DELHI PHARMACEUTICAL SCIENCES & RESEARCH UNIVERSITY

(The First Pharmacy University in India)

School of Allied Health Sciences and Management

Programme Structure

Diploma in Medical Lab Technology (DMLT)

Program Overview, Outcome, Program Outline & Structure and Scheme of Examination

The aim of this Medical Laboratory Science program is to recruit, educate, and prepare highly competent paramedical scientists to serve their patients and the healthcare profession while demonstrating high ethical and moral standards and the utmost in technical competence. Through this course, students prepare for a career as a medical lab technician with requisite skills for diagnosing and treating illness through using lab instruments and performing diagnostic tests in hospitals, commercial laboratories, private clinics, nursing homes and other health centres, thus meeting the demand for quality healthcare management.

Program Outcomes: After completion of the program, the students would be able to:

PO1. Critical Thinking: Solve problems and take informed actions after identifying the assumptions that frame our thinking and actions and would enhance their administrative competence and decision making, when facing the challenges of the hospital and healthcare industry, as they must perform a multitude of tests and need to be able to assess if further tests are needed or, occasionally, if a test must be done over.

PO2. Effective Communication: Speak, read, write and listen in person and through electronic media to promote knowledge through applied and conceptual research relevant to hospital and healthcare management as they must communicate well with both patients and other departments and employees who are part of the health care team for the most effective patient care results.

PO3. Social Interaction: Act as a team player and part of a lab department as they must be in close contact with others, need to be able to facilitate good relations with them, need to smile, keep an orderly workspace, and attend staff meetings, conferences, employee activities, elicit views of others and mediate disagreements while applying skills in planning and managing hospitals and healthcare organizations to help reach conclusions in group settings.

PO4. Effective Citizenship: Demonstrate empathetic social concern towards national development, and the ability to act with an informed awareness of healthcare issues and hospital policies.

PO5. Ethics: Recognize ethical issues, ethical and social responsibility towards healthcare providers, patients and society, to justify the moral judgement concerning medical profession and inspire social values.

PO6. Environment and Sustainability: Get responsible towards the wellbeing of environment, the patients, healthcare professionals and the community by reducing toxicity of hospital waste, minimizing the use of hazardous chemicals, recycling and realising the importance of sustainable designs and building techniques to create true healing environment.

PO7. Self-directed and Life-long Learning: Engage in independent and life-long personal and professional learning and developing skills to cope with and socio-technological changes

Program Specific Outcomes: After completion of the program, graduates should be able to

PSO 1. Gain knowledge in basic medical laboratory sciences and laboratory procedures to become well trained technician and technologist to work in a variety of laboratory settings.

PSO2. Perform medical tests with the help of medical instruments and the treatment of diseases, this program also equips candidates with the knowledge and skills required to handle the advanced lab equipment and perform accurate medical laboratory tests.

PSO3. Understand the latest concepts and techniques of medical lab technology and their applications in making the roles of the medical lab technologists effective and efficient.

PSO4. To develop responsible citizenship in imparting the responsibility and leadership qualities among each and every student along with advanced professional skills

PSO5. Understand normal ranges/values for all common haematology/biochemical parameters and their clinical significance.

PSO6. As a health professional the students shall have a value added responsibility towards the community health issues.

PSO7. Understand and manage the prevailing health problems and apply suitable remedial measure.

PSO8. Appropriate and successful collection of blood specimens through venipuncture and capillary puncture.

PSO9. Describe the morphological variations of various blood cells and discuss their clinical importance.

PSO10. Learn various gram positive and gram negative bacteria, viruses and fungi causing diseases to human beings.

PSO11. Describe primary aspects of the blood bank including ABO-Rh and other common blood group systems, transfusion therapy, transfusion reactions, and hemolytic disease of the newborn.

PSO12. Explain principle, rationale uses and interpretation of routine biochemical tests for organism identification. Demonstrate proficient use of routine biochemical tests.

PSO13. Perform routine tissue processing and freeze drying technique in histopathology. Perform various staining techniques to identify premalignant or malignant condition.

PS014. Have the skills to analyse and solve operational problems in the delivery of hospital and healthcare services.

PS015. Assist in the research projects in the area of life science.

Program outline and Structure

The course of study enhances student's knowledge and skills in several major categorical areas of medical laboratory technology. The diploma in medical laboratory technology provides along with a basic knowledge and practical training and skills to perform routine clinical laboratory procedures within acceptable quality control parameters in haematology, biochemistry, pathology and microbiology. The course provides knowledge of diagnostic instruments and procedures and impart required proficiency in handling those instruments to enable these students to work in various laboratory settings. Total course duration is two years comprising of four semesters including 12 weeks of training in reputed external Hospitals/institutes.

Semester-I

Semester	Paper Code:	Subject	Periods			Credit Units	Evaluation scheme		
			L	T	P		Internal*	External	Total
I	DML 101T	Anatomy and Physiology -I Theory	3	1	-	4	20	80	100
	DML102T	General Biochemistry Theory	3	1	-	4	20	80	100
	DML103T	General Microbiology Theory	3	1	-	4	20	80	100
	DML104T	Fundamentals of Medical Lab Technology	3	1	-	4	20	80	100
	DML105T	Computer Applications Theory	2	-	-	2	50*	-	50
	DML106	Communication Skills	2	-	-	2	50*	-	50
	DML 101P	Anatomy and Physiology -I Practical	-	-	4	2	20	30	50
	DML 102P	General Biochemistry Practical	-	-	4	2	20	30	50
	DML 103P	General Microbiology Practical	-	-	4	2	20	30	50

	DML 105P	Computer Applications Practical	-	-	4	2	50*	-	50
Total			**16**	**4**	**16**	**28**	**290**	**410**	**700**

*Evaluation to be conducted by internal faculty/examiner.

Semester-II

	Paper Code:	**Subject**	**Periods**			**Credit Units**	**Evaluation scheme**		
			L	**T**	**P**		**Internal**	**External**	**Total**
	DML 201T	Anatomy and Physiology -II Theory	3	1	-	4	20	80	100
	DML 202T	Haematology –I Theory	3	1	-	4	20	80	100
	DML 203T	Pathology -Theory	3	1	-	4	20	80	100
	DML 204T	Clinical Biochemistry Theory	3	1	-	4	20	80	100
II	DML 205T	Clinical Bacteriology Theory	3	1	-	4	20	80	100
	DML 201P	Anatomy and Physiology -II Practical	-	-	4	2	20	30	50
	DML 202P	Haematology- I Practical	-	-	4	2	20	30	50
	DML 203P	Pathology Practical	-	-	4	2	20	30	50
	DML 204P	Clinical Biochemistry Practical	-	-	4	2	20	30	50
	DML 205P	Clinical Bacteriology Practical	-	-	4	2	20	30	50
Total			**15**	**5**	**20**	**30**	**200**	**550**	**750**

Semester-III

Semester	Paper Code:	Subject	Periods			Credit Units	Evaluation scheme		
			L	T	P		Internal*	External	Total
III	DML 301T	Haematology – II Theory	3	1	-	4	20	80	100
	DML 302T	Immunology, Parasitology and Serology-Theory	3	1	-	4	20	80	100
	DML 303T	Histopathology and Cytology-Theory	3	1	-	4	20	80	100
	DML 304T	Blood Banking Theory	3	1	-	4	20	80	100
	DML 301P	Haematology – II Practical	-	-	4	2	20	30	50
	DML 302P	Immunology, Parasitology and Serology-Practical	-	-	4	2	20	30	50
	DML 303P	Histopathology and Cytology-Practical	-	-	4	2	20	30	50
	DML 304P	Blood Banking Practical	-	-	4	2	20	30	50
Total			**12**	**4**	**16**	**24**	**160**	**440**	**600**

Semester-IV

Semester	Paper Code:	Subject	Periods			Credit Units	Evaluation scheme		
			L	T	P		Internal*	External	Total
IV	DML 401T	Diagnostic Biochemistry – Theory	3	1	-	4	20	80	100
	DML 402T	Clinical Virology and Mycology Theory	3	1	-	4	20	80	100
	DML 401P	Diagnostic Biochemistry Practical	-	-	4	2	10	40	50
	DML 402P	Clinical Virology and Mycology - Practical	-	-	4	2	10	40	50
	DML 403	Project/ Internship*	-	-	-	4	-	100	100
Total			**6**	**2**	**8**	**16**	**60**	**340**	**400**

***Students will undergo an Internship of 12 weeks.**

Internship/Project duration: 12 weeks

S.No	Lab	Duration (weeks)
1	Biochemistry	3
2	Blood Bank	3
3	Pathology/Histopathology	3
4	Microbiology	3
	Total	**12**

Scheme of Examination

The University has adopted the semester examination system. In addition to End Semester Examination, there is continuous evaluation of student's performance throughout the academic programme. There will be two internal/ sessional examinations in each semester conducted by the University and one external End Semester examination at the end of each semester. The Odd Semester Examination are conducted in month of December-January and Even Semester Examination are Conducted in the month of May-June every year.

Evaluation and Award of Degree

The overall weightage of a course in the syllabi and Scheme of Examination is determined in terms of credits assigned to the course. Obtaining a minimum of 50% marks in aggregate in each course including the End Semester Examination and teacher's continuous evaluation is essential to earn the assigned credits. A student who secures less than 50% of marks in a course is, therefore, deemed to have failed in that course. A student is eligible for the award of University degree, if he/ she has registered himself/herself, has undergone the regular course of studies, completed the internship project report/dissertation specified in the curriculum of his/her programme within the stipulated time, and has secured the minimum number of credits as prescribed for the award of concerned degree.

Grading System

The grade awarded to a student will be based on his/her performance in sessional and final examinations combined together. The letter Grades and their equivalent grade/ numerical points are given below:

Percentage of Marks Obtained	**Grade**	**Grade Point**	**Description of Performance**
90.00 – 100	O	10	Outstanding
80.00 – 89.99	A	9	Excellent
70.00 – 79.99	B	8	Good
60.00 – 69.99	C	7	Fair
50.00 – 59.99	D	6	Average
Less than 50	F	0	Fail
Absent	AB	0	Fail

Attendance

- All the students must attend every lecture delivered, however to account for the late joining or other such contingencies, the attendance requirement for appearing in the semester examination shall be 80% of the actual classes held.
- Attendance on account of participation in the prescribed functions of NSS, inter college sports, educational tours/ laboratory visits/ field work assigned by the University to the students shall be credited to the aggregate, provided by the attendance record, duly signed by the officer in charge, has to send to the Head of the department within two weeks' time after the function/activity.
- The teacher in charge will consolidate the attendance record for the lecture attended by each student.
- Any student with less than 80% attendance of the lectures in each course shall be detained from appearing in sessional/internal exams conducted by University. The HOD/ Dean Academics may consider application for the consolidation of shortage of attendance up to 5% on account of sickness or any other extra ordinary circumstances, provided the medical certificate duly signed by Registered Medical Practitioner, has to be submitted within 7 days of the recovery from illness
- If a student is found continuously absent from the classes without information for a period of 30 days, the teacher in charge shall report to the Head of Department, who will inform Registrar through Dean Academics. Registrar will issue a notice to the student.

Internship Report Evaluation

The students have to complete compulsory 3 months (12 weeks) Internship training during the 4th semester (Final semester), preferably in Government Hospitals of Delhi.

The details and duration of training:

1. Biochemistry:	3 weeks
2. Blood Bank:	3 weeks
3. Pathology/Histopathology:	3 weeks
4. Microbiology:	3 weeks

- During internship training the student has to prepare a project file, one project file for each subject. This shall be based on the work done, or techniques performed that is followed by the industry, hospital or organizations where the student has undergone training.
- The project file has to be submitted or produced during internal or external exams conducted by the University. Equal weightage of marks shall be allotted to all the four projects.

- After completion of training, the concerned Hospital or industry etc, shall issue the training certificate to the concerned student indicating clearly the duration and the labs where the students had completed 3 months internship training. The certificate copy has to be submitted to the University.
- On the basis of certificate issued by the Hospital or industry, the students may be issued original BMLT Certificate by the University provided the students clear all the university exams for all the semester exams and viva voce. Without completing compulsory 3 months internship/ training, students shall not be awarded DMLT degree by the University.
- It is desirable that, all the students have to undergo Training/ Internship preferably in Delhi Govt. Hospitals. But Internship training may also be permitted in Private Hospitals or Hospitals run by Autonomous body or organizations where all the required training facilities are available. However, it is with prior approval or permission of the Competent Authority.
- Further, it may be possible that, due to unforeseen situations, incidents or due to some unavoidable reasons or circumstances the student may not be able to take the internship/training in Delhi. Hence, in such circumstances the student may be permitted to undergo training in other states of Govt. Hospitals, Private Hospitals or Autonomous body that have all the facilities to undergo the Training. However, under such cases also, prior approval of the Competent Authority in writing has to be obtained by the concerned student.

SEMESTER-I

Semester I

Semester	Paper Code:	Subject	Periods			Credit Units	Evaluation scheme		
			L	T	P		Internal*	External	Total
I	DML 101T	Anatomy and Physiology -I Theory	3	1	-	4	20	80	100
	DML102T	General Biochemistry Theory	3	1	-	4	20	80	100
	DML103T	General Microbiology Theory	3	1	-	4	20	80	100
	DML104T	Fundamentals of Medical Lab Technology	3	1	-	4	20	80	100
	DML105T	Computer Applications Theory	2	-	-	2	50*	-	50
	DML106	Communication Skills	2	-	-	2	50*	-	50
	DML 101P	Anatomy and Physiology -I Practical	-	-	4	2	20	30	50
	DML 102P	General Biochemistry Practical	-	-	4	2	20	30	50
	DML 103P	General Microbiology Practical	-	-	4	2	20	30	50
	DML 105P	Computer Applications Practical	-	-	4	2	50*	-	50
Total			**16**	**4**	**16**	**28**	**290**	**410**	**700**

* Evaluation to be conducted by internal faculty/examiner

Anatomy and Physiology – I Theory
Paper code: DML 101T

Contacts: 3L+1T Credits: 04

Course Overview

Human Anatomy and Physiology is a laboratory-based course that investigates the structure and function of the human body. It includes human anatomy, different tissues, human digestive system, skeletal, smooth and cardiac muscles, circulatory system, human bones and joints. This course is designed to develop the knowledge of Anatomy and physiology in students.

Course Outcomes: After Completion of this course, students would be able to:
CO1: Describe the general structure and functions of the body as a whole.
CO2: Describe the structure and functions of bones, joints and muscles.
CO3: Describe the functions of blood, structure of human heart and lymphatic system.
CO4: Explain the structure and functions of respiratory system and digestive system.

Course contents:

Module 1: Introduction to human Anatomy & Physiology:

- Introduction to human anatomy and physiology,
- Basic anatomical terminology.
- Basic tissues of the body (Gross structure and functions)

a) Epithelial tissue b) Connective tissue c) Muscular tissue d) Nervous tissue

Module 2: Musculo-Skeletal System

- Basic structure, function and classification of skeletal system.
- Bones of appendicular and axial skeleton
- Joints & Articulations: Types of joints (Structural and functional classification).
- Muscles: Classification, structure and functions of muscles.
- Introduction to Muscular contraction & fatigue

Module 3: Cardiovascular System

- Composition and functions of blood, Basic structure of blood vessel, major arteries and veins of the body, and Homeostasis.
- Anatomy of heart, External & Internal features, Chambers and blood vessels attached to it, Circulation of Blood, Cardiac cycle, Heart sounds, Cardiac output, and Heart rate.
- Lymph and lymphatic organs: Clinical importance & applications.

Module 4: Respiratory System

- Introduction to the respiratory system
- Mechanism of Respiration: Exchange of Respiratory gases and Control of respiration,
- Lung volumes and capacities, transport of respiratory gases, Artificial respirations

Module 5: Gastro Intestinal System**:**

- Organs associated with Gastro Intestinal System (Digestive system) with its functions: Introduction and function: Stomach, Pancreas, Liver, Gall bladder, Spleen, Small and Large Intestine
- Process and phases of digestion

Textbooks and References

1. Elements of Pharmacology, Prof. (Dr.) Ramesh K Goyal, B. S. Shah Publications.
2. Practical Anatomy and Physiology, Prof. (Dr.) Ramesh K Goyal, Dr. N. M. Patel
3. Ross and Wilson, Anatomy and Physiology in Health and Illness, Anne Waugh, Allison Grant
4. Handbook of General Anatomy, Dr. B.D. Chaurasia
5. Colour Atlas of Anatomy, a Photographic study of the Human Body, Roben, Johanneswetal
6. Gray's Anatomy, M. Berry, Lawrence H. Bannister
7. Text Book of Anatomy (3 vol.), B.D. Chaurasia
8. Textbook of Anatomy by Inderbir Singh; 4th edition; Jaypee Publications
9. McMinn's- A colour atlas of human anatomy, Mosby
10. Manual of Practical Physiology, A.K. Jain
11. Review of Medical Physiology, Ganong
12. Text Book of Medical Physiology, Guyton, Arthur C & John E. Hall
13. A text book for Medical students, R.L. Bijlani
14. Essentials of Medical Physiology - K. Sembulingam & Prema Sembulingam
15. Text book of physiology - Choudhary
16. Text book of physiology - G.K.Pal.

Anatomy and Physiology - I Practical
Paper code: DML 101P

Contacts: 4P **Credits: 02**

Course Overview

Practical anatomy and physiology is complimentary to the theoretical discussions in anatomy and physiology. Practicals allow the verification of anatomical and physiological processes discussed in theory classes through experiments on living tissue, or normal human beings. Helps the students to understand the alterations in anatomical structures and physiological functions in diseases and more emphasis shall be given to those relevant for medical laboratory technology students.

Course Outcomes: After completion of this course, students would be able to:

CO1: Demonstrate the different parts of the body.
CO2: Explain and demonstrate the structural differences between different types of muscles.
CO3: Analyse the differences in the tissues of the body.
CO4: Learn and explain the various parts of bones, features of heart.
CO5: Demonstrate the different parts of gastro-intestinal, respiratory system.

List of practicals:

(Note: Demonstration may be performed from models and charts wherever applicable)

1. Demonstration of different parts of body

- Cranial cavity (Brain)
- Thoracic cavity (Heart and lungs)
- Abdominal cavity (Stomach, intestines, Liver, Gall bladder, spleen, pancreas, kidney,)
- Pelvic cavity (Reproductive organs)

2. Demonstration of basic tissues of the body

1. Epithelial tissue 2. Connective tissue 3. Muscular tissue 4. Nervous tissue

3. Demonstration of various parts of bones

- Bones of upper limb: Humerus, radius, ulna, fibula and articulated hand, Scapula and clavicle
- Bones of lower limb: Pelvic/hip bone, femur, tibia, fibula and articulated foot.
- Bones of Skull and mandible: Sternum and ribs, Bones of vertebral column

4. Demonstration of heart:

- External features, internal features, valve areas, blood vessels attached to chambers, Coronary arteries
- Demonstration of Apex beat and Median Cubital vein (Ante cubital vein)

5. Demonstration of Radial pulse examination.

6. Demonstration of Blood pressure Estimation or recording

8. Demonstration of parts of respiratory system:

- Nose, pharynx and larynx, Trachea, bronchus and lungs.
- Demonstration of techniques of respirometer.

General Biochemistry-Theory
Paper code: DML 102T

Contacts: 3L+1T **Credits: 04**

Course Overview:

This course will introduce and cover the basics of biochemistry and cell composition. Students will learn about the general structure and function of lipids, carbohydrates, and nucleic acids, as well as the composition, structure, and function of proteins.

Course Outcomes: After Completion of this course, students would be able to:

CO1: Learn about the structure and functions of biomolecules in human body

CO2: Learn about the basics of compositions of genetic materials and their role.

CO3: Learn about the role and importance of vitamins and minerals in human and the disease associated with it.

CO4: Learn about the importance of Enzyme and hormone in biological system.

CO4: Learn about the various instruments used in biochemistry lab.

Course contents

Module 1: Carbohydrates:
- Definitions, chemistry, classifications, biological importance,
- Isomers, optical activity, epimers, enantiomers, anomers, mutarotation,
- Monosaccharides, disaccharides, homopolysaccharides and heteropolysaccarides
- Clinical aspects of carbohydrates.

Module 2: Lipids:
- Definitions, classification, chemistry and properties of fatty acids,
- Essential fatty acids, triglycerides, lipoprotein,
- Clinical aspects of lipids.

Module 3: Proteins:
- Definitions, classifications and properties of amino acids,
- Structure and properties of proteins, classification of proteins,
- Clinical aspects of proteins.

Module 4: Nucleic acids and Enzymes:
- Introduction, chemistry and structure of purine, pyrimidine, nucleoside and nucleotides,polynucleotide,
- Chargaff rule of DNA composition, DNA double helix, structure and types of RNA

- Clinical aspects of nucleic acid.
- Introduction to enzyme with IUBMB nomenclature, factors affecting enzyme activity,
- Isoenzyme, coenzyme & cofactors.
- Liver enzymes as markers of pathological conditions.

Module 5: Vitamins and Minerals

- Introduction, classification of vitamins (fat soluble and water soluble), sources,
- Recommended dietary allowance (RDA),
- Diseases associated with the deficiency of the vitamins. Associated lab investigations

- Minerals: Classification, Dietary sources, daily requirement,
- Biochemical functions & metabolism of important minerals. Associated lab investigations.

Module 6: Hormones

- Introduction and classification,
- Role of various hormones, clinically important hormones.

Textbooks and References

1. Lehninger,(2013), Principles of Biochemistry, 6th edition, W H Freeman
2. U Satyanarayan,(2008), Essentials of Biochemistry, 2nd edition, Standard Publishers
3. Moran, L. A., Horton, R. A., Scrimgeour, K. G., & Perry, M. D. (2014). Principles ofbiochemistry.
4. Gaw, A., Murphy, M., Srivastava, R., Cowan, R. A., & O'Reilly, D. S. J. (2013). ClinicalBiochemistry E-Book: An Illustrated Colour Text. Elsevier Health Sciences.
5. Devlin, T. M. (Ed.). (2006). Textbook of biochemistry: with clinical correlations.
6. McKee, T., & McKee, J. R. (1999). Biochemistry: an introduction. WCB/McGraw-Hill.
7. Baynes, J. W., & Dominiczak, M. H. (2014). Medical Biochemistry E-Book. ElsevierHealth Sciences.

General Biochemistry- Practical
Paper code: DML 102P

Contacts: 4P **Credits: 02**

Course Outcomes: After completion of this course, students would be able to:

CO1: Prepare different types of solutions and reagents.

CO2: Use and maintain the different types of equipment used in biochemistry lab.

CO3: Detect the presence of different bio-molecules in the sample.

CO4: Perform quantitative and qualitative analysis of different biomolecules in the samples.

List of Practicals:

1. Preparation of standard solution, % solution (v/v, w/v), Normal & Molar solution and preparation of reagent
2. pH determination by qualitative /quantitative methods.
3. Preparation of buffer: Acetate/Phosphate/Tris / Normal saline
4. Demonstration and working principal of Semi-automatic Biochemistry Analyzer
5. General reactions and identification of Mono, -Di and polysaccharides.
6. Quantitative analysis of reducing sugar (Dinitrosalicylic acid, DNSA method) and protein (Biuret method)
7. Benedict's test and heat coagulation test
8. Demonstration and working principal of colorimeter
9. Demonstration and working principal of ELISA plate reader

General Microbiology-Theory
Paper code: DML 103T

Contacts: 3L+1T Credits: 04

Course Overview:

This course will introduce and cover the basics of microbiology and cultivation of microorganisms. Students will learn about the general lab equipment, sterilization techniques and staining methods for identification of microorganisms.

Course Outcomes: After Completion of this course, students would be able to:

CO1: Learn about general characteristics of bacteria, viruses, and fungi

CO2: Learn about the common lab equipment used in microbiology lab.

CO3: Learn about sterilization and disinfection techniques to control the growth of microorganisms.

CO4: Learn about the different types of media used for growth and cultivation of microorganisms.

Course contents

Module 1: Introduction to Microbiology

- Introduction, importance, safety measures in microbiology;
- General characteristics of bacteria, viruses, fungi.
- Difference between prokaryotic and Eukaryotic microorganisms.

Module 2: Common Laboratory Equipment

Incubator, Microscope, working, care and handling of autoclave, hot air oven and laminar air flow.

Module 3: Sterilization and Disinfection

- Definitions: Antibacterial, bactericidal, bacteriostatic and germicide agents. Classification of Sterilization methods.
- Sterilization and disinfection with the help of :
    - Physical agents: Dry heat (flaming, incineration and hot air oven),
    - Moist heat (pasteurization, boiling, autoclaving and Tyndallisation), filtration and UV radiation.
    - Chemical agents: ethanol, phenol and ethylene oxide.

Module 4: Growth and Cultivation of Microorganisms

- Nutritional requirement of microorganisms, Types of media – liquid, solid, semi-solid, enriched, selective, differential, enrichment,
- Methods for isolation of pure cultures (streak plate, pour plate, spread plate methods).
- Bacterial growth curve.

Module 5: Staining Techniques

- Simple staining, gram staining, Ziehl Neelsen Acid-fast staining, Staining of spores, capsule,
- Principal & Techniques of biochemical test – Carbohydrate utilization test, Catalase, Oxidase, coagulase, Urease test and Indole, Methyl Red, Voges Proskauer & Citrate (IMViC) test.

Textbooks and References

1. Pelczar, M.J., Chan, E.C.S. and Krieg, N.R. (1993). Microbiology. 5th edition. McGraw Hill, USA.
2. Cappuccino, J. and Welsh, C.T. (2016). Microbiology: A Laboratory Manual. 11th edition. Pearson Education, USA.
3. Greenwood, D., Slack, R. C., Barer, M. R., & Irving, W. L. (2012). Medical Microbiology E-Book: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control. With STUDENT CONSULT Online Access. Elsevier Health Sciences.
4. Ryan, K. J., & Ray, C. G. (2004). Medical microbiology. McGraw Hill, 4, 370.
5. Isenberg, H. D. (1998). Essential procedures for clinical microbiology (pp. 3-36). Washington, DC: ASM press.
6. Levinson, W., &Jawetz, E. (1996). Medical microbiology and immunology: examination and board review. Appleton & Lange.
7. Talaro, K. P., & Chess, B. (2018). Foundations in microbiology. McGraw-Hill.
8. Hart, C. A., & Shears, P. (1996). Color atlas of medical microbiology (No. C QR46 H37 2004). Mosby-Wolfe.
9. Goldman, E., & Green, L. H. (Eds.). (2008). Practical handbook of microbiology. CRC press.
10. Cappuccino, J. G., & Sherman, N. (2005). Microbiology: a laboratory manual (p. 507). San Francisco: Pearson/Benjamin Cummings.
11. Text Book of Microbiology-Ananthanarayanan& Jayaram Panikker
12. Mackie & McCartney practical medical Microbiology - Colle. Fraser, Marmion, Simmons

General Microbiology – Practical
Paper code: DML 103P

Contacts: 4P **Credits: 02**

Course Outcomes: After Completion of this course, students would be able to:

CO1: Prepare different types of media for cultivation of microorganisms.

CO2: Utilize common lab equipment in microbiology lab.

CO3: Perform sterilization and disinfection techniques to control the growth of microorganisms.

CO4: Perform staining techniques for the identification of microorganisms.

List of practicals

1. Microbiology good laboratory practices.
2. Introduction and demonstration of laboratory instruments: Hot air oven, Water bath, centrifuge, laminar air flow, incubators, pH meter.
3. Demonstration of use of autoclave for sterilization and assessment for sterility,
4. Preparation and sterilization of media: Nutrient broth and agar.
5. Preparation of cotton plugs, pouring of media and preparation of slants.
6. Inoculation of culture media.
7. Perform simple and gram staining.
8. Demonstrate/Perform isolation of pure bacterial culture by streaking method.
9. Demonstrate/Perform Standard plate count.
10. Demonstrate/Perform Kirby-Bauer disk diffusion: Antibiotic sensitivity test.

Fundamentals of Medical Lab Technology
Paper code: DML 104

Contacts: 3L+1T Credits: 04

Course Overview

In this course, students will learn to Identify and enumerate different kinds of medical Laboratories and explain the role of medical laboratory services. Students will learn to introduce the laboratory rules, ethics, and professional code of conduct and polices and describe the practice of collection, handling and shipment of medical laboratory specimens.

Course Outcomes: After completion of this course, students would be able to:

CO1: Know and understand about the various lab wares, instruments, their importance and applications in the laboratory.
CO2: Understand the classification, structure, and principles of medical laboratories.

CO3: Learn about the various laboratory hazards, biosafety levels and biomedical waste management.
CO4: Understand blood collection techniques, preservation of blood samples, sampling errors, its safe transportation.
CO5: Understand the social, ethical and professional duties of laboratory technician.

Course Content:

Module 1: Introduction to Clinical laboratory

- Layout of medical laboratories, Basic laboratory principles, Code of conduct of medical laboratory personnel,
- Organization of clinical laboratory and role of medical laboratory technician, Medical laboratory professional and professionalism in laboratory workers,
- Bio hazards, fire hazards, chemical hazards, Overview of Biomedical waste management, Bio safety levels

Module 2: Common Laboratory Equipment

- Working and maintenance of micro pipettes
- Burettes, Beakers, Petri dishes,
- Flasks - Volumetric, round bottmed, Erlemeyer conical flasks.
- Funnels – Conical, Buchner. Dessicator, Dispensers – reagent and sample
- Bottles – Reagent bottles – graduated and common, Wash bottles
- Measuring cylinders, Porcelain dish, Bunsen burner, Cuvette holders
- Tubes – Test tubes, centrifuge tubes,

- Racks – Bottle, Test tube, Pipette racks.

Module 3: Phlebotomy

- Materials required for blood collection. Blood collection techniques, venous and capillary, preservations and sampling errors.
- Home collection of blood, its preservations and safe transportation of blood sample,
- Uses of anticoagulants, Process of analysing the blood specimens, layout of laboratory report.

Module 4: Preparation of Reagents

- Buffer and pH- Basics of Preparation of reagents: Normal, percent and Molar solution, normal saline, Methods of measuring liquids (w/v, v/v).
- Cleaning of general laboratory glassware

Module 5: Medical Records & Medical Ethics

- Definition, Medical Record Forms and their Content, Incomplete Record Control, Utility & functions of Medical Records in Laboratories,
- Medical ethics- Definition, Goal, Scope
- Basic principles of medical ethics – Confidentiality, Malpractice and negligence.
- Rational and irrational drug therapy, Autonomy and informed consent - Right of patients**,** Informed consent.

Textbooks and References

1. Textbook of Medical Lab Technology ,Sood, Jaypee Brothers Publications
2. Fundamentals of urine and body fluid analysis (3rd ed.) - Brunzel, N. A
3. Textbook of Medical Laboratory Technology- Darshan P. Godkar, Praful B. Godkar

Computer Applications - Theory
Paper code: DML 105T

Contacts: 2L Credits: 02

Course Overview

This subject deals with the introduction Database, Database Management system, computer application in clinical studies and use of databases.

Course Outcomes: After completion of this course, students would be able to:

CO1: Understand the number system.

