DELHI PHARMACEUTICAL SCIENCES & RESEARCH UNIVERSITY

(The First Pharmacy University in India)

School of Allied Health Sciences and Management

Programme Structure

Bachelors in Medical Lab Technology (BMLT)

Program Overview, Outcome, Program Outline & Structure

And
Scheme of Examination

Program Overview

This program aims to develop professional hospital administrators with requisite skills in planning, implementation, operational Management, problem solving, consultancy and entrepreneurship. Through this rigorous program, graduates are able to manage hospitals and healthcare organizations globally, both in the public and the private sectors, 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

PSO1. 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.

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. Use appropriate strategies for effective planning, implementation and evaluation of institutional and community-based health and family welfare program.

PSO4. Develop skills with the focus on strategic responsibility for training and development of human resource for health care delivery.

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

PSO6. Promote the efficient and equitable allocation of resources and development of strategies to promote cost-effective healthcare.

PSO7. Apply scientific approach to reduce cost of care through better material and money management.

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.

Program outline and Structure

The course of study enhances student's knowledge and skills in several major categorical areas of medical laboratory technology. The degree in medical laboratory technology provides along with a basic knowledge and advanced training and skills in latest technologies of laboratories and blood bank, these graduates play an important role in determining quality of health care provided. After the completion of the course, these laboratory professionals will be in a position to completely assist in the Biochemistry, Pathology, Microbiology laboratories and blood bank in all types of health care delivery system. Total course duration is four years comprising of six semesters including 16 weeks of training in reputed external Hospitals/institutes.

Semester-I

	Paper Code:	Subject	Periods			Credit Units	Evaluation scheme		
			L	T	P		Internal	External	Total
I	BML 101T	Human Anatomy and Physiology -I Theory	3	1	-	4	20	80	100
	BML 102T	General Biochemistry Theory	3	1	-	4	20	80	100
	BML103T	Fundamentals of Medical Lab Technology	3	1	-	4	20	80	100
	BML104T	Environmental Science and Health	3	1	-	4	20	80	100
	BML105T	Computer Applications Theory	2	-	-	2	50*	-	50
	BML106T	Communication Skills	2	-	-	2	50*	-	50
	BML101P	Human Anatomy and Physiology -I Practical	-	-	4	2	20	30	50
	BML102P	General Biochemistry Practical	-	-	4	2	20	30	50
	BML105P	Computer Applications Practical	-	-	4	2	50*	-	50
		Total	**16**	**4**	**12**	**26**	**270**	**380**	**650**

*Evaluation to be conducted by internal faculty/examiner.

Semester-II

	Paper Code:	Subject	Periods			Credit Units	Evaluation scheme		
			L	T	P		Internal	External	Total
II	BML201T	Human Anatomy and Physiology -II Theory	3	1	-	4	20	80	100
	BML202T	Haematology-I –Theory	3	1	-	4	20	80	100
	BML203T	General Pathology –Theory	3	1	-	4	20	80	100
	BML204T	Clinical Biochemistry -I-Theory	3	1	-	4	20	80	100
	BML205T	General Microbiology and Immunology-Theory	3	1	-	4	20	80	100
	BML201P	Human Anatomy and Physiology -II Practical	-	-	4	2	20	30	50
	BML202P	Haematology-I -Practical	-	-	4	2	20	30	50
	BML203P	General Pathology – Practical	-	-	4	2	20	30	50
	BML204P	Clinical Biochemistry -I-Practical	-	-	4	2	20	30	50
	BML205P	General Microbiology and Immunology- Practical	-	-	4	2	20	30	50
		Total	**15**	**5**	**20**	**30**	**200**	**550**	**750**

Semester-III

	Paper Code:	Subject	Periods			Credit Units	Evaluation scheme		
			L	T	P		Internal	External	Total
III	BML301T	Haematology-II-Theory	3	1	-	4	20	80	100
	BML302T	Systemic Bacteriology and Mycology -Theory	3	1	-	4	20	80	100
	BML303T	Clinical Biochemistry -II-Theory	3	1	-	4	20	80	100
	BML304T	Biomedical Instrumentation-Theory	3	1	-	4	20	80	100
	BML301P	Haematology-II-Practical	-	-	4	2	20	30	50
	BML302P	Systemic Bacteriology and Mycology -Practical	-	-	4	2	20	30	50
	BML303P	Clinical Biochemistry -II-Practical	-	-	4	2	20	30	50
	BML304P	Biomedical Instrumentation-Practical	-	-	4	2	20	30	50
		Total	**12**	**4**	**16**	**24**	**160**	**440**	**600**

Semester-IV

	Paper Code:	Subject	Periods			Credit Units	Evaluation scheme		
			L	T	P		Internal	External	Total
IV	BML401T	Parasitology /Entomology and Virology Theory	3	1	-	4	20	80	100
	BML402T	Clinical Pathology and Cytology Theory	3	1	-	4	20	80	100
	BML403T	Diagnostic Biochemistry Theory	3	1	-	4	20	80	100
	BML404T	Lab Accreditation and Management	3	1	-	4	20	80	100
	BML401P	Parasitology /Entomology & Virology Practical	-	-	4	2	20	30	50
	BML402P	Clinical Pathology and Cytology Practical	-	-	4	2	20	30	50
	BML403P	Diagnostic Biochemistry Practical	-	-	4	2	20	30	50
		Total	**12**	**4**	**12**	**22**	**140**	**410**	**550**

Semester-V

	Paper Code:	Subject	Periods			Credit Units	Evaluation scheme		
			L	T	P		Internal	External	Total
V	BML501T	Histopathology and Cytology-Theory	3	1	-	4	20	80	100
	BML502T	Immunohematology and transfusion Medicine-Theory	3	1	-	4	20	80	100
	BML503T	Applied Microbiology-Theory	3	1	-	4	20	80	100
	BML504T	Genetics and Genomics	3	1	-	4	20	80	100
	BML501P	Histopathology and Cytology-Practical	-	-	4	2	20	30	50
	BML502P	Immunohematology and transfusion Medicine-Practical	-	-	4	2	20	30	50
	BML503P	Applied Microbiology-Practical	-	-	4	2	20	30	50
	BML504P	Genetics and Genomics	-		4	2	20	30	50
Total			**12**	**4**	**16**	**24**	**160**	**440**	**600**

Semester-VI

	Paper Code:	Subject	Periods			Credit Units	Evaluation Scheme		
			L	T	P		Internal*	External	Total
VI	BML 601T	Research Methodology and Biostatistics Theory	3	1	-	4	20	80	100
	BML 602	Internship Report	-	-	-	6	-	150	150
		Internal Assessment	-	-	-	6	150*	-	150
		Viva-voce	-	-	-	4	-	100	100
Total			**3**	**1**		**20**	**170**	**330**	**500**

***Students will undergo an internship of 16 weeks**

Internship duration: 16 weeks

S. No	Lab	Duration (weeks)
1	Biochemistry	3
2	Blood Bank	3
3	Pathology/Histopathology	3
4	Microbiology	3
5	Radiology	2
6	Cardiology/Any other	2
	Total	**16**

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 teachers' 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 sent 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 upto 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 incharge 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 4 months (16 weeks) Internship training during the 6th 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

5. Radiology: 2 weeks

6. Cardiology/ Any Other: 2 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 six 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 4 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 4 months internship/ training, students shall not be awarded BMLT 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

	Paper Code:	Subject	Periods			Credit Units	Evaluation scheme		
			L	T	P		Internal*	External	Total
I	BML101T	Human Anatomy and Physiology -I Theory	3	1	-	4	20	80	100
	BML102T	General Biochemistry Theory	3	1	-	4	20	80	100
	BML103T	Fundamentals of Medical Lab Technology	3	1	-	4	20	80	100
	BML104T'	Environmental Science and Health	3	1	-	4	20	80	100
	BML105T	Computer Applications Theory	2	-	-	2	50*	-	50
	BML106T	Communication Skills	2	-	-	2	50*	-	50
	BML101P	Human Anatomy and Physiology -I Practical	-	-	4	2	20	30	50
	BML102P	General Biochemistry Practical	-	-	4	2	20	30	50
	BML105P	Computer Applications Practical	-	-	4	2	50*	-	50
		Total	**16**	**4**	**12**	**26**	**270**	**380**	**650**

*Evaluation to be conducted by internal faculty/examiner.

Human Anatomy and Physiology -I -Theory

Paper code: BML 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:

- Definition and scope of anatomy and physiology, levels of structural organization and body systems, basic anatomical terminology.
- Structure and functions of cell
- Classification of tissues: structure and functions of **i)** Epithelial, **ii)** Muscular, **iii)** Nervous and **iv)** Connective tissue.

Module 2: Musculo Skeletal System

- Gross 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.
- Mechanism of Muscular contraction & fatigue

Module 3: Cardiovascular System

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

Module 4: Respiratory System

- Functional anatomy of the respiratory system
- Mechanism and Control of respiration
- Lung volumes and capacities transport of respiratory gases, Artificial respirations

Module 5: Digestive System

- Organs associated with Gastro Intestinal System with its functions:
- Stomach, Pancreas, liver and Gall bladder, Spleen, Intestines
- Process and phases of digestion

Textbooks and References:

1. Elements of Pharmacology, Dr. Ramesh K. Goyal, B. S. Shah Publication
2. Practical Anatomy and Physiology, 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. Textbook 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.

