

Bachelor of Science - Medical Lab Technology

Syllabus - First Semester

HEMATOLOGY-I

Course Code: MLT2108

Credit Units: 03

Course Objectives:

- To impart the knowledge about the blood and blood formation in bone marrow.
- To provide the knowledge about handling of haematological apparatus.
- To impart the knowledge of routine haematology tests.
- To develop the understanding of advanced haematological techniques.

Course Contents:

Module-I

Hematology: Introduction and importance of hematology.

Blood: Definition, composition, functions of blood.

Blood cells: Shape, size, structure and functions of blood cells.

Haemopoiesis: Erythropoiesis, leucopoiesis and thrombopoiesis.

Module-II

Instruments and apparatus used in hematology laboratory: Neubauer chamber, pipettes, colorimeter, cell counter.

Hemoglobin: Formation, Degradation, types and functions.

Haemoglobinometry: Methods, principle, procedure, application and error analysis.

Anticoagulants and preservatives: Mode of action, composition, merits and demerits of EDTA, citrate, oxalate, heparin and sodium fluoride.

Blood collection: Capillary, venous and arterial method, order of blood draw, preservation of blood sample; Changes during blood storage.

Module-III

Blood cells count: Red blood cell, white blood cells, platelets, eosinophil and reticulocyte count.

ESR: Mechanism, methods, factors influencing and clinical significance.

PCV: Methods, principle, factors influencing and clinical significance.

Buffy coat: Preparation of buffy coat and its application.

Peripheral blood smear: Methods of preparation, importance and error analysis.

Staining: Methods, principle, composition and staining procedure and error analysis

Module-IV

Hemocytometer: Principle, procedure, application, precautions and clinical significance.

Red cell indices: Different parameters, calculations, color index and maturation index and clinical significance.

Automated cell counter: Principle, application and procedures.

Examination Scheme

Components	CA	A	ME	EE
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Weightage(%)	15	5	10	70
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Recommended books:

- Shrish M. Kawthalkar, Essential Hematology, 2nd Edition 2013, Jaypee Publication.
- Bain, Decie & Lewis Practical Hematology, 11th Edition 2016, Churchill Livingstone.
- J Ochei and A Kolhatkar, Medical Laboratory Science- Theory and Practice, 1st Edition 2000, Tata Mcgraw Hill Publishing Co. Ltd.
- Praful B. Godkar, Darshan P. Godkar, Text book of Medical Laboratory Technology, 3rd Edition 2014, Bhalani Publishing House.
- Harse Mohan, Text Book of Pathology 7th Edition 2015, Jaypee & Brothers Medical Publishers LTD.
- Richard A. McPherson, Henry's Clinical Diagnosis and Management by Laboratory Methods, 22 Edition 2014 Elsevier.
- E M Keohane, L Smith, J Walenga, Rodak's Hematology: Clinical Principle and Application, 5th Edition 2015, Elseivier.
- 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.
- Bernadette F. Rodak, George A. Fritsma, Kathryn Doig, Hematology: Clinical Principles and Applications, 4th Edition 2012. Saunders & Elseviers.

HEMATOLOGY LAB-I

Course Code: MLT2111

Credit Units: 01

Course objectives:

- To impart the basic knowledge of principles, techniques and clinical importance of routine and selected laboratory procedures.
- To familiarize with basic knowledge of instruments commonly utilized in the clinical hematology laboratory.

List of experiments:

1. Preparation of anticoagulants vials.
2. Collection of Blood by various methods.
3. Estimation of hemoglobin.
4. To perform RBC count.
5. To perform WBC count.
6. To perform Platelets count.
7. To perform ESR and PCV.
8. Preparation of Romanosky stain.
9. Preparation and staining of peripheral blood smear.
10. Examination of blood cells morphology.

Examination Scheme

Components	Internal Assessment	Attendance	Record	EE
Weightage (%)	20	5	5	70

Recommended books:

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

CLINICAL TRAINING-I

Course Code: MLT2112

Credit Units: 2

Course Objective: The purpose of a Clinical training is to provide hands on practical experience in relevant sections of diagnostic labs as per the need of healthcare system. Students will participate in samples collection, documentation, transportation, receiving, processing and dispatch of reports. Students will help in the performance of clinical protocols, quality maintenance and laboratory research. In some cases, students may be deputed in community services or assist in organizing camps like blood testing or blood donation camp.

Students will be sent to diagnostic laboratory or hospital once a week outside campus or may be within the campus if facility available.

Plan for clinical training:

1. Hematology Lab
2. Microbiology Lab

Note: Students must submit training report during examination and the same would be evaluated through Viva voice and presentation.

Examination Scheme

Components	Viva	A	ME	EE
Weightage (%)	10	5	15	70

Syllabus - Second Semester

HEMATOLOGY-II

Course Code: MLT2208

Credit Units: 03

Course Objectives:

- To impart the knowledge about disorders of blood cells.
- To familiarize students about pathogenesis and laboratory diagnosis of various anemia.

Course Contents:

Module-I

Blood cell disorders: Morphological disorders of Blood cells; Physiological variation of erythrocytes, leucocytes and thrombocytes.

Bone Marrow: Introduction, collection, processing, indications and significance.

Module-II

Anemia: Introduction, causes, sign and symptoms, classification and laboratory diagnosis of anemia; Pathogenesis and laboratory diagnosis of iron deficiency anemia, pernicious anemia, megaloblastic anemia, aplastic anemia, sideroblastic anemia; anemia due to chronic renal failure and liver disease.

