Needs: Local : Pink, National : Orange, Regional: light blue, International : green

Colour Coding
Global GREEN
Regional BLUE
National ORANGE
Local (State) PINK

Elaboration of course curriculum

First Semester

BMLS-101: Introduction to National Healthcare Delivery System in India

Rationale: The course provides the students a basic insight into the main features of Indian health care delivery system and how it compares with the other systems of the world. Topics to be covered under the subject are as follows:

1. Introduction to healthcare delivery system
1.1. Healthcare delivery system in India at primary, secondary and tertiary care
1.2. Community participation in healthcare delivery system
1.3. Health system in developed countries.
1.4. Private Sector
1.5. National Health Mission
1.6. National Health Policy
1.7. Issues in Health Care Delivery System in India
2. National Health Programme- Background objectives, