

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 Structure, Course Curriculum

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.

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
	BML103	Fundamentals of Medical Lab Technology	2	1	-	3	20	80	100
	BML 104	Environmental Science and Health	2	1	-	3	20	80	100
	BML105 T	Computer Applications Theory	2	-	-	2	50*	-	50*
	BML106	Communication Skills	2	-	-	2	50*	-	50*
	BML 101P	Human Anatomy and Physiology -I Practical	-	-	4	2	20	30	50
	BML 102P	General Biochemistry Practical	-	-	4	2	20	30	50
	BML105 P	Computer Applications Practical	-	-	4	2	50*	-	50*
Total			14	4	12	24	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	BML 201T	Human Anatomy and Physiology -II Theory	3	1	-	4	20	80	100
	BML 202T	Haematology-I – Theory	2	1	-	3	20	80	100
	BML 203T	General Pathology – Theory	2	1	-	3	20	80	100
	BML 204T	Clinical Biochemistry -I-Theory	2	1	-	3	20	80	100
	BML 205T	General Microbiology and Immunology-Theory	2	1	-	3	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			11	5	20	26	200	550	750

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 304P	Biomedical Instrumentation-Practical	-	-	4	2	20	30	50
Total			12	4	16	24	160	440	600

Semester-IV

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

Semester-V

Semester	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	2	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			11	4	16	24	160	440	600

Semester-VI

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

Project duration: 16 weeks

S.No	Lab	Duration (weeks)
1	Biochemistry	3
2	Haematology	4
3	Pathology/Histopathology	3
4	Microbiology	3
5	Others	3
	Total	16

SEMESTER-I

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
	BML103	Fundamentals of Medical Lab Technology	2	1	-	3	20	80	100
	BML 104	Environmental Science and Health	2	1	-	3	20	80	100
	BML105 T	Computer Applications Theory	2	-	-	2	50*	-	50*
	BML106	Communication Skills	2	-	-	2	50*	-	50*
	BML 101P	Human Anatomy and Physiology -I Practical	-	-	4	2	20	30	50
	BML 102P	General Biochemistry Practical	-	-	4	2	20	30	50
	BML105 P	Computer Applications Practical	-	-	4	2	50*	-	50*
Total			14	4	12	24	270	380	650

*Evaluation to be conducted by internal faculty/examiner.

Human Anatomy and Physiology -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 skeletal system.

CO3: Explain the structure and functions of cardiovascular system, respiratory system and digestive system.

Course contents:

Module 1: Introduction to human Anatomy & Physiology:

- Parts of human body, Major body divisions.
- Terminology - Anatomical landmarks, regions & directions, terms of positions, body movements.
- Basic tissues of the body (Gross structure and functions)
a) Epithelial tissue b) Connective tissue c) Muscular tissue d) Nervous tissue

Module 2: Musculo Skeletal System

- Gross structure, function and classification of skeletal system
- Bones of appendicular and axial skeleton (Names and brief description)
- 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.
- Blood Pressure: Apparatus used and recording of blood pressure.
- Lymph and lymphatic organs. (Gross structure, function, clinical importance & applications).

Module 4: Respiratory System

- Functional anatomy of the respiratory system
- Mechanism of Respiration, Exchange of Respiratory gases and Control of respiration,
- lung volumes and capacities, Artificial respirations
- Respirometer: Procedure, clinical applications & Importance

Module 5: Digestive System:

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

Text and References

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

Human Anatomy and Physiology- Practical

Paper Code BML 101P

Contacts: 4P

Credits :02

Course Overview

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

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

CO1: Demonstrate the different parts of the body.

CO2: Explain and demonstrate the structural differences between different types of muscles.

CO3: Analyse the 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 structural differences between: (from prepared slides)

Skeletal muscle, Smooth muscle and Cardiac muscle

5. 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)

6. Demonstration of Radial pulse examination.

7. Demonstration of Blood pressure Estimation or recording

8. Demonstration of parts of respiratory system:

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

9. Demonstration of various parts of Gastro Intestinal system:

Mouth, esophagus, 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 the different types of biomolecules, their classification, and functions in the body.

CO2: Gain knowledge and understanding of biochemistry, structure and function of biological molecules.

CO3: Prepare the solutions in different concentration as per the requirement in the biochemistry laboratory.

CO4: Describe the various instruments used in biochemistry lab.

Course contents

Module 1 : Carbohydrates:

Definitions, chemistry, functions, classifications, structural aspects, biological importance, isomers, optical activity, epimers, enantiomers, anomers, mutarotation, reactions of monosaccharide, derivatives of monosaccharide, structures of disaccharides, homopolysaccharides and heteropolysaccharides and clinical aspects of carbohydrates.

Module 2 : Lipids:

Definitions, functions, classification chemistry and properties of fatty acids, essential fatty acids, triglycerides, phospholipids, glycolipids, lipoprotein, steroids and clinical aspects of lipids.

Module 3 : Proteins:

Definitions, general functions, classifications 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 of RNA 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.

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, secondary messengers, role of various hormones, clinically important hormones

Text 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.