Module-III

Hemolytic Anemia: Pathogenesis and laboratory diagnosis of hereditary spherocytosis, hereditary elliptocytosis, thalassemia and sickle cell anaemia; other types of anemia- Glucose -6-phosphate dehydrogenase deficiency, pyruvate kinase deficiency, paroxysmal nocturnal haemoglobinuria, warm antibody type, cold antibody type, incompatible blood transfusion, hemolytic disease of new born.

Module-IV

Leukemia: Introduction, causes, sign & symptoms, classification and laboratory diagnosis; myeloid and lymphoid leukemia.

Examination Scheme

Components	CA	A	ME	EE
Weightage(%)	15	5	10	70

Recommended books:

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

- 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.
- Bernadette F. Rodak, George A. Fritsma, Kathryn Doig, Hematology: Clinical Principles and Applications, 4th Edition 2012. Saunders& Elseviers.

CLINICAL BACTERIOLOGY

Course Code: MLT2209

Credit Units: 03

Course Objective:

- To impart the knowledge of morphology, culture characteristics, pathogenicity, lab diagnosis and prophylaxis of major bacterial pathogens.
- To provide the understanding of special laboratory techniques.

Course Contents:

Module-I

Bacteriology: Introduction, bacterial reproduction, bacterial growth curve and factors effecting bacterial growth; Bacterial genetics- plasmid, mutation, transformation, transduction and conjugation.

Module-II

Gram negative bacteria: Morphology, pathogenicity, lab diagnosis and prophylaxis of: Neisseria gonorrhoeae, Neisseria meningitides, Escherichia coli, Shigella, Klebsiella, Proteus, Yersinia, Salmonella, Vibrio, Aeromonas, Pseudomonas, Campylobacter, Bacteroides, Fusobacterium, Brucella, Haemophilus, Bordetella and Helicobacter pylori.

Module-III

Gram positive bacteria: Morphology, pathogenicity, lab diagnosis and prophylaxis of: Staphylococci, Streptococci, Pneumococcus, Enterococcus, Bacillus, Corynebacterium, Clostridia, Mycobacterium, Actinomycetes and Listeria.

Miscellaneous bacteria: Morphology, pathogenicity, lab diagnosis and prophylaxis of: Spirochetes, Rickettsiae, Chlamydia and Mycoplasma.

Module-IV

Staining: Gram stain, AFB stain, Albert's stain and special stains for spore, capsule and flagella.

Biochemical test: Catalase, coagulase, oxidase, indole, MR, VP, citrate, urease and triple sugar iron agar.

Special laboratory techniques: Antimicrobial susceptibility testing; Bacteriological examination of water, milk and air.

Examination Scheme

Components	CA	A	ME	EE
Weightage(%)	15	5	10	70

Recommended books:

- C P Baveja, Text book of Microbiology, 4th Edition 2010, Arya Publication.
- Arti Kapil, Ananthanarayan and Paniker's Textbook of Microbiology, 9th Edition 2013, Orient BlackSwan.
- Mark Gladwin, Trattler William, C. Scott, Mahan, Clinical Microbiology Made Ridiculously Simple. 6th Edition 2013, Medmaster.
- D.R.Arora / Brij Bala Arora, Textbook of Microbiology, 5th Edition 2016, CBS Publishers & Distributors.
- 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.
- R C Dubay & D.K.Maheshwari, Practical Microbiology, Revised edition 2014, S Chand & Company LTD.
- Dr. C.P. Baveja, Dr. V. Baveja, Textbook of Microbiology for MLT, 2nd Edition, Arya Publication.

- Joanne Willey, Linda Sherwood, Christopher J. Woolverton, Prescott's Microbiology, 9th Edition 2014, McGraw-Hill Education.
- Gary W Procop & Elmer W. Koneman Koneman's Color Atlas and Textbook of Diagnostic Microbiology, 7th Edition 2016, Wolters Kluwer Health.
- F. H. Kayser, K. A. Bienz, J. Eckert, Medical Microbiology, 10th German Edition 2005, Thieme Stuttgart, New York.
- Michael Ford, Medical Microbiology, 2nd Edition 2014, Oxford university press.
- Neal Chamberlain, Medical Microbiology: The Big Picture, 1st Edition 2008, Mc Grew Hill Medical.

Course Code: MLT2211

Credit Units: 01

Course Objectives:

- To impart the basic knowledge of principles, techniques and clinical importance of routine and selected laboratory procedures.
- To familiarize with basic knowledge of instruments commonly utilized in the clinical hematology laboratory.

List of experiments:

1. Demonstration of abnormal blood cells.
2. Demonstration of microcytic and hypochromic anemia.
3. Demonstration of macrocytic and normochromic anemia.
4. Demonstration of hemolytic anemia.
5. Demonstration of hemorrhagic anemia.
6. Demonstration myeloid leukemia.
7. Demonstration of lymphoid leukemia.
8. To perform osmotic fragility test.
9. To perform sickling test.
10. Demonstration of normal and abnormal bone marrow cells in permanent slides.