CO2: Learn HTML, XML, CSS and programming languages.

CO3: Understand the application of IT in various functions of labs.

CO4: Learn softwares used commonly in medical lab technologies.

Course Contents

Module 1: Number System

- Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary,
- binary addition, binary subtraction – One's complement ,Two's complement method, binary multiplication, binary division

Module 2: Concept of Information Systems and Software

- Information gathering, requirement and feasibility analysis, data flow diagrams,
- Process specifications, input/output design, process life cycle, planning and managing the project

Module 3: Web technologies

- Introduction to HTML, XML,CSS and Programming languages, introduction to web servers and Server Products.
- Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database

Module 4: IT in Labs

- Awareness on the application of IT in Various functions of labs;
- Working knowledge of commonly used software in medical lab technologies.

Computer Applications-Practical
Paper code: DML 105P

Contacts: 4P **Credits: 02**

Course Outcomes: After completion of this course, students would be able to:

CO1: Design a questionnaire using a word processing package.

CO2: Learn the various tools and techniques for efficient working in medical laboratory.

CO3: Export tables, queries, forms and reports to web pages and XML pages.

CO4. Gain the working knowledge of commonly used software in medical lab technologies.

List of Practicals

1. Design a questionnaire using a word processing package to gather information about a particular disease.
2. Create a HTML web page to show personal information.
3. Retrieve the information of a drug and its adverse effects using online tools
4. Creating mailing labels Using Label Wizard , generating label in MS WORD
5. Create a database in MS Access to store the patient information with the required fields Using access
6. Using Excel in minor Statistics
7. Design a form in MS Access to view, add, delete and modify the patient record in the database Generating report and printing the report from patient database
8. Creating invoice table using – MS Access
9. Drug information storage and retrieval using MS Access
10. Creating and working with queries in MS Access
11. Exporting Tables, Queries, Forms and Reports to web pages

Communication Skills
Paper code: DML 106

Contacts: 2L Credits: 02

Course Overview

This course is designed to facilitate the students to communicate effectively by emphasizing on practical communication through refurbishing their existing language skills and also to bring one and all to a common take-of level.

Course Outcomes: After completion of this course, students would be able to:

CO1: Understand the process, types and channels of communication.

CO2: Learn the body language and develop listening skills.

CO3: Learn presentation skills, email writing, resume writing, business correspondence, circulars & advertisements.

CO4: Learn stress management, time management, conflict management, diversity Management.

Course Contents

Module 1: Introduction to communication

Meaning, Process of Communication, Types of Communication, verbal and non-verbal, advantages and disadvantages.

Body Language, Channels of Communication, Formal and Informal, Directions of Communication within organisation, Barriers to communication-Listening Skills.

Module 2: Presentation Skills and confidence building

- Presentation skills, Email writing, Resume writing, business correspondence, circulars & advertisements.
- Telephone etiquettes, Group Discussion, Networking skills, Facing Interviews – Mock Interview.

Module 3: Management skills

- Stress management, Time Management, Conflict Management,
- Diversity Management. Managing meeting and Personal attitudes.

Module 4: Team Building

- Leadership and team building; Corporate etiquettes,
- Human behaviour and communication, its role in public health problems and solutions.

Textbooks and References

1. Sharan J.Gerson and Steven M.Gerson – "Technical Writing – Process and Product" –

Pearson Education – 2000.
2. Raymond V.Lesikar, John D. Pettit and Mary E.Flatley – Lesikass Basic Communication Tata McGraw Will 8th Edition – 1999.
3. Stevel. E. Pauley, Daniel G.Riordan – Technical Report Writing Today – AITBS Publishing & Distributors, India 5th edition – 2000.
4. Robert L. Shurter, Effective letters in business Third Ed. 1983.
5. Communication Skills by Vasantha Patri
6. McGraith – Basic Managerial Skills for all Prentice Hall of India – 6th Edition 2002.
7. Halliday, M.A. K R .Hasan, Cohesion in English, Longman, London 1976.

SEMESTER-II

Semester II

	Paper Code:	Subject	Periods			Credit Units	Evaluation scheme		
			L	T	P		Internal	External	Total
II	DML 201T	Anatomy and Physiology -II Theory	3	1	-	4	20	80	100
	DML 202T	Haematology –I Theory	3	1	-	4	20	80	100
	DML 203T	Pathology -Theory	3	1	-	4	20	80	100
	DML 204T	Clinical Biochemistry Theory	3	1	-	4	20	80	100
	DML 205T	Clinical Bacteriology Theory	3	1	-	4	20	80	100
	DML 201P	Anatomy and Physiology -II Practical	-	-	4	2	20	30	50
	DML 202P	Haematology- I Practical	-	-	4	2	20	30	50
	DML 203P	Pathology Practical	-	-	4	2	20	30	50
	DML 204P	Clinical Biochemistry Practical	-	-	4	2	20	30	50
	DML 205P	Clinical Bacteriology Practical	-	-	4	2	20	30	50
Total			**15**	**5**	**20**	**30**	**200**	**550**	**750**

Anatomy and Physiology-II-Theory
Paper code: DML 201T

Contacts: 3L+1T Credits: 04

Human Anatomy and Physiology is a laboratory-based course that investigates the structure and function of the human body. It includes human anatomy, different tissues, sense organs, urinary system, reproductive system, nervous system and endocrine system. This course is designed to develop the knowledge of anatomy and physiology in students.

Course Outcomes: After Completion of this course, students would be able to:

CO1: Explain the anatomy and physiology of sense organs and Urinary system.

CO2: Explain the anatomy and physiology of nervous system, structure of nerve cell and conduction of impulse.

CO3: Explain the anatomy and physiology of male and female reproductive system.

CO4: Explain the anatomy and physiology of endocrine system and explains how hormones work.

Course Contents:

Module 1. Sense Organs:

- Elementary knowledge of structures and functions of Eyeball, Ear, Nose, Tongue and Skin

Module 2: Urinary System:

- Structures and functions of various organs of Urinary system: Kidney, ureter, Urinary bladder, Urethra
- Structure and functions of nephron.
- Physiology of urine formation
- Composition of urine

Module 3: Reproductive System:

- Structures and functions of Female reproductive organs: Uterus, Ovary, Uterine tubes, vagina
- Ovarian cycle, ovulation and fertilization
- Structures and functions of Male reproductive organs: Testis, spermatic cord, epididymis, vas deferens, seminal vesicles, ejaculatory ducts, prostate.
- Spermatogenesis

Module 4: Nervous System:

- Central Nervous system: Structure and functions Brain and spinal cord

- Peripheral Nervous system: Structures and functions of Cranial nerves and spinal nerves
- Structure and functions of Neurons, transmission of nerve impulse

Module 5: Endocrine Glands

- Structures and functions of Endocrine glands:
- Pituitary gland, Thyroid gland, Parathyroid gland, Suprarenal glands, Thymus gland.

Textbooks and References

1. Tortora, G. J., & Derrickson, B. H. (2008). Principles of anatomy and physiology. John Wiley & Sons.
2. Martini, F. (2006). Anatomy and Physiology'2007 Ed. Rex Bookstore, Inc..
3. Guyton, A. C. (1991). Basic neuroscience: anatomy and physiology. Philadelphia, PA: Saunders.
4. Shier, D., Butler, J., & Lewis, R. (2015). Hole's essentials of human anatomy & physiology. New York: McGraw-Hill Education.
5. Keller, M. (2015). The science of grapevines: anatomy and physiology. Academic Press.
6. Waugh, A., & Grant, A. (2014). Ross & Wilson Anatomy and physiology in health and illness E-book. Elsevier Health Sciences.
7. Coad, J., &Dunstall, M. (2011). Anatomy and Physiology for Midwives E-Book. Elsevier Health Sciences.Kapit, W., Elson, L. M., & Elson, L. M. (1977). The anatomy coloring book. New York: Harper & Row.

Anatomy and Physiology- II Practical
Paper code: DML 201P

Contacts: 4P **Credits: 02**

Course Overview

Practical anatomy and physiology is complimentary to the theoretical discussions in anatomy and physiology. Practical allow the verification of anatomical and physiological processes discussed in theory classes through experiments on living tissue, or normal human beings. Helps the students to understand the alterations in anatomical structures and physiological functions in diseases and more emphasis shall be given to those relevant for medical laboratory technology students.

Course Outcomes: After completion of this course, students would be able to:

CO1: Demonstrate the different sense organs of the body.

CO2: Explain the urinary system, male and female reproductive system.

CO3: Demonstrate the parts of brain and endocrine glands.

Course Contents:

(Note: Demonstration may be performed from models and charts wherever applicable)

1. **Sense Organs:** Demonstration of various sense organs:
   - Eyeball, Ear, Nose, tongue, skin

2. **Urinary System**: Demonstration of various parts of Urinary system:
   - Kidney, Ureter, Urinary bladder and Urethra.

3. **Reproductive System**:
   - Demonstration of various parts of female reproductive organs. Ovary, Uterus, Uterine tubes, cervix and Vagina
   - Demonstration of various parts of Male reproductive organs: Testis, spermatic cord, epididymis, vas deferens, seminal vesicles, ejaculatory ducts, prostate

4. **Nervous System**: Demonstration of Various parts of Brain:
   - Cerebrum, Cerebellum, Pons and Medulla.

5. **Endocrine Glands**: Demonstration of various Endocrine glands:
   - Pituitary gland, Thyroid gland, Parathyroid glands, Suprarenal glands and Thymus glands.

Haematology – I Theory
Paper code: DML 202T

Contacts: 3L+1T **Credits: 04**

Course Overview

Hematology course includes basic concept of Hematology, Instruments and apparatus used in hematology laboratory, Blood cells count, Haemocytometer and Automated cell counter. This course is designed to develop the knowledge about blood its various components, identification &analysis (Hematology) in students.

Course Outcomes: After completion of this course, students would be able to:

CO1: Understand the basic components and concepts of Haematology.
CO2: Explain the different types of instruments or devices with their functions commonly used in medical laboratory.
CO3: Understand the responsibilities of a lab technologist
CO4: Describe basic theories of homeostasis.
CO5: Gain knowledge and understanding about the basic haematological diagnosis.