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 equipment used in biochemistry lab.

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

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

List of Practicals:

1. Uses of Analytical balance, preparation of standard solutions, % solutions (V/V, W/V normal and molar solutions and preparation of reagents.
2. General reactions and identification of carbohydrates glucose, fructose, maltose, lactose and starch.
3. General reaction of proteins, colour reaction and precipitation of proteins- albumin, casein, gelatin, peptone.
4. Acidimetry and alkalimetry
5. pH determination using colorimetric methods and using pH meter.
6. Preparation of buffers : acetate ,phosphate and tris buffers and measurement
7. Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose, , dextrin, starch and glycogen.)
8. Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method)
9. Reactions of Amino acids, colour reactions of albumin, globulin, casein, gelatin and peptone.
10. Benedict's test and Heat Coagulation tests.

Paper Code: BML 103

Contacts : 2L+1T

Crédits : 03

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 Objectives :

- To Identify and enumerate the different kinds of medical Laboratories and to explain the role of medical laboratory services.
- To introduce the laboratory rules, ethics, professional code of conduct and polices.
- To describe the practice of collection, handling and shipment of medical laboratory specimens.

Course Contents :

Module 1 : Introduction to Laboratory apparatus

- Classification and structure of medical laboratories
- Types, working principle and handling of micro pipettes
- Burettes, Beakers, Petri dishes, depression plates.
- Flasks - different types)Volumetric, round bottmed, Erlemeyer conical etc.,)
- Funnels – different types (Conical, Buchner etx.,)
- Bottles – Reagent bottles – graduated and common, Wash bottles – different type Specimen bottles etc.,
- Measuring cylinders, Porcelain dish Tubes – Test tubes, centrifuge tubes, test tube draining rack Tripod stand, Wire gauze, Bunsen burner.
- Cuvette holders Racks – Bottle, Test tube, Pipette Dessicator, Stop watch, rimers, scissors Dispensers – reagent and sample
- Any other apparatus which is important and may have been missed should also be covered.

Module 2 :Clinical Laboratory and lab safety

- Clinical laboratory design and layout, Classification of medical laboratories
- 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.
- Cleaning and care of general laboratory glassware and equipment
- 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, preservations and sampling errors. Home collection of blood, its preservations and safe transportation of blood sample, transportation and preservation of biological fluids, Uses of anticoagulants, Process of analysing the 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. The chemical composition, structure, and properties of substances, chemical processes, the use of chemicals and their interactions, danger signs, preparation techniques, and safe disposal methods, Cleaning and care of general laboratory glassware and equipment, Preparation and storage of distilled water, analytical balance

Module 5- Medical Records and medical Ethics

Definition, Medical Record Forms and their Content, Incomplete Record Control, Utility & functions of Medical Records in Laboratories, Reports & returns in Medical Record System. Medical ethics- Definition, Goal, Scope; 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, Medical ethics and its principles, Informed consent.

Text and References

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

Environmental Science and Health

Paper Code BML 104

Contacts: 2L+1T

Credits: 03

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

CO1: Understand technologies on the basis of ecological principles and environmental regulations which in turn help in sustainable development.

CO2: Understand the structure and function of an ecosystem.

CO3: Understand about different types of pollution and its impact on human health.

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 and function of an ecosystem, Introduction, types, characteristic features, structure and function of the ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Module 3: Environmental Pollution

Air pollution; Water pollution; Soil pollution.

Module 4: Various biological standards, including WHO guidelines for third world countries.

Text 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, Clarendon 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

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), sorting and filtering, Gridlines, Merge, basic short cut keys 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 of commonly used software in medical lab technologies like LIMS, Apex LIS, eLAB.

Text 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

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. Demonstration of commonly used software in medical lab technologies like LIMS, Apex LIS, eLAB

**Communication Skills
Paper Code BML 106**

Contacts: 2L

Credits: 02

Course Overview:

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

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

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

CO2: Learn the body language and develop listening skills.

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

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

Course Contents:

Module 1:

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:

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

Text and References:

1. Sharan J.Gerson and Steven M.Gerson – “Technical Writing – Process and Product” – Pearson Education – 2000.
2. Raymond V.Lesikar, John D. Pettit and Mary E.Flatley – Lesikass Basic Communication Tata McGraw Will 8th Edition – 1999.
3. Stevel. E. Pauley, Daniel G.Riordan – Technical Report Writing Today – AITBS Publishing & Distributors, India 5th edition – 2000.

4. Robert L. Shurter, Effective letters in business Third Ed. 1983.
5. Communication Skills by Vasantha Patri
6. McGraith – Basic Managerial Skills for all Prentice Hall of India – 6th Edition 2002.
7. Halliday, M.A. K R .Hasan, Cohesion in English, Longman, London 1976.