Examination Scheme

Components	Internal Assessment	Attendance	Record	EE
Weightage (%)	20	5	5	70

Recommended books:

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

CLINICAL TRAINING-II

Course Code: MLT2212

Credit Units: 2

Course objective: The purpose of a Clinical training is to provide hands on practical experience in relevant sections of diagnostic labs as per the need of healthcare system. Students will participate in samples collection, documentation, transportation, receiving, processing and dispatch of reports. Students will help in the performance of clinical protocols, quality maintenance and laboratory research. In some cases, students may be deputed in community services or assist in organizing camps like blood testing or blood donation camp.

Students will be sent to diagnostic laboratory or hospital once a week outside campus or may be within the campus if facility available.

Plan for clinical training:

1. Bacteriology Lab
2. Hematology Lab

Note: Students must submit training report during examination and the same would be evaluated through Viva voice and presentation.

Examination Scheme

Components	Viva	A	ME	EE
Weightage (%)	10	5	15	70

Syllabus – Third Semester

HAEMATOLOGY-III

Course Code: MLT2308

Credit Units: 03

Course Objectives:

- To familiarize students about mechanism of haemostasis and related disorders.
- To impart the knowledge of investigation required in coagulation study.
- To impart the understanding of pathogenesis, lab diagnosis and prevention of multiple myeloma and lymphoma.

Course Contents:

Module-I

Hemostasis: Introduction and mechanism of hemostasis, role of platelets in hemostasis, clotting factors and coagulation cascade- intrinsic, extrinsic and common pathway; Fibrinolytic system.

Module-II

Hemostatic disorders: Hemophilia, von Willebrand's syndrome, disseminated intravascular coagulation and other coagulation factor deficiencies, vitamin K deficiency, anticoagulant therapy, liver diseases, platelets disorders.

Module-III

Laboratory diagnosis: Principle, procedure, reference values and significance of – Bleeding Time, Clotting Time, Prothrombin Time, Activated Partial Prothrombin Time, Thrombin Time, Hess Test, Clot Retraction Time, Fibrinogen Degradation Product and assays for coagulation factors.

Coagulometer: Principle, working and applications.

Module-IV

Lymphoma and Multiple Myeloma: Introduction, Classification and pathogenesis, laboratory diagnosis, prevention and control.

LE cell: LE cell phenomena, various methods for diagnosis and clinical significance.

Examination Scheme

Components	CA	A	ME	EE
Weightage (%)	15	5	10	70

Recommended books:

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

- 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.
- Bernadette F. Rodak, George A. Fritsma, Kathryn Doig, Hematology: Clinical Principles and Applications, 4th Edition 2012. Saunders & Elseviers.

CLINICAL PARASITOLOGY

Course Code: MLT2309

Credit Units: 03

Course Objectives:

- To impart knowledge about detrimental effects of parasites on human health.
- To develop understanding of life cycle, transmission, pathogenicity, and control strategies of clinically important parasites.
- To familiarize with techniques of sample collection and processing to diagnose parasitic infection.

Course Contents:

Module-I

Introduction of Parasitology: Introduction to clinical parasitology, general characteristics, morphology and classification of parasites, classification of hosts and vectors, relationship between parasites and host, mode of transmission of parasitic infections.

Module-II

Protozoology: Morphology, life cycle, pathogenicity, prevention and lab diagnosis of Entamoeba, Dientamoeba, Iodamoeba, Trichomonas, Trypanosomes, Leishmania, Giardia, Plasmodium, Isospora, Balantidium and Toxoplasma.

Module-III

Helminthology: Morphology, life cycle, pathogenicity, prevention and lab diagnosis of-

i) Platyhelminthes: Diphylobothrium, Taenia, Echinococcus, Hymenolepis, Schistosoma, Fasciola, Fasciolopsis, Clonorchis, Peragonimus.

ii) Nematelminthes: Ascaris, Ancylostoma, Necator, Strongyloides, Trichinella, Enterobius, Trichurias, Wucheria, Brugia, Loa loa, Onchocerca, Dracunculus.

Module-IV

Diagnostic Methods: Collection, transportation, processing of different clinical specimens for parasitological examination, concentration techniques, rapid diagnostic techniques and permanent smears preparation techniques.

Examination Scheme

Components	CA	A	ME	EE
Weightage (%)	15	5	10	70

Recommended books:

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

HAEMATOLOGY LAB-III

Course Code: MLT2311

Credit Units: 01

Course Objectives:

- To impart the basic knowledge of principles, techniques and clinical importance of routine and selected laboratory procedures.
- To familiarize with basic knowledge of instruments commonly utilized in the clinical hematology laboratory.

List of Experiments:

1. To perform bleeding time.
2. To perform clotting time.
3. To perform prothrombin time.
4. To perform activated partial prothrombin time.
5. To perform thrombin time.
6. To perform Hess's test.
7. To perform clot retraction time.
8. To study LE cell phenomena.
9. To perform osmotic fragility test.
10. To perform reticulocyte counts.

Examination Scheme:

Components	Internal Assessment	Attendance	Record	EE
Weightage (%)	20	5	5	70

Recommended books:

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

CLINICAL BIOCHEMISTRY LAB

Course Code: MLT2312

Credit Units: 01

Course Objectives:

- To impart the basic knowledge of principles, techniques and clinical importance of routine and selected laboratory procedures.
- To familiarize with basic knowledge of instruments commonly utilized in the clinical biochemistry laboratory.

List of Experiments:

1. To perform blood glucose.
2. To perform blood urea.
3. To perform total bilirubin.
4. To perform total plasma protein.
5. To perform serum creatinine.
6. Estimation of serum calcium ion.
7. Estimation of serum uric acid.
8. To perform blood urea nitrogen.
9. Estimation of serum phosphate.
10. Estimation of serum phosphorus.