Human Anatomy and Physiology- I -Practical
Paper code: BML 101P

Contacts: 4P **Credits: 02**

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

CO1: Differentiate the different parts of the body.
CO2: Explain and demonstrate the structural differences between different types of muscles.
CO3: Able to Analyse the difference 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, Gallbladder, spleen, pancreas, kidney,)
- Pelvic cavity (Reproductive organs)

2. Demonstration of basic tissues of the body (from prepared slides)

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)
- Demonstration and counting of Radial pulse examination.
- Demonstration of Blood Pressure Estimation or recording

5. Demonstration of parts of respiratory system:

- Nose, pharynx and larynx, Trachea, bronchus and lungs.
- Estimation of respiration rate and forced expiration volume by spirometer

6. Demonstration of various parts of Gastro Intestinal system:

Mouth, oesophagus, stomach, intestines, liver & gall bladder, pancreas, kidney

General Biochemistry-Theory
Paper code: BML 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, structural aspects, biological importance.
- Isomers, optical activity, epimers, enantiomers, anomers, mutarotation.
- Reactions of monosaccharide, derivatives of monosaccharide, structures of disaccharides homo polysaccharides and hetero polysaccharides.
- Clinical aspects of carbohydrates.

Module 2: Lipids

- Definitions, classification, functions, chemistry and properties of fatty acids.
- Essential fatty acids, triglycerides, phospholipids, glycolipids, lipoprotein, steroids.
- Clinical aspects of lipids.

Module 3: Proteins

- Definitions, classifications, general functions and properties of amino acids.
- Structure and properties of proteins, denaturation, classification of protein.
- Plasma proteins and clinical aspects of protein.

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 ofRNA and clinical aspects of nucleic acid.
- Introduction to enzyme with IUBMB nomenclature, factors affecting enzyme activity, enzyme inhibitors, isoenzyme, alloenzyme, coenzyme & cofactors. Enzymes as markers of pathological conditions (Liver enzymes).

Module 5: Vitamins and Minerals

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

- **Minerals:** Classification, Dietary sources, daily requirement, biochemical functions &metabolism. Associated lab investigations.

Module 6: Hormones

- Introduction, classifications, mechanism of action of Insulin, clinically important hormones and associated laboratory Investigation

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. Dr. R B Bodla, Practical Biochemistry
4. Moran, L. A., Horton, R. A., Scrimgeour, K. G., & Perry, M. D. (2014). Principles of biochemistry.
5. 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.
6. Devlin, T. M. (Ed.). (2006). Textbook of biochemistry: with clinical correlations.
7. McKee, T., & McKee, J. R. (1999). Biochemistry: an introduction. WCB/McGraw-Hill.
8. Baynes, J. W., & Dominiczak, M. H. (2014). Medical Biochemistry E-Book. Elsevier Health Sciences.

General Biochemistry- Practical

Paper code: BML 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 Application of equipments 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. Use of Analytical Balance and pH meter.
2. Preparation of standard solution, % solution (v/v, w/v), Normal & Molar solution and preparation of reagent
3. pH determination by qualitative and quantitative methods.
4. Preparation of buffer: Acetate, Phosphate, Tris and Normal saline
5. Demonstration and working principal of Semi-automatic Biochemistry Analyzer
6. General reactions and identification of Mono, -Di and polysaccharides.
7. Quantitative analysis of reducing sugar (DNSA method) and protein (Biuret method)
8. Benedict's test and heat coagulation test
9. Demonstration and working principal of colorimeter
10. Demonstration and working principal of ELISA plate reader
11. Demonstration and working principal of Electrophoresis apparatus
12. Demonstration and working principal of Spectrophotometer

Fundamentals of Medical Lab Technology - Theory
Paper code: BML 103T

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

Course Overview:

This course will introduce and w i l l cover t h e general laboratory safety, identification of laboratory glassware, flask and their use in experiment, cleaning procedure, reagent preparation, blood collection techniques, safe and proper handling of medical records and medical ethics.

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 contents

Module 1: Introduction to Laboratory apparatus

- Layout of medical laboratories
- Types and working principle of micro pipettes
- Burettes, Beakers, Petri dishes.
- Flasks - different types (Volumetric, round bottom, Erlenmeyer conical)
- Funnels – different types (Conical, Buchner)
- Bottles – Reagent bottles – graduated and common, Wash bottles – different type Specimen bottles
- Measuring cylinders,– Test tubes, centrifuge tubes, test tube, Wire gauze, Bunsen burner.
- Cuvette – Bottle, Test tube, Pipette Desiccator
- Cleaning of glasswares.

Module 2: Clinical Laboratory and lab safety

- Basic laboratory principles, Code of conduct of medical laboratory personnel, Organization of clinical laboratory and role of medical laboratory technician, Common lab accidents their prevention and their first aid.
- Preparation and storage of distilled water, analytical balance
- Preparation of reagents and standard solutions, storage of chemicals.
- Bio hazards, fire hazards, chemical hazards
- Overview of Biomedical waste management

- Bio safety levels

Module 3: Phlebotomy

- Materials required for blood collection.
- Blood collection techniques (venous and capillary).
- Transportation, preservations and sampling errors.
- Home collection of blood, its preservations and safe
- Uses of anticoagulants, Process of analyzing the blood specimens, laboratory report.

Module 4: Preparation of Reagents &Characteristics of laboratory Substances

- Buffer and pH- Preparation of reagents: Normal, per cent and Molar solution, normal saline, Methods of measuring liquids (w/v, v/v).
- Danger signs and safe disposal methods of laboratory wastes.
- Cleaning and care of general laboratory glassware and equipment.
- Preparation and storage of distilled water.

Module 5- Medical Records and medical Ethics

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

Text books and References

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

Environmental Science and Health - Theory

Paper code: BML 104T

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

Course Overview:

Environmental Sciences is the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.

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

CO1: Understand the biotic and abiotic components of environment

CO2: Understand different ecosystems and their association with each other

CO3: Understand the cause and effect of pollutions on the environment

CO3: Understand the major environmental problems at global level

Course contents

Module 1: The Multidisciplinary Nature of Environmental Studies

- Natural Resources Renewable and non-renewable resources: Natural resources and associated problems **a)** Forest resources; **b)** Water resources; **c)** Mineral resources; **d)** Food resources; **e)** Energy resources; **f)** Land resources:
- Role of an individual in conservation of natural resources.

Module 2: Ecosystems

- Concept of an ecosystem, Structure (Biotic and Abiotic factors) and function of an ecosystem.
- **Dynamics of Ecosystem:** Food Chain, Food web and Ecological Pyramids. Salient features of Forest, Grassland, Desert and Aquatic ecosystem.

Module 3: Environmental Pollution and Health

- Environmental Pollution: Definition, Causes, Effects of air, water, soil, noise, thermal and nuclear pollution.
- Control and preventive measures of air, water, soil noise, thermal and nuclear.

Module 4: Global Environmental Problems

- Global Warming and Climate Change, Photochemical Smog, Ozone Layer Depletion, Acid Rain.

Textbooks and References

1. Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
3. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India.
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
5. Clark R.S., Marine Pollution, Clanderson Press Oxford
6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p
7. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
8. Down of Earth, Centre for Science and Environment

Computer Applications-Theory
Paper code: BML 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 components of personal computer, hardware and software.

CO2: Learn different operating systems, MS-WORD, MS-POWERPOINT, MS-EXCEL.

CO3: They acquire knowledge about utility of multimedia in laboratory.

CO4: Learn software used commonly in medical lab technologies.

Course contents

Module I: Introduction to computer

- Introduction, characteristics of computer, block diagram of computer, computer languages.

Module 2: Input output devices

- Input devices (keyboard, point and draw devices, data scanning devices, digitizer, electronic card reader, voice recognition devices, vision input devices), output devices (monitors, pointers, plotters, screen image projector, voice response systems).

Module 3: Processor and memory

- The central Processing Unit CPU, Main memory.

Module 4: Introduction of Operating System

- Introduction, operating system concepts, types of operating system.
- History of Windows, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows opening, closing, moving, resizing, minimizing and maximizing etc. and install different software.

Module 5: Introduction to MS Word and Power Point

- Complete menu of the MS-word, Basic shortcut keys for MS- Word.
- Introduction, creating and manipulating presentation, views, formatting and enhancing text slide with graphs

Module 6: Introduction to excel

- Introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs, macron, tables, basic formulas/ Functions (Sum, count, average, logical operators), forting and filtration, Gridlines, Merge, basic short cutkeys for MS- Excel, performing statistical analysis using Excel.

Module 7: Internet and its applications

- Definition, basic services email, File transfer protocol, telnet, the World Wide Web (WWW), www browsers, use of the internet.
- Computer networks: introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network.
- Awareness on the application of IT in Various functions of labs; Working knowledge ofcommonly used software in medical lab technologies like LIMS, Apex LIS, eLAB.

Textbooks and References

1. Fundamentals of computer by V. Rajaraman, Neeharika Adabala
2. Computer Fundamentals by Anita Goel
3. Introduction to computer Science: a textbook for beginners in informatics by Gilbert Brands

Computer Applications-Practical
Paper code: BML 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. 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
7. Creating invoice table using – MS Access 9. Drug information storage and retrieval using MS Access Creating and working with queries in MS Access
8. Exporting Tables, Queries, Forms and Reports to web pages
9. Exporting Tables, Queries, Forms and Reports to XML pages
10. Demonstartion of commonly used software in medical lab technologies like LIMS, Apex LIS, eLAB

Communication Skills
Paper code: BML 106T

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, and resume writing, business correspondence, circulars & advertisements.

CO4: Learn stress management, time management, conflict management, diversityManagement.

Course contents

Module 1: Introduction to Communication Skill

- Communication Skills-Meaning and Introduction- Process of Communication-Types of Communication-Verbal- Non-verbal -Advantages, Disadvantages.
- Body Language-Channels of Communication- Formal and Informal -Directions of Communication within organisation–Barriers to communication-Listening Skills.

Module 2: Introduction to Presentation Skill

- Presentation Skills and confidence building, Aids to Correct business Writing, Email writing, Resume writing.
- Telephone etiquettes, Group Discussion, Mind mapping, Networking skills, Facing Interviews-Mock interviews-FAQ, Stress management

Module 3: Medical interpersonal and communication skills

- Practices for effective verbal communication with patients and other healthcare providers, skills for listening and paraphrasing.
- Methods of questioning the patient, strategies for working with patients who may be angry or anxious, benefits of patient education.