SEMESTER II

Semester-II

	Paper Code:	Subject	Periods			Credit Units	Evaluation scheme		
			L	T	P		Internal*	External	Total
II	BML 201T	Human Anatomy and Physiology -II Theory	3	1	-	4	20	80	100
	BML 202T	Haematology-I – Theory	2	1	-	3	20	80	100
	BML 203T	General Pathology – Theory	2	1	-	3	20	80	100
	BML 204T	Clinical Biochemistry -I- Theory	2	1	-	3	20	80	100
	BML 205	General Microbiology and Immunology-Theory	2	1	-	3	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			11	5	20	26	200	550	750

Human Anatomy and Physiology-II-Theory

Paper Code BML 201T

Contacts: 3L+1T

Credits: 04

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

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

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

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

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

CO4: Explain the anatomy and physiology of endocrine system, Categorizes endocrine organs, 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
- Pathophysiology of renal disease and edema
- Glomerular Filtration Rate.

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 Neurone.
- Transmission of nerve impulse

Module 5: Endocrine Glands

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

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: 2L+1T

Credits: 03

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 hematology, both blood physiology and functions.

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

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

Course Contents

Module 1:

Hematology: Introduction and importance of hematology.

Blood: Definition, composition, functions of blood.

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

Module 2:

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

Abnormal hemoglobin

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

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

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

Module 3:

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

Erythrocyte sedimentation rate(ESR): Mechanism, methods, factors influencing and clinical significance.

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

Buffy coat: Preparation of buffy coat and its application.

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

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

Module 4:

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

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

Automated cell counter: Principle, application and procedures.

Text 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., & Thelml, 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 their 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:

Demonstrations

1. Instruments & appliances for use in Haematology- 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 Haematology

Practicals

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 perform RBC Count.
11. To perform WBC Count.
12. To perform platelet Count.
13. To perform blood grouping system.
14. To perform DLC.
15. Coagulation profile: bleeding time (BT) Clotting time (CT), and clot retraction test (CRT)

General Pathology -Theory

Paper Code BML 203T

Contacts: 2L+1T

Credits: 03

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

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

CO1:Demonstrate an understanding of essential basic pathological processes including cell death and injury, inflammation, thrombosis.

CO 2:Acquire the ability to relate these essential basic pathological processes to the pathogenesis of common and important diseases.

CO3:Demonstrate an understanding of the predisposing factors, causes, pathogenesis, morphology and potential complications of such diseases.

Course Contents

Module 1

Basic Terminologies: Inflammation, Acute inflammation - vascular event, cellular event, inflammatory cells. Chronic Inflammation - general features, granulomatous inflammation, tuberculoma. 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

Pathology of specific chronic infective disorders: Tuberculosis, Leprosy and Syphilis
Immunity: Definition, types and determinations of innate immunity and its mechanism.

Module 3

Phagocytosis, Compliment systems, Formation of antibody-hybridoma technology. Study of microbes responsible for pathogenesis of tumors and their oncogenesis.

Module 4

Derangement of body fluids, Disorders of circulation, AIDS and Hepatitis, Adaptive Disorders of Growth.

Text 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.

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 about the inflammation process in various organs.

CO2: Explain the various types of cell injuries, calcification and inflammatory changes.

CO3: Describe about the types of necrosis, features of neoplastic and non-neoplastic diseases.

List of Practical:

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: 2L +1T

Credits: 03

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 disorders by 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:

Disorders of carbohydrate metabolism: Diabetes: types and clinical features. Glycogen storage diseases, pentosuria, galactosemia, fructose & Lactose intolerance.

Diabetic Profile Tests and their clinical significance: Glycosylated hemoglobin (HbA1C), fructosamine test in serum, Oral and Intravenous Glucose tests, Various methods of blood sugar estimation and collection, and galactose tolerance tests, glycogen storage diseases.

Module 2:

Disorders of lipid metabolism : Dyslipoproteinemia –Hypolipoproteinemia, hyperlipoproteinemia, Abetalipoproteinemia Atherosclerosis and sphingolipidosis.

Lipid profile test. Ketosis. Principle, assay procedure and clinical significance of cholesterol, triglycerides, HDL-C, LDL-C, VLDL-C, Friedwalds equation. Obesity, Atherosclerosis

Module 3:

Inborn Errors of metabolism – Phenylketonuria, alkaptonuria, albinism, tyrosinosis, maple syrup urine disease, Lesch-Nyhan syndrome, sickle cell anemia, histidinemia. Homocystinuria. Disorders of liver and kidney – Jaundice, fatty liver, normal and abnormal functions of liver and kidney. Inulin, urea and creatinine clearance tests.

Module 4

Gastric function Test: Introduction, gastric secretions, total and free acid, stimulation test, physical & chemical examination of gastric secretions. Acid base balance - pH, Buffers, Henderson Hassel balch equation, maintenance of pH, Acidosis, Alkalosis. Arterial blood gas analysis.

Text 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-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, serum uric 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
2. Preparation of Plasma and Serum Serum/PPF
3. Estimation of Blood/Serum/Plasma of Glucose
4. Estimation of Cholesterol, Triglyceride, Phospholipids, serum total cholesterol
5. Estimation of Urea, Total protein, Albumin, - Uric Acid, Creatine, Creatinine, Ammonia, Non- protein nitrogen, Amino Acid Nitrogen
6. Glucose tolerance test and GCT
7. Estimation of Glycosylated Haemoglobin

General Microbiology and Immunology-Theory

Paper Code BML 205T

Contacts: 2L+1T

Credits: 03

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 various microorganisms 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:

Microbiology: Introduction, importance and scopes, contribution of Antony Van Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch and Joseph Lister; golden era of microbiology; safety measures in microbiology.