Examination Scheme:

Components	Internal Assessment	Attendance	Record	EE
Weightage (%)	20	5	5	70

Recommended books:

- J. Ochei and A. Kolhatkar, Medical Laboratory Science- Theory and Practice, 1st Edition 2000, Tata McGraw Hill Publishing Co Ltd.
- Praful B. Godkar, Darshan P. Godkar, Text book of Medical Laboratory Technology, 3rd Edition 2014, Bhalani Publishing House.
- Manual of Basic Technique for Health Laboratory, 2nd Edition 2003, WHO Geneva.
- Ranjna Chawla, Practical Clinical Biochemistry: Methods and Interpretations, 4th Edition 2014, Jaypee & Brothers Medical Publishers (P) Ltd.
- Shivaraja Shankara YM, ,araknahSL ,KM hsenagaboratory Manual for Practical Biochemistry, 2nd Edition 2013, Jaypee & Brothers Medical Publishers (P) Ltd.
- David T Punmmer, An Introduction to Practical Biochemistry, 3rd Edition 2004, Tata McGrew Hill.
- Sood, Textbook of Medical Laboratory Technology, 1st Edition 2006, Jaypee Brothers Publishers, 2006.

CLINICAL TRAINING-III

Course Code: MLT2313

Credit Units: 2

Course Objective: The purpose of a Clinical training is to provide hands on practical experience in relevant sections of diagnostic labs as per the need of healthcare system. Students will participate in samples collection, documentation, transportation, receiving, processing and dispatch of reports. Students will help in the performance of clinical protocols, quality maintenance and laboratory research. In some cases, students may be deputed in community services or assist in organizing camps like blood testing or blood donation camp.

Students will be sent to diagnostic laboratory or hospital once a week outside campus or may be within the campus if facility available.

Plan for clinical training:

1. Serology Lab
2. Parasitology Lab
3. Biochemistry Lab
4. Hematology Lab

Note: Students must submit training report during examination and the same would be evaluated through Viva voice and presentation.

Examination Scheme

Components	Viva	A	ME	EE
Weightage (%)	10	5	15	70

LAB MANAGEMENT & SAFETY PROCESS

Course Code: MLT2306

Credit Units: 03

Course Objective: The students will aware about the ethics of a clinical laboratory and learn about good laboratory practice, safety measures and quality management in a clinical laboratory.

Course Contents:

Module-I

Quality control: Introduction to quality control, total quality management framework, quality laboratory processes, quality assurance, quality assessment, quality control, quality planning and quality improvement, costs of conformance and non conformance, appraisal costs, prevention costs, internal quality control, basic steps, sources of error and their correction methods, CAPA - corrective action & preventive action and sources of variation in laboratory results.

Module-II

External quality control: Quality control charts, Levy- Jennings and Cusum charts, external quality control, quality control programme, intrinsic and extrinsic and random errors, current trends in laboratory accreditation, ISO certificate, West guard rules and demonstration of various methods of quality control.

Module-III

Laboratory ethics: Ethical Principles and standards for a clinical laboratory professional – Duty to the patient, colleagues, other professionals and the society.

Laboratory accreditation: Good Laboratory Practice (GLP) Regulations and Accreditation – Introduction, aims and advantages of GLP and accreditation.

Module-IV

Laboratory safety measures: Awareness / Safety in a clinical laboratory, general safety precautions; HIV – pre and post-exposure guidelines; Hepatitis B & C – pre and Post-exposure guidelines; Drug resistant tuberculosis; Patient management for clinical samples collection, transportation and preservation of sample; Sample, purpose and methods of accountability.

Examination Scheme

Components	P	A	ME	EE
Weightage (%)	15	5	10	70

Recommended books:

- Textbook of Medical Lab Technology ,Sood, Jaypee Brothers Publications
- Fundamentals of urine and body fluid analysis (3rd ed.) - Brunzel, N. A

Syllabus - Fourth Semester

CLINICAL PATHOLOGY & CYTOLOGY

Course Code: MLT2405

Credit Units: 03

Course Objectives:

- To develop the knowledge about physical, chemical and microscopic examination of various clinical sample.
- To provide the understanding of collection, processing and clinical aspects of various body fluids.
- To develop the knowledge about various stains used in cytology.

Course Contents:

Module-I

Urine Analysis: Introduction, collection, handling, transportation, preservation and storage of urine; Physical, chemical and microscopic examinations with clinical significance; other specific tests and 24 hrs urine analysis.

Module-II

Stool analysis: Introduction, collection, preservation, transportation and clinical aspects of stool sample; Physical, chemical and microscopic examination with clinical significance.

Semen analysis: Introduction, composition and clinical aspects of semen, collection, preservation and transportation of semen sample; Physical, chemical and microscopic examinations with clinical significance.

Module-III

CSF analysis: Introduction, collection, transportation, processing and clinical indications of CSF analysis.

Synovial fluid analysis: Introduction, collection, transportation, processing and clinical indications of synovial fluid analysis.

Serous fluids analysis: Introduction, collection, transportation, processing and clinical indications of pleural, pericardial and peritoneal fluids analysis.

Module-IV

Cytology: Introduction to cytology and exfoliative cytology and clinical importance; Collection, preservation, transportation and processing of cytological specimens (Sputum, Bronchial brush, Esophageal and gastric brush, oral scraping, Breast aspiration and Nipple discharge, Cervical and vaginal specimens).