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. Halliday, M.A. K R .Hasan, Cohesion in English, Longman

SEMESTER II

Semester-II

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

Human Anatomy and Physiology-II-Theory
Paper code: BML 201T

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, 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
- Autonomic Nervous system: Structures and functions Parasympathetic and Sympathetic nerves.
- Structure and functions of Neuron.
- 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. Elements of Pharmacology, Dr. Ramesh K. Goyal
2. Practical Anatomy and Physiology, 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. Gray's Anatomy, M. Berry, Lawrence H. Bannister
6. Text Book of Anatomy (3 vol.), B.D. Chaurasia
7. Textbook of Anatomy by Inderbir Singh; 4th edition; Jaypee Publications
8. McMinn's- A colour atlas of human anatomy, Mosby
9. Manual of Practical Physiology, A.K. Jain.
10. Review of Medical Physiology, Ganong
11. Text Book of Medical Physiology, Guyton, Arthur C & John E. Hall
12. A text book for Medical students, R.L. Bijlani
13. Essentials of Medical Physiology - K. Sembulingam & Prema Sembulingam

Human Anatomy and Physiology- II -Practical

Paper code: BML 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 of Eyeball, Ear, Nose, tongue, skin

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

3. Reproductive System:

A) Demonstration of various parts of female reproductive organs. Ovary, Uterus, Uterine tubes, cervix and Vagina

B) 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: BML 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, Hemocytometer and Automated cell counter. This course is designed to develop the knowledge about blood its various components, identification & analysis (Hematology) in students.

Course Outcomes: By the end of this course, the students should be able to

CO1: Understand the principles of haematology, both blood physiology and functions.

CO 2: Differentiate various haematological procedures and the use of basic equipment essential to working in a Clinical Haematology Laboratory

CO 3: Identify the various skills necessary to withdraw blood and to perform blood counts.

Course contents

Module 1: Introduction to Haematology

- Hematology: Introduction and importance of hematology.
- Blood: Definition, composition, functions of blood.
- Blood cells: Shape, size, structure and functions of blood cells.
- Hemoglobin: definition, function, synthesis and degradation

Module 2: Instrumentation in Hematology

- **Hemocytometer:** Principle, application and clinical significance.
- **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 ofblood sample; Changes during blood storage.

Module 3: Blood Components and Synthesis

- Blood cells count: Red blood cell, white blood cells, platelets, eosinophil and reticulocytecount.
- Formation of cellular components of blood (Hemopoiesis)
- Erythropoiesis
- Leucopoiesis
- Thrombopoiesis
- Introduction and clinical significance of Erythrocyte sedimentation rate (ESR), Packed Cell Volume (PCV), Buffy Coat

Module 4: Introduction to Red Cell Indices and Automated Cell Counter

- **Red Cell Indices:** Different parameters, calculations, color index and maturation index andclinical significance.
- Electrical Impedance based Automated cell counter: Principle, application and procedures.
- Introduction to Automated Haematology Analyzer (3 part/ 5 part)

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's Hematology 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's Hematology-E-Book: Clinical Principles and Applications. Elsevier Health Sciences.

Haematology-I-Practical

Paper code: BML 202P

Contacts: 4P **Credits: 02**

Course Outcomes: By the end of this course, the students should be able to

CO1: Understand haematology lab instruments and there uses lab safety measures.

CO2: Understand the estimation of haemoglobin, RBCs, WBCs their procedure principal & uses.

CO3: Learn about bleeding time, clotting time, clot retraction test.

List of Practicals:

1. Instruments & appliances for use in Hematology- Working & maintenance
2. Preparation of various anticoagulants
3. Preparation, sterilization of buffers and solutions
4. Preparation of the stains and other reagents
5. Quality control in Hematology
6. Collection of venous and capillary blood
7. Preparation of peripheral blood film
8. Estimation of hemoglobin by Sahli's method
9. Estimation of hemoglobin by cyanmethaemoglobin (CMG) method.
10. To Demonstrate/perform RBC Count
11. To Demonstrate/perform WBC Count.
12. To Demonstrate/perform blood grouping system (Slide Method).
13. Coagulation profile: bleeding time (BT) Clotting time (CT)

General Pathology –Theory

Paper code: BML 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 Outcome: After completion of this course, students would be able to:

CO1: Understand the role and scope of pathology in medical laboratory technology

CO1: Able to understand the importance of Immuno-pathology in disease biology

CO3: Understand the role and function of body fluids

Course contents

Module 1: **Introduction to Pathology**

- Introduction and scope of Pathology
- Basic Inflammation (Acute and Chronic inflammation) -
- Hepatitis
- Pathology of localized and systematic infections.
- Healing: Definition, different phases of healing, factors influencing wound healing.
- Cell death and necrosis. Thrombosis, Embolism, Ischemia and Infarction

Module 2: Basics of Chronic Infective Disorder

- Pathology of specific chronic infective disorders: Tuberculosis, Leprosy and Syphilis
- AIDS

Module 3: Immuno-pathology

- Phagocytosis
- Compliment systems
- Formation of antibody-hybridoma technology.

Module 4: Introduction to Body Fluid

- Derangement of body fluids
- Disorders of circulation (Atherosclerosis)
- Nutritional Diseases - Definition and brief discussion; Protein energy malnutrition - Marasmus, Kwashiorkor
- Vitamin deficiency disorders; Classification with specific examples
- Disorders of Mineral metabolism such as **a)** zinc, **b)** calcium

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: BasicHistopathologic 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. JohnWiley & 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.

General Pathology –Practical

Paper code: BML 203P

Contacts: 4P **Credits: 02**

Course Outcomes: By the end of this course, the students should be able to

CO1: Understand haematology lab instruments and there uses lab safety measures.

CO2: Understand the estimation of haemoglobin, RBCs, WBCs their procedure principal & uses.

CO3: Learn about bleeding time, clotting time, clot retraction test.

List of Practicals:

Demonstration

1. Identify and interpret gross and microscopic features of acute inflammations in organs such as appendix, lungs, meninges.

2. Cellular components of chronic and granulomatous inflammation.

3. Granulation tissue, callous.

4. Histopathological slides to demonstrate the various types of cell injury reversible and irreversible cell injury, calcification and extracellular accumulation.

5. Demonstration of inflammatory changes morphologically by suitable histopathological slides.

6. Types of necrosis: caseous, coagulative, liquifactive.

7. Identify and interpret gross and microscopic features of organs in commonly occurring neoplastic and non-neoplastic diseases.

Clinical Biochemistry-I-Theory

Paper code: BML 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: By the end of this course, the students should be able to:

CO1: Discuss the fundamental biochemistry knowledge related to health.

CO2: Explain the disorders due to carbohydrates and lipid metabolism, diagnosis of clinical disordersby estimating biomarkers.

CO3: Determine various substances including substrates, enzymes, hormones, etc and their use in diagnosis and monitoring of disease.

CO4: Evaluate the abnormalities which commonly occur in the clinical field.

Course contents

Module 1: Introduction to clinical biochemistry

- Introduction & Importance to clinical biochemistry
- The Role of clinical biochemistry in medicine
- Interpretation of the Clinical laboratory test data

Module 2: Disorders of carbohydrate metabolism

- **Diabetes:** types and clinical features.
- Glycogen storage diseases; Von Gierke disease
- Lactose intolerance
- **Diabetic Profile Tests and their clinical significance:** Glycosylated hemoglobin (HbA1C), Blood sugar estimation (Enzymatic and Biochemical method)

Module 3: Disorders of lipid metabolism

- Dyslipidemia, hyper and hypolipidemia, Atherosclerosis.
- Lipid profile test
- Ketosis
- Principle, assay procedure and clinical significance of cholesterol, triglycerides, HDL-Cholesterol, LDL-Cholesterol, VLDL-Cholesterol,

Module 4: Inborn Errors of metabolism

- Phenylketonuria,

- Alkaptonuria,
- Albinism
- Maple syrup urine disease,
- Glucose-6 phosphate dehydrogenase (G6PD)
- Homocystinuria.
- **Disorders of liver and kidney –** Jaundice, fatty liver, SGOT, SGPT, Liver cirrhosis, urea and creatinine clearance tests, Chronic Kidney Disease (CKD)

Module 5: Gastric Disorders

- Introduction,
- Gastric secretions,
- Peptic ulcer,
- Duodenal ulcer
- Zollinger-Ellison Syndrome

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. ElsevierHealth 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., & Stetten Jr, D. (1959). Principles of biochemistry. Principles of Biochemistry., (Edn 2).

Clinical Biochemistry-I-Practical

Paper code: BML 204P

Contacts: 4P **Credits: 02**

Course Outcomes: By the end of this course, the students should be able to:

CO1: Students can prepare plasma, serum, protein free filtrate from blood for biochemical analysis.

CO2: Students can determine blood glucose, total protein serum, blood urea, blood creatinine, serumuric acid, serum TG, blood cholesterol, blood phospholipids and ketone bodies.

CO3: Students can do glucose tolerance test, Glycosylated Hemoglobin test.

List of Practicals:

1. Preparation of Vials for blood collection and blood sample collection methods

2. Preparation of Plasma and Serum Serum/PPF

3. Test for Estimation of Glucose in Blood/Serum/Plasma.

4. Test for Estimation of / Triglyceride / Phospholipids in blood/serum

5. Test for Estimation of serum total cholesterol in blood/serum.

6. Test for Estimation of Urea, , - Uric Acid, in blood/serum

7. Test for Estimation of Total protein, Albumin in blood/serum.

8. Test for Estimation of, Creatinine / Ammonia / Non- protein nitrogen / Amino Acid Nitrogen in blood/serum.

9. Glucose tolerance test and GCT in blood/serum.

10. Test for Estimation of Glycosylated Haemoglobin in blood/serum.

11. Test for determination of serum enzyme-alkaline phosphatase

12. Methods for electrolyte Estimation.- Na, K, Cl, calcium

General Microbiology and Immunology-Theory

Paper code: BML 205T

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

Course overview

General Microbiology and immunology course contains basic concept of Microbiology, Microscopy and Microbial Pathogenicity, Sterilization and Disinfection, Culture media and Inoculation. This course is designed to develop the knowledge of Microbiology in students.