Microorganisms: Classification and taxonomy; Classification and morphological characteristics of bacteria, viruses, fungi, protozoa and helminthes.

Introduction to microbes, source of infection, models of spread, bacterial Cell, growth requirements of bacteria, bacteria Cycle.

Bacterial genetics- plasmid, mutation, transformation, transduction and conjugation.

Module 2:

Microscopy: Principle, parts, working, care and maintenance of compound, dark ground, fluorescent, phase contrast and electron microscope.

Identification of Bacteria : Morphology Principle and staining procedures; Gram's stain; Ziehl-Neelsen stain; Modified ZN Staining; Albert Stain

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, bacterial enzymes,

Infection: Classification, sources, mode of transmission and portal of entry.

Module 3:

Basic terminology: Antibacterial, bactericidal, bacteriostatic and germicide agents.

Sterilization: Definition and classification; Methods of Sterilization procedures, Techniques and uses, Parts, working, care and handling of autoclave, hot air oven and laminar air flow; Sterilization indicators and calibration of equipments.

Disinfection: Definition, types, mode of action, properties and use of disinfectants and antiseptics, efficiency testing of disinfectants.

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; Peptone water media, Hiss's serum water, Thioglycolate transport media, Agar Media, Nutrient Agar, Blood Agar, Deoxycholate citrate Agar (DCA), Chocolate Agar, Loeffler's media, Dorsett's egg media, MacConkey's media (MC), Lowenstein-Jensen's media, Blood Potassium tellurite media, TC BS media, Bile salt Agar (BSA) media, Nucleic-Hinton media, Sabouraud's media

Inoculation: Pouring, spreading, streaking, stroke, stab, slant and anaerobic culture methods; Colony characteristics.

Basic Principles of antibiotic susceptibility method of sensitivity testing

Module 5:

Immunity: Definition, types - Innate, acquired, local and herd immunity, opsonization and phagocytosis, relationship between innate and acquired immunity, vaccine and immunization.

Antigen: Antigen properties, structure and types; Adjuvant.

Antibody: Immunoglobulin – structure, classes, properties and function; Monoclonal and polyclonal antibody.

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, cytokines, TNF, Interferon

Module 7: Hypersensitivity and Antigen Antibody Reaction

Definition and classification- Type-I, Type-II, Type-III and Type-IV.

General properties and types of antigen antibody reaction, precipitation reaction, agglutination reaction, complement fixation test, neutralization test, radio immuno assay (RIA), enzyme-linked immune-sorbent assay ELISA and immunofluorescence assay.

Text 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. Textbook 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

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: Perform 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. Sterilization of heat labile fluids, glass wares, liquids, plastic and other laboratory and hospital wares
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 – ASO, CRP, RA, VDRL.
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, collection, processing, indications and significance.

Module 2:

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

Module 3: Haemolytic Anaemia: Pathogenesis and laboratory diagnosis of hereditary spherocytosis, hereditary elliptocytosis, thalassemia and sickle cell anemia; other types of anemia- Glucose -6-phosphate dehydrogenase deficiency, pyruvate kinase deficiency, paroxysmal nocturnal haemoglobinuria, warm antibody type, cold antibody type, incompatible blood transfusion, hemolytic disease of newborn.

Module 4:

Leukemia: Introduction, causes, sign & symptoms, classification and laboratory diagnosis;
Haemopoiesis- cell maturation -myeloid and lymphoid leukemia

Text 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., & Thiel, 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 hemolytic and hemorrhagic anemia

List of Practicals

1. To perform DLC
2. To perform GBP
3. Demonstration of AML slide
4. Demonstration of CML slide
5. Demonstration of CLL slide
6. Demonstration of CLL slide
7. Preparation of thick blood smear
8. Demonstration of malarial parasites
9. Determination of Ag and Ab by rapid kit methods
10. To perform TLC
11. To perform tissue processing
12. Demonstration of abnormal blood cells.
13. Demonstration of microcytic and hypochromic anemia.
14. Demonstration of macrocytic and normochromic anemia.
15. Demonstration of hemolytic anemia.
16. Demonstration of hemorrhagic 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:

Biochemical test: Catalase, coagulase, oxidase, indole, MR, VP, citrate, urease and triple sugar iron agar, OF, Sugar fermentation and amino acid tests

Media Preparation

Module 2: Gram positive bacteria:

Habitat, Morphology; Antigenic classification structure cultural characteristics, biochemical reactions enzymes; Toxins; Pathogenicity, serology, sensitivity tests of: Staphylococci, Streptococci, Pneumococcus, Enterococcus, Bacillus, Corynebacterium, Clostridia, Mycobacterium, Actinomycetes and Listeria.