Cytological stains: Introduction, composition and preparation of cytological stains; Staining procedure - Giemsa stain, Papanicolaou stain, PAS stain, Haematoxylin and eosin stain, Masson's trichrome stain and Ziehl-Neelsen stain.

Examination Scheme

Components	CA	A	ME	EE
Weightage (%)	15	5	10	70

Recommended books:

- Medical Laboratory Science: Theory and practice by J. Ochei, Arundhati kolhatkar, 1st Edition 2000, Mcgraw Hill Education.
- P K Godkar, Text book of Medical Laboratory technology, 3rd Edition 2014, Bhalani Publication.
- Sabitri Sanyal & Arpana Bhattacharya, Clinical Pathology: A Practical Manual, 4th Edition 2008, Elsevier.
- Susan King Strasinger, Marjorie Schaub Di Lorenzo, Urinalysis and Body Fluids, 6th Edition 2014, F A Davids Company.
- Karen Munson Ringsrud, Jean Jorgenson Linné, Urinalysis and Body Fluids: A Colortext and Atlas, 1st Edition 1995, Mosby.
- Richard A. McPherson, John Bernard Henry, Matthew R. Pincus, Henry's Clinical Diagnosis and Management by Laboratory Methods, 22nd Edition 2014, Elsevier/Saunders.
- Lillian A. Mundt, Kristy Shanahan, Graff's Textbook of Routine Urinalysis and Body Fluids, 2nd Edition 2016, Philadelphia : Wolters Kluwer/Lippincott Williams & Wilkins Health.
- Leopold G. Koss, Myron R. Melamed, Koss' Diagnostic Cytology and Its Histopathologic Bases, Volume 1, 5th Edition 2006, Lippincott Williams & Wilkins.
- Edmund S. Cibas, Barbara S. Ducatman, Cytology: Diagnostic Principles and Clinical Correlates. 4th Edition 2014, Saurenders and Elseviers.
- Gabrijela Kocjan, Fine Needle Aspiration Cytology: Diagnostic Principles and Dilemmas, 1st Edition 2005, Springer.

CLINICAL VIROLOGY AND MYCOLOGY

Course Code: MLT2406

Credit Units: 03

Course Objectives:

- To impart knowledge of diagnosis of viral diseases.
- To impart knowledge of diagnosis of fungal disease.
- To provide understanding of molecular method of diseases diagnosis.

Course Contents:

Module-I

Virology: General properties of viruses; Collection, transportation and storage of clinical samples; Cultivation of viruses; Molecular methods for virus diagnosis.

Module-II

Clinically important virus: Human immunodeficiency viruses, viral hepatitis, rabies virus, herpes viruses, influenza viruses, rubella, mumps, measles, rota virus, poliomyelitis, japanese encephalitis, dengue, chikungunya, human oncogenic viruses and kyananur forest disease.

Module-III

Mycology: General properties, morphology, classification and cultivation of fungi; Types of mycoses; Lab diagnosis of fungal infections.

Module-IV

Common fungal infections: Dermatophytes, candidiasis, mycetoma, rhinosporidium, sporotrichosis, histoplasmosis, blastomycosis, coccidioidosis, paracoccidioidosis, cryptococcosis, aspergillosis, pencillosis, zygomycosis and pneumocystis.

Examination Scheme

Components	CA	A	ME	EE
Weightage (%)	15	5	10	70

Recommended books:

- C P Baveja, Text book of Microbiology, 4th Edition 2010, Arya Publication.
- Arti Kapil, Ananthanarayan and Paniker's Textbook of Microbiology, 9th Edition 2013, Orient BlackSwan.
- Mark Gladwin, Trattler William, C. Scott, Mahan Clinical Microbiology Made Ridiculously Simple. 6th Edition 2013, Medmaster
- D.R.Arora / Brij Bala Arora, Textbook of Microbiology, 5th Edition 2016, CBS Publishers & Distributors.
- 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.
- R C Dubay & D.K.Maheshwari, Practical Microbiology, Revised edition 2014, S Chand & Company LTD.
- Dr. C.P. Baveja, Dr. V. Baveja, Textbook of Microbiology for MLT, 2nd Edition, Arya Publication.
- Joanne Willey, Linda Sherwood, Christopher J. Woolverton, Prescott's Microbiology, 9th Edition 2014, McGraw-Hill Education.
- Gary W Procop & Elmer W. Koneman Koneman's Color Atlas and Textbook of Diagnostic Microbiology, 7th Edition 2016, Wolters Kluwer Health.
- F. H. Kayser, K. A. Bienz, J. Eckert, Medical Microbiology, 10th German Edition 2005, Thieme Stuttgart, New York.
- Michael Ford, Medical Microbiology, 2nd Edition 2014, Oxford university press.

- Neal Chamberlain, Medical Microbiology: The Big Picture, 1st Edition 2008, Mc Grew Hill Medical.

DIAGNOSTIC BIOCHEMISTRY-I

Course Code: MLT2407

Credit Units: 03

Course Objectives:

- To enhance the knowledge of various diagnostic tests for human health.
- To impart the knowledge of biochemical parameters in metabolic disorders.

Course Contents:

Module-I

Haem catabolism and bilirubin metabolism: Bilirubin formation and excretion, Conjugated and unconjugated bilirubin, Normal and abnormal values and clinical importance of serum bilirubin.