Course Outcomes: By the end of this course, the students should be able to:

CO1: Describe the structure, classification, growth and identification of variousmicroorganisms including bacteria, fungi, parasite and virus.
CO2: Describe the various disease producing organisms that includes bacteria, fungi, parasite and virus.
CO3: Describe the different methods of infection control and practices in laboratory and their role in hospital infection control program
CO4: Describe the various diagnostic tests employed in the laboratory diagnosis of diseases.
CO5: Explain the concepts and principles of immunity, hypersensitivity, Autoimmunity , and immunization.

Course Contents:

Module 1: Introduction to Microbiology

- **Microbiology:** Introduction, importance and scopes
- Contribution of Antony Van Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch
- Safety measures in microbiology.
- **Microorganisms:**
- Systems of classification - Binomial nomenclature and Whittaker's five kingdom classification
- General morphological characteristics of bacteria, viruses, fungi.
- Bacterial Cell, Growth requirements of bacteria, Bacteria Cycle.
- Bacterial genetics- plasmid, mutation, transformation, transduction and conjugation.

Module 2: General Becteriology

- Identification of Bacteria: Gram's stain; Zieh/Nelson stain; India Ink.
- List of pathogenic Gram positive and Gram negative bacteria and diseases caused by them
- **Normal micro flora:** Importance of normal flora in human body
- **Microbial Pathogenicity:** Virulence factors - antigenicity, toxicity

Module 3: Basic terminology

- Antibacterial, bactericidal, bacteriostatic and germicide agents.

- **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: Culture media

- Composition of culture media and broth, basal media, enriched media, enrichment media, selective media, differential media, transport media, anaerobic media.
- **Common Culture Media in Laboratories:** Nutrient broth; Nutrient Agar, Blood Agar, Deoxycholate citrate Agar (DCA), Chocolate Agar, Dorsett's egg media, Mac Conkey's media(MC), Lowenstein-Jensen's media
- Introduction to Pure Culture

Module 5: Introduction to Immunity

- Definition, types - Innate, acquired, local and herd immunity
- Phagocytosis
- **Antigen:** Antigen properties, structure and types; Adjuvant.
- **Antibody:** Immunoglobulin – structure, classes, properties and function; Monoclonal and polyclonal antibody.
- Introduction to Auto-immunity

Module 6: Immune Response

- Principles of Humoral and cellular immune response
- Major histocompatibility complex
- **Cell and Organs of Immune System:** Overview of Primary lymphoid organ, secondary lymphoid organ, T-lymphocytes, B-lymphocytes

Module 7: Hypersensitivity and Antigen-Antibody Reaction

- Definition and classification- Type-I, Type-II, Type-III and Type-IV
- Radio immuno assay (RIA)
- Enzyme-linked immune-sorbent assay (ELISA)
- Immunofluorescence assay.

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. Textbook Ananthnarayan & paniker
10. Texbook of Microbiology; CP baveja
11. Levinson, W., & Jawetz, E. (1996). Medical microbiology and immunology: examination and board review. Appleton & Lange.

General Microbiology and Immunology-Practical

Paper code: BML 205P

Contacts: 4P **Credits: 02**

Course Outcomes: By the end of this course, the students should be able to:

CO1: Learn the laboratory safety rules and regulation in microbiology laboratory.
CO2: Explain the usage and proper maintenance of various laboratory instruments.
CO3: Demonstrate the different types of physical methods of sterilization.
CO4: Learn the different methods of disinfection.
CO5: Prepare the media and reagents for different biochemical tests.
CO6: Performm and report the results of various biochemical tests.

List of Practicals:

1. Study of laboratory safety rules and regulation in microbiology laboratory.
2. Introduction and demonstration of Laboratory Equipment used in Microbiology
3. Demonstration of different types of physical methods of sterilization.
4. Demonstration of different methods of disinfection
5. Preparation of cotton plugs.
6. Collection and handling of specimens for microbial examination.
7. Preparation of solid and liquid culture media.
8. Pouring of the culture media.
9. Preparation of Slants.
10. Smear preparation
11. Performing simple staining, Gram staining & ZN staining
12. Performing autoclaving.
13. Disc diffusion and broth dilution methods for antibiotic susceptibility testing
14. Demonstration of disposal of Biological (Laboratory) hazards.
15. To perform rapid test.
16. Demonstration of western blotting.
17. ELISA machine demonstration and handling
18. ELFA machine demonstration & Handling
19. Immuno-diffusion

SEMESTER III

Semester-III

	Paper Code:	Subject	Periods			Credit Units	Evaluation scheme		
			L	T	P		Internal	External	Total
III	BML 301T	Haematology-II-Theory	3	1	-	4	20	80	100
	BML 302T	Systemic Bacteriology and Mycology -Theory	3	1	-	4	20	80	100
	BML 303T	Clinical Biochemistry - II-Theory	3	1	-	4	20	80	100
	BML 304T	Biomedical Instrumentation-Theory	3	1	-	4	20	80	100
	BML 301P	Haematology-II-Practical	-	-	4	2	20	30	50
	BML 302P	Systemic Bacteriology and Mycology - Practical	-	-	4	2	20	30	50
	BML 303P	Clinical Biochemistry - II-Practical	-	-	4	2	20	30	50
	BML 404P	Biomedical Instrumentation-Practical	-	-	4	2	20	30	50
Total			**12**	**4**	**16**	**24**	**160**	**440**	**600**

Haematology-II-Theory

Paper code: BML 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: By the end of this course, the students should be able to:

CO1: Differentiate various haematological procedures and the use of basic equipment essential to working in a Clinical Hematology Laboratory.

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

CO3: Explains the pathogenesis and laboratory diagnosis of different types of anaemia and leukemia.

Course Contents:

Module 1:

- **Blood cell disorders:** Morphological disorders of Blood cells
- Physiological variation of erythrocytes, leucocytes and thrombocytes
- **Bone Marrow:** Introduction, processing and significance.

Module 2: Introduction to Anemia

- **Anemia:** Introduction, Pathogenesis, Causes, Sign and symptoms of anemia.
- Types of Anemia
- Laboratory diagnosis of iron deficiency anemia, pernicious anemia, megaloblastic anemia, aplastic anemia.

Module 3: Haemolytic Anaemia

- Pathogenesis and laboratory diagnosis of thalassemia and sickle cell anemia
- Blood transfusion
- Hemolytic disease of newborn

Module 4: Leukemia

- Definition, classification, causes and Clinical features
- Introduction and laboratory diagnosis of Acute myeloid leukemia (AML)
- Chronic myeloid leukemia (CML)
- Acute lymphocytic leukemia (ALL)
- Chronic lymphoid leukemia (CLL)

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's Hematology and Oncology of Infancy and Childhood E- Book. Elsevier Health Sciences.

Haematology-II-Practical
Paper code: BML 301P

Contacts: 4P **Credits: 02**

Course Outcomes: By the end of this course, the students should be able to:

CO1: Perform experiments on TLC, DLC, PCV, AML, CML, CLL by different methods.

CO2: Perform tests for haemolytic and haemorrhagic anaemia

List of Practicals:

1. To demonstrate/ perform Differential Leukocyte Count (DLC)
2. To Demonstrate Complete Blood Count (CBC)
3. Demonstration of Acute myeloid leukaemia (AML) slide
4. Demonstration of Chronic myeloid leukaemia (CML) slide
5. Demonstration of Acute lymphocytic leukaemia (ALL) slide
6. Demonstration of Chronic lymphoid leukaemia (CLL) slide
7. Demonstration of malarial parasites
8. Identification of Antigen (Ag)/Antibody (Ab) by rapid kit methods
9. To perform Total Lymphocyte Count (TLC)
10. Demonstration of abnormal blood cells (microcytic, macrocytic, hypochromic anemia).

Systemic Bacteriology and Mycology-Theory

Paper code: BML 302T

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

Course Overview

The course will provide students with an introduction to the theory and practical of Clinical bacteriology and mycology. Specifically, it will equip students with an appreciation of the role of the clinical Bacteriology and mycology for diagnosis and management of common diseases. Specific topics covered will include: Introduction of Bacteriology, Staining technique and Biochemical reaction, Gram positive bacteria, Gram negative bacteria and miscellaneous bacteria.

Course Outcomes: By the end of this course, the students should be able to:

CO1: Apply the knowledge to understand the microbial physiology and to identify the microorganisms.

CO 2: Understand the basic microbial structure and function and understand the structural similarities and differences among various physiological groups of bacteria.

CO 3: Comprehend the various methods for identification of unknown microorganisms. Knowledge of various culture media and their applications.

CO 4: Understand the basic structure of fungi, laboratory diagnosis of various fungal infections.

Course Contents:

Module 1: Introduction to Systemic Bacteriology

- Introduction, Classification and Control of Nosocomial infections.

