

*Department of Biotechnology M.Sc. (MLT) 2 year
Effective from session 2019-2020 all batches*

DEPARTMENT OF BIOTECHNOLOGY SYLLABUS

FOR M.Sc. 2 Year MLT (Semester I to IV)

(Under Choice Based Continuous Evaluation Grading System)

Effective from session 2019-2020 all batches



FATEHGARH SAHIB (INDIA)

**SRI GURU GRANTH SAHIB WORLD UNIVERSITY
FATEHGARH SAHIB**

EXAMINATION SCHEME

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External:

Theory: 75 Marks

Practical: 38 Marks

1. The paper should consist of three sections A, B and C.
2. Section A should comprise of nine questions of three (3) marks each from the whole syllabus (Part I and Part II) and it is compulsory to attempt all the questions.
3. Section B will have four questions of twelve (12) marks each from Part I of syllabus and a student is required to attempt any two.
4. Section C will have four questions of twelve (12) marks each from Part II of syllabus and a student is required to attempt any two questions from this section.

Internal Assessment:

THEORY (25 Marks)

Weightage of First Mid Semester Test : 6.5 Marks

Weightage of Second Mid Semester Test : 6.5 Marks

Weightage of Seminars/Assignments/Quiz etc : 09 Marks

Class Performance/Weightage of Attendance : 03 Marks

PRACTICAL (12 Marks)

Lab performance = 6 marks

Practical Notebook = 3 marks

Lab attendance = 3 marks

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SCHEME OF TEACHING

M.Sc. MLT Semester I

COURSE CODE	COURSE NO.	TITLE	SCHEDULE OF TEACHING			CREDIT	MAXIMUM MARKS		
			LECTURE	TUTORIAL	PRACTICAL		INTERNAL	EXTERNAL	
C1	MMLT – 101	Introduction to Medical Laboratory Technology (MLT)	4	0	0	4	25	75	
C2	MMLT – 102	Human Anatomy and Physiology	4	0	0	4	25	75	
C3	MMLT – 103	Biomolecules and Metabolism	4	0	0	4	25	75	
C4	MMLT – 104	Medical Microbiology	4	0	0	4	25	75	
DSE	MMLT – 105E		4	0	0	4	25	75	
C1L	MMLT – 106L	Introduction to Medical Laboratory Technology (MLT) Lab	0	0	3	2	12	38	
C2L	MMLT – 107L	Medical Microbiology Lab	0	0	3	2	12	38	
			20		6	24	149	451	
TOTAL							600		

C: Core Courses; GE: General Elective; DSE: Discipline Specific Elective

***: GE subjects are to be selected by the students from the pool of GE Subjects offered by various Departments of the University (minimum students in each group should be 10).**

Discipline Specific Elective:

1. Ethical Practices in Medical Technology
2. Biomass Characterization (SWAYAM MOOCs)

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M.Sc. MLT Semester II

COURSE CODE	COURSE NO.	TITLE	SCHEDULE OF TEACHING			CREDIT	MAXIMUM MARKS		
			LECTURE	TUTORIAL	PRACTICAL		INTERNAL	EXTERNAL	
C1	MMLT – 201	Haematology	4	0	0	4	25	75	
C2	MMLT – 202	Clinical Biochemistry	4	0	0	4	25	75	
C3	MMLT – 203	Immunopathology & Immunotechnology	4	0	0	4	25	75	
DSE	MMLT – 204E		4	0	0	4	25	75	
GE1	MMLT – 205E		4	0	0	4	25	75	
C1L	MMLT – 206L	Haematology Lab	0	0	3	2	12	38	
C2L	MMLT – 207L	Clinical Biochemistry Lab	0	0	3	2	12	38	
	MMLT – 208L	Immunopathology & Immunotechnology Lab	0	0	3	2	12	38	
			20		9	26	161	489	
TOTAL							650		

C: Core Courses; GE: General Elective; DSE: Discipline Specific Elective

***: GE subjects are to be selected by the students from the pool of GE Subjects offered by various Departments of the University (minimum students in each group should be 10).**

Discipline Specific Elective:

1. Forensic Science and Toxicology.
2. Academic Writing (SWAYAM-MOOCs)

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M.Sc. MLT Semester III

COURSE CODE	COURSE NO.	TITLE	SCHEDULE OF TEACHING			CREDIT	MAXIMUM MARKS	
			LECTURE	TUTORIAL	PRACTICAL		INTERNAL	EXTERNAL
C1	MMLT – 301	Fluid Analysis and Human Disorders	4	0	0	4	25	75
C2	MMLT – 302	Advanced Instrumentation in Medical Laboratory Technology	4	0	0	4	25	75
C3	MMLT – 303	Modern Diagnostics	4	0	0	4	25	75
DSE	MMLT – 304E		4	0	0	4	25	75
GE2	MMLT – 305E		4	0	0	4	25	75
C1L	MMLT – 306L	Fluid Analysis and Human Disorders Lab	0	0	3	2	12	38
C2L	MMLT – 307L	Modern Diagnostic Lab	0	0	3	2	12	38
C4	MMLT-308	Summer Training Program (STP)	0	0	8	4	25	75
			20	0	14	28	174	526
TOTAL							700	

C: Core Courses; GE: General Elective; DSE: Discipline Specific Elective

***: GE subjects are to be selected by the students from the pool of GE Subjects offered by various Departments of the University (minimum students in each group should be 10).**

Discipline Specific Elective:

1. Clinical Application of Molecular Diagnostics in Healthcare
2. Biostatistics & Mathematical Biology (SWAYAM MOOCs)

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M.Sc MLT Semester IV

COURSE CODE	COURSE NO.	TITLE	SCHEDULE OF TEACHING			CREDIT	MAXIMUM MARKS	
			LECTURE	TUTORIAL	PRACTICAL		INTERNAL	EXTERNAL
C1	MMLT – 401	Internship	32			16	50	200
	TOTAL						250	

BIOTECHNOLOGY

Semester I

Course Code: MMLT-101
(MLT)
[SGGSWU – DBT]

Title: Introduction to Medical Laboratory Technology

L/T/P: 4/0/0

Objective of the Subject: The objective of this course is to understand the use of various instruments in measuring the biochemical and physiological parameters

Outcome of the Subject: The students are expected to have knowledge of the principles and procedures of various instruments

Relevance of the Subject: This course is important in making students familiar with the various instruments used in medical lab technology

UNIT I

Basic laboratory principles, Code of conduct of medical laboratory personnel, Organization of clinical laboratory, Role of medical laboratory technician, Safety measures, Medical laboratory professional and professionalism in laboratory workers, communication between physician and lab technician; Hospital and clinic borne infection and personnel hygiene.

Common glass wares in clinical laboratory: care and maintenance, Calibration of pipettes and volumetric apparatus, Cleaning and sterilization methods, antiseptics and disinfectants; Microscopy: Principle and application of Light, Fluorescent, Phase contrast, Electron microscopes, care and maintenance; Staining techniques: vital staining.