Clinically important Iso-enzymes: Creatine kinase, Lactate dehydrogenase, SGOT, SGPT, ALP, ACP.

Module-II

Liver function test: Introduction, normal ranges and clinical significance of albumin, aspartate transaminase, transaminases, alkaline phosphatase, lactate dehydrogenase, total bilirubin, direct bilirubin, gamma glutamyl transpeptidase, INR, 5' nucleotidase, coagulation test, clinical conditions.

Module-III

Pancreatic function test: Amylase, lipase, insulin, glucagon, clinical conditions.

Diabetes: Introduction and biochemical changes, types of diabetes, biochemical changes, role of insulin and glucagon, complications of diabetes, diabetes in relation to pregnancy and cardiovascular disease.

Diabetes profile: Oral glucose tolerance test and HbA1c.

Module-IV

Thyroid function test: T3 and T4, TSH, TRH, free T3 and T4, rT3 and rT4, Calcitonin, anti TSH, Thyroglobin, Iodine, clinical conditions

Infertility profile: Testosterone, Estrogen, Progesterone, Prolactin, Oxytocin, LH, FSH, clinical conditions

Examination Scheme

Components	CA	A	ME	EE
Weightage (%)	15	5	10	70

Recommended books:

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

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

DIAGNOSTIC BIOCHEMISTRY LAB-I

Course Code: MLT2408

Credit Units: 01

Course Objectives:

- To impart the basic knowledge of principles, techniques and clinical importance of routine and selected laboratory procedures.
- To familiarize with basic knowledge of instruments commonly utilized in the clinical biochemistry laboratory.

List of experiments:

1. To perform serum albumin and A: G ratio.
2. To perform serum ALP.
3. To perform SGPT.
4. To perform SGOT.
5. To perform serum amylase
6. To perform serum lipase.
7. To perform triiodothyronine hormone.
8. To perform tetraiodothyronine hormone.
9. To perform OGTT.
10. To perform HbA_{1c}.

Examination Scheme

Components	Internal Assessment	Attendance	Record	EE
Weightage(%)	20	5	5	70

Recommended books:

- J. Ochei and A. Kolhatkar, Medical Laboratory Science- Theory and Practice, 1st Edition 2000, Tata Mcgraw Hill Publishing Co. Ltd.
- Praful B. Godkar, Darshan P. Godkar, Text book of Medical Laboratory Technology, 3rd Edition 2014, Bhalani Publishing House.
- Manual of Basic Technique for Health Laboratory, 2nd Edition 2003, WHO Geneva.
- Ranjna Chawla, Practical Clinical Biochemistry: Methods and Interpretations, 4th Edition 2014, Jaypee & Brothers Medical Publishers (P) Ltd.
- Shivaraja Shankara YM, Shankara, Ganesh MK, Laboratory Manual for Practical Biochemistry, 2nd Edition 2013, Jaypee & Brothers Medical Publishers (P) Ltd.
- David T Punmmer, An Introduction to Practical Biochemistry, 3rd Edition 2004, Tata McGrew Hill.
- Sood, Textbook of Medical Laboratory Technology, 1st Edition 2006, Jaypee Brothers Publishers, 2006.

CLINICAL TRAINING-IV

Course Code: MLT2409

Credit Units: 2

Course Objectives: The purpose of a Clinical training is to provide hands on practical experience in relevant sections of diagnostic labs as per the need of healthcare system. Students will participate in samples collection, documentation, transportation, receiving, processing and dispatch of reports. Students will help in the performance of clinical protocols, quality maintenance and laboratory research. In some cases, students may be deputed in community services or assist in organizing camps like blood testing or blood donation camp.

Students will be sent to diagnostic laboratory or hospital once a week outside campus or may be within the campus if facility available.

Plan for clinical training:

1. Pathology Lab
2. Virology and Mycology Lab
3. Biochemistry Lab

Note: Students must submit training report during examination and the same would be evaluated through Viva voice and presentation.

Examination Scheme

Components	Viva	A	ME	EE
Weightage (%)	10	5	15	70

BASICS IN COMPUTER & PC PACKAGE

Course Code: MLT2410

Credit Units: 03

Course Objective:

This course aims at preparing the students to handle personal computers, learn basics of the current hardware, software and windows operating systems being used.

Course Contents:

Module-I

Computer Basics: History of computers, Definition of computers, Input Devices, storage devices, types of memory, and units of measurement, range of computers, generations of computers and characteristics of computers.

Module-II

System: Hardware, Software,, system definition, fundamentals of networking, internet, performing searches and working with search engines ,types of software and its applications.

Module-III

Office Application Suite: Word Processor, spread sheet, presentations, other utility tools
Fundamentals of Linux /windows operating system, functions, interfaces and basic commands.

Module-IV

Special Applications: Use of database software for clinic records; Use of specialized software for optometric use.

List of practical:

- Various browsers, Search engines, E-mail
- Text document with multiple formatting option using specific office package
- Spread sheet using a specified office package
- Presentation on a specified topic using a specified office package.

Examination Scheme

Components	A	HA	(CT)	V	P
Weightage (%)	20	20	20	20	20

(CT-Class Test; V-Viva; HA - Home Assignment; P-Practical; A- Attendance)

Syllabus - Fifth Semester

IMMUNOHEMATOLOGY AND BLOOD TRANSFUSION

Course Code: MLT2508

Credit Units: 03

Course objectives:

- To impart the basic knowledge of blood group antigens and antibodies.
- To provide the concepts of donor screening and blood transfusion reactions.

Course Contents:

Module-I

Blood group system: Introduction and history of blood group systems, ABO blood group system and Rh system, blood group antigens and antibody, Sub groups, Bombay group, Red cell membrane structure,

Module-II

Phlebotomy and blood storage: blood bags and preservatives, donor selection criteria, blood collection procedure, component separation, cryoprecipitate, screening and storage of blood.

Pre-transfusion testing: blood grouping and typing, compatibility testing, coomb's test, D^u test and HLA type.

Module-III

Blood transfusion: Indication, types, apheresis, transfusion reactions, erythroblastosis fetalis, investigation of transfusion reaction.

Artificial blood: Clinical trials, blood substitutes and uses.

Module-IV

Blood banking: Organization, operation and administration of blood bank and blood donation camp; quality control in blood banking.

Advances in transfusion medicine: Cord blood bank, Automation, blood collection machine.

Examination Scheme

Components	CA	A	ME	EE
Weightage(%)	15	5	10	70

Recommended books:

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

DIAGNOSTIC BIOCHEMISTRY-II

Course Code: MLT2510

Credit Units: 04

Course Objectives:

- To enhance the knowledge about the bio molecules and their role in human health.
- To impart the knowledge of analysis of biochemical parameters in metabolic disorders.
- To impart the knowledge of principles of biochemical tests and their clinical significance.

Course Contents:

Module-I

Renal function test: Glomerular Filtration Tests, tests for renal blood flow, tests of tubular function, other miscellaneous tests to assess renal function.

Lipoproteins: Formation of HDL, LDL, VLDL, circulation of lipoproteins, role in atherosclerosis, hyper and hypolipoproteinemia.

Module-II

Gastric function test: Patient preparation, principle and procedure of gastric analysis, fasting gastric juice analysis, post meal gastric analysis, post stimulation gastric analysis, clinical significance.

Intestinal malabsorption analysis: Principle, procedure of xylose absorption test, clinical significance of xylose absorption test.

Module-III

Acid base balance test: Buffer systems, acidosis and its pathophysiology, alkalosis and its pathophysiology, arterial blood gas test, metabolic panel, pulmonary function test.

Blood electrolytes: Sodium, potassium, magnesium, chloride and calcium.

Module-IV

Tumour markers: Biochemical changes in cancer, etiology of cancer, tumor markers, apoptosis and its role in carcinogens.

Toxicology: Drug abuse, lead, mercury, salicylates, aspirin, alcohol, illegal drugs, barbiturates.

Examination Scheme

Components	CA	A	ME	EE
Weightage (%)	15	5	10	70

Recommended books:

- U Satyanarayan and U Chakrapani, Text book of Biochemistry, 4th Edition 2013, Elsevier.
- M N Chatterjea and Rana Shinde, Text book of Medical Biochemistry , 8th Edition 2012, Jaypee & Brothers Medical Publishers (P) LTD.
- S Ramakrishana, Test Book of Medical Biochemistry, 3rd Illustrated Edition 2004, Orient Longman.
- D M Vasudevan, Sreekumari S, Kannan Vaidyanathan, Textbook of Biochemistry for Medical Students, 8th Edition 2016, Jaypee & Brothers Medical Publishers (P) LTD.
- S Chitiprol, Biochemistry: Instant Notes for Medical students, 1st Edition 2006, Jaypee & Brothers Medical Publishers.
- P K Godkar, Text Book of Medical Laboratory Technology, 3rd Edition 2014, Bhalani Publication.
- Ranjna Chawla, Practical Clinical Biochemistry: Methods and Interpretations, 4th Edition 2014, Jaypee & Brothers Medical Publishers (P) LTD.
- David T Punmmer, An introduction to practical biochemistry, 3rd Edition 2004, Tata McGrew Hill.

- Shivaraja Shankara YM, Shankara, Laboratory Manual for Practical Biochemistry, 2nd Edition 2013, Jaypee & Brothers Medical Publishers (P) LTD.
- Carl A Buttis, David E. Bruns, Teitz fundamental of clinical chemistry and molecular diagnosis, 7th Edition 2015, Elsevier.
- Albert L Lehninger, Michel M Cox, David L Nension, Lehninger Principle of Biochemistry, 6th Edition 2013, W H Freeman & Co.
- Robert Kincaid Murray, David Bender, Kathleen M. Botham, Peter J. Kennelly, Harpers Illustrated Biochemistry, 30th Edition 2015, McGraw Hill Professional.
- Michael Lieberman, Allan D. Marks, Colleen M. Smith, Dawn B. Marks, Marks' Essential Medical Biochemistry, 2nd Edition 2007, Lippincott Williams & Wilkins.
- Donald Voet, Judith G. Voet, Charlotte W. Pratt, Fundamentals Of Biochemistry: Life At The Molecular Level, 5th Edition 2016, John Wiley and Sons.

DIAGNOSTIC BIOCHEMISTRY LAB-II

Course Code: MLT2511

Credit Units: 01

Course Objectives:

- To impart the basic knowledge of principles, techniques and clinical importance of routine and selected laboratory procedures.
- To familiarize with basic knowledge of instruments commonly utilized in the clinical biochemistry laboratory.