Biochemical tests

- **Gram Positive Bacteria:** Catalase Test, Coagulase Test
- **Gram Negative Bacteria:** Oxidase Test, IMViC Test, Sugar Fermentation Test

Module 2: Gram Positive Bacteria

- **Morphology And Pathogenicity of** *Staphylococcus aureus, Streptococcus pneumoniae, Bacillus anthracis, Corynebacterium diphtheriae, Clostridium tetani*
- **Acid Fast Bacteria:** *Mycobacterium tuberculosis*

Module 3: Gram Negative Bacteria

- **Morphology And Pathogenicity of** *Escherichia coli, Klebsiella Pneumoniae, Salmonella typhi, Vibrio cholerae, Haemophilus influenza* and *Helicobacter pylori.*

Module 4: Mycology

- General properties, morphology, And classification of fungi
- Types of mycoses
- Laboratory diagnosis of fungal infections

- Types of Media for fungus (Sabouraud's Dextrose Agar (SDA), Brain Heart Infusion (BHI), Potato Dextrose Agar (PDA)

Module 5: Common Fungal Infections

- Dermatophytosis (Ringworm)
- Candidiasis
- Histoplasmosis
- Blastomycosis
- Cryptococcosis
- Aspergillosis

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.
3. Levinson, W., & Jawetz, E. (1996). Medical microbiology and immunology: examination and board review. Appleton & Lange.
4. 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.
5. Goldman, E., & Green, L. H. (Eds.). (2008). Practical handbook of microbiology. CRC press.
6. Cappuccino, J. G., & Sherman, N. (2005). Microbiology: a laboratory manual (p. 507). San Francisco: Pearson/Benjamin Cummings.

Systemic Bacteriology and Mycology-Practical

Paper code: BML 302P

Contacts: 4P **Credits: 02**

Course Outcomes: By the end of this course, the students should be able to:

CO1: Students can do biochemical test for bacterial differentiation.

CO2: Students can examine fungi from skin scrapping and culture techniques.

CO3: Various serological tests for bacterial diseases.

List of Practicals:

1. To perform Serial Dilution with Streak plate, Pour plate and Spread plate method
2. Demonstration/perform of Acid-fast staining
3. Demonstration/perform of anaerobic culture techniques
4. Demonstration/perform of Serological tests for detection of bacterial diseases
5. Antimicrobial susceptibility test.
6. Demonstration of Skin scrapping technique
7. Fungal potassium hydroxide (KOH) mount and LCB
8. Demonstration of Fungal culture techniques
9. Demonstration of Germ tube test
10. Identification of dermatophytes
11. Demonstration of microscopic features of common pathogenic fungi
12. Demonstration of Carbohydrate Utilization test

Clinical Biochemistry-II-Theory

Paper code: BML 303T

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

Course Overview:
The course will provide students with an introduction to the basic outline of metabolic processes as applicable to organ systems, composition, functions of various body fluids.

Course Outcomes: By the end of this course, the students should be able to:

CO1: Describe collection of urine specimen and processing of sample.

CO2: Understand the concept about sodium, potassium, chloride, calcium etc. Their role in treatmentand diagnosis of disease

CO3: They will get knowledge about fat soluble and water soluble vitamins, daily requirements, Physiological function and diseases due to vitamin deficiency, their biochemical estimations.

CO4: They can perform chemical analysis of different body fluids also quantitatively determine sugar,proteins and chlorides in specific samples.

Course contents

Module 1: Clinical Importance of Urine

- **Urine:** Composition of Urine (normal and abnormal constituents)
- **Sample collection:** Spot urine and 24 hour
- **Routine examination of Urine:** Specific gravity, detection of protein, reducing sugar, ketone bodies, bile pigment, bile salts, Urobilinogen and blood in Urine.

Module 2: Clinically Important Minerals

- **Iron:** Source, functions, absorption, Clinical significance
- **Sodium, Potassium, Chlorides:** Source, functions, absorption, Clinical Importance
- **Calcium and Phosphorous:** Source, functions, absorption, Clinical Importance

Module 3: Vitamins

- **Fat and Water soluble Vitamins**: Chemistry, sources, RDA , Biochemical role and Deficiency.

Module 4: Cerebro Spinal Fluid (CSF) and Other Body Fluids

- **Cerebro Spinal Fluid (CSF):** Chemical composition and Physical examinations
- Estimation of sugar, protein and chloride
- Clinical significance and importance of Synovial, Pleural, Peritoneal, Pericardial, Amniotic fluid.

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., & Stetten Jr, D. (1959). Principles of biochemistry. Principles of Biochemistry., (Edn 2).

Clinical Biochemistry-II-Practical

Paper code: BML 303P

Contacts: 4P **Credits: 02**

Course Outcomes: By the end of this course, the students should be able to:

CO1: Understand the normal and abnormal constituents of urine.

CO2: Students can estimatechloride in Urine, Urea, Creatinine, Uric Acid, Aminoacids, Ammonia, Keto acids in Urine.

CO3: Students can estimate the Na, K, Cl, Lithium, Ionised calcium in serum samples.

CO4: Understand the principle and working of autoanalyzer.

List of Practicals:

1. Quantitative analysis of Bilirubin in blood.
2. Qualitative detection of normal and abnormal constituents of Urine.
3. Quantitative analysis for Urine protein / Bence-Johne's protein
4. Quantitative analysis of Reducing sugars
5. Quantitative of analysis, Urea/Creatinine/Uric Acid/ Amino acids, Ammonia, Keto acids in Urine.
6. Study /Estimation of sugar, protein and chloride from Cerebro Spinal Fluid (CSF), plural fluid, peritoneal fluid, amniotic fluid - foam test.
7. Estimation of Ketone bodies in blood /urine.
8. Study of test for inborn errors of Amino Acid metabolism in Urine.
9. Estimation of Vitamin A, C, E/ Metabolites of Vitamins in serum /Urine (B complex)
10. Methods for electrolyte estimation -Na, / K, / Cl, calcium in serum/urine
11. Test for determination of serum enzyme-alkaline phosphatase, SGOT, SGPT
12. Diagnostic equipment- Autoanalyzer (Demonstration)

Biomedical Instrumentation-Theory
Paper code: BML 304T

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

Course Overview:

This course will introduce and cover the basics of microscope, general equipments use in microbiology, Immunology and molecular biology as well as about the handling and knowledge of animal models in the laboratory.

Course Outcomes: By the end of this course, the students should be able to:

CO1: Understand the concept, importance and types of microscopes.

CO2: Understand the importance of pH in microbiology and their method of measurement

CO3: Learn about the principle, working and uses of different instruments used in laboratory.

CO4: Understand the handling care and maintenances of laboratory experimental animals:

Course contents

Module 1: Microscopy

- **Study of Compound Microscope –** Magnification, Numerical aperture, Resolution and Components of Microscope.
- **Types of Microscopes:** Bright field, Dark field, Phase contrast

Module 2: pH Measurement and Its Application

- Methods for measurements of pH.
- pH meter: Principle, components, working.
- Oxidation –reduction (redox) potential.

Module 3: General Instrumentation

- **Principle, Working and Uses of:** Distillation plant, Centrifuge Machine, Analytical Balance, Hotplate, Magnetic stirrer, water bath, Autoclave, incubator, Laminar Air Flow,

Module 4: Instruments Used In Immunology and Molecular biology

- Electrophoresis
- Immunodiffusion
- Chromatography
- Enzyme Linked Immuno Sorbent Assay (ELISA) Reader
- automatic washer and
- Radioimmunoassay (RIA)
- Chemiluminescence immunoassay (CLIA)
- Thermocycler

- Real Time-Polymerase Chain Reaction (RT PCR)
- Concept of Western blotting
- Concept of Flow Cytometer

Module 5: Animal Handling and Care

- **Handling, Care and Maintenances of Various Experimental Animals-** Rabbits, Mice, Rats, Hamsters and Monkeys- Their Data, Cages, Feeding and Handling.

Textbooks and References:

1. A. Sarah Jane Pitt, James M. Cunningham, "An Introduction to Biomedical Science in Professional and Clinical Practice?, John Wiley & Sons, 6 April 2009 Medical. B.
2. Barbara H. Estridge, Anna P. Reynolds, Norma J. Walters, "Basic Medical Laboratory Techniques", Cengage Learning, 2000. C.
3. "Research Training in the Biomedical, Behavioural and Clinical Research Sciences" National Academics Press, 28 Feb 2011.

Biomedical Instrumentation-Practical

Paper code: BML 304P

Contacts: 4P **Credits: 02**

Course Outcomes: By the end of this course, the students should be able to:

CO1: Understand the principle, working and uses of Electrophoresis, Starplate, Chromatography, ELISA reader, automatic washer and RIA. CLIA, thermocycler RT PCR, Centrifuge Machine

CO2: Understand the principle, working and uses of Analytical Balance, Hotplate, Magnetic stirrer, water bath, Automatic dispensers, and Diluters or de iodizer etc. Autoclave incubator,Hot Air Oven, Laminar Air Flow, Autoanalyser.

List of Practicals:

Demonstration

1. Safe and proper handling of equipments used in Immunology and molecular biology
2. Micro pipette, Serological pipette and Steri Pipette
3. Hot plate, Analytical Balance, Magnetic Stirrer, Water Bath
4. Autoclave, Incubator, Hot Air Oven and pH meter
5. Centrifuge machine (Refrigerated, Non-refrigerated, Out-swing, Ultracentrifuge)
6. Laminar Air Flow and Bio-safety cabinet
7. Electrophoresis (Horizontal and Vertical) and Western Blotting
8. Polymerase Chain Reaction (PCR) and RT-PCR
9. Enzyme Linked Immuno-Sorbent Assay (ELISA) plate reader and washer
10. Semi-automatic Biochemistry Analyzer
11. Chromatography (Paper, TLC)

SEMESTER IV

Semester-IV

	Paper Code:	Subject	Periods			Credit Units	Evaluation scheme		
			L	T	P		Internal	External	Total
IV	BML 401T	Parasitology /Entomology and Virology Theory	3	1	-	4	20	80	100
	BML 402T	Clinical Pathology and Cytology Theory	3	1	-	4	20	80	100
	BML 403T	Diagnostic Biochemistry Theory	3	1	-	4	20	80	100
	BML 404	Lab Accreditation and Management	3	1	-	4	20	80	100
	BML 401P	Parasitology /Entomology & Virology Practical	-	-	4	2	20	30	50
	BML 402P	Clinical Pathology and Cytology Practical	-	-	4	2	20	30	50
	BML 403P	Diagnostic Biochemistry Practical	-	-	4	2	20	30	50
Total			**12**	**4**	**12**	**22**	**140**	**410**	**550**

Parasitology/Entomology and Virology-Theory
Paper code: BML 401T

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

Course Overview:

This course will cover importance of parasites, vectors and viruses in relation to human diseases. Clinical importance and control of the diseases spread through the above microorganisms will be discussed in this paper.