Module 3 Gram negative bacteria:

Habitat, Morphology; Antigenic classification structure cultural characteristics, biochemical reactions enzymes; Toxins; Pathogenicity, serology, sensitivity tests of: Neisseria gonorrhoeae, Neisseria meningitides, Escherichia coli, Shigella, Klebsiella, Proteus, Yersinia,

Salmonella, Vibrio, Aeromonas, Pseudomonas, Campylobacter, Bacteroides, Fusobacterium, Brucella, Haemophilus, Bordetella and Helicobacter pylori.

Module 4: Miscellaneous bacteria: Morphology, pathogenicity, lab diagnosis and prophylaxis of: Spirochetes, Rickettsiae, Chlamydia and Mycoplasma.

Module 5: Mycology

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

Media preparation for fungus

Module 6: Common fungal infections

Dermatophytes, candidiasis, mycetoma, rhinosporidium, sporotrichosis, histoplasmosis, blastomycosis, coccidioidosis, paracoccidioidosis, cryptococcosis, aspergillosis, penicilliosis, zygomycosis and pneumocystis.

Text 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.

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.

1. To perform streak plate method
2. To perform pour plate method
3. To perform spread plate method or carpet culture
4. To perform Acid fast staining
5. Identification of medically important bacteria from pure culture: Staphylococcus, Streptococcus, E.coli, Klebsiella.
6. Demonstration of anaerobic culture techniques
7. Serological tests for detection of bacterial diseases
8. Antibiotic susceptibility protocols for Pathogenic bacteria. Introduction to CLSI guidelines
9. Skin scrapping technique
10. Fungal KOH mount
11. Fungal culture techniques
12. Germ tube test
13. Identification of dermatophytes
14. Mycrosopic features of common pathogenic fungi

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 treatment and 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:

Urine : Composition of normal and abnormal constituents Sample collection –spot urine and 24 hour Routine examination of Urine, Specific gravity, reactions, detection of protein, reducing sugar, ketone bodies, bile pigment, bile salts, Urobilinogen and blood in Urine.

Urinary screening for Metabolic inherited diseases

Module 2:

Iron Metabolism- Source, functions, absorption, transport, storage, clinical significance.
Sodium, Potassium, Chlorides- Source, functions, Deficiency, Clinical Importance
Calcium and Phosphorous- Source, functions, absorption, Clinical Importance
Fluoride, Magnesium, Copper-Clinical Importance

Module 3:

Vitamins and Co-enzymes: Vitamins- water soluble-Chemistry, sources, RDA, Biochemical role ,Deficiency and assay. Vitamins Fat soluble-chemistry, sources, RDA, biochemical role, Deficiency, toxicity and assay. Estimation of Vitamin A, C, E and B.

Module 4:

C.S.F and other body fluids: Physical and chemical examinations. Estimation of sugar, protein and chloride .Composition and Chemical analysis of Synovial, Pleural, Peritoneal, Pericardial, Amniotic fluid etc . Estimation of sugar, protein and chlorides in CSF

Text 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 estimate chloride 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.

1. Qualitative detection of normal and abnormal constituents of Urine.
2. Quantitative analysis for Urine protein, Bence-Johne's protein, Reducing sugars and chloride in Urine, Urea, Creatinine, Uric Acid, Aminoacids, Ammonia, Keto acids in Urine.
3. Estimation of sugar, protein and chloride from C.S.F., plural fluid, peritoneal fluid, amniotic fluid - foam test.
4. Estimation of Ketone bodies in blood and urine.
5. Estimation of Vitamin A,C,E and Metabolites of Vitamins in Urine (B complex)
6. Tests for inborn errors of Amino Acid metabolism in Urine.
7. Methods for electrolyte estimation.-Na, K, Cl, Lithium, Ionised calcium
8. Diagnostic equipment- Autoanalyzer,

Biomedical Instrumentation-Theory
Paper Code BML 304T

Contacts: 3L +1T

Credits: 04

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

CO1: Understand the components of compound microscope. Understand the types of microscopy.

CO2: Understand the pH, methods to measure pH.

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 microscopy: Bright field, Dark field, Phase contrast, Fluorescent and electron microscope. Preparation of smear for electron microscope. Micrometry.

Module II

Importance of pH in Microbiology: Methods for measurements of pH. pH meter: Principle, components, working. Preparation of solution, dilution and chemistry of suspension fluids. Oxidation –reduction (redox) potential.

Module III

General Instrumentation: principle, working and uses of: Distillation plant, Centrifuge Machine, Analytical Balance, Hotplate, Magnetic stirrer, water bath, Automatic dispensers, and Diluters or de iodizer etc. Autoclave incubator, Hot Air Oven, Laminar Air Flow, Colony Counter, Muffle Furnace

Module IV

Instruments used in Immunology and Molecular biology: Electrophoresis, Immunodiffusion, starplate, chromatography, ELISA reader, automatic washer and RIA. CLIA, thermocycler, RT PCR

Module V

Handling care and Maintenances of laboratory experimental animals: general direction for the care of animals, material inoculated, necroscopy, common diseases and experimental procedures. Various experimental animals- rabbits, guineapigs, mice, rats, hamsters, fowls and monkeys- their data, cages, feeding and handling.

