and Hydration. Post Staining Procedure- Dehydration and Mounting. Special Post-staining Treatments.

Unit-III

Aspiration and exfoliative cytology, Patient preparation, Sample collection, Fixation, Processing and Staining FNAC, collection, processing of sample and staining, on site quick staining procedure

Unit-IV

Pap staining, Progressive & Regressive, Hormonal cytology in different age groups, Collection and processing of sputum, BAL, CSF, Pleural, peritoneal and pericardial fluid, Gynaecologic sample

PRACTICALS

1. Preparation of different types of decalcifications
2. Perform the Dehydration step
3. Perform the Clearing step
4. Process of paraffin Impregnation
5. Perform the paraffin embedding
6. Perform the section cutting
7. Preparation of H & E Stain
8. Any other practical's based on theory paper

RECOMMENDED BOOKS

1. Cellular Pathology Techniques by CFA Culling, Butterworths Co., London
2. Theory of Practice of Histopathological Techniques by Bancroft and Stevens
3. Histological Techniques by Carleton, Harry, Oxford
4. An Introduction to Medical Laboratory Technology by FJ Baker et. al., Butterworths Co., London
5. Laboratory Methods of Histotechnology by Armed Forces Institute of Pathology, Washington DC
6. Histotechnologic Basis of Diagnostic Cytology by Koss LG
7. Cytopathology by Naib's
8. Cytology Technical Manual by et.al. Luthra

Immunology & Serology
(1001405)

Unit I

Immunity, Antigen & Antibody (Immunoglobins), Immunological Disorders, Antigen Antibody Reactions, Complement System, Hypersensitivity, Autoimmunity, Immunoprophylaxis / Immunization / Vaccinology.

Unit II

Introduction to serology & Clinical significance, Serological Test-Widal, ASO, CRP, Rose Waller, Brucella Agglutination , Cold Agglutination, VDRL,TPHA,STDs, Hepatitis Marker- HBsAg, HBV, HCV, HBcAg, HEV, HIV Marker & Torch Profile. Serological Diagnosis of Bacterial, Viral Fungal Parasitological diseases, Principle, Procedure & application of Rapid Test Kit. Lab Hazard & Safety Precautions in Serology Lab.

Unit III

Autoimmune disorders, pathogenesis, organ specific and systemic autoimmune disorders and its markers such parietal cell antibody, anti sperm antibody, lupus anticoagulants, anti-

mitochondrial antibody, ANA, ds DNA, HLA-B27, ASMA, anti CCP

Unit-IV

Immunological disorders: primary and secondary immunodeficiency, SCID, AIDS,

Tumour, types of tumours, Various Tumour Markers, their significance and method of estimation.

Vaccines, classification and applications, Active and passive immunization, Immunoprophylaxis schedule in neonates, children and in pregnancy

PRACTICALS

1. Perform Widal test
2. Perform VDRL test
3. Perform RPR test
4. Perform ASO Titer test
5. Perform CRP test
6. Perform Rh Factor test
7. Perform HBsAg test
8. Perform HIV test
9. Perform TPHA test
10. Perform HCV test
11. Any other practical's based on theory paper

RECOMMENDED BOOKS

1. Dale Male, Jonathan Brostoff, David B Roth and Ivan Roitt Kuby Immunology, 7th Edition 2012, Mosby (Elsevier).
2. C P Baveja, Text book of Microbiology, 4th Edition 2010, Arya Publication.
3. Arti Kapil, Ananthanarayan and Paniker's Textbook of Microbiology, 9thEdition 2013, Orient BlackSwan.
4. D.R.Arora / Brij Bala Arora, Textbook of Microbiology, 5th Edition 2016,CBS Publishers & Distributors.
5. B S Nagoba and D V Bedpathsk, Immunology, 1st Edition 2008, BI Publications.