UNIT II

Laboratory instruments: Introduction ,Chemical balance: types, principle and practice; Photometry: Principles and use; Calorimeter and Spectrophotometer: Beer Lambert law; Centrifuges ,Water bath, Refrigerator, Autoclave , Hot air oven, Laminar air flow, Water distillation unit (De ionized and double distilled water)- Automation

Clinical samples and specimens: Specimen collection, transport, storage and disposal; common laboratory infections; Anticoagulants: EDTA, Di-potassium salts of EDTA, double oxalate, single oxalate, sodium citrate and sodium fluoride

Acid - Base balance: Electrolytes, Buffer and pH; Preparation of solution: Normal , per cent and Molar solution, normal saline; Methods of measuring liquids; Clinical laboratory records; Modern laboratory set up; Quality control: Accuracy, Precision, and Reference values.

References:

1. Fischbach, F.T. and M.B. Dunning, 2009. *A Manual of laboratory and Diagnostic Tests*, Lippincott Williams Wilkins, New York.
2. Sonnenwirth, A.C. and L. Jarret, 2000 *Gradwohls' Clinical laboratory methods and diagnosis*. M.D.B.I., New Delhi.
3. Ochei, J. and A. Kolhatkar, 2000. *Medical Laboratory Science, Theory and Practice*, McGraw Hill, New Delhi.
4. Mukerjee, K. L. and S. Ghosh, 2010. *Medical Laboratory Technology, Volume I*, McGraw Hill, New Delhi.
5. Sood.R., 2006. *Textbook of Medical Laboratory Technology*, Jaypee, New Delhi.

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Course Code: MMLT-102
[SGGSWU – DBT]

Title: Human Anatomy and Physiology
L/T/P: 4/0/0

***Objective of Subject:** The objective of this course is to provide students with the comprehensive overview of functional anatomy and physiology of the human body*

***Outcome of Subject:** Upon the completion of this course, the students will have the knowledge and skills to identify and describe the major structures of the human body, discuss the structural organization and functions of each system of the human body, describe how the major body systems or organs function, describe what would happen if some parts of the body systems do not work properly*

***Relevance of Subject:** This course provides the students with skills to prepare for clinical or health related careers*

UNIT I

Human Body- An overview; Directional and regional terms; Cavities and planes.

Tissues: Structure, function and locations of epithelial, connective and nerve tissues.

Skin: Structure, function and pigmentation

Skeletal System: Axial and appendicular skeleton functions, anatomy, histology, Structural and functional classification of joints and movements.

Digestive System: Gross anatomy, gastrointestinal secretions and function.

Respiratory system: Anatomy of respiratory organs and functions, mechanism and regulation of respiration, respiratory volumes and capacities

UNIT II

Endocrine System: Basic anatomy and physiology of the Pituitary, Thyroid, Parathyroid, Adrenals, Pancreas, Testes and ovary, their hormones, functions and disorders.

Circulatory system: Functions of circulatory system, Heart structure, Circulatory routes (systemic, pulmonary, coronary and portal circulation) and Blood vessels.

Lymphatic system: Structure and function.

Central nervous system: Brain- structure, location and functions- Spinal Cord: Anatomy, functions, reflex- arc- meninges- Peripheral nervous system – Cranial and spinal nerves- Autonomic nervous system (Physiology and functions) - structure of neuron- synapse- transmission of nerve impulse

Sense Organs: Basic anatomy and physiology of eye, ear, taste buds, tactile and olfactory sense organs

Muscular system: Types of muscles, Mechanism of muscle contraction.

References:

1. *Derrickson, B.H., 2011. Principles of Anatomy and Physiology, Harper Collins, New York.*
2. *Sarada, S. and M. Kutty, 1995. Textbook of Physiology, Orient Blackswan, Hyderabad.*
3. *Tortora, G.J. and Waugh, A. and Grant, A., 2010. Ross and Wilson Anatomy and physiology in health and illness, Elsevier, New Delhi.*
4. *Costanzo, L.S., 2007, Physiology, Williams and Wilkins, New York.*
5. *Guyton, A.C. and J.E. Hall, 2010. Textbook of Medical Physiology, Elsevier, New Delhi.*
6. *Johnson, L.R., 2003. Essential Medical Physiology, Elsevier, New Delhi.*
7. *Stanfield, C.L., and W.J. Germann, 2010. Principles of Human Physiology, Pearson/Benjamin Cummings, California.*
8. *Thibodeau, G.A., and C.P. Anthony, 2006. Text book of Anatomy and Physiology, Mosby, United states.*

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Course Code: MMLT-103
[SGGSWU – DBT]

Title: Biomolecules and Metabolism
L/T/P: 4/0/0

Objective of Subject: To learn about the properties of biomolecules and their metabolism

Outcome of Subject: Understanding of structures and functions of biomolecules and their metabolic pathways.

Relevance of Subject: To understand the biochemical basis to maintain health.

UNIT I

Carbohydrates Structure: Classification, characteristics and functions of monosaccharides, disaccharides, polysaccharides. Epimers, isomers, anomers, chiral carbon atom, chair and boat form, glucopyranose and fructopyranose.

Metabolism: General scheme of metabolism: Glycolysis - Aerobic and anaerobic, regulation of glycolysis, Krebs cycle and its regulation; Hexose monophosphate shunt, Cori cycle; Glycogenesis, glycogenolysis and their regulation; Gluconeogenesis.

Proteins Structure: Classification of proteins according to biological functions (Enzymes, transport, storage, contractile, structural, defense and regulatory).

Secondary structure- Alpha helix and beta pleated structure, Ramchandran plot, triple helix (collagen) and supersecondary structures; Tertiary structure - Forces stabilising tertiary structure, prediction of secondary and tertiary structure. Dynamics of protein folding, Role of molecular chaperones in protein folding; Quaternary structure - Forces stabilising quaternary structure. Structure function relationship -myoglobin and hemoglobin.

Metabolism: Amino acid and protein metabolism- Transamination, oxidative deamination, biosynthesis of nutritionally non-essential amino acids; Amino acid oxidation and production of urea- pathways of amino acid degradation, metabolic fates of amino groups and nitrogen excretion; Urea cycle: Biosynthesis and regulation

UNIT II

Lipids: Definition and classification of lipids. Fatty acids- General formula, nomenclature and chemical properties structure, function and properties of simple, complex, acylglycerols, phosphoglycerides, sphingolipids, waxes, terpenes, steroids and prostaglandins.

Metabolism: Beta oxidation - Pathway and regulation. Role of acyl carnitine in fatty acyl transport. Synthesis of fatty acid - Structure and composition of fatty acid synthetase complex, pathway and regulation. synthesis of triacyl glycerides; Ketone bodies - Formation and utilization.

Nucleic Acids: Structure of nucleoside, nucleotide; Experimental evidence for nucleic acids as genetic material; Secondary structure of DNA, Watson and Crick model of DNA. A, B and Z forms of DNA, Tm and its relation to GC content.

Metabolism: Purine, pyrimidine Synthesis: De novo and salvage pathways.