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 of

1. Instruments used in Immunology and Molecular biology
2. Electrophoresis,
3. Starplate,
4. Chromatography,
5. ELISA reader, automatic washer and RIA.
6. CLIA, thermocycler
7. RT PCR
8. Centrifuge Machine
9. Analytical Balance, Hotplate
10. Magnetic stirrer, water bath
11. Automatic dispensers, and Diluters or de iodizer etc.
12. Autoclave incubator,
13. Hot Air Oven
14. Laminar Air Flow
15. Autoanalyser

SEMESTER IV

Semester-IV

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

The objective of this course is to

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

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, classification of hosts and vectors, relationship between parasites and host, mode of transmission of parasitic infections.

Module 2

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

Module 3:

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

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

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

Module 4:

Introduction of Entomology: Introduction, Definition and classification of medically important insects/vectors, Medical importance of entomology in relation clinical microbiology.

Module 5

Introduction to mosquitoes: External Morphology, Medical Importance and Control of: Anophilinae, Culicinae, Culex, Aedes, Haemagogus, Sabethes, Mansonia, Coquillettida, Psorophora

Module 6

External Morphology, Medical Importance and Control of: Flies: Morphology, Medical Importance and Control of: Black flies (Simuliidae). Phlebotomine sandflies (Phlebotominae), Bugs, Ticks, Mites and Cockroaches: Morphology, Medical Importance and Control of Bed bugs (cimicidae), Cockroaches (Blattaria), Soft ticks (Argasidae), Hard ticks (Ixodidae), Scabies mites (sarcoptidae), Scrub typhus mites (Trombiculidae), Miscellaneous mites.

Module 7: Virology

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

Module 8: Clinically important virus

Human immunodeficiency viruses, viral hepatitis, rabies virus, herpes viruses, influenza viruses, rubella, mumps, measles, rota virus, poliomyelitis, japanese encephalitis, dengue, chikungunya, human onocogenic viruses and kysanur forest disease.

Text 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.

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 Arthropods (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.

1. Identification of parasites of medical importance dealt in the theory
2. Demonstration of Culex, aedes, anophilies, sand fly , Tse Tse fly, fleas and lice.
3. Collection of blood and preparation of thin and thick smears
4. Staining of blood smears for blood parasites
5. Examination of blood smears for malaria and microfilaria and their identification
6. Identification of arthropods of Medical importance dealt in the theory. Identification up to genera of common vectors of Malaria, Filariasis, Japanese. Encephalitis and Dengue.
7. Stool examination- concentration and wet mount preparation
8. Demonstration of helminths
9. Cultural Studies
10. Laboratory rules and regulation of virology laboratory.
11. Demonstration of cultivation of viruses
12. Determination of IgG and IgM class antibodies to herpes simplex virus by ELISA
13. Determination of Hepatitis virus of different antigens by ELISA
14. Determination of HIV antibodies in human serum or plasma.
15. To perform rapid test for the diagnosis of different viral disease.

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; other specific tests and 24 hrs urine analysis

Module 2

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

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

Module 3:

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

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

Recommended books:

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, clotting time and prothrombin 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

1. To determine the Bleeding Time
2. To determine the Clotting Time
3. To perform Prothrombin Time
4. To perform APTT
5. To perform platelet count
6. To perform Haemoglobin estimation
7. To perform RBC count.
8. To perform Cross Matching
9. Demonstration of Histopathological Instruments.
10. Preparation of various types of reagent used in Histopathology
11. Routine urine examination.
12. Examination of faeces, detection of occult blood in stool

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 have skills to perform various diagnostic profiles such as Liver function test, pancreatic tests, thyroid tests etc.

CO2: Operation of Lab information systems and Reporting.

CO3: Students will be able to provide accurate laboratory results in a timely manner as well as safeguard experimental controls, calibrate laboratory instruments.

Course contents

Module 1:

Haem catabolism and bilirubin metabolism :

Bilirubin formation and excretion, Conjugated and un-conjugated bilirubin.

Normal and abnormal values and clinical importance of serum bilirubin.

Module 2:

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

Module 3: Pancreatic function test

Amylase, lipase, insulin, glucagon, clinical conditions.

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

Diabetes profile: Oral glucose tolerance test and HbA1c.

Module 4: Thyroid function test and Infertility profile

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

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

Text and References

9. Moran, L. A., Horton, R. A., Scrimgeour, K. G., & Perry, M. D. (2014). Principles of biochemistry.
10. 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.
11. Devlin, T. M. (Ed.). (2006). Textbook of biochemistry: with clinical correlations.
12. McKee, T., & McKee, J. R. (1999). Biochemistry: an introduction. WCB/McGraw-Hill.
13. Baynes, J. W., & Dominiczak, M. H. (2014). Medical Biochemistry E-Book. Elsevier Health Sciences.
14. In, E. C. (1997). Textbook of biochemistry with clinical correlations.
15. Varley, H. (1954). Practical clinical biochemistry. Practical clinical biochemistry.
16. 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 information systems 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.