V Semester

Toxicology & Biostatistics
(1001501)

Unit I

Introduction of toxicology & importance, Toxic Compound like – Alcohol, Paracetamol, Heavy Metal (Zn, Hg, Salicylates). Drug abuse Its Type, Drugs Used, Screenings of Drugs Uses. Amphetamines, Benzodiazepine, Marijuana Metabolites, Methaquglon , Barbiturates, Cocaine Metabolites, Methadone, Opiates Metabolites, Propoxyphene function and Clinical Importance. Method of Screening of drugs.

Unit II

Introduction to Biostatistics, Importance in Medical Laboratory Technology.

Central Tendency & importance, Basics Biostatistics for Quality control. Standard Error, Coefficient of Variation, Normal Distribution. T-Test & Chi Square test.

Standard Error /Correlation &Variation. Coefficient of variation.Null Hypothesis, Prevalence & Incidence. Probability & Randomization

Unit-III

Infertility profile: LH, FSH, TSH, Estrogen, Progesterone, Total Testosterone, Free testosterone, DHEA-S, 17- Ketosteroids, Prolactin, their estimation and clinical significance, reference range, hypo and hyper secretion, Triple Test

Unit-IV

Growth hormone, ACTH, Aldosterone, Cortisol their estimation and clinical significance, reference range, hypo and hyper secretion

PRACTICALS

1. Estimation of Salicylates
2. Estimation of Zn
3. Estimation of Hg
4. Screening of drugs in Urine Sample by Card Method
5. Sample collection for drugs screening
6. Determination of SD
7. Determination of Chi square test
8. Preparation of Control charts
9. Preparation of Levey Jennings Chart

10. Any other practical's based on theory paper

RECOMMENDED BOOKS

1. Henary Clinical Diagnosis management by Laboratory Method- Richard AMcPherson.
2. Text book of Toxicology

Applied Medical Microbiology (100502)

Unit I

Microbiology of Water: Distribution of microorganisms in aquatic environment, Sources of water pollution, Potable and contaminated water, Standards for water and Indicator organisms.

Unit II

Microbiology of Air: Outdoor microflora, Indoor microflora, Atmospheric air composition, Air-quality, Enumeration and assessment of microorganisms in air, Impingement in liquids, Impingement on solids and Sources of contamination.

Unit III

Microbiology of Food: Common food items, Sources of microorganisms in foods, Causes of food spoilage, Causes of food poisoning and Food borne diseases.

Microbiology of Milk: Sources of microorganisms in milk, Microbiological standard and grading of milk and Grading of milk.

Unit-IV

Microbiology of Soil: Distribution of different types of soil microorganisms, Factors that influencing microbial population and Harmful microbial interactions.

PRACTICALS

1. Microbial Examination of Milk.
2. Microbial Examination of Water
3. Microbial Examination of Foods
4. Microbial examination of Air
5. Isolation of Micro-organism from Nosocomial Infections
6. Any other practical's based on theory paper

RECOMMENDED BOOKS

15. C P Baveja, Text book of Microbiology, 4th Edition 2010, Arya Publication.
16. Arti Kapil, Ananthanarayan and Paniker's Textbook of Microbiology, 9th Edition 2013, Orient Black Swan.
17. Mark Gladwin , Trattler William , C. Scott, Mahan, Clinical Microbiology Made Ridiculously Simple. 6th Edition 2013, Medmaster.
18. D.R.Arora / Brij Bala Arora, Textbook of Microbiology, 5th Edition 2016, CBS Publishers & Distributors.
19. Eds J. G. Collee, J. P. Duguid, A. G. Fraser & B. P. Marmio, Mackie and McCartney: Practical medical microbiology, 14th Edition 2007, Church New Delhi (India): Elsevierill Livingston.
20. R C Dubay & D.K.Maheshwari, Practical Microbiology, Revised edition 2014, S Chand & Company Ltd.
21. Dr. C.P. Baveja, Dr. V. Baveja, Textbook of Microbiology for MLT, 2nd Edition, Arya Publication.
16. Joanne Willey, Linda Sherwood, Christopher J. Woolverton, Presscot's Microbiology, 9th Edition 2014, McGraw-Hill Education.
17. Gary W Procop & Elmer W. Koneman Koneman's Color Atlas and Textbook of Diagnostic Microbiology, 7th Edition 2016, Wolters Kluwer Health.
18. F. H. Kayser, K. A. Bienz, J. Eckert, Medical Microbiology, 10th German Edition 2005, Thieme Stuttgart, New York.
19. Michael Ford, Medical Microbiology, 2nd Edition 2014, Oxford university press.