List of Experiments:

1. To perform serum total cholesterol.
2. To perform serum triglyceride.
3. To perform serum HDL, LDL and VLDL.
4. Determination of Acid Phosphatase.
5. To perform urea clearance test.
6. To perform creatinine clearance test.
7. Estimation of Lactate dehydrogenase .
8. Estimation of serum sodium.
9. Estimation of serum potassium.
10. To perform serum chloride.

Examination Scheme:

Components	Internal Assessment	Attendance	Record	EE
Weightage (%)	20	5	5	70

Recommended books:

- J. Ochei and A. Kolhatkar, Medical Laboratory Science- Theory and Practice, 1st Edition 2000, Tata Mcgraw Hill Publishing Co. Ltd.
- Praful B. Godkar, Darshan P. Godkar, Text book of Medical Laboratory Technology, 3rd Edition 2014, Bhalani Publishing House.
- Manual of Basic Technique for Health Laboratory, 2nd Edition 2003, WHO Geneva.
- Ranjna Chawla, Practical Clinical Biochemistry: Methods and Interpretations, 4th Edition 2014, Jaypee & Brothers Medical Publishers (P) Ltd.
- David T Punmmer, An Introduction to Practical Biochemistry, 3rd Edition 2004, Tata McGrew Hill.
- Sood, Textbook of Medical Laboratory Technology, 1st Edition 2006, Jaypee Brothers Publishers, 2006.
- Shivaraja Shankara YM, Shankara, Ganesh MK, Laboratory Manual for Practical Biochemistry, 2nd Edition 2013, Jaypee & Brothers Medical Publishers (P) Ltd.

CLINICAL TRAINING-V

Course Code: MLT2512

Credit Units: 2

Course Objective: The purpose of a Clinical training is to provide hands on practical experience in relevant sections of diagnostic labs as per the need of healthcare system. Students will participate in samples collection, documentation, transportation, receiving, processing and dispatch of reports. Students will help in the performance of clinical protocols, quality maintenance and laboratory research. In some cases, students may be deputed in community services or assist in organizing camps like blood testing or blood donation camp.

Students will be sent to diagnostic laboratory or hospital once a week outside campus or may be within the campus if facility available.

Plan for clinical training:

1. Histopathology Lab
2. Immunohematology and Blood Transfusion Lab
3. Biochemistry Lab

Note: Students must submit training report during examination and the same would be evaluated through Viva voice and presentation.

Examination Scheme

Components	Viva	A	ME	EE
Weightage (%)	10	5	15	70

PROJECT

Course code: MLT2532

Credit Units: 03

Course objective:

The aim of the project is to provide the students with an opportunity to further their intellectual and personal development in the chosen field by undertaking a significant practical unit of activity. The project can be defined as a scholarly inquiry into a problem or issues, involving a systematic approach to gathering and analysis of information / data, leading to production of a structured report.

Chapter Scheme and distribution of marks:

Chapter 1: Introduction – 10 marks

Chapter 2: Conceptual Framework/ National/International Scenario – 25 marks

Chapter 3: Presentation, Analysis & Findings -- 25 marks

Chapter 4: Conclusion & Recommendations -- 10 marks

Chapter 5: Bibliography -- 05 marks

Examination scheme:

Project Report	Power Point Presentation & Viva
75 marks	25 marks

Components of a Project Report

The outcome of Project Work 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 author, name of the supervisor, year of submission of the project work, name of the University.
- 2) **Acknowledgement:** Various 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) **Abstract:** The body of the report should have summary of the project.
 - 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, inclusion & exclusion criteria and method of analysis), Limitations of the Study, and Planning.
 - b) **Conceptual Framework / National and International Scenario:** (relating to the topic of the Project).
 - c) **Presentation of Data, Analysis and Findings.**
 - 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.
(The main text of the Project should normally be in the range of 5000 words. However, there may be annexure in addition to the main text)

The Steps of a Project Report

Step I: Selection of the topic for the project by taking following points into consideration:

- Suitability of the topic.
- Relevance of the topic
- Time available at the disposal.
- Feasibility of data collection within the given time limit.
- Challenges involved in the data collection (time & cost involved in the data collection, possibility of getting responses, etc.)

Step II: Finalisation of the Topic and preparation of Project Proposal in consultation with the Supervisor.

Step III: Collection of information and data relating to the topic and analysis of the same.

Step IV: Writing the report dividing it into suitable chapters, viz.,

Chapter 1: Introduction,

Chapter 2: Methodology,

Chapter 3: Analysis & Findings

Chapter 4: Conclusion and Recommendations.

Step V: The following documents are to be attached with the Final Project Report.

1) Approval letter from the supervisor (Annexure-IA)

2) Student's declaration (Annexure-IB)

3) Certificate from the Competent Authority of the Organisation / Institution, if the student undertakes the Project Work in any Organisation / Institution.

Guidelines for Evaluation:

- 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.
- Language of Project Report and Viva-Voce Examination may be English. The Project Report must be typed and hard bound.
- 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 has to submit the Project Report and appear at the Viva-Voce Examination in the subsequent years (within the time period as per University Rules).
- No marks will be allotted on the Project Report unless a candidate appears at the Viva-Voce Examination. Similarly, no marks will be allotted on Viva-Voce Examination unless a candidate submits his/her Project Report.
- 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.

Syllabus - Sixth Semester

INTERNSHIP

Course Code: MLT2637

Credit Units: 15

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 5th 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).

Evaluation Scheme:

Internship Project Report	Power Point Presentation & Viva
75 marks	25 marks