References:

1. *Biochemistry* by V. Voet and J.G. Voet, 3rd edition, John Wiley, New York, 2004.
2. *Principles of Biochemistry* by A.L. Lehninger, 4th edition, W.H Freeman and Company, 2004.
3. *Biochemistry* by L. Stryer, 5th edition, W.H. Freeman and Company, 2002.
4. *Biochemistry* by G. Zubay, 4th edition, W.C. Brown Publishers, 1998.
5. *Biochemistry* by Laurence A. Moran, K.G. Scrimgeour, H. R. Horton, R.S. Ochs and J. David, 2nd edition, Neil Patterson Publishers Prentice Hall, 1994.
6. *Biochemistry* by R.H. Garrett and C.M. Grisham, 2nd edition, Saunders college Publishing, NY, 1999.

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Course Code: MMLT-104
[SGGSWU – DBT]

Title: Medical Microbiology
L/T/P: 4/0/0

Objective of Subject: To study isolation, identification, classification and pathogenesis of microbes.

Outcome of Subject: Students will be able to identify common infectious agents and diagnose the diseases that they cause.

Relevance of Subject: The knowledge of identifying pathogenic microbes and diagnose of related diseases can increase jobs prospective in clinical testing laboratories.

UNIT I

Methods of classification of microorganisms, general characteristics of main groups of microorganisms. Mycoplasmas. Gram +ve and Gram –ve bacteria with structure and functions of peptidoglycan in them. Different phases of microbial growth and physical conditions required. Culture media and isolation of pure bacterial cultures. Staining methods for bacteria. Quantitative measurement of bacterial growth, microbial taxonomy, Bacterial morphology, growth and nutrition of bacteria

Bacterial genetics, pathogenesis, antibacterial agents, drug resistance and drug sensitivity tests, laboratory diagnosis of bacterial infections. Chemical control of microorganisms: Heat, filtration and radiation. Identification of bacteria on the basis of cultural characteristics (morphological and serological features): Staphylococcus and streptococcus including pneumococci, Family Enterobacterial, Haemophilus & Bordetella, Corynebacterium and Neisseria & Treponema.

UNIT II

Virus structure including viral proteins, virus classification and lytic/lysogenic life cycles in viruses. Virus-induced changes in cells, methods of assay of viruses. Replication of RNA viruses- negative strand (VSV), positive strand (polio) and retroviruses. Replication of DNA viruses (Adenovirus or SV40).

Air borne infections (Tuberculosis, Whooping cough, Influenza, Pneumonia, streptococcal infections, Diphtheria, Measles, Chicken pox, Mumps), Food and water borne infections (Cholera, Typhoid, Shigellosis, Brucellosis, Gastroenteritis, Amoebiasis, Taeniasis, Poliomyelitis, Jaundice) Sexually transmitted diseases (AIDS, Syphilis, Gonorrhoea, Lymphogranuloma venereum, Genital Herpes, Trichomoniasis) Vector borne diseases (Plague, Rickettsia, Malaria, Filariasis, Rabies, Leptospirosis),

References:

1. *Microbiology: An Introduction, Eighth Edition* by Gerard J. Tortora, Berdell R. Funke, Christine L. Case. Pearson Education.
2. *Fundamentals of Microbiology* by I. Edward Alcamo. Benjamin-Cummings Pub Co.
3. *Microbiology (Hardcover)* by Lansing M. Prescott, John P Harley and Donald A. Klein. Publisher: McGraw Higher Education.
4. *Medical Microbiology* by FH Kayser, KA Bienz, J Eckert and RM Zinkernagel. Publisher: Thieme Medical Publishers, Germany.
5. *Medical Microbiology* by P Murray, KS Rosenthal and MA Pfaller. Publisher: Mosby, Elsevier.
6. *Principles of Microbiology* by Ronald M. Atlas
7. *Microbiology* by BD Davis, R Delbecco, HM Eisent and HS Ginsberg. Medical Division, NY.
8. *Microbial Biochemistry* by ML Srivastava, Alpha Science Intl Ltd.
9. *Microbial Biochemistry* by GN Cohen, Publisher: Springer.
10. *Principles of Virology: Molecular Biology, Pathogenesis and Control.* by SJ Flint, LW Enquist, RM Krug, VR Racaniello and AM Skalka. ASM Press.
11. *Fundamentals of Molecular Virology* by Nicholas H. Acheson. John Wiley & Sons. 12. *Basic Virology* by Edward K. Wagner (Author), Martinez J. Hewlett, David C. Bloom and David Camerini. Publisher: WileyBlackwell.

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Course Code: MMLT – 106L Title: Introduction to Medical Laboratory Technology (MLT) Lab
[SGGSWU-DBT] L/T/P: 0/0/3

1. Operation and working of equipments: Autoclave, centrifuge, incubator, BOD incubator, incubator orbital shaker, orbital shaker, pH meter, water bath, hot air oven, magnetic stirrer, distillation unit, spectrophotometer, etc.
2. Washing and sterilization of glassware and plasticware.
3. Preparation of Buffers.
4. Quantitative estimation of analyte in sample using colorimetry or spectrophotometry-Beer Lambert Law.
5. Microscopy: Introduction to Light, Bright field, Phase contrast, Confocal, Fluorescence Microscopy, Electron Microscopy.
6. Collection and storage of human specimens.
7. Vital staining for visualization of cell organelles.

References:

1. *An Introduction to Practical Biochemistry, 3rd edition, by David T. Plummer, Tata McGraw Hill. 1988.*
2. *Practical Biochemistry for Students by Malhotra, Jaypee Brothers Publishers, 2003.*
3. *Cell biology: A laboratory handbook Vol 1, 2, 3 (2006) by Celis J.E. (Academic Press, UK).*

Course Code: MMLT – 107L
[SGGSWU-DBT]

Title: Medical Microbiology Lab
L/T/P: 0/0/3

1. To study the compound microscope and to learn Its important parts and their functions and How to focus and use it to study microorganisms C. Its proper care and handling.
2. To make aseptic transfers of pure cultures and to examine them for important gross features.
3. To observe bacteria in a hanging drop, study their morphology, and determine their motility
4. To observe bacteria in a simple wet mount and determine their motility.
5. To learn the value of simple stains in studying basic microbial morphology
6. To learn the Gram-stain technique and to understand its value in the study of bacterial morphology
7. To learn the acid-fast technique and to understand its value when used to stain a clinical specimen.
8. To learn a technique for staining bacterial endospores.
9. To study the activity of some disinfectants and to learn the importance of time, germicidal concentration, and microbial species in disinfection

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Course Code: MBT-105E DSE1 Title: Ethical Practices in Medical Technology
[SGGSWU – DBT]

L/T/P: 4/0/0

Objective of Subject: *To learn about the ethical issues in the medical lab technology.*

Outcome of Subject: *Understanding of ethical standards and concerns about practices related to medical lab technology*

Relevance of Subject: *Practices in diagnostic laboratories*

UNIT I

Accreditation and Lab safety: Laboratory requirements for quality and competence- International Perspectives. Preparing a Quality Manual (Structure and Format)-NABL 160. ISO 15189: 2007. Chemical hazards, Biological hazards- Biological agents, and toxins, Physical hazards - Ergonomic hazards, Radiation Hazards

Cloning and Ethical implications: Reproductive cloning , therapeutic cloning ; Ethical, legal and socio-economic aspects of gene therapy, germ, line, somatic, embryonic and adult stem cell research- GM crops and GMO's – biotechnology and biopiracy –ELSI of human genome project.