Applied Histopathology & Cytopathology (1001503)

Unit I

Routine Haematoxyline and Eosin Staining Preparation and Procedure. Special Stains and Staining Technique: Connective Tissue Stain- Collagen and Collagen Fibers,.Phosphotungstic Acid Haematoxylin Technique (PTHA). Reticulin Stain- Silver impregnation Method, Aniline Blue stain. Stains for Particular Substances; Carbohydrates- Periodic Acid-Schiff (PAS). Miles-Benhold's Congo Red Stain, Toluidine Blue Stain and Crystal Violet Stain. Hemosiderin and Iron Stain- Prussian Blue Stain.

Unit II

Frozen Section Technique: Tissue Preparation, Freezing the Tissue, Freezing Microtomy and Mounting of Frozen Section.Staining of Frozen sections- Haematoxylin-eosin, Polychrome Methylene Blue stain, Sudan IV stain, Sudan Black B Stain and Oil Red O Stain.
Laboratory Technique in Diagnostic Exfoliative Cytology: Collection of specimens, Preparation of specimens for Cytological

Evaluation, Concentrating Specimen by Centrifugation and Preparation of Smear. Fixatives- Alcohol-ether, Schaudinn's Fluid and Carnoy's Fluid. Cytological Stains and Staining Technique- Papanicolaou staining and Cresyl Violet Staining.

Unit-III

Demonstration of nucleic acids, Processing and staining of bone marrow sample. Fixation, Processing and section cutting of bones, eye ball, Techniques in neuropathology: Neurons staining, Myelin, Neuropathology lab specimen handling

Unit-IV

Demonstration of sex chromatin, Museum techniques

Electron microscopy: Principle and working, fixation, processing and staining of tissue Fluorescence Microscope: Principle and working

Immunohistochemistry: principle, types, applications, antigen retrieval, APAAP, PAP Staining, Quality control in histopathology

PRACTICALS

1. Vaginal, Cervical & Urethral sample collection of cytological examination
2. Staining of cervical smear by PAP method
3. Fixation of Smear for Staining.
4. Preparation of PAP Stain.
5. Perform the routine Haematoxyline and Eosin staining
6. Collection of Sample for Fine needle aspiration cytology
7. Preparation of smear by automatic method
8. Preparations of stains for cytology examination
9. Any other practical's based on theory paper

RECOMMENDED BOOKS

1. Cellular Pathology Techniques by CFA Culling, Butterworths Co., London
2. Theory of Practice of Histopathological Techniques by Bancroft and Stevens
3. Histological Techniques by Carleton, Harry, Oxford
4. An Introduction to Medical Laboratory Technology by FJ Baker et. al., Butterworths Co., London
5. Laboratory Methods of Histotechnology by Armed Forces Institute of Pathology, Washington DC

Transplant Technology
(1001504)

Unit I

Introduction, Classification & Importance of Transplant Technology. Type of Transplants, Reactions of Transplants, Liver transplant, heart transplant, hair transplant, hip joint transplant, knee joint transplant.

Unit II

Graft versus Host Reactions, Tumor Antigens – Specific & Associated Antigens, Immune Response of Transplantations. Tissue Tying & Matching. ABO Compatibility, HLA Compatibility.

Unit III

HLA Complex, HLA Molecules Antigen & Its Classification. Indicators of HLA & Its Reactions. Immunogenetics of Transplantation, Factors of Transplantations.

Unit-IV

Theory Behinds the Transplantation of Bone Marrow, Kidney, Skin. Diagnosis of transplant Acceptance & Rejections. Microbiology Associated with transplantation.