Course Contents

Module 1: Introduction to Haematology and its Equipment

- Components of blood, functions of blood; Shape, size, structure and functions of blood cells.
- Haemopoiesis: Erythropoiesis, leucopoiesis and thrombopoiesis.
- Automated Cell Counter, Urine Analyser, Coagulometer, Responsibilities of a lab technologist

Module 2: Coagulation Studies

- Hemostasis - Basic concept and principle, Basic steps involved in Hemastosis.
- Basic Physiology of Coagulation, Coagulation factors, Mechanism of blood coagulation, Role of coagulation factors,

Module 3: Basic Haematological diagnosis

- Introduction to Blood Smears, Cover slip method, Spreader slide method, Types of Smear,
- Staining Of the Blood Films, Preparation of Stains, Total Cell Count, Red Blood Cells (RBC), White Blood Cells (WBC), Platelets, Absolute Eosinophil Count, Estimation of Hemoglobin, Packed Cell Volume (PCV) & Erythrocyte Indices,
- Erythrocyte Sedimentation Rate (ESR), Importance of ESR, Differential Count, Bleeding time, clotting time, prothrombin time.

Textbooks and References

1. Godkar, P. B., & Godkar, P. D. (2005). Text Book of Medical Laboratory Technology: Basic Histopathologic Techniques and the Laboratory Requirements.
2. Rodak, B. F., Keohane, E. M., &Fritsma, G. A. (2013). Hematology-E-Book: Clinical Principles and Applications. Elsevier Health Sciences.
3. Sacher, R. A. (1987). Clinical hematology and fundamentals of haemostasis. Davis.
4. Diem, H., Haferlach, T., &Theml, H. (2004). Color Atlas of Hematology: Practical Microscopic and Clinical Diagnosis. Thieme.
5. Orkin, S. H., Nathan, D. G., Ginsburg, D., Look, A. T., Fisher, D. E., & Lux, S. (2014). Nathan and Oski'sHematology and Oncology of Infancy and Childhood E-Book. Elsevier Health Sciences.
6. Rodak, B. F., &Carr, J. H. (2015). Clinical Hematology Atlas-E-Book. Elsevier Health Sciences.
7. Mazza, J. J. (Ed.). (2002). Manual of clinical hematology. Lippincott Williams & Wilkins.
8. Keohane, E. M., Otto, C. N., &Walenga, J. M. (2019). Rodak'sHematology-E-Book: Clinical Principles and Applications. Elsevier Health Sciences.

Haematology-I Practical
Paper code: DML 202P

Contacts: 4P **Credits: 02**

Course Outcomes: After completion of this course, students would be able to:

CO1: Learn the working, use and maintenance of the various haematological instruments.

CO2: Explain the preparation of the various types of anticoagulants.

CO3: Understand the collection of venous and capillary blood.

CO4: Perform various haematological tests.

List of Practicals

1. Demonstration of Instruments & appliances for use in Haematology
2. Preparation of anticoagulants (EDTA)
3. Preparation, sterilization of buffers and solutions
4. Preparation of the stain (Haemoxylin & Eosin)
5. Collection of venous and capillary blood
6. Preparation of peripheral blood film
7. Estimation of hemoglobin by Sahli's method
8. RBC Count, WBC Count, platelet Count, DLC
9. To perform blood grouping system.
10. Coagulation profile: bleeding time (BT) Clotting time (CT)

Pathology -Theory
Paper code: DML 203T

Contacts: 3L+1T Credits: 04

Course Overview

Pathology Course is designed to provide students with essential medical knowledge and a broad understanding of human disease. The Course emphasizes "the language of disease" as a necessary foundation for self-education and lifelong learning. glossary or important diseases discussed in lecture.

Course Outcomes: After completion of this course, students would be able to:

CO1: Understand the pathology of various diseases.
CO2: Explain the role of microbes responsible for pathogenesis of tumors and their oncogenesis.
CO3: Describe the science behind the process of healing.
CO4: Learn the definition, types and determinations of innate immunity and its mechanism.

Course Contents

Module 1: Basic Terminologies

- Introduction to Inflammation: Definition, basic concept, acute inflammation - and Chronic Inflammation.
- Basic introduction to Pathology of localized and systematic infections.
- Healing: Definition, different phases of healing,
- Definitions of Thrombosis, Embolism, Ischaemia and Infarction.

Module 2: Pathology of specific chronic infective disorders

- Pathology of Tuberculosis, Leprosy.
- Immunity: Definition, types (innate and acquired immunity), Complement system.

Module 3: Introduction to cell functions

- Introduction to Phagocytosis,
- Cell death (apoptosis) and necrosis.
- Introduction to hybridoma technology.

Module 4: Pathophysiology

- Derangement of body fluids,
- Pathophysiology of Atherosclerosis, AIDS and Hepatitis.

Textbooks and References

1. J Ochei and A Kolhatkar (2000). Medical Laboratory Science- Theory and Practice, 1st Edition , Tata Mcgraw Hill Publishing Co Ltd.

2. Godkar, P. B., &Godkar, P. D. (2005). Text Book of Medical Laboratory Technology: Basic Histopathologic Techniques and the Laboratory Requirements
3. C F A Culling (1974). Handbook of Histopathological and Histochemical Techniques, 3rd Edition, Butterworth-Heinemann.
4. Bancroft J. D and Gamble M (2008). Theory & Practice of Histological Techniques, 6thEdition, Churchill livingstone.
5. Haven, M. C., Tetrault, G. A., &Schenken, J. R. (Eds.). (1994). Laboratory instrumentation. John Wiley & Sons.
6. Saliterman, S. S. (2006). Fundamentals of BioMEMS and medical microdevices. Bellingham, WA: Wiley-Interscience.
7. Baker, F. J., & Silverton, R. E. (2014). Introduction to medical laboratory technology. Butterworth-Heinemann.

Pathology - Practical
Paper code: DML 203P

Contacts: 4P Credits: 02

Course Outcomes: After completion of this course, students would be able to:

CO1: Understand the pathological conditions and their clinical importance.

CO2: Correlate normal and altered morphology of different organ systems in different diseases together with their clinical significance.

CO3: Classify diseases of various body systems and how they manifest clinically and histopathologically.

List of Practicals

Demonstration of

1. Microscopic features of acute inflammations in lungs,
2. Cellular components of chronic and granulomatous inflammation
3. Granulation tissue, callous
4. Histopathological slides to demonstrate the various types of cell injury, calcification and extracellular accumulation
5. Inflammatory changes morphologically by suitable histopathological slides.
6. Types of necrosis: caseous and coagulative,
7. Identify and interpret gross and microscopic features of organs in commonly occurring neoplastic and non-neoplastic diseases.

Clinical Biochemistry -Theory
Paper code: DML 204T

Contacts: 3L+1T Credits: 04

Course overview

Clinical biochemistry combines analytical chemistry with aspects of physiology, physical chemistry, pathophysiology and diagnostic medicine. Clinical biochemistry uses biochemical knowledge and techniques to assist in the diagnosis of human disease, to follow its progress and to monitor the effect of treatment. Biochemistry, biochemical testing, and specialist biochemical practitioners have an important role in clinical practice in both diagnosis and management.

Course Outcomes: After completion of this course, students would be able to:

CO1: Learn about urine analysis and its clinical significance.
CO2: Understand the physical characteristics and composition of stool.
CO3: Explain the composition, functions and clinical significance of CSF.
CO4: Estimate various parameters in CSF and understand the normal and abnormal levels.
CO5: Describe the nomenclature, chemical nature and their relation in diseases.

Course contents

Module 1: Urine Analysis
- Normal Composition of Urine, Clinical Importance of Urine Analysis,
- Abnormal Constituents like Sugar, Proteins, Bile Salts, Bile Pigments, Blood, Ketone bodies,
- Identification of Sugar, Glycosuria and Proteinuria.

Module 2: Stool Chemistry
- Physical characteristics and Composition of Stool;
- Significance of Blood in stool, Excess fats in stool and Stercobilinogens in Stool,
- Significance of Occult blood.

Module 3: Cerebrospinal Fluid
- Composition and Functions of Cerebrospinal Fluid (CSF). Clinical significance of CSF Analysis.
- Normal and Abnormal levels of Sugar, Chloride, Proteins in CSF.

Module 4: Biological Fluids
- Composition and clinical significance of Biological Fluids: Peritoneal / Pleural / Gastric Juice;
- Clinical importance of Protein Estimation in Biological Fluids;

Module 5 : Enzymes
- Introduction to enzymes: Definition, characteristics, classification,
- Factors affecting enzyme activity, Active sites, Co-enzyme, Isoenzymes.

Module 6: Chromatography

- Introduction and principle of chromatography.
- Chromatographic Methods: Paper and Thin Layer Chromatography.

Textbooks and References

1. Moran, L. A., Horton, R. A., Scrimgeour, K. G., & Perry, M. D. (2014). Principles of biochemistry.
2. Gaw, A., Murphy, M., Srivastava, R., Cowan, R. A., & O'Reilly, D. S. J. (2013). Clinical Biochemistry E-Book: An Illustrated Colour Text. Elsevier Health Sciences.
3. Devlin, T. M. (Ed.). (2006). Textbook of biochemistry: with clinical correlations.
4. McKee, T., & McKee, J. R. (1999). Biochemistry: an introduction. WCB/McGraw-Hill.
5. Baynes, J. W., &Dominiczak, M. H. (2014). Medical Biochemistry E-Book. Elsevier Health Sciences.
6. In, E. C. (1997). Textbook of biochemistry with clinical correlations.
7. Varley, H. (1954). Practical clinical biochemistry. Practical clinical biochemistry.
8. White, A., Handler, P., Smith, E., &StettenJr, D. (1959). Principles of biochemistry. Principles of Biochemistry., (Edn 2).

Clinical Biochemistry-Practical
Paper code: DML 204P

Contacts: 4P **Credits: 02**

Course Outcomes: After completion of this course, students would be able to:

CO1: Prepare the vials for blood collection.

CO2: Prepare plasma /serum/ PFF

CO3: Perform basic biochemistry laboratory testing and estimate the levels of the various parameters in biological samples.

List of Practicals

1. Preparation of vials for blood collection
2. Preparation of Plasma /Serum
3. Qualitative analysis of urine for abnormal constituents
4. Estimation/Study of glucose in Blood/plasma/Serum
5. Estimation of Total Protein in urine sample
6. .Estimation of chloride in urine sample
7. Demonstration of Estimation of occult blood in stool sample.
8. Demonstration of Estimation of Alkaline phosphatase (ALP) in blood
9. Demonstration of Estimation of Serum Glutamic-oxaloacetic transaminase (SGOT) and Serum Glutamic pyruvic transaminase (SGPT) in blood
10. Separation of Amino Acids through paper/TLC.

Clinical Bacteriology - Theory
Paper code: DML 205T

Contacts: 3L+1T **Credits: 04**

Course Overview

The course will provide students with an introduction to the theory of clinical bacteriology. It will equip students with an appreciation of the role of the clinical Bacteriology for diagnosis and management of common diseases.