UNIT II

Reproduction and Bioethics: Maturation and fertilization of ovum, function of the placenta, hormonal control in pregnancy and parturition. Adjustment of the infant to extra uterine life, special functional problems in the neonate, the role of fetal factors, in programming adult- onset of diseases. Personhood – Abortion – Bioethical issues in reproduction, population explosion and control – Assisted reproduction – Egg donation – Prenatal screening and sex, selection – Cloning- Ethical issues on life & death – Brain Vs Cortical death – Persistent vegetative state –Voluntary euthanasia and physician assisted suicide.

Human Genome and Therapy: Ethical issues on New Genetics – Human Genome Project. Experimentation with human subjects – National Practice of health care – Public and Private medical practice – National resource allocations. Ethical issues in research on human subjects – organ Transplantation - justification of transplantation – Patient selection – organ donation. Guidelines for preparing Standard Operating Procedures (SOP) for Institutional Ethics Committee for Human Research.

References:

1. *Basterra, E. and F. Javier., 1989. Bioethics, Liturgical Press Collegeville, United States.*
2. *Hope, R.A., 2004. Medical Ethics: A Very Short Introduction, Oxford University Press, New Delhi.*
3. *Braunwald, E., A.S. Fauci, D.L.Kasper, S.L.Hauser, and D.L. Longo, 2001. Principles of Internal*
4. *medicine, Volume 1, McGraw Hill, New Delhi.*
5. *Gile, T.J., 2010. Complete Guide to Laboratory Safety, HC Pro Inc., United States.*
6. *Hall, J. E. and A.C. Guyton, 1996. A text book of Medical physiology, Saunders, New York.*
7. *Rose, S., 1984. Clinical Laboratory Safety, Lippincott. Philadelphia.*
8. *Kumar, V., S. R. Cotran and S.L.Robbins, 2012. Basic pathology, Saunders, New York.*

Semester II

Course Code: MMLT-201
[SGGSWU – DBT]

Title: Haematology
L/T/P: 4/0/0

Objectives: Demonstrate an understanding of the components of human blood and characteristics, functions, and abnormalities and disease states of each.

Relevance: It is important for students to have theoretical and practical knowledge about this subject.

Outcome: Students will have practical knowledge necessary to perform blood cell counts, and evaluation of blood elements within stated limits of accuracy.

UNIT I

Blood components, Blood functions, Plasma proteins, Hemoglobin –derivatives, synthesis, destruction, estimation techniques, red cell indices, red blood cells and hemoglobin - physiological variation, pathological variation, variation in the size, estimation of red cells, fragility of red cells

Haemopoietic system: Erythropoiesis, thrombopoiesis and leucopoiesis.

Anaemia – symptoms, diagnosis, classification, causes, treatment; Genetic disorders; Hemostasis, Fibrinolysis; Blood clotting factors, mechanism of coagulation, tests of blood coagulation, bleeding disorders

UNIT II

Quality control and quality assessment, anticoagulants; Clotting time, Bleeding time, Haemoglobin estimation, Erythrocyte Sedimentation Rate, microhematocrit, macrohematocrit, red cell indices, Differential count, Total Red Blood cell count, Total White blood cell count, Platelet count, Eosinophilic count, Reticulocyte count

Osmotic fragility, Heinz body preparation, Sickle cell preparation, Lupus erythematosus (LE) cell preparation, NESTROF.

References:

1. Hoffbrand, A.V. and P. Moses, 2011. *Essential Haematology*, John Wiley and Sons, Chichester.
2. Mukerjee, K.L. and S. Ghosh, 2010. *Medical Laboratory Technology, Volume I*, McGraw Hill, New Delhi.
3. Godkar, P.B. and D.B. Godkar, 2006. *Medical Laboratory Technology*, Bhalani, New Delhi.
4. Hoffman, R., E.J. Benz, S. J. Shattil, B. F. Harvey, J. Cohen, L. E. Silberstein and P. McGlave, 2005. *Haematology-Basic principles and practice*, Churchill livingstone, Philadelphia.
5. Manoharan, A. and S. Sethuraman, 2003. *Essentials of Clinical haematology*, Jaypee Brothers, New Delhi.
6. Richard, A., McPherson, M.R. Pincus, 2007. *Clinical Diagnosis and management by Laboratory methods*, Elsevier, New Delhi.
7. Sood, R., 2006. *Medical Laboratory methods and Interpretation*, Jaypee, New Delhi.

Course Code: MMLT-202
[SGGSWU – DBT]

Title: Clinical Biochemistry
L/T/P: 4/0/0

Objective of Subject: To learn about the biochemical basis of the disease and its diagnosis.

Outcome of Subject: Understanding of practises used for clinical diagnosis of the disease.

Relevance of Subject: To understand the clinical significance of the diagnostic tests

UNIT I

Disorders of carbohydrate metabolism: Diabetes mellitus, glycohemoglobins, hypo-glycemias, galactosemia and ketone bodies, Various types of glucose tolerance tests, Glycogen storage diseases; Physiology of lipids/lipoproteins, Lipidosis, Clinical inter-relationships of lipids (sphingolipidosis and multiple sclerosis), lipoproteins and apolipoproteins; Diagnostic tests for HDL-cholesterol, LDL-cholesterol and triglyceride disorders.

Inborn errors of metabolism: Disorders of amino acid metabolism: Phenylalanemia, homocystinuria, tyrosinemia, MSUD, phenylketonuria, alkaptonuria, albinism and aminoacidurias; Disorders of nucleic acid metabolism-Disorders in purine/ pyrimidine metabolism.

Evaluation of organ function tests: Assessment and clinical manifestations of renal, hepatic, pancreatic, gastric and intestinal functions; Clinical importance of bilirubin.

Diagnostic enzymes: Principles of diagnostic enzymology. Clinical significance of aspartate aminotransferase, alanine aminotransferase, creatine kinase, aldolase and lactate dehydrogenase. Enzyme tests in determination of myocardial infarction. Enzymes of pancreatic origin and biliary tract.

UNIT II

Hormonal disturbances: Protein hormones (anterior pituitary hormones, posterior pituitary hormones), steroid hormones, adrenocorticosteroids, and reproductive endocrinology. Disturbances in thyroid function; Disorders of mineral metabolism: Hypercalcaemia, hypocalcaemia, normocalcaemia, hypophosphataemia and hyperphosphataemia.

Electrolytes, blood gases, respiration and acid-base balance; Disorders of acid-base balance and their respiratory and renal mechanisms; Mechanism of drug action and channels of its excretion; Detoxification in the body, enzymes of detoxification, polymorphism in drug metabolizing enzymes.