PRACTICALS

1. Demonstration of Transplant technology
3. Determination of Hormone & Enzyme As tumor Marker
4. Perform the ABO Compatibility
5. Perform the ABO Compatibility Test
6. Identification of micro-organism in transplant patients
7. Any other practical's based on theory paper

RECOMMENDED BOOKS

1. Dale Male, Jonathan Brostoff, David B Roth and Ivan Roitt Kuby Immunology, 7th Edition 2012, Mosby (Elsevier).
2. B S Nagoba and D V Bedpathsk, Immunology, 1st Edition 2008, BI Publications.
3. J Ochei and A Kolhatkar, Medical Laboratory Science-Theory and Practice, 1st Edition 2000, Tata Mcgraw Hill Publishing Co Ltd.
4. .
5. Peter Lydyard, Alex Whelan, Michael Fanger, Instant Notes in Immunology 3rd Edition 2011, BIOS Scientific Publisher.

6. William E. Paul, Fundamental Immunology 7th Edition 2013, Woulters Kluwar / Lippincott Williams & Wilkins.
7. T Doan, R Mervold, S Visseli, C Waltenbough, Immunology 2nd Edition 2013, Woulters Kluwar / Lippincott Williams & Wilkins.

Clinical Microbiology
(1001505)

Unit I

Normal Flora: Anatomical location of normal flora, normal flora of conjunctival sac, Oral cavity, Upper respiratory tract, Sore throat and tonsillitis, Infection of middle ear and sinuses, Lower respiratory tract infection.

Unit II

Acutelaryngo-tracheo-bronchitis, Chronic bronchitis. Bacterial food poisoning and Nonbacterial infective diarrhea.Urinary tract infection-Clinical types, Pathogenesis, Laboratory diagnosis.

Unit II

Meningitis: Acute pyogenic meningitis, Aseptic meningitis. Infection of skin and subcutaneous tissue, Infection of wounds, Infection of burns and Infection of eye.

Unit-IV

Sexually transmitted diseases: etiology, Epidemiology, Clinical manifestations, Laboratory diagnosis. Hospital-acquired infection: Factors influencing hospital-acquired infection, sources, Mode of transmission, Common hospital-acquired infections, prevention and Investigation of hospital-acquired infection.

PRACTICALS

1. Microbial Sample collection
2. Transportation and transporting Medium
3. Identification of pathogenic and non-pathogenic microorganisms
4. Sample collection fromconjunctival and identification of pathogenic bacteria
5. Sample collection from wounds and identification of pathogenic bacteria
6. Sample collection from urethra and identification of pathogenic bacteria
7. Any other practical's based on theory paper

RECOMMENDED BOOKS

8. C P Baveja, Text book of Microbiology, 4th Edition 2010, Arya Publication.

9. Arti Kapil, Ananthanarayan and Paniker's Textbook of Microbiology, 9th Edition 2013, Orient BlackSwan.
10. Mark Gladwin , Trattler William , C. Scott, Mahan, Clinical Microbiology Made Ridiculously Simple. 6th Edition 2013, Medmaster.
11. D.R.Arora / Brij Bala Arora, Textbook of Microbiology, 5th Edition 2016, CBS Publishers & Distributors.
12. Eds J. G. Collee, J. P. Duguid, A. G. Fraser & B. P. Marmio, Mackie and McCartney: Practical medical microbiology, 14th Edition 2007, Church New Delhi (India): Elsevierill Livingston.
13. R C Dubay & D.K.Maheshwari, Practical Microbiology, Revised edition 2014, S Chand & Company LTD.
14. Dr. C.P. Baveja, Dr. V. Baveja, Textbook of Microbiology for MLT, 2nd Edition, Arya Publication.
13. Joanne Willey, Linda Sherwood, Christopher J. Woolverton, Presscot's Microbiology, 9th Edition 2014, McGraw-Hill Education.
14. Gary W Procop & Elmer W. Koneman Koneman's Color Atlas and Textbook of Diagnostic Microbiology, 7th Edition 2016,Wolters Kluwer Health.
15. F. H. Kayser, K. A. Bienz, J. Eckert, Medical Microbiology,10th German Edition 2005, Thieme Stuttgart, New York.
16. Michael Ford, Medical Microbiology, 2nd Edition 2014, Oxford university press.
17. Neal Chamberlain, Medical Microbiology: The Big Picture, 1st Edition 2008, Mc Grew Hill Medical.