Course Outcomes: After completion of this course, students would be able to:

CO1: Learn the detailed systematic and diagnostic study of bacteria.
CO2: Understand the morphology, pathogenicity, lab diagnosis and prophylaxis of various types of bacteria.
CO3: Learn the processing of the various biological specimens.
CO4: Explain the common type of nosocomial infection.
CO5: Describe the bacteriological examination of water, milk and air.

Course Contents

Module 1: Bacteriology
- Introduction to bacterial cell structure,
- Bacterial growth curve,
- Bacterial genetics- Introduction to plasmids, transformation, transduction and conjugation.

Module 2: Types of Bacteria
Pathogenicity, lab diagnosis and prophylaxis of:
- **Gram negative bacteria**: *Neisseria gonorrhoeae, Escherichia coli, Salmonella typhi, Pseudomonas aeruginosa,* and *Helicobacter pylori*.
- **Gram positive bacteria**: *Staphylococcus aureus, Streptococcus pneumoniae, Bacillus anthracis, Corynebacterium diphtheria, Clostridium tetani*,
- **Acid fast Bacilli:** *Mycobacterium tuberculosis, Mycobacterium lepare*

Module 3: Nosocomial infections
- Introduction to nosocomial infections
- Types of nosocomial infection: respiratory infections, catheter associated urinary tract infections.
- Control of nosocomial infection.

Module 4: Processing of clinical samples
- Processing of Blood, sputum, throat swab, nasopharyngeal swab, Pus & wound swab,
- Antimicrobial susceptibility testing.

Textbooks and References

1. Greenwood, D., Slack, R. C., Barer, M. R., & Irving, W. L. (2012). Medical Microbiology E-Book: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control. With STUDENT CONSULT Online Access. Elsevier Health Sciences.
2. Ryan, K. J., & Ray, C. G. (2004). Medical microbiology. McGraw Hill, 4, 370.
3. Isenberg, H. D. (1998). Essential procedures for clinical microbiology (pp. 3-36). Washington, DC: ASM press.
4. Levinson, W., &Jawetz, E. (1996). Medical microbiology and immunology: examination and board review. Appleton & Lange.
5. Talaro, K. P., & Chess, B. (2018). Foundations in microbiology. McGraw-Hill.
6. Hart, C. A., & Shears, P. (1996). Color atlas of medical microbiology (No. C QR46 H37 2004). Mosby-Wolfe.
7. Goldman, E., & Green, L. H. (Eds.). (2008). Practical handbook of microbiology. CRC press.
8. Cappuccino, J. G., & Sherman, N. (2005). Microbiology: a laboratory manual (p. 507). San Francisco: Pearson/Benjamin Cummings.
9. Mackie & Macartney practical medical Microbiology - Collee. Fraser, Mar mion, Simmons

Clinical Bacteriology - Practical
Paper code: DML 205P

Contacts: 4P Credits: 02

Course Outcomes: After completion of this course, students would be able to:

CO1: Perform streak plate and pour plate, spread plate method or carpet culture.

CO2: Identify the medically important bacteria from pure culture.

CO3: Process the various biological samples for culture and identification of pathogens.

List of Practicals

1. To perform streak plate and pour plate, spread plate method or carpet culture
2. Identification of medically important bacteria: *Staphylococcus*, *Streptococcus, E.coli, Klebsiella*.
3. Demonstration of anaerobic culture techniques
4. Preparation of Nutrient broth and agar culture media
5. Processing of following clinical samples for culture and identification of pathogens: –
   i) Blood
   ii) Throat swab
   iii) Sputum
   iv) Urine
6. Processing of water, milk, food and air samples for bacteriological examination

SEMESTER-III

Semester III

Semester	Paper Code:	Subject	Periods			Credit Units	Evaluation scheme		
			L	T	P		Internal*	External	Total
III	DML 301T	Haematology – II Theory	3	1	-	4	20	80	100
	DML 302T	Immunology, Parasitology and Serology-Theory	3	1	-	4	20	80	100
	DML 303T	Histopathology and Cytology-Theory	3	1	-	4	20	80	100
	DML 304T	Blood Banking Theory	3	1	-	4	20	80	100
	DML 301P	Haematology – II Practical	-	-	4	2	20	30	50
	DML 302P	Immunology, Parasitology and Serology-Practical	-	-	4	2	20	30	50
	DML 303P	Histopathology and Cytology-Practical	-	-	4	2	20	30	50
	DML 304P	Blood Banking Practical	-	-	4	2	20	30	50
Total			**12**	**4**	**16**	**24**	**160**	**440**	**600**

Haematology-II - Theory
Paper code: DML 301T

Contacts: 3L+1T Credits: 04

Course overview

To develop the knowledge about the pathophysiology and investigation of important morphological blood cell disorders such as anisocytosis, poikilocytosis, anemia and leukemia based on an up-to-date knowledge.

Course Outcomes: After completion of this course, students would be able to:

CO1: Explain the morphological disorders of blood cells, physiological variations of erythrocytes, leucocytes and thrombocytes.

CO2: Describe the various components of blood, their functions, and roles in various disease states.

CO3: Understand about anemia.

CO4: Describe the details of Leukemia and its classification.

CO5: Explains the pathogenesis and laboratory diagnosis of different types of anaemia and leukemia.

Course Contents

Module 1: Blood Cells Disorders

- Morphological disorders of blood cells, physiological variations of erythrocytes, leucocytes and thrombocytes
- Bone Marrow: Composition and aspiration of normal adult Bone marrow,

Module 2: Anemia

- Introduction, classification and laboratory diagnosis of Anemia: Iron deficiency anemia, Pernicious anemia, Megaloblastic anemia, Aplastic anemia, Sideroblastic anemia.
- Other types of Anemia: Glucose -6-phosphate dehydrogenase deficiency, thalassemia and sickle cell anemia
- Incompatible blood transfusion, hemolytic disease of newborn.

Module 3: Leukemia

- Definition, classification, Blood Picture, causes,
- Clinical features and laboratory diagnosis of Acute Myeloid Leukemia (AML), Acute Lymphocytic Leukemia (ALL), Chronic Myeloid Leukemia (CML) Chronic Lymphocytic Leukemia (CLL).

Text books and References

1. Godkar, P. B., &Godkar, P. D. (2005). Text Book of Medical Laboratory Technology: Basic Histopathologic Techniques and the Laboratory Requirements.

2. Rodak, B. F., Keohane, E. M., &Fritsma, G. A. (2013). Hematology-E-Book: Clinical Principles and Applications. Elsevier Health Sciences.
3. Sacher, R. A. (1987). Clinical hematology and fundamentals of haemostasis. Davis.
4. Diem, H., Haferlach, T., &Theml, H. (2004). Color Atlas of Hematology: Practical Microscopic and Clinical Diagnosis. Thieme.
5. Orkin, S. H., Nathan, D. G., Ginsburg, D., Look, A. T., Fisher, D. E., & Lux, S. (2014). Nathan and Oski's Hematology and Oncology of Infancy and Childhood E-Book. Elsevier Health Sciences.

Haematology-II-Practical
Paper code: DML 301P

Contacts: 4P Credits: 02

Course Outcomes: After completion of this course, students would be able to:

CO1: Perform DLC and GBP.
CO2: Prepare thick blood smear.
CO3: Determine malarial Ag and Ab by rapid kit methods.
CO4: Demonstrate the abnormal blood cells and various types of anemia.

List of Practicals

1. Demonstrate/Perform Differential Leucocyte Count (DLC)
2. Demonstrate/Perform Complete blood count (CBC)
3. Demonstration of Acute Myeloid Leukemia (AML) slide
4. Demonstration of Chronic Myeloid Leukemia (CML)slide
5. Demonstration of Acute Lymphocytic Leukemia (ALL) slide
6. Demonstration of Chronic Lymphocytic Leukemia (CLL) slide
7. Demonstration of malarial parasites,
8. Identification of malarial antigen (Ag) / antibody (Ab) by rapid kit methods
9. Demonstrate/Perform Total Leucocyte Count (TLC)
10. Demonstration of abnormal blood cells (microcytic, macrocytic and hypochromic anemia)

Immunology, Parasitology and Serology-Theory
Paper code: DML 302T

Contacts: 3L+1T Credits: 04

Course Overview

The course will provide students with an introduction to the theory Immunology, Parasitology and Serology. The students will be able to explain the pathogenesis and laboratory diagnosis of different diseases caused by various protozoans and helminths. The students will be able to apply knowledge of the various serological tests and advanced diagnostic techniques to diagnose parasitic infection and also interpret the tests.

Course Outcomes: After completion of this course, students would be able to:

CO1: Understand the human immune system and their responses, detailed idea about the immunity of the body.
CO2: Describe the innate, acquired, and local & herd immunity.
CO3: Learn about the concept of antibody, their structure, classes, properties and function.
CO4: Describe the parasite and host relationship.
CO5: Gain knowledge about the life cycle, transmission, pathogenicity, and control strategies of clinically important parasites.

Course Contents

Module 1: Immunity, Antigen and Antibody

- Definitions: Infection, Pathogenicity, Virulence, primary and secondary immune responses.
- Immunity: Definition, types - Innate, acquired, and local and herd immunity, opsonisation and phagocytosis, vaccines: general concept.
- Antigen: properties, structure and types; Adjuvant, Definition of Hapten.
- Antibody: general structure, classes, properties and function;
- Introduction to Monoclonal and polyclonal antibody.

Module 2: Immune System

- Principles of Humoral and cellular immune response; Major histocompatibility complex;
- Cell and Organs of Immune System - Primary lymphoid organ, secondary lymphoid organ, T-lymphocytes, B-lymphocytes, cytokines, Interferon;
- Introduction to General Properties and Pathways of Complement system

Module 3: Introduction of Parasitology

- General characteristics and classification of parasites (endo- and ecto-parasites),
- Classification of hosts and vectors, relationship between parasites and host, mode of transmission of parasitic infections.

Module 4: Protozoology and Helminthology

- Life cycle, prevention and lab diagnosis of *Entamoeba histolytica*, *Trypanosoma gambiense, Leishmania donovani*, *Plasmodium falciparum*,
- Life cycle, prevention and lab diagnosis of Platyhelminthes (flatworm: *Taenia solium*) and Nemathelminthes (Round worm: *Ascaris lumbricoides*).

Module 5

- **Antigen Antibody Reactions** – Principle and application of agglutination, precipitation and flocculation reaction.