References:

1. Gaw, A., M.J. Murphy, R.A. Cowan, D.J. O'Reily, M.J. Stewart and J. Shepherd, 2008. *Clinical Biochemistry*, Elsevier.
2. *Lehninger Principles of Biochemistry 5th Ed* By David L. Nelson and Michael M. Cox, WH Freeman and Company.
3. *Davidson's Principles and Practice of Medicine: A Textbook for Students and Doctors (Hardcover) 15th Ed* By LSP Davidson, J MacLeod and CRW Edwards. Publisher: Churchill Livingstone.
4. *Medical Biochemistry*, John W. Baynes and Marek Dominiczak Publisher: Mosby.
5. *Clinical Biochemistry: An Illustrated Colour Text (Paperback) 3rd Ed* By Allan Gaw, Michael Murphy, Robert Cowan, Denis O'Reilly, Michael Stewart and James Shepherd. Publisher: Churchill Livingstone.
6. *Review of Medical Physiology (Lange Basic Science)*; William F Ganong. Publisher: McGraw-Hill Medical
7. *Harper's Biochemistry (Lange Medical Books) (Paperback)* By Robert K. Murray, Daryl K. Granner, Peter A. Mayes and Victor W. Rodwell. Publisher: Appelton and Lange.
8. *Clinical Biochemistry* By Richard Luxton. Scion Publishing Ltd.
9. *Principles of Medical Biochemistry: With STUDENT CONSULT Online Access*, Gerhard Meisenberg and William H. Simmons. Publisher: Mosby.

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Course Code: MMLT-203

Title: Immunopathology and Immunotechnology

[SGGSWU – DBT]

L/T/P: 4/0/0

Objective of Subject: To introduce students about the basics of defense mechanisms of the body (immunity).

Outcome of Subject: Better understanding of various immunological processes and immune system.

Relevance of Subject: Helps to understand body's defense/response in context of infections, malignancy or many other disorders/diseases.

UNIT I

Introduction to Immune System: Memory, specificity, diversity, innate and acquired immunity, self vs non-self-discrimination. Structure and functions of primary and secondary lymphoid organs. Cells Involved in Immune Responses: Phagocytic cells and their killing mechanisms; T and B lymphocytes; Differentiation of stem cells and idiotypic variations. Nature of Antigen and Antibody: Antigen vs Immunogen, Haptens; Structure and functions of immunoglobulins; Isotypic, allotypic and idiotypic variations.

Generation of Diversity in Immune System: Clonal selection theory - concept of antigen specific receptor. Organization and expression of immunoglobulin genes: generation of antibody diversity. T cell receptor diversity. Humoral and Cell Mediated Immune Responses: Kinetics of primary and secondary immune response. Complement activation and its biological consequences. Antigen processing and presentation. Cytokines and costimulatory molecules; Role in immune responses. T and B cell interactions. Major Histocompatibility Complex (MHC) Genes and Products MHC antigens in transplantation.

UNIT II

Development, Regulation and Evolution of the Immune System: Measurement of Antigen-Antibody Interaction. Production of polyclonal and monoclonal antibodies: Principles, techniques and applications. Agglutination and precipitation techniques. Radio immunoassay, ELISA, immunofluorescence assays: Fluorescence activated cell sorter (FACS) technique. Tolerance vs Activation of Immune System: Immunotolerance, Immunosuppression, Hypersensitivity (Types I, II, III and IV).

Immune Responses in Diseases: Immune responses to infectious diseases: viral, bacterial and protozoal. Cancer and immune system. Immunodeficiency disorders. Autoimmunity. Immunization: Active immunization (immunoprophylaxis), Passive immunization (Immunotherapy) and role of vaccines in the prevention of diseases.

References:

1. *Fundamental Immunology (Hardcover)* by William E. Paul. Publisher: Lippincott Williams and Wilkins.
2. *Immunology: International Edition (Paperback)* by Janis Kuby, Thomas J. Kindt, Barbara A. Osborne and Richard A. Goldsby. WH Freeman and Co. Ltd.
3. *Immunology (Paperback)* By Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne and Janis Kuby. WH Freeman and Co. Ltd.
4. *Immunology (Paperback)* By Ivan M. Roitt, Jonathan Brostoff and David Male. Publisher: Mosby.
5. *Introduction to Medical Immunology*, Gabriel Virella, Marcel Dekker Inc.
6. *Roitt's Essential Immunology* By Ivan M. Roitt and Peter J. Delves, Blackwell Publishing *Understanding Immunology (Cell and Molecular Biology in Action) (Paperback)*, Peter Wood. Publisher: Prentice hall.
7. *Basic Immunology: The Functions of the Immune System (Paperback)* By Abul K. Abbas and Andrew H. Lichtman. Publisher: Saunders.
8. *Fundamental Immunology (Hardcover)* by Robert M. Coleman and M.F. Lombard. Publisher: Brown (William C.) Co, U.S.
9. *Atlas of Immunology (Hardcover)* By J.M. Cruse (Author), Robert E. Lewis. CRC Press Inc. *Immunology* by Edwards S Golub. Sinauer Associate, Sunderland.

Course Code: MMLT – 206L
[SGGSWU-DBT]

Title: Haematology Lab
L/T/P: 0/0/3

Selected Practicals will be performed

1. Collection of blood.
2. Hemocytometer: Differential count, Total Red Blood cell count, Total White blood cell count, Platelet count, Eosinophilic count, Reticulocyte count.
3. Determination of Clotting time, Bleeding time, Haemoglobin estimation, Erythrocyte Sedimentation Rate, microhematocrit, macrohematocrit, red cell indices.
4. Osmotic fragility, Heinz body preparation, Sickle cell preparation, Lupus erythematosus (LE) cell preparation.

References:

1. *Cheesbrough, M, 2006, Medical Laboratory Manual for Tropical Countries Vol. I and II, Cambridge University Press; UK*
2. *Ochei, J. and A. Kolhatkar, 2000. Medical Laboratory Science, Theory and Practice, McGraw Hill, New Delhi.*
3. *Sood, R., 2006. Medical Laboratory methods and Interpretation, Jaypee, New Delhi.*
4. *Godkar, P.B. and D.B. Godkar, 2006. Medical Laboratory Technology, Bhalani, New Delhi.*
5. *Mukerjee, K.L. and S. Ghosh, 2010. Medical Laboratory Technology, Volume II, McGraw Hill, New Delhi.*

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Course Code: MMLT – 207L
[SGGSWU-DBT]

Title: Clinical Biochemistry Lab
L/T/P: 0/0/3

1. Cardiac function tests- Lipid Profile.
2. Renal function tests: Urea ,Creatinine , Uric acid .
3. Liver Function: Total proteins, Bilirubin , SGOT , SGPT, Alkaline phosphatase , Bile pigments.
4. Gastric, pancreatic and intestinal function: Serum amylase, Serum lipase, Serum insulin level
5. Thyroid and salivary gland functions: T3, T4, TSH and PTH.
6. Adrenocortical function: Estimation of ACTH.
7. Determination of electrolytes.
8. Determination of LH, FSH and Prolactin.
9. Determination of Progesterone, Estrogens, Corticosteroids, Prolactin, Growth hormones, FSH, LH, Testosterone, β -HCG.