Course Outcomes: By the end of this course, the students should be able to:

CO1: Understands the role of parasitic disease causing & their laboratory diagnosis as well as general morphology, culture characteristics and classification of parasites.

CO2: Salient features of helminths and their classification and also knows the differences between clinical and non-clinical related parasites.

CO3: Understand the introduction and classification of medically important insects/vectors.

Course contents

Module 1: Introduction of Parasitology

- Introduction to clinical parasitology,
- General characteristics, morphology and classification of parasites and hosts
- Relationship between parasites and host
- Mode of transmission of parasitic infections

Module 2: Introduction to Protozoology

- **Protozoology:** Morphology, life cycle, pathogenicity, prevention and lab diagnosis of *Entamoeba histolytica, Trichomonas vaginalis*, *Leishmania donovani*, Giardia, *Plasmodium falciparum* and *Wucheria bancrofti*.

Module 3: Introduction to Helminthology

- **Helminthology:** Morphology, pathogenicity and lab diagnosis of-

i) **Platyhelminthes:** *Taenia solium, T. seginata,* Schistosoma, *Fasciola hepatica*

ii) Nemathelminths: Ascaris, Ancylostoma, Trichurias

iii) Pin Worm (Enterobius)

Module 4 Medically Important Insects/Vectors

Medical Importance and Control of: Anopheles, Culex, Aedes, Sand flies

Module 6: Introduction To Clinically Important Ticks/Mites/Bugs

- **Medical Importance and Control of:** Phlebotomine sandflies (Phlebotominae),

Bed bugs (cimicidae), Cockroaches (Blattaria), Soft ticks (Argasidae), Scabies mites (sarcoptidae)

Module 7: Introduction to Virology

- Medical importance of HIV, Viral hepatitis, Rabies (Rhabdo virus), Herpes viruses, Influenzaviruses, , Poliomyelitis, Dengue, Chikungunya viruses
- Introduction to collection, transportation, and storage of clinical samples
- Molecular methods for virus diagnosis (RT-PCR).

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.

Parasitology/Entomology and Virology- Practical
Paper code: BML 401P

Contacts: 4P **Credits: 02**

Course Outcomes: By the end of this course, the students should be able to:

CO1: Students can identify different disease causing Arthopods (Housefly, Mosquito etc). They can learn whole mount preparation technique of slide of different disease causing arthropods, Helminth and Protozoan for their detailed anatomical studies.

CO2: Students can identify the different phases of life cycle of arthropods, protozoa, helminth having medical importance for causing disease

CO3: Students can identify microfilaria, Taenia solium, ascaris and different stages of malaria.

CO4: Rapid test for the diagnosis of different viral disease by ELISA.

List of Practicals:

1. Demonstration of model of Culex, aedes, anophilies, sand.
2. Demonstration of blood smears for malaria and their identification
3. Demonstration of Stool examination (concentration : Formol Ether Technique, Zinc Sulphate Flotation technique)
4. Demonstration of Identification of helminths
5. Good Laboratory Practices of virology laboratory.
6. Demonstration of cultivation of viruses
7. To perform rapid test for the diagnosis of viral disease.
8. Demonstration of Leishmania parasite's promastigote culture.
9. Demonstration of DAT (Direct Agglutination Test) for evaluation of parasite infection.
10. Demonstration of molecular diagnosis (PCR/RT-PCR) of parasite infection.
11. Demonstration of ELISA.

Clinical Pathology and Cytology -Theory

Paper code: BML 402T

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

Course Overview:

To develop the knowledge about collection, transportation, handling, physical, chemical and microscopic examination of various clinical sample like urine, stool, CSF and body fluids.

Course Outcomes: By the end of this course, the students should be able to:

CO1: Knowledge about collection procedure of urine, stool, semen specimen and preservation of these specimens.
CO2: Students will learn about physical and microscopic examination of urine.
CO3: They learn about procedure of chemical test of urine for glucose, protein, ketone bodies, bilirubin, urobilinogen and blood.
CO4: Students will study about laboratory investigation procedure of serous fluid and gastric juice.
CO5: Students will learn about collection and processing of CSF and its laboratory investigation

Course contents

Module 1: Urine Analysis

- Introduction, Collection, Handling, Transportation, Preservation and Storage of urine
- Physical, Chemical and Microscopic examinations with clinical significance

Module 2: Stool, Semen and Sputum Analysis

- **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.
- **Sputum examination:** Physical, chemical and microscopic examination with clinical significance

Module 3: Other Body Fluids

- **Cerebro Spinal Fluid (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 4: Cytology

- Collection, preservation, transportation and processing of cytological specimens (Sputum, Bronchial brush, Esophageal and gastric brush, oral scraping, Breast aspiration.

- **Cytological Stains:** Introduction, Composition of Cytological Stains; Giemsa stain, Periodic Acid-Schiff (PAS) stain, Haematoxylin and eosin stain, Ziehl-Neelsen stain.

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. Sheehan, C. (1997). Clinical immunology: principles and laboratory diagnosis.

3. Haven, M. C., Tetrault, G. A., & Schenken, J. R. (Eds.). (1994). Laboratory instrumentation. John Wiley & Sons.

4. Saliterman, S. S. (2006). Fundamentals of BioMEMS and medical microdevices. Bellingham, WA: Wiley-Interscience.

5. Baker, F. J., & Silverton, R. E. (2014). Introduction to medical laboratory technology. Butterworth-Heinemann.

6. Burtis, C. A., & Bruns, D. E. (2014). Tietz fundamentals of clinical chemistry and molecular diagnostics-e-book. Elsevier Health Sciences.

7. Kottke-Marchant, K., & Davis, B. (Eds.). (2012). Laboratory hematology practice (p. 509). John Wiley & Sons.

8. Psillos, D., & Niedderer, H. (Eds.). (2006). Teaching and learning in the science laboratory (Vol. 16). Springer Science & Business Media.

9. Webster, J. G., & Clark, J. W. (1995). Medical instrumentation: application and design (Vol. 200). John Wiley & Sons.

10. McPherson, R. A., & Pincus, M. R. (2017). Henry's Clinical Diagnosis and Management by Laboratory Methods E-Book. Elsevier Health Sciences.

11. Mahon, C. R., Lehman, D. C., & Manuselis, G. (2018). Textbook of diagnostic microbiology-e-book. Elsevier Health Sciences.

Clinical Pathology and Cytology- Practical

Paper code: BML 402P

Contacts: 4P **Credits: 02**

Course Outcomes: By the end of this course, the students should be able to:

CO1: To determine bleeding time, cloting time and prothromin time.

CO2: To determine Hb by haemoglobinometer.

CO3: Student can do physical and microscopic examination of urine and stool. Peripheral blood smear examination and reporting

List of Practicals:

1. To determine the Bleeding Time
2. To determine the Clotting Time
3. To perform Prothrombin Time
4. Demonstration/Perform of Activated Partial Thromboplastin Clotting Time (APTT)
5. Demonstration of platelet count
6. Demonstration of Haemoglobin estimation
7. Demonstration of RBC count.
8. Demonstration of Histopathological Instruments.
9. Preparation of various types of reagents used in Histopathology
10. Routine urine examination.

Diagnostic Biochemistry-Theory

Paper code: BML 403T

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: By the end of this course, the students should be able to:

CO1: Students will understand various diagnostic profiles such as Liver function test, pancreatic tests, thyroid tests etc.

CO2: Students will be able to understand accurate laboratory results in a timely manner as well assafeguard experimental controls and knowledge about calibration of laboratory instruments.

Course Contents

Module 1: Introduction to Haem and Bilirubin Metabolism

- **Introduction and Clinical Importance:** Bilirubin formation and excretion, conjugated and un conjugated bilirubin, normal and abnormal values and clinical importance of serum bilirubin

Module 2: Introduction to Liver Function Tests

- Introduction, normal ranges and clinical significance of albumin, aspartate transaminase, Alanine transaminases, alkaline phosphatase, , total, direct, Indirect bilirubin, gamma glutamyl transpeptidase

Module 3: Introduction to Pancreatic Function Test and Overview of Diabetes

- Introduction, normal ranges and clinical significance of Amylase, lipase
- **Diabetes**: Introduction types of diabetes, role of Insulin and glucagon, biochemical ranges of oral glucose tolerance tests and glycosylated hemoglobin (HbA1C)

Module 4: Introduction to Thyroid Function Test and Infertility Profile

- **Thyroid Function Test:** Total Triiodo thyronine (T3), Total Thyroxine (T4), Thyroid stimulating hormone (TSH) and their clinical significance
- **Infertility Profile:** Testosterone, Estrogen, Progesterone, Prolactin, Oxytocin, Leutinizing Hormone (LH), Follicle Stimulating Hormone (FSH), clinical significance

Textbooks and References

1. Moran, L. A., Horton, R. A., Scrimgeour, K. G., & Perry, M. D. (2014). Principlesof 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., & Stetten Jr, D. (1959). Principles of biochemistry. Principles of Biochemistry., (Edn 2).

Diagnostic Biochemistry-Practical

Paper code: BML 403P

Contacts: 4P **Credits: 02**

Course Outcomes: By the end of this course, the students should be able to:

CO1: Students will have skills to perform various diagnostic profiles, operation of Lab informationsystems and reporting.

CO2: They can also quantitatively determine liver function and kidney function tests in samples.

CO3: They can determine cardiac function tests, diabetic profile in blood samples.