1. Estimation of serum albumin and A:G ratio.
2. Estimation of serum ALP.
3. Estimation of SGPT.
4. Estimation of SGOT.
5. Estimation of direct Bilirubin Total Bilirubin, ALP
6. Estimation of serum amylase
7. Estimation of serum lipase.
8. Estimation of triiodothyronine hormone.
9. Estimation of tetraiodothyronine hormone.
10. Estimation of OGTT.
11. To perform HbA_{1c}.
12. Cardiac function test

Lab Accreditation and Management

Paper Code BML 404

Contacts: 3L +1T

Credits: 04

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

CO1: Differentiate between certification, accreditation, licensure, and the regulatory organizations critical to the clinical laboratory.

CO2: Identify the different clinical laboratory settings and roles in a health care organization.

CO3: Identify the basic diagnostic techniques and procedures performed in a clinical laboratory

CO4: Apply essential skills to procedures commonly performed in a clinical laboratory. Evaluate quality control parameters

Course contents

Module 1

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

Module II

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 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 III

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

SEMESTER V

Semester-V

Semester	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	2	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			11	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 I:

Grossing: Introduction, histological specimens, labeling and reporting.

Fixation: Definition, classification, properties, composition, advantages and disadvantages of fixatives; Post chroming.

Decalcification: Importance, decalcifying agent, composition, advantages and disadvantages.

Module II

Tissue processing: Definition, importance, steps, dehydrating agents and dehydration process, clearing agents and clearing process.

Embedding: Embedding media, water soluble embedding media;

Module III

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

Mounting: Mounting media, advantages and disadvantages.

Module IV:

Staining: Hematoxylin and eosin staining; Specific stain for collagen, reticulin, elastin, fat, amyloid, glycogen, mucin, iron and neuron.

Module V

Solvents mordents accelerators and accenuators.Special staining procedure for connective tissues.Special staining procedure for Carbohydrates.Special staining procedure for Amyloids and Pigments.

Meta chromasia and Metachromatic dyes. Museum technique. Exfoliative cytology, FNAC and Cervical cytology, Techniques, Applications and interpretation of results.

Text 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.
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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.

1. Demonstration of Histopathological Instruments: Laboratory Microscopes, Compound light microscope, Paraffin wax bath, slide warmer, Microtomes, Automatic Tissue Processor,
2. Preparation of various types of reagent used in Histopathology
3. To perform Gram's staining
4. To perform Acid fast staining
5. To perform Geimsta staining
6. To perform Hematoxylin -eosin staining
7. Demonstration of AML slide
8. Demonstration of CML slide
9. Demonstration of 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:

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

Module 2

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

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

Module 3:

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

Artificial blood: Clinical trials, blood substitutes and uses.

Module 4:

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

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

Text 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)

1. To perform coagulation profile
2. Preparation of 5% cell suspension
3. Preparation of pooled cells
4. To perform direct Coomb's test
5. To perform direct Coomb's test
6. To perform forward typing of ABO and Rh
7. To perform reverse typing of ABO blood group system

Applied Microbiology-Theory

Paper Code BML 503T

Contacts: 3L+1T

Credits: 04

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 laboratory and 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 basic and 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:

- Microbial analysis of food and water
- Immuno diagnostics: Application and uses, EIA/ELISA, Immuno Diffusion; CIEP Gel Electrophoresis; IFA
- PCR: Uses and applications, RT PCR
- BMW: Laboratory disposal; Decontaminations; Disinfections
- Principles of quality control including knowledge of standards, controls, replicates and checks.
- Cleaning and maintenance of equipments & glassware disinfection
- Proper collection, anticoagulation, preservation and methods of transmission of various specimens and materials for laboratory exams
- Quality Control
- Hospital associated infection: source, organism responsible, surveillance strategies and prevention

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 laboratory and safety regulation of the laboratory.

CO2: Tounderstand the handling and microbial examination of urine, respiratory, stool, genital secretions.

CO3:Tounderstand the handling and microbial examination of blood, bone marrow and CSF samples.

- Handling, and microbiological examination of Urine
- Handling, and microbiological examination of Respiratory samples
- Handling, and microbiological examination of Genital secretions
- Handling, and microbiological examination of stool and vomitus
- Handling, and microbiological examination of Blood , Bone marrow aspirate & CSF
- Microbial analysis of food and water
- Handling, and microbiological examination of pus, aspirates and swabs
- EIA/ELISA, Immuno Diffusion; CIEP Gel Electrophoresis; IFA
- PCR
- BMW: Laboratory disposal; Decontaminations; Disinfections
- Cleaning and maintenance of equipments & glassware disinfection
- Hospital associated infection surveillance techniques

Genetics and Genomics

Paper code BML 504T

Contacts: 3L +1T

Credits: 04

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 genetic diseases.

Course contents:

Module 1: Introduction to mendelian genetics

Mendel's work on transmission of traits, genetic variation, molecular basis of genetic information. Interrelation between the cell structure and the genetics function. Mitosis, Meiosis (explaining Mendel's ratios).