References:

1. *Medical Biochemistry, John W. Baynes and Marek Dominiczak Publisher: Mosby.*
2. *Clinical Biochemistry, 3rd Ed, Allan Gaw, Michael Murphy, Robert Cowan, Denis O'Reilly, Michael Stewart and James Shepherd. Publisher: Churchill Livingstone.*

Course Code: MMLT – 208L Title: Immunopathology and Immunotechnology Lab
[SGGSWU-DBT] L/T/P: 0/0/3

Selected Practicals will be performed

1. To perform Radial Immunodiffusion (RID) by Mancini's technique.
2. To perform Double Immunodiffusion (DID) by using Ouchterlony method.
3. To perform the Quantitative precipitation assay-test.
4. To perform hemagglutination assay for ABO blood group typing determination of and Rh factor.
5. To learn the technique of rocket Immuno-electrophoresis.
6. To perform Immuno-electrophoresis of given sample.
7. To determine the concentration of antigen by sandwich ELISA method.
8. Isolation of lymphocytes from peripheral blood by ficoll method and check the viability of isolated lymphocytes.
9. Amplification of Interleukin-28b gene using Polymerase Chain Reaction assay.
10. Lysis of red blood cells (hypotonic lysis with H₂O and ammonium chloride)
11. To perform Erythrocyte Rosette-forming Cell Test, ERFC.

References:

1. *A Handbook of Practical Immunology, By G. P. Talwar, Pub: Vikas Publishing House.*

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Course Code: MMLT-204E DSE2
[SGGSWU – DBT]

Title: Forensic Science and Toxicology
L/T/P: 4/0/0

Objective of the Subject: *The objective of this course is to provide students with an overview of a variety of topics within the area of Forensic Sciences including crime scene investigation, fingerprinting, Ballistics and Forensic DNA analysis*

Outcome of the Subject: *On completion of the course, the students will be able to develop an understanding of the scientific principles of crime scene investigation*

Relevance of the Subject: *Forensic Science plays a vital role in the criminal justice system by providing scientifically based information through the analysis of physical evidence*

UNIT I

Forensic Toxicology: Introduction and scope of forensic toxicology; Different types of poisons commonly encountered; Different routes of ingestion, toxicity of poisons. Fate of drug in body; Samples in fatal and non- fatal cases; Packing and preservations of viscera. Extraction and screening of common poisons and methods of analysis of poison; Forensic toxicology of Ethyl alcohol; Determination of alcohol in field by breath analyser

Radioactive isotopes and compounds: Introduction: Nuclear energy and radioactive sources of exposure and contact, acute and chronic effect on the organs of the body methods of detection and measurements; handling and disposal of body and tissues containing radioactive material. Medico-legal interpretation

UNIT II

Forensic Pharmacology: Pharmacology and its branches, Forensic Pharmacological studies, absorption, distribution, pharmacokinetic, metabolic pathways of common drugs and poisons, Drug toxicity, excretion of drugs and poisons, method of extraction, isolation, identification of metabolites. Metabolites of methanol and ethanol, acetyl salicylate, DDT, Parathion, carbaryl, pheno barbitone, diazepam, amphetamine and heroin metabolite identification by GC-Mass and LC-Mass

DNA profiling and Forensic significance: DNA profiling systems- RFLP analysis, PCR amplifications, sequence polymorphism; Analysis of SNP, Y- STR. Mitochondrial DNA, evaluation of results, frequency estimate calculations, interpretations, allele frequency determination. Applications in disputed paternity cases, child swapping, missing person's identity- civil immigration, veterinary, wildlife and agriculture cases; The Combined DNA Index System (CODIS), legal perspectives- legal standards for admissibility of DNA profiling, procedural and ethical concerns, status of development of DNA profiling in India and abroad; limitations of DNA profiling.

References:

1. Butler, J. M., 2005. *Forensic DNA Typing: Biology, Technology and Genetics of STR Markers*, Academic Press, New York.
2. Niesink, R.J.M., 1996. *Toxicology - Principle and Application*, CRC Press, New York.
3. Norah, R., 2002. *An Introduction to Forensic DNA Analysis*, CRC Lewis, New York.
4. Paul, T., 1998. *Recent Advances in Pharmacology and Toxicology*, Churchill Living Stone, London.
5. Sethi, P.D., 2005. *Quantitative Analysis of Drugs in Pharmaceutical Formulations*, CBS, New Delhi.
6. Basu. R., 2004. *Fundamentals of Forensic Medicine and Toxicology*, Books and Allied, Kolkata.

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**Course Code: MLT – 205E GE1
[SGGSWU-DBT]**

**Title: General Elective
L/T/P: 4/0/0**

To be selected by students from the list of subjects offered by university as open elective.

BIO TECHNOLOGY

Semester III

Course Code: MMLT-301
[SGGSWU – DBT]

Title: Fluid Analysis and Human Disorders
L/T/P: 4/0/0

Objective of the Subject: Aim of this subject is to analyse the different body fluids and study of different diseases related to humans.

Outcome of the Subject: Analysis and evaluation of body fluids helps in detection of different diseases and in depth study of various human disorders helps to understand the symptoms, causes and steps to avoid the disorder.

Relevance of the Subject: The study of body fluids helps the MLT students to understand the importance of body fluid in relation to different diseases and can suggest the diagnostic test relevant to disorder.

UNIT I

Physical properties of body fluids: Body fluid compartments, Solutes in body fluid, Clinical abnormalities of fluid volume regulation, Measurements of body fluid compartments, Movement of body fluids.

Amniotic and Cerebrospinal fluids: Formation and function of amniotic fluid, Chemical composition. Collection, Testing – Alpha foetoprotein, Acetyl cholinesterase, Neural tube defects, Haemolytic disease of newborn, Gestation age, Foetal maturation.

Cerebrospinal fluid: Formation, Specimen collection, Causes of CSF pressure changes, Gross examination, Chemical analysis, Microbiological examination, Immunological tests, Cytological examination and clinical correlation.

Synovial fluid, Serous fluid and other body fluids: Classification of joint disorders, Non-inflammatory joint diseases: Osteoarthritis, Traumatic arthritis and Neurogenic joint disease;

Inflammatory joint disease: Rheumatoid arthritis, Lupus arthritis, Cell count, Chemical and serological examinations, Clinical correlations.

Serous fluid: Formation, Collection, Classes of effusions, Cell types and clinical correlations.

Lymph, Gastric fluid, Urine, Faeces, Seminal fluid, Sputum and Sweat.

UNIT II

Genetic disorders: Colour blindness, Cri du chat syndrome, Cystic fibrosis, Down's syndrome, Duchenne muscular dystrophy, Haemochromatosis, Haemophilia, Klinefelter's syndrome, Turner syndrome, Polycystic kidney disease, Prader-Willi syndrome, Sickle-cell disease.

Neurological disorders : Alzheimer's disease, autism, Canavan's disease, Parkinson's disease, Carpal tunnel syndrome, Lesch- Nyhan syndrome, Lyme disease, multiple sclerosis, Wallenberg's syndrome and Werdnig-Hoffman disease.

Disorders of Vitamins: Beriberi, Pellagra, Biotin Deficiency, Scurvy, Rickets, Arabiflavinosis, Vitamin K deficiency, Night blindness.