Module 6: Serological tests and Advanced Diagnostic Techniques

- Principle, technique, interpretation of - WIDAL, C-Reactive Protein (CRP) test by agglutination technique,
- Advance diagnostic techniques like ELISA (Types: Direct, Indirect and Sandwich).

Textbooks and References

1. Greenwood, D., Slack, R. C., Barer, M. R., & Irving, W. L. (2012). Medical Microbiology E-Book: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control. With STUDENT CONSULT Online Access. Elsevier Health Sciences.
2. Ryan, K. J., & Ray, C. G. (2004). Medical microbiology. McGraw Hill, 4, 370.
3. Isenberg, H. D. (1998). Essential procedures for clinical microbiology (pp. 3-36). Washington, DC: ASM press.
4. Levinson, W., &Jawetz, E. (1996). Medical microbiology and immunology: examination and board review. Appleton & Lange.
5. Talaro, K. P., & Chess, B. (2018). Foundations in microbiology. McGraw-Hill.
6. Hart, C. A., & Shears, P. (1996). Color atlas of medical microbiology (No. C QR46 H37 2004). Mosby-Wolfe.
7. Goldman, E., & Green, L. H. (Eds.). (2008). Practical handbook of microbiology. CRC press.
8. Cappuccino, J. G., & Sherman, N. (2005). Microbiology: a laboratory manual (p. 507). San Francisco: Pearson/Benjamin Cummings.

Immunology, Parasitology and Serology- Practical
Paper code: DML 302P

Contacts: 4P **Credits: 02**

Course Outcomes: After completion of this course, students would be able to:

CO1: Collect blood and prepare thin and thick smears.

CO2: Identify the parasites, arthropods of medical importance.

CO3: Examine the blood smears for malaria and microfilaria together with their identification.

CO4: Perform Widal test, RPR test, ASO, CRP by agglutination method.

CO5: Perform routine stool examination for the detection of intestinal parasites.

List of Practicals

1. Demonstrate/Perform isolation of lymphocytes from blood.
2. Demonstration of ELISA technique.
3. Demonstration of malaria thin and thick smears.
4. Demonstration of Widal test (Slide & Tube).
5. Demonstration of Rapid Plasma Reagin (RPR) test.
6. Demonstration of C - reactive Protein (CRP) test.
7. Demonstration of RA (Rheumatoid factor, Rf) test.
8. Demonstration of ouchterlony double immunodiffusion technique.
9. Demonstration of Rapid diagnostic test for Malaria/ Leishmania.
10. Microscopic identification of Malaria/Leishmania using permanent slides/ photographs.

Histopathology and Cytology-Theory
Paper code: DML 303T

Contacts: 3L+1T Credits: 04

Course Overview

The course introduces the students to the various types of tissue preparations and developing expertise in the students in Tissue processing, Embedding, Microtome and Mounting and Staining procedure in Histopathology. Cytology part exposes the students to the latest advancements in cytological investigations.

Course Outcomes: After completion of this course, students would be able to:

CO1: Understand the concept of tissue processing and embedding.
CO2: Describe fixatives, their classification, properties, and composition.
CO3: Learn about the concept of microtome and mounting.
CO4: Describe the principle and theory of hematoxylin and eosin staining.
CO5: Describe and recognize cells of specific histological tissues and organ systems.
CO6: Learn the collection of sample, preparation of smears and their staining for cytology.

Course contents

Module 1: Grossing, Fixation and Decalcification

- Basics of histopathology: Introduction, receiving, registration & preservation of samples in histopathology.
- Basics of Grossing of mammalian tissue (respiratory tract and gastro-intestinal tract)
- Fixatives - classification, Introduction to Post chroming.
- Decalcification - decalcifying agent and composition.

Module 2: Tissue processing and Embedding

- Tissue processing, dehydrating agents and dehydration process,
- Clearing, Impregnation, Paraffin Embedding.

Module 3: Microtome and Mounting

- Introduction to Microtome: Definition, types (Rotary, Base Sledge and Cryostat), Microtome knife, honing and stropping;
- Mounting solutions.

Module 4: Staining

- Principle and theory of hematoxylin and eosin staining; Differential staining (Geimsa),
- Specific stain for collagen

Module 5

- Solvents mordents accelerators and accenuators.
- Meta chromasia and Metachromatic dyes.

- Introduction and clinical significance of Exfoliative cytology, Fine Needle Aspiration Cytology (FNAC) and cervical cytology. Introduction to PAP smear test.

Textbooks and References

1. J Ochei and A Kolhatkar (2000). Medical Laboratory Science- Theory and Practice, 1st Edition , Tata Mcgraw Hill Publishing Co Ltd.
2. Godkar, P. B., &Godkar, P. D. (2005). Text Book of Medical Laboratory Technology: Basic Histopathologic Techniques and the Laboratory Requirements
3. C F A Culling (1974). Handbook of Histopathological and Histochemical Techniques, 3rd Edition, Butterworth-Heinemann.
4. Bancroft J. D and Gamble M (2008). Theory & Practice of Histological Techniques, 6thEdition, Churchill livingstone.
5. Haven, M. C., Tetrault, G. A., &Schenken, J. R. (Eds.). (1994). Laboratory instrumentation. John Wiley & Sons.
6. Saliterman, S. S. (2006). Fundamentals of BioMEMS and medical microdevices. Bellingham, WA: Wiley-Interscience.
7. Baker, F. J., & Silverton, R. E. (2014). Introduction to medical laboratory technology. Butterworth-Heinemann.

Histopathology and Cytology-Practical
Paper code: DML 303P

Contacts: 4P **Credits: 02**

Course Outcomes: After completion of this course, students would be able to:

CO1: Demonstrate the various histopathological instruments.

CO2: Prepare the various types of reagent used in Histopathology.

CO3: To perform Gram's, Acid fast, Geimsa and Hematoxylin eosin staining.

CO4: Demonstrate the normal cytology of respiratory tract, urinary tract, CSF.

List of Practicals

1. Demonstration of Histopathological Instruments: Compound light microscope, Paraffin wax bath, slide warmer, Automatic Tissue Processor
2. Demonstration of Microtome knives, honing and stropping
3. Preparation of various types of reagent used in Histopathology
4. To perform Gram's staining
5. Demonstration of Acid fast staining,
6. To perform Geimsa staining,
7. Demonstration of Embedding ,trimming and cutting of cross-section
8. Demonstration of Tissue processing: Dehydration, Making solution of different reagents and fixatives
9. Demonstration of normal cytology of respiratory tract, urinary tract, Cerebrospinal Fluid (CSF).

Blood Banking- Theory
Paper code: DML 304T

Contacts: 3L+1T Credits: 04

Course Overview

The students would be able to know the basic components of blood and their significance in normal health, by examination of blood and various types of diseases can be diagnosed.

Course Outcomes: After completion of this course, students would be able to:

CO1: Understand the principle of blood grouping.
CO2: Describe the blood collection procedure, storage of blood and it's transfusion.
CO3: Learn the significance of cross matching and screening of blood.
CO4: Explain the preparation of various blood components and their storage.

Course Contents

Module 1: Introduction to Blood Grouping

- ABO Grouping, Rh Grouping
- Erythroblastosis Foetalis.

Module 2: Collection and Storage of Blood

- Screening and selection of donor, Collection and preservation of blood in blood bank,
- Anticoagulants used in Blood Banking,
- Cleaning and Care of Glassware in Blood Banking

Module 3: Cross Matching and Screening of Blood

- Major and Minor Cross Matching, Preparation of Working Antiglobulin Serum, Principle and Importance of Cross Matching,
- Transfusion Reactions, Screening of blood for AIDS, Hepatitis and Syphilis.

Module 4: Testing

- ABO testing slides, reverse grouping, sources of error, rouleux formation and methods of checking it.
- RH grouping test slide or rapid tube test false - positive and false - Negative results, Du system & its significance.
- Coombs test- Direct and indirect, principle, explanation of procedure and sources of error control, interpretation and clinical application.
- Preparation of various blood components, their storage and Uses of Refrigerated Centrifuge

Textbooks & References

1. Medical Laboratory manual for trophical countries Vol, l ≪ Monica Chesbrough, ELBS Edition

2. Medical Laboratory technology: A procedure manual for routine Diagnostic Tests Vol l, ll, lIl; Kanai L. Mukharjee, Tata McGraw Hill Pub.

3. Dacie and lewis : Practical Hematology

4. De Gruchy's : Clinical Hematology in Medical practice; Frank Firlin, Colin cheterman David Peningtom and Bryan Rush

5, Manual of basic techniques for a Health Laboratory; WHO Publication, World health house, Indrapratha Estate, Ring Road, New Delhi-02.

Blood Banking-Practical
Paper code: DML 304P

Contacts: 4P **Credits: 02**

Course Outcomes: After completion of this course, students would be able to:

CO1: Perform direct Coomb's test.

CO2: Prepare the 5% cell suspension.

CO3: Perform coagulation profile.

CO4: Perform forward typing of ABO and Rh and reverse typing of ABO blood group system.

CO4: Perform section cutting.

List of Practicals

1. Demonstration of various instruments used for blood banking
2. Demonstration of storage of different blood products
3. To prepare different concentration of cell suspensions
4. To perform Blood grouping
5. To perform haemoglobin estimation
6. To perform Red Blood Cell (RBC) count
7. Total white blood cell (WBC) count
8. Demonstration of Fine Needle Aspiration Cytology (FNAC) techniques
9. Demonstration of Hematoxylin and Eosin (H&E) staining
10. Demonstration of direct Coomb's test
11. Demonstration of reverse typing of ABO blood group system

SEMESTER-IV

Semester IV

Semester	Paper Code:	Subject	Periods			Credit Units	Evaluation scheme		
			L	T	P		Internal*	External	Total
IV	DML 401T	Diagnostic Biochemistry – Theory	3	1	-	4	20	80	100
	DML 402T	Clinical Virology and Mycology Theory	3	1	-	4	20	80	100
	DML 401P	Diagnostic Biochemistry Practical	-	-	4	2	10	40	50
	DML 402P	Clinical Virology and Mycology - Practical	-	-	4	2	10	40	50
	DML 403	Project/ Internship*	-	-	-	4	-	100	100
Total			**6**	**2**	**8**	**16**	**60**	**340**	**400**

*Students will undergo an Internship of 12 weeks.