Principles of Inheritance, Chromosome theory of inheritance, Pedigree analysis, Incomplete dominance and codominance. Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Environmental effects on phenotypic expression, sex linked inheritance. Linkage and crossing over, Interference and coincidence, Somatic cell genetics – an alternative approach to gene mapping.

Module 2: Mutation and sex determination: Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy. Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations, Molecular basis of Mutations in relation to UV light and chemical mutagens, Detection of mutations: CLB method, Attached X method, DNA repair mechanisms. Chromosomal mechanisms, Environmental factors effecting sex determination, Barr bodies, Dosage compensation.

Module 3: Genetic analysis and genome dynamics: Conjugation; Transformation; Transduction, Recombination. Prokaryotic transposable elements- IS elements, Genomics, bioinformatics and proteomics: Human genome project; Evolution and Comparative Genomics. Introduction to Bioinformatics,

Module 4: Genomic analysis: Genetic analysis using mutations, forward genetics, genomics, reverse genetics, RNAi, functional genomics and system biology. Population and evolutionary genetics: Allele frequencies, Genotype frequencies,

Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and Speciation

Text 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.
3. 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: To study the microscopic study of different cell types and different components of human blood.

CO2: To able to prepare different buffers and solutions. Able to explain the process of mitosis.

CO3: Culturing and handling techniques of *Drosophila melanogaster*. Identification of male and female flies.

List of Practicals

1. Study of museum specimens and slides of invertebrates
2. Molecular modeling- Nitrogenous bases, Nucleosides, Nucleotides using bead and stick method.
3. Microscopic study of different cell types: Buccal epithelial cells, Neurons, Striated muscle cells.
4. Preparation and study of different components of human blood.
5. Permeability study of plasma membrane-Effect of isotonic, hypotonic and hypertonic solutions on mammalian RBCs.
6. Chromosomal preparation
7. Mitosis in root tip of onion
8. Preparation of different buffers and solutions: 1 M Tris-HCl (pH 8), 10 N NaOH, 1 N HCl, 20% KOH, 5 M NaCl etc.
9. *Drosophila* Genetics -Culture, handling of flies, preparation of food and setting up of genetic crosses.

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	Project Thesis				6		150	150
		Internal Assessment				6	150*		150*
		Viva-voce				4		100	100
Total			3	1		20	170	330	500

Project duration: 16 weeks

S.No	Lab	Duration (weeks)
1	Biochemistry	3
2	Haematology	4
3	Pathology/Histopathology	3
4	Microbiology	3
5	Others	3
	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 Objectives: The objectives of this course are to:

- Develop understanding on various kinds of research, objectives of doing research, research process, research designs and sampling.
- Impart knowledge for enabling students to develop data analytics skills and meaningful interpretation to the data sets so as to solve the organizational problems.
- Describe the participants in conducting research work and formulating research synopsis and report.

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, writing research questions, Development of conceptual framework.

Module 2: Sampling & Research Designs

Sampling, Sampling Procedure, types of Sampling Techniques, reliability & validity in research, Research Designs- Non-experimental & experimental research designs.

Module 3: Review of Literature & Hypothesis

Sources of literature review, Writing literature review, Hypothesis- Meaning and types of hypothesis, Type I & Type II errors in hypothesis testing.

Module 4: Data Collection

Different methods of data collection- Observation method, interview method, Questionnaire and schedule, Data Management: editing, entry and preparing data sets for analysis; Design and development of questionnaire.

Module 5: Introduction to biostatistics

Classification of data, Source of data, Variables, Scales of measurement- nominal, ordinal, ratio and interval scale, building composite scales, measuring reliability and validity of scales.

Module 6: 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, Karl Pearson's coefficient of correlation, Spearman Rank correlation

Module 7: Project proposal and research report writing

- Rationale for project, Proposal workplan; Structure and Components of Research Report, Types of Reports, Layout of Research Report, Method of writing a research report.

Text 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 Health Sciences, J.Richard Prentice Hall, 1996.
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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.
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8. Chandan J S - Statistics for Business and Economics (Vikas 1998.1st 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).

Text and References

1. Gummerrson, E. *Qualitative methods in Management Research*, Sage publications
2. Grundy F and Reinke W A, *Health Practice Research and formalize Managerial Methods*, Geneva, WHO
3. *Designing and conducting Health surveys*, Jossey Bass Publishers.
4. Varkevisser, C. M., Pathmanathan, I., & Brownlee, A. T. (2003). *Designing and conducting health systems research projects* (Vol. 1). IDRC.
5. John Creswell (2013). *Research Design: Qualitative, Quantitative, and mixed methods approaches. Fourth edition*, Sage Publications
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7. Ulin P, Robinson E, Tolley E. (2005), *Qualitative Methods in Public Health : A field guide for Applied Research*, Jossey Bass Pub.
8. Russell Bernard H., Gery W. Ryan (2010), *Analyzing Qualitative Data: Systematic Approaches*, SAGE Publications.
9. Coley, Soraya M. and Scheinberg, Cynthia A. (2008) *Proposal Writing. Effective Grantsmanship*. Thousand Oaks, CA: Sage.