List of Practicals

1. Estimation of serum albumin and A:G ratio.
2. Estimation of serum Alkaline Phosphatase (ALP)
3. Estimation of SGPT.
4. Estimation of SGOT.
5. Estimation of direct Bilirubin Total Bilirubin
6. Demonstration of serum amylase
7. Demonstration of serum lipase.
8. Demonstration of triiodothyronine hormone.
9. Demonstration of tetraiodothyronine hormone.
10. Estimation of Oral Glucose Tolerance Test (OGTT)
11. Demonstration of Haemoglobin A1c (HbA1C)
12. Demonstration of Electrocardiogram (ECG)

Lab Accreditation and Management-Theory

Paper code: BML 404T

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

Course Overview:

This course will introduce the general laboratory accreditation, guideline and quality assurance required for understanding good laboratory practice (GLP).

Course Outcome: By the end of this course, the students should be able to:

CO1: Students will understand importance of National Accreditation Board for Testing and Calibration Laboratories (NABL) as well as concept of laboratory design

CO2: Students will understand the significance of quality management and assurance in laboratory

CO3: Student will learn the concept and importance of safety measure in the laboratory

Course contents

Module 1: Introduction to National Accreditation Board for Testing and Calibration Laboratories (NABL)

- National Accreditation Board for Testing and Calibration Laboratories (NABL) guidelines and accreditation process

Module 2: Laboratory Design

- **Basic Concept of Laboratory Organization:** Location, space requirement, light, ventilation, temperature control, electrical supply, water supply, sanitation, noise control, Use of fume hood/safety hood Partition of the section, floor management, standard size of working area.
- **Introduction to Different Sections of Lab:** list of different labs and basic tests performed. List different instruments in each labs and their functions Laboratory work flow: Description of work flow in lab- Specimen collection, specimen organization, transport, testing and reporting of the results

Module 3: Total Quality Management And Quality Assurance

- Define TQM (Total quality management), QA (quality assurance) and QC (quality control).
- Define accuracy, precision, sensitivity and specificity
- Introduction to Internal quality control, errors (pre analytical, analytical and post analytical), use of controls.
- Introduction to External quality assurance scheme
- **Basic Concept of Medical Ethics:** Medical ethics and its principles. Confidentiality. Ethical consent

Module 4: Laboratory Safety

- Fire, chemical, radiation and infection control (body substance precautions),

- Hazardous waste and transport of hazardous materials
- **Maintenance of Records:** Procedure manuals, ward manuals, quality control programs, patient data retrieval;

Textbooks and References:

1. Accreditation Board for Testing and Calibration Laboratories (NABL) guidelines (https://nabl-india.org/)
2. Guidelines for Laboratory Design: Health, Safety, and Environmental Considerations, 4th Edition; Publisher-Wiley.
3. A Key Concepts of Total Quality Management, By S. Muthu Vijaya Pandian, Publisher Notion Press.
4. Medical ethics byRobert M. Veatch Published by Jones and Bartlett Publisher.
5. Manual of basic techniques for a health laboratory, 2nd ed World Health Organization. (WHO) / (https://apps.who.int/iris/handle/10665/42295).
6. **Chemical Safety in The Laboratory by K. Hall,** Publisher **Taylor & Francis**.
7. Handbook of Clinical Laboratory Techniques By P.S. Ajmani Publisher AITBS Publishers & Distributors.
8. Manual of Laboratory Safety By: Najat Rashid (Author) , Ramnik Sood (Author) | Publisher: Jp Medical Ltd.

SEMESTER V

Semester-V

	Paper Code:	Subject	Periods			Credit Units	Evaluation scheme		
			L	T	P		Internal	External	Total
V	BML 501T	Histopathology and Cytology-Theory	3	1	-	4	20	80	100
	BML 502T	Immunohematology and transfusion Medicine-Theory	3	1	-	4	20	80	100
	BML 503T	Applied Microbiology-Theory	3	1	-	4	20	80	100
	BML 504T	Genetics and Genomics	3	1	-	4	20	80	100
	BML 501P	Histopathology and Cytology-Practical	-	-	4	2	20	30	50
	BML 502P	Immunohematology and transfusion Medicine-Practical	-	-	4	2	20	30	50
	BML 503P	Applied Microbiology-Practical	-	-	4	2	20	30	50
	BML 504P	Genetics and Genomics	-		4	2	20	30	50
Total			**12**	**4**	**16**	**24**	**160**	**440**	**600**

Histopathology and Cytology-Theory
Paper code: BML 501T

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

Course Overview:

Histopathology and Cytology course contains introduction of Histopathology, Tissue processing, Embedding, Microtome and Mounting and Staining procedure in Histopathology. This course is designed to develop the knowledge of Histopathology in students.

Course Outcomes: By the end of this course, the students should be able to:

CO1: Apply the basic knowledge of histopathology and cytology in laboratory.

CO2: Perform the techniques and staining procedure in histopathology and cytology.

Course contents

Module 1: Introduction to Histopathology

- **Grossing:** Introduction, histological specimens, labeling and reporting.
- **Fixation:** Definition**,** classification, properties, composition, advantages and disadvantages offixatives; Post chroming.
- **Decalcification:** Importance, decalcifying agent**,** composition, advantages and disadvantages.

Module 2: Understanding Tissue processing in Histopathology

- **Tissue processing:** Definition, importance, steps, dehydrating agents and dehydration process, clearing agents and clearing process.
- **Embedding:** Embedding media, water soluble embedding media;

Module 3: Microtome in Histopathology

- **Microtome:** Definition, types, care and use of microtome; Microtome knife, honing and stropping; Technique for sectioning, paraffin embedded tissue, frozen section; Errors insectioning and remedies.

Module 4: Introduction to Mounting and Staining

- **Mounting:** Mounting media, advantages and disadvantages
- **Staining:** Hematoxylin and eosin staining; Specific stain for connective tissue.

Module 5: Cytology

- Solvents, Mordents, Accelerators and Accentuators
- Meta chromasia and Metachromatic dyes
- Museum technique.
- Exfoliative Cytology, Fine Needle Aspiration Cytology (FNAC), Pap/Smear and Cervical cytology Techniques
- Applications and interpretation of results.

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: BML 501P

Contacts: 4P **Credits: 02**

Course Outcomes: By the end of this course, the students should be able to:

CO1: The student should be able to apply the basic knowledge of histopathology and cytology in laboratory.

CO2: The student should perform the techniques and staining procedure in histopathology and cytology.

List of Practicals:

1. Demonstration of Histopathological Instruments: Laboratory Microscopes, Paraffin wax bath, slide warmer, Microtomes, Automatic Tissue Processor
2. Demonstration of use of Microtome
3. Preparation of various types of reagents used in Histopathology
4. To perform Gram's staining
5. Demonstration of Acid fast staining
6. To perform Giemsa staining
7. To perform Hematoxylin -eosin staining
8. Demonstration of Acute Myeloid Leukaemia (AML) slide
9. Demonstration of Chronic Myeloid Leukaemia (CML) slide
10. Demonstration of Chronic Lymphocytic Leukaemia (CLL) slide

Immunohematology and Transfusion Medicine-Theory
Paper code: BML 502T

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

Course Overview:

Immunohematology and Blood Transfusion course contains basic concept of Blood group system, Phlebotomy and blood storage, Blood transfusion, and artificial blood, Advances in transfusion medicine. This course is designed to develop the knowledge of Immunohematology and Blood Transfusion in students.

Course Outcomes: By the end of this course, the students should be able to:

CO1: Students can learn about principle of blood grouping. Blood collection procedure and storage of blood.

CO2: They also get knowledge about transmission of disease in relation to blood transfusion. Students will get knowledge about storage of blood and its transfusion.

CO3: Students can acquire knowledge about preparation of reagents for blood banking.

CO4: They also learn storage procedure of fractionation of blood. They will learn the criteria for blood donation.

Course contents

Module 1: Introduction to Blood Grouping

Blood group system

- Introduction and history of blood group systems
- ABO blood group system
- Rh system
- Blood group Antigens and Antibody
- Bombay group

Module 2: Introduction to Phlebotomy and Blood Storage

- Introduction to 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

Module 3: Blood transfusion

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

Module 4: Blood banking

- Organization and operation of blood donation camp
- Quality control in blood banking
- **Advances in transfusion medicine:** Cord blood bank, Automation, Working of blood collection machine.

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. Sheehan, C. (1997). Clinical immunology: principles and laboratory diagnosis.
4. Psillos, D., & Niedderer, H. (Eds.). (2006). Teaching and learning in the science laboratory (Vol. 16). Springer Science & Business Media.
5. Webster, J. G., & Clark, J. W. (1995). Medical instrumentation: application and design (Vol. 200). John Wiley & Sons.
6. McPherson, R. A., & Pincus, M. R. (2017). Henry's Clinical Diagnosis and Management by Laboratory Methods E-Book. Elsevier Health Sciences.
7. Mahon, C. R., Lehman, D. C., & Manuselis, G. (2018). Textbook of diagnostic microbiology-e-book. Elsevier Health Sciences.

Immunohematology and transfusion Medicine-Practical
Paper code: BML 502P

Contacts: 4P **Credits: 02**

Course Outcomes: By the end of this course, the students should be able to:

CO1: Students can determine 'ABO' blood grouping and 'Rh' typing.

CO2: Students can test Antigen – Antibody reaction.

CO3: They can able to perform quantitative assay of Immunoglobins in plasma (IgG, IgM)

List of Practicals:

1. Various instruments used in blood bank
2. Demonstration of Storage of different blood products
3. To perform coagulation profile
4. Preparation of pooled cells
5. To perform forward typing of ABO and Rh
6. To prepare different concentration cell suspensions
7. Demonstration/Perform of Hb determination
8. To perform Red Blood Cell (RBC) count
9. To perform white blood cell (WBC) count
10. To perform Bleeding time
11. Demonstration/perform of direct Coomb's test
12. Demonstration/perform of reverse typing of ABO blood group system

Applied Microbiology-Theory
Paper code: BML 503T

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

Course Overview:

Applied microbiology course gives an overview of the infections caused by the microorganisms and their analysis. It will also cover about the collection and handing of microbiological samples.