Internship/Project duration: 12 weeks

S.No	Lab	Duration (weeks)
1	Biochemistry	3
2	Blood Bank	3
3	Pathology/Histopathology	3
4	Microbiology	3
	Total	**12**

Diagnostic Biochemistry-Theory
Paper code: DML 401T

Contacts: 3L+1T **Credits: 04**

Course Overview

Diagnostic biochemistry combines analytical chemistry with aspects of physiology, physical chemistry, pathophysiology and diagnostic medicine. Diagnostic clinical biochemistry uses biochemical knowledge and techniques to assist in the diagnosis of human disease, to follow its progress and to monitor the effect of treatment. Biochemistry, biochemical testing, and specialist biochemical practitioners have an important role in clinical practice in both diagnosis and management.

Course Outcomes: After completion of this course, students would be able to:

CO1: Learn the concept of bilirubin formation, excretion, its normal and abnormal values and clinical significance.
CO2: Understand the normal ranges and clinical significance of various enzymes.
CO3: Explain the role of liver.
CO4: Estimate various liver function tests.
CO5: Describe the coagulation of blood, significance of PT determination, and the principle of estimation.
CO6: Understand the clinical significance of pancreatic function test, Lipid Profile test and Diabetes, Kidney Function Test, Thyroid function test and Infertility profile.

Course contents

Module 1: Haem-catabolism and bilirubin metabolism

- Bilirubin formation and excretion, Conjugated and un-conjugated bilirubin,
- Normal and abnormal values and clinical importance of serum bilirubin in relation to differential diagnosis.

Module 2: 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,
- Liver and its functions, Estimation of bilirubin, A:G ratio, Serum Glutamic-Oxaloacetic Transaminase (SGOT), Serum Glutamic Pyruvic Transaminase (SGPT), Alkaline Phosphatase (ALP).

Module 3: Prothrombin Time (PT)

- Coagulation of blood, significance of PT determination,
- Principle of estimation

Module 4: Lipid Profile test

- Important biological fats, cholesterol, clinical significance of cholesterol estimation,
- Lipid profile - low-density lipoprotein (LDL) cholesterol, Very-low-density lipoprotein (VLDL), High Density Lipoprotein (HDL), Triglycerides (TG), Principle and its estimation.

Module 5: Pancreatic function test and Diabetes

- Amylase, lipase, insulin, glucagon, clinical conditions.
- Diabetes: Introduction and Types of diabetes, biochemical changes, role of insulin and glucagon, diabetes in relation to pregnancy and cardiovascular disease.
- Oral glucose tolerance test and HbA1c.

Module 6: Kidney Function Test

- Function of kidney in respect of Non-protein nitrogen (NPN), Difference between PN and NPN,
- Estimation of different NPN like urea, creatinine, uric acid in blood.

Module 7: Thyroid function test and Infertility profile

- Thyroid function test: Triiodothyronine (T3) and Thyroxine (T4), Thyroid Stimulating hormone (TSH), Calcitonin, Thyroglobin, Iodine
- Infertility profile: Testosterone, Estrogen, Progesterone, Prolactin, Oxytocin, Luteinizing hormone (LH), Follicle-Stimulating hormone (FSH), clinical significance.

Textbook and References

1. Moran, L. A., Horton, R. A., Scrimgeour, K. G., & Perry, M. D. (2014). Principles of biochemistry.
2. Gaw, A., Murphy, M., Srivastava, R., Cowan, R. A., & O'Reilly, D. S. J. (2013). Clinical Biochemistry E-Book: An Illustrated Colour Text. Elsevier Health Sciences.
3. Devlin, T. M. (Ed.). (2006). Textbook of biochemistry: with clinical correlations.
4. McKee, T., & McKee, J. R. (1999). Biochemistry: an introduction. WCB/McGraw-Hill.
5. Baynes, J. W., &Dominiczak, M. H. (2014). Medical Biochemistry E-Book. Elsevier Health Sciences.
6. In, E. C. (1997). Textbook of biochemistry with clinical correlations.
7. Varley, H. (1954). Practical clinical biochemistry. Practical clinical biochemistry.
8. White, A., Handler, P., Smith, E., &StettenJr, D. (1959). Principles of biochemistry. Principles of Biochemistry., (Edn 2).

Diagnostic Biochemistry-Practical
Paper code: DML 401P

Contacts: 4P **Credits: 02**

Course Outcomes: After completion of this course, students would be able to:

CO1: Perform basic biochemistry laboratory testing for various parameters.

CO2: Determine prothrombin time.

CO3: Perform HbA1C.

List of Practicals

1. Estimation of low-density lipoprotein cholesterol (LDLC), High Density Lipoprotein cholesterol (HDLC),
2. Prothrombin time determination
3. Estimation of Total Bilirubin,
4. Demonstration of Estimation of serum albumin and A : G ratio
5. Demonstration of Estimation of Serum Amylase and serum lipase
6. Demonstration of Estimation of Glycosylated haemoglobin.
7. Demonstration of Estimation of Oral Glucose Tolerance Test (OGTT).
8. Demonstration of Estimation of Urea, uric acid, Creatinine in blood sample
9. Estimation of T3 and T4 hormone in blood sample.

Clinical Virology and Mycology -Theory
Paper code: DML 402T

Contacts: 3L+1T Credits: 04

Course overview

This course contains virology, clinically importance virus, mycology and common fungal infections modules. This course is designed to develop the knowledge of virology and mycology in students.

Course Outcomes: After completion of this course, students would be able to:

CO1: Know about various medically important viruses, their pathogenesis and laboratory diagnosis.
CO2: Understand the strategies of prediction of HIVs and Hepatitis B.

CO3: Learn the basic morphology and cultural characteristics of fungi, their growth and their laboratory diagnosis.
CO4: Explain the common fungal infections.
CO5: Samples collection, processing and storage of clinical specimens for the diagnosis of fungi.

Course contents

Module 1: Virology

- General properties of viruses; Collection, transportation and storage of clinical samples; Cultivation of viruses;
- Molecular method for virus diagnosis (RT-PCR),

Module 2: Clinically important virus

- Introduction and clinical significance of Human immunodeficiency viruses, viral hepatitis, rabies virus, herpes viruses, influenza viruses, rota virus,
- Poliomyelitis, japanese encephalitis, dengue, chikungunya.

Module 3: Mycology

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

Module 4: Common fungal infections

- Causative agent, symptoms and prevention of Dermatophytes, candidiasis, mycetoma, rhinosporidium, sporotrichosis, histoplasmosis,
- blastomycosis, aspergillosis, pencillosis, zygomycosis and pneumocystis.

Module 5: Sample handling and processing

- Samples collection, processing and storage of clinical specimens for the diagnosis of fungi.

Textbook and References

1. C P Baveja (2010). Text book of Microbiology, 4th Edition, Arya Publication.
2. Arti Kapil, Ananthanarayan and Paniker's (2013). Textbook of Microbiology, 9th Edition 2013, Orient Black Swan.
3. Greenwood, D., Slack, R. C., Barer, M. R., & Irving, W. L. (2012). Medical Microbiology E-Book: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control. With STUDENT CONSULT Online Access. Elsevier Health Sciences.
4. Ryan, K. J., & Ray, C. G. (2004). Medical microbiology. McGraw Hill, 4, 370.
5. Isenberg, H. D. (1998). Essential procedures for clinical microbiology (pp. 3-36). Washington, DC: ASM press.
6. Levinson, W., & Jawetz, E. (1996). Medical microbiology and immunology: examination and board review. Appleton & Lange.
7. Talaro, K. P., & Chess, B. (2018). Foundations in microbiology. McGraw-Hill.
8. Hart, C. A., & Shears, P. (1996). Color atlas of medical microbiology (No. C QR46 H37 2004). Mosby-Wolfe.
9. Goldman, E., & Green, L. H. (Eds.). (2008). Practical handbook of microbiology. CRC press.
10. Cappuccino, J. G., & Sherman, N. (2005). Microbiology: a laboratory manual (p. 507). San Francisco: Pearson/Benjamin Cummings.

Clinical Virology and Mycology -Practical
Paper code: DML 402P

Contacts: 4P **Credits: 02**

Course Outcomes: After completion of this course, students would be able to:

CO1: Understand the various laboratory rules and regulation of virology laboratory
CO2: Determine Hepatitis virus of different antigens by ELISA.
CO3: Perform various staining techniques.
CO4: Collect, and process the various biological samples for the diagnosis of fungal infections.

List of Practicals

1. Good Laboratory practice (GLP) for virology laboratory.
2. Demonstration of cultivation of viruses
3. Demonstration of HIV antibodies in human serum or plasma (flow cytometry).
4. Demonstrate/Perform rapid test for the diagnosis of viral disease (COVID-19).
5. Preparation of culture media: Sabouraud Dextrose Agar (SDA), Corn Meal Agar (CMA),
6. Demonstrate/Perform staining techniques like Potassium hydroxide (KOH) mount, Lactophenol cotton blue (LPCB) Mount and Indiaink
7. Demonstration of Collection, processing of samples for the diagnosis of fungal infections: Skin, Nail, Hair & body fluids

DISSERTATION PROJECT / INTERNSHIP
Paper code: DML 403

Credits: 08

The students have to complete compulsory 3 months (12 weeks) internship training during the 4th semester (Final semester), preferably in Government Hospitals of Delhi.

The details and duration of training:

1. Biochemistry	3 weeks
2. Blood Banking	3 weeks
3. Pathology/Histopathology	3 weeks
4. Microbiology	3 weeks

During internship training the student has to prepare a project file (one project file for each subject). This shall be based on the work done, or techniques performed that is followed by the industry, hospital or organizations where the student has undergone training. The project file has to be submitted or produced during internal or external exams conducted by the / University. Equal weightage of marks shall be allotted to all the five projects.

After completion of training, the concerned Hospital or industry etc, shall issue the training certificate to the concerned student indicating clearly the duration and the labs where the students had completed 3 months internship/training.

The certificate copy has to be submitted to the University. On the basis of certificate issued by the Hospital or industry, the students may be issued original DMLT Certificate by the University provided the students clear all the university exams for all the semester exams and viva voce. Without completing compulsory 3 months internship/ training, students shall not be awarded DMLT degree by the University.

It is desirable that, all the students have to undergo Training/ Internship preferably in Delhi Govt. Hospitals. But Internship training may also be permitted in Private Hospitals or Hospitals run by Autonomous body or organizations where all the required training facilities are available. However, it is with prior approval or permission of the Competent Authority.

Further, it may be possible that, due to unforeseen situations, incidents or due to some unavoidable reasons or circumstances the student may not be able to take the internship/ training in Delhi. Hence, in such circumstances the student may be permitted to undergo training in other states of Govt. Hospitals, Private Hospitals or Autonomous body that have all the facilities to undergo the Training. However, under such cases also, prior approval of the Competent Authority in writing has to be obtained by the concerned student.