References:

1. Guyton, A.C. and J.E. Hall, 2010. *Textbook of Medical Physiology*, Elsevier, New Delhi.
2. Brunzel, N.A., 2013. *Fundamentals of Urine and Body Fluid Analysis*, Saunders, New Delh.
3. Cella, J.H. and J. Watson, 2004. *Manual of Laboratory Tests*, AITBS Publishers, New Delhi.
4. Ellington, J.R. and T.S. Danowski, 2002. *The Body Fluids*, Williams and Wilkins, Baltimore.
5. Porth, C.M., 2011. *Essentials of Pathophysiology. Concepts of Altered Health States*, Williams and Wilkins, Baltimore.
6. Strasinger, S.K. and M.S. Di Lorenzo, 2008. *Urinalysis and Body Fluids*, F.A. Davis, Philadelphia.
7. Tortora, G.J. and B.H. Derrickson, 2011. *Principles of Anatomy and Physiology*, Harper Collins, NewYork.

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Course Code: MMLT-302

**Title: Advanced Instrumentation Medical
in Laboratory Technology
L/T/P: 4/0/0**

[SGGSWU – DBT]

Objective: *The objective of this course is to understand the use of various instruments in measuring the biochemical and physiological parameters*

Outcome: *The students are expected to have knowledge of the principles and procedures of various instruments*

Relevance: *This course is important in making students familiar with the various instruments used in medical lab technology*

UNIT I

Basic principles, instrumentation and applications of potentiometer, UV - visible spectroscopy, infrared spectroscopy, atomic absorption spectroscopy and flame photometry, Biosensors, Chemoreceptors, hot and cold receptors, baro receptors, sensors for smell, sound, vision, osmolality and taste. Transducers for the measurement of ions and dissolved gases. Ion exchange membrane electrodes - Measurement of pH - Glass pH electrodes. Measurement of pO₂, M, pCO₂. ISFET for glucose, urea. Ultracentrifugation, electrophoresis, immunoelectrophoresis, capillary electrophoresis, isoelectrophoresis, blot techniques, northern and southern blotting, preparatory and analytical centrifuge sedimentation analysis, zonal and density gradient, ultracentrifugation, flame photometry analyzer.

Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Recording Electrodes – Electrode-tissue interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode gels and creams, microelectrodes, Needle electrodes.

UNIT II

Principle of absorption and partition chromatography, liquid chromatography, gas-liquid chromatography, Ion exchange chromatography, HPLC and its applications in Biology, DNA electrophoresis, separation of isoenzymes and lipoproteins by PAGE, separation of amino acids by paper chromatography, separation of carbohydrate and amino acids by thin layer chromatography, estimation of proteins by Bradford and Folins lowry methods, scanning of absorption spectra by single beam spectrophotometer.

PET Scan, CT Scan, MRI scanning, Endoscopy, laparoscopy, Fiber optics, Nuclear medicine, radiotherapy, X-ray, Teletherapy, Cobalt Machines, Brachytherapy, Simulator-CT-Phebus, Radiation Oncology Physics, HDR Brachytherapy, IMRT and Dosimetry, Spectroscopy, interaction of radiation with matter, emission of radiation, Fluorimetric methods, Radioisotopes, nature of radioactivity, types of radioactivity, radioactive decay, units of radioactivity, detection and measurements of radioactivity, autoradiography and biochemical uses of radioactive isotopes,

References :

Lab view based advance instrumentation system by S. Sumathi and P. Surekha S. sumathi Springer

Course Code: MMLT-303
[SGGSWU – DBT]

Title: Modern Diagnostics
L/T/P: 4/0/0

Objective of Subject: *The objective of this course is to make use of new laboratory and analysis techniques for medical diagnostics*

Outcome of Subject: *Students are expected to have indepth knowledge of the various tools and techniques used in Histopathology*

Relevance of Subject: *This course offers students to get familiar with techniques which are being used in the occupational fields of healthcare and beyond*

UNIT I

Introduction to histopathology: Definition, Morphology and physiology of cell, laboratory management and planning, sources and types, histological specimens, kinds of histological presentations; recording and labeling, fixation, properties of fixing fluids, classification and composition of fixing fluids; advantages and disadvantages of secondary fixatives.

Tissue processing, processing of histological tissues; tissue processor: dehydration and cleaning; Embedding: Water soluble, substances, embedding in paraffin nitrocellulose. Technique of processing bone for histological studies. Mounting: techniques, various mountings. Decalcification of calcified tissue.

UNIT II

Section Cutting; equipment for sectioning: Microtome, knife, honing and stropping; Types, care and use of microtome. Techniques and principles of sections cutting: Frozen section techniques: carbon dioxide freezing, cryostat, and freezing microtome.

Technique for sectioning: Paraffin embedded tissue, Errors in sectioning and remedies. Attaching blocks to carriers.

Slide preparation & Staining, Preparation of slide, deparaffinization, Staining – theory, types of staining agent. Automatic slide stainer, Instruments for grossing, electric saw, Microphotography; Hematoxylin and Eosin staining. Types of hematoxylin and its preparation. Eosin stock stain and other counter stains;

Pharmacodynamics mechanism of drug action, Drug receptors, Receptors for physiological regulatory molecules, Physiological receptors: Structural and functional families, Regulation of receptors, Quantitation of drug-receptor interactions and effects.

References:

1. Brunton, L.L., J.S. Lazo and K.L. Parker, 2006. *The Pharmacological Basis of Therapeutics*, McGraw, Hill, New Delhi.
2. Freifelder, D., 2004. *Molecular Biology*, Narosa Publishing House, New Delhi.
3. Burger, A. and R. Willey, 1970. *Medicinal chemistry Volume I & II*. CRC Press, New York.
4. Tripathi, K.D., 1998. *Essentials of medicinal Pharmacology*, Jaypee, New Delhi.
5. Satoskar, R.S. and S.C. Bhandarkar, 1978. *Pharmacology and Pharmacotherapeutics, Vol. I & II*, Popular Prakashan, Mumbai.
6. Wilson, K. and J. Walker, 2004. *Practical Biochemistry - Principles and Techniques*, Cambridge, University Press, United Kingdom.

Course Code: MMLT – 306L
[SGGSWU-DBT]

Title: Fluid Analysis and Human Disorders Lab
L/T/P: 0/0/3

Selected practicals will be performed

1. Estimation of minerals (e.g., sodium, potassium, calcium, chloride, bicarbonate, phosphorous, magnesium etc) in biological fluids.
2. Determination of Vitamin K and folic acid.
3. Composition, collection and preservation of urine for various tests urine; Types of preservatives.
4. Physical examination of urine: Volume, colour, odour, appearance, specific gravity and pH.
5. Chemical examination of urine: Reducing sugar(Benedict test), protein (Heat and acetic acid test and sulfosalicylic acid method), Ketone bodies (Rothera's test), Bile pigment (Fouchet method), bile salt (Hay's test), Urobilinogen (Ehrlich aldehyde test and Bence Jones protein test), Renal clearance test (urea, creatine), Test for Drugs of Abuse (e.g., Methadone, metha – Amphetamine/ Benzodiazepine/ Cocaine/ Morphine/ Cannabinoids/ Phenobarbitone).
6. Microscopic examination of urine: Identification of casts and crystals and blood cells -RBC, WBC, smear for gram staining and urine culture.
7. Collection and disposing sputum
8. Physical examination of sputum: Identification of Eosinophils -wet mount method, Eosin method, Identification of *Aspergillus*-Potassium Hydroxide method.
9. Microscopic examination of sputum: Gram staining of sputum, AFB staining of sputum, concentration techniques, culture techniques.