VI Semester

Assignment (Project Work)
(100603)

Course objectives:
The basic objective of internship is to provide first hand practical exposure of the medical laboratory and to acquaint students with the culture of medical lab. The internship training will also provide an opportunity to the students to apply their theoretical understanding while working on the concerned project in the laboratory. Thus, this internship programme is an attempt to bridge the gap between theory and practice. This will also enhance the student's intellectual ability and attributes related to data handling, decision making, report writing, oral presentation and imbibing an interdisciplinary approach.

General guidelines:
Every student of under graduate courses will be required to undergo a practical training in a medical laboratory organization approved by the Institute for four months, after the end of the 5^{th} semester examinations. The candidates shall be required to undergo training in the various areas like clinical pathology, clinical hematology, clinical microbiology, clinical biochemistry and blood banking labs of the concerned organization. The organization may assign a specific project to the student, which will be completed by him/her during the period of training. The work done by the student during the training period shall be submitted in the form of a report as per the guidelines provided by the department.

Chapter scheme for the internship project report:
Chapter I: Introduction
- 20 marks

Chapter II: Conceptual Framework/National/International Scenario
- 5 marks

Chapter III: Presentation, Analysis and Findings
- 35 marks

Chapter IV: Conclusion and Recommendations
- 15 marks

The report has to be written in font style – Times New Roman, font size – 12, line spacing on both sides of the paper – 1.5 and should be spiral bound. The report should comprise of a maximum of 70 pages and has to be submitted in two copies.

The components of internship project report:

The outcome of internship training is the project report. A project report should have the following components:

1) Cover Page: This should contain the title of the project proposal, to whom it is submitted, for which degree, the name of the student, name of the supervisor, year of submission of the project work and name of the University.

2) Acknowledgement: Various laboratory organizations and individuals who might have provided assistance /co-operation during the process of carrying out the study.

3) Table of Content: Page-wise listing of the main contents in the report, i.e., different Chapters and its main Sections along with their page numbers.

4) Body of the Report: The body of the report should have these four logical divisions

a. Introduction: This will cover the background, rationale/ need / justification, brief review of literature, objectives, methodology (the area of the study, sample, type of study, tools for data collection, and method of analysis), limitations of the study, and chapter planning.
b. Conceptual framework / national and international scenario: (relating to the topic of the project).
c. Presentation of data, analysis and findings: (using the tools and techniques mentioned in the methodology).
d. Conclusion and Recommendations: In this section, the concluding observations based on the main findings and suggestions are to be provided.

5) Bibliography or References: This section will include the list of books and articles which have been used in the project work, and in writing a project report.

6) Annexure: Questionnaires (if any), relevant reports, etc.

Guidelines for evaluation:

1. Each of the students has to undertake a project individually under the supervision of a teacher and to submit the same following the guidelines stated below.
2. Language of project report and viva-voce examination should be in English. The project report must be typed and hard (spiral) bound.
3. Failure to submit the project report or failure to appear at the viva-voce examination will be treated as "Absent" in the examination. He /she have to submit the project report and appear at the viva-voce examination in the subsequent years (within the time period as per university rules).
4. No marks will be allotted on the project report unless a candidate appears at the viva-voice examination. Similarly, no marks will be allotted on viva-voce examination unless a candidate submits his/her project report.

	5. Evaluation of the project work to be done jointly by one internal expert and one external expert with equal weightage, i.e., average marks of the internal and external experts will be allotted to the candidate. 6. A candidate has to qualify in the project work separately, obtaining minimum marks of 40 (project report and viva-voce taken together).	

****