Course Outcomes: By the end of this course, the students should be able to:

CO1: Students will get an idea about specimen collection and handling in microbiological laboratoryand safety regulation of the laboratory

CO2: They will learn microscopic examination techniques, culture media and quality control in microbiology.

CO3: Students will gain their knowledge about diagnostic bacteriology. They are introduced to basicand advanced methods used in the field of diagnostic Microbiology

Course contents

Module I: Applied Microbiology

- Microbiological examination of body fluids and laboratory diagnosis of common infections
- Urinary tract infection
- Respiratory infections
- Genital infections
- Diarrhea and Dysentery
- Food Poisoning
- Blood infection
- Meningitis

Module 2: Diagnostic Microbiology

- Microbial analysis of food and water
- Immuno diagnostics: Application and uses, Enzyme Immunoassay/Enzyme Linked Immunosorbent Assay (EIA/ELISA), Immuno Diffusion; Gel Electrophoresis; Immuno Fluorescent Assay (IFA)
- **Polymerase Chain Reaction (PCR):** Uses and applications,
- **Reverse Transcriptase- Polymerase Chain Reaction (RT PCR):** Uses and applications
- **Bio-Medical Waste (BMW):** Laboratory disposal; Decontaminations; Disinfections
- Cleaning and maintenance of equipments & glassware disinfection
- Proper collection, Anticoagulation, Preservation and Methods of Transportation of various specimens and materials for laboratory exams
- Quality Control

Textbooks and References:

1. Greenwood D., Slack, R, Barer, M.R. & Irving, W.L. (2012). Medical Microbiology E-Book: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and control.
2. Levinson, W. & Jawetz E. (1996). Medical Microbiology and immunology: examination and board review. Appleton& Lange
3. Hart, C.A. & Shears, P. (1996). Color atlas of medical microbiology (No. C QR46 H37 2004). Mostly-Wolfie.
4. L.M. Prescott (2002). Microbiology

Applied Microbiology-Practical

Paper code: BML 503P

Contacts: 4P **Credits: 02**

Course Outcomes: By the end of this course, the students should be able to:

CO1: Students will get an idea about specimen collection and handling in microbiological laboratoryand safety regulation of the laboratory.

CO2: To understand the handling and microbial examination of urine, respiratory, stool, genitalsecretions.

CO3: To understand the handling and microbial examination of blood, bone marrow and Cerebro Spinal Fluid (CSF) samples.

List of Practicals:

1. To demonstrate/perform microbiological examination of Urine
2. To demonstrate/perform microbiological examination of Respiratory samples
3. To demonstrate/perform microbiological examination of Genital secretions
4. To demonstrate/perform microbiological examination of stool and vomitus
5. To demonstrate/perform microbiological examination of Blood, Bone marrow aspirate & CSF
6. Microbial analysis of food and water
7. To demonstrate/perform microbiological examination of pus, aspirates and swabs
8. Demonstration of ELISA Gel Electrophoresis
9. Demonstration of Polymerase Chain Reaction (PCR)
10. **Bio-Medical Waste (BMW):** Laboratory disposal; Decontaminations; Disinfections
11. To demonstrate/perform Cleaning and maintenance of equipments & glassware disinfection

Genetics and Genomics - Theory

Paper code: BML 504T

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

Course Overview:

This course will provide preliminary concept of heredity, chromosomal basis of inheritance, microbial genetics, human genetics and molecular genetics.

Course Outcomes: By the end of this course, the students should be able to:

CO 1: Discuss the different methods available to study genetics

CO 2: Describe genes structure, chromosomes and proteins

CO 3: Describe the different methods of genetic testing

CO 4: Demonstrate Knowledge and practical skills of molecular genetic analysis of geneticdiseases.

Course contents

Module 1: Introduction to Mendelian Genetics

- **DNA as a genetic material-** its structure, chemical composition and replication
- Structure of RNA and its role in protein synthesis
- Vectors
- Plasmids
- Concept of genes and chromosomes
- Mendel's Laws of Inheritance
- Mitosis, Meiosis (explaining Mendel's ratios)
- Chromosome theory of inheritance
- Sex linked inheritance.
- Linkage and crossing over

Module 2: Introduction to Mutations

- **Chromosomal Mutations:** Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy.
- **Gene Mutations:** Induced versus Spontaneous mutations
- Molecular Basis of Mutations in relation to UV light and chemical mutagens

Module 3: Genetic Variation and Genome Dynamics

- Conjugation, Transformation, Transduction, Recombination.
- Cell Cycle

Module 4: Introduction to Genomics, Proteomics and Bioinformatics

- Human Genome Project
- Gel Electrophoresis
- Western Blotting
- National Centre for Biotechnology Information (NCBI)
- Concept of Primer designing

Module 5: Genomic Analysis

- **Concept of Population and Evolutionary Genetics:** Hardy-Weinberg Law, role of natural selection, mutation, genetic drift.

Textbooks and References:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). VIII ed. Principles of Genetics.Wiley India.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. XI

Genetics and Genomics-Practical

Paper code: BML 504P

Contacts: 4P **Credits: 02**

Course Outcomes: By the end of this course, the students should be able to:

CO1: Understand the concept of molecular biology

CO2: To able to prepare different buffers and solutions required in study of genetics and molecular biology

CO3: To be able to learn about the techniques used in molecular genomics study.

List of Practicals:

1. Demonstration of Molecular Modelling- Nitrogenous bases, Nucleosides, Nucleotides using bead and stick method.
2. Preparation of different buffers and solutions: 50X TAE, 1 M Tris-HCl (pH 8), 10 N NaOH, 1N HCl
3. Demonstration of DNA isolation from blood.
4. Demonstration of RNA isolation from blood by Trizol method.
5. Demonstration of DNA/RNA quality through spectrophotometry method.
6. Demonstration of Horizontal gel electrophoresis for genomic DNA separation.
7. Demonstration of Primer designing for gene amplification
8. Demonstration of amplification of gene by PCR (Polymerase Chain Reaction).
9. Demonstration of gel documentation system for DNA gel image capture
10. Demonstration of gene expression by RT-PCR

SEMESTER VI

Semester-VI

	Paper Code:	Subject	Periods			Credit Units	Evaluation scheme		
			L	T	P		Internal*	External	Total
VI	BML 601	Research Methodology and Biostatistics Theory	3	1	-	4	20	80	100
	BML 602	Internship Report	-	-	-	6	-	150	150
		Internal Assessment	-	-	--	6	150*	-	150*
		Viva-voce	-	-	-	4	-	100	100
Total			3	**1**		**20**	**170**	**330**	**500**

Internship Duration: 16 weeks

S. No	Lab	Duration (weeks)
1	Biochemistry	3
2	Blood Bank	3
3	Pathology/Histopathology	3
4	Microbiology	3
5	Radiology	2
6	Cardiology/Any Other	2
	Total	**16**

Research Methodology and Biostatistics

Paper code: BML 601

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

Course Overview:

The course introduces the concepts of research, ethical principles and challenges and the elements of the research process within quantitative, qualitative, and mixed methods approaches. The rigorous curriculum prepares students to become leading public health professionals capable of addressing current global health problems with multidisciplinary, evidence-based approaches. Students will use these theoretical learnings to review literature relevant to their field or interests.

Course Outcomes: By the end of this course, the students should be able to:

CO1: They will get concept about Research and its type.

CO2: Students will gain a concept of hypothesis and basic idea about project formation.

CO3: Students will learn the method of data collection and to draw an experimental design. Students will learn statistical analysis method.

Course contents

Module 1: Basics of Research

- Definitions & Uses of Research in Healthcare,
- Steps Involved in Research Process
- Variables in Research
- Formulation of Research Problems

Module 2: Sampling and Research Designs

- Sampling, Sampling Procedure, types of Sampling Techniques
- Overview of Research Designs

Module 3: Review of Literature & Hypothesis and Data Collection

- Sources of Literature Review,
- Hypothesis- Meaning and types
- **Different Methods of Data Collection-** Observation method, Interview method, Questionnaire.

Module 4: Introduction to Biostatistics

- Classification of Data
- Source of Data

Scales of measurement- Nominal, Ordinal,Ratio and Interval scale

Module 5: Measures of central tendency measures of dispersion and correlation

- **Measures of Central Tendency-** Mean, Median, Mode
- **Measures of Dispersion –** Range, Mean deviation & Standard deviation
- Definition, types of correlation, degrees of correlation

Module 6: Project Proposal and Research Report Writing

- Proposal workplan
- Structure and Components of Research Report,
- Types of Reports
- Layout of Research Report

Textbooks and References:

1. B.K. Mahajan. Methods in Biostatistics, Jaypee Brothers
2. P.S.S. Sundar Rao. An Introduction to Biostatistics: A manual for students in HealthSciences, J.Richard Prentice Hall, 1996.
3. Daniel, Wayne.W. Bio-Statistics: A foundation for Analysis in the Health Sciences, JohnWiley and Sons Pub, 1991.
4. K. Vishwas Rao. Bio-Statistics: A Manual of statistical methods for use in the Health,Nutrition and Anthropology, Jaypee Brothers Medical Pub, 1996.
5. Verma B.L., Shukla G.D. Bio-Statistics perspective in Health care research and practice,
   C.B.S. Pub, 1993.
6. Krishnaiah, P.K. Rao, C.R. (ed), Handbook of Statistics, Elsevier Science Pub, 1988.
7. Beri - Business Statistics (Tata Mc Graw Hill 2nd Edition).
8. Chandan J S - Statistics for Business and Economics (Vikas 1998.Ist Edition).
9. Render and Stair Jr - Quantitative Analysis for Management (Prentice-Hall, 7th edition)
10. Sharma J K - Business Statistics (Pearson Education 2nd Edition).
11. Gupta C B, Gupta V - An Introduction to Statistical Methods (Vikas1995, 23rd Edition).