References:

1. Godkar, P.B. and B.Godkar, 2003. *Medical Laboratory Technology*, Bhalani Book Depot, New Delhi.
2. Marks, V., T.Cantor, D.Mesko, R.Pullman and G. Nosalova, 2003. *Differential Diagnosis in Lab Medicine*, Springer, India.
3. Ochei, J. and A. Kolhatkar, 2000. *Medical Laboratory Science, Theory and Practice*, McGraw Hill, New Delhi.
4. Mukerjee, K.L. and S. Ghosh, 2010. *Medical Laboratory Technology, Volume II*, McGraw Hill, New Delhi.
5. Sood, R., 2006. *Medical Laboratory methods and interpretation*, Jaypee, New Delhi.

**Course Code: MMLT – 307L
[SGGSWU-DBT]**

**Title: Modern Diagnostic Lab
L/T/P: 0/0/3**

Selected Practicals will be performed

1. Hormone assay for thyroid (TSH, T3, T4), Sexual disorders (testosterone, dihydrotestosteron, estradiol, FSH, LH by RIA)
2. Amplification of Short Tandem Repeats (STR)/microsatellites.
3. Single strand conformation polymorphism (SSCP) analysis.
4. Microarrays for pathogen detection and SNP studies (Demo).
5. Bioinformatic tools for genome and proteome analysis.
6. Metaphase chromosome preparations from human cells.
7. Chromosome preparation from lymphocyte culture / mouse bone marrow.
8. Automated Karyotyping 5. Sex chromatin (buccal mucosa, hair bud).
9. Micronucleus assay .
10. Sister Chromatid Exchange (SCE).

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Course Code: MMLT-304E DSE3

**Title: Clinical Applications of Molecular
Diagnosis in Healthcare**

[SGGSWU – DBT]

L/T/P: 4/0/0

Objective of the Subject: To learn the techniques used to understand the molecular mechanism of various diseases.

Outcome of the Subject: Learning of various techniques helps in detection of diseases, and suggests which therapies will work best for individual patients.

Relevance of the Subject: The scope of this subject is to understand the techniques and learn the impact of various diseases on humans.

UNIT I

Introduction to Molecular Diagnostics: History of diagnostics, Age of molecular diagnostics, Significance, Scope, Rise of diagnostic industry in Indian and global scenario.

Cellular Complexity: Cell components, Cell Differentiation, Cellular communication: endocrine signalling, paracrine signalling and autocrine signalling, contact dependent and synaptic communications Intracellular networks: transport pathways, signalling pathways and metabolic networks. Normal vs diseased cells; Principle, types and application of different microscopes.

Molecular oncology and Mitochondrial disorders: Cancer: Benign and Malignant neoplasms, multifactorial disposition, Cancer pathogenesis, positive and negative mediators of neoplastic development, Proto-oncogenes, Oncogenes and Tumor suppressors. Allele loss and loss of Heterozygosity. Mitochondrial inheritance, Mitochondrial myopathy, lactic acidosis, MELAS, LHONs, identity testing.

UNIT II

Biomarkers in disease diagnostics: FDA definition of disease markers, Role of markers in Disease diagnosis. Approaches and methods in the identification of disease markers, predictive value, diagnostic value, emerging blood markers for sepsis, tumor & cancer markers, markers in inflammation and diagnosis of cytoskeletal disorders.

Chromosomes, Human disorders, and Cytogenetic analysis :Structure, types and organization; Chromosome organization, Euchromatin and heterochromatin and Histone modifications. Chromosome banding and nomenclature; Nomenclature and functional significances of chromosome bands. GC and AT rich isochores. Sex determination and Y chromosome; function, and diseases. Uniparental disomy, Genomic Imprinting and disorders. FISH, CGH, Flow cytometry techniques and clinical diagnostics.

References:

1. *Molecular biology of the cell.* Bruce Alberts, 6th Edition
2. *Principles of tissue engineering.* Robert Lanza. Elsevier Publications.
3. *Introduction to Tissue engineering, applications and challenges.* Ravi Birla. Wiley Publications.
4. *Molecular Cell Biology: Darnell J, Lodish H and Baltimore D*
5. *Cell and Molecular Biology: De Robertis EDP and De Robertis EMF*
6. *Animal cell culture: Ian Freshney*
7. *An introduction to Human Molecular Genetics by Pasternak et al., John Wiley & Sons*
8. *Human Chromosomes by Miller & Tharman, Springer Publishing Company,*
9. *Molecular Biology of the cell by Alberts et al., Garland Press*
10. *Genes IX, by Lewin B, Pearson India .*

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**Course Code: MMLT – 305E
[SGGSWU-DBT]**

GE2

Title: General Elective

L/T/P: 4/0/0

To be selected by students from the list of subjects offered by university as open elective.

BIO TECHNOLOGY

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Course Code: MMLT- 308
[SGGSWU – DBT]

Title: Summer Training Program (STP)
LTP: 0/0/8

Objective of the Subject: *The aim of Research Projects is to give the students sufficient experience and proficiency in the research methodology. Projects will be assigned as per individual's interest and availability of specialized faculty and to be carried out in labs of the Department/University/Industry. After submission of their dissertation, they will undergo a viva voce by external expert.*

Relevance of the Subject: *It is important for students to have practical lab experience, to raise a query, its possible hypothesis, experimentation and analysis of data obtained.*

Outcome of the Subject: *This will enable students to carry out independent research.*

The Candidate has to gain knowledge about the experimental techniques used in laboratories of any reputed Paramedical or Medical Industry by working there for the minimum period of 24 hours per week for 3-4 weeks. Afterwards, the candidate has to submit the following documents:

1. The confidential report of candidate's participation in the training duly signed by the Head/Supervisor of the Paramedical or Medical Industry in the sealed envelope.
2. A brief report about the techniques learned by him/her during the training.

On the basis of his report, Viva-voice will be conducted.

Semester IV

**Course Code: MMLT-401
[SGGSWU – DBT]**

Title: Internship

Objective of the Subject: *The aim of Research Projects is to give the students sufficient experience and proficiency in the research methodology. Projects will be assigned as per individual's interest and availability of specialized faculty and to be carried out in labs of the Department/University/Industry. After submission of their dissertation, they will undergo a viva voce by external expert.*

Relevance of the Subject: *It is important for students to have practical lab experience, to raise a query, its possible hypothesis, experimentation and analysis of data obtained.*

Outcome of the Subject: *This will enable students to carry out independent research.*

The Candidate has to knowledge about the sample handling and experimental techniques used in laboratories (*viz.* Biochemistry, Microbiology and Pathology) of any reputed hospital working there for the minimum period of 24 hours per week for 6 months. Hospital training includes 2 month training each in Biochemistry, Microbiology and Pathology Labs. Afterwards, the candidate has to submit the following documents:

1. The confidential report of candidate's participation in the training duly signed by the Head/Supervisor of the institute/Company/Workshop in the sealed envelope.
2. A complete report about the techniques learnt by him/her during the internship.

On the basis of his report, Viva-voice will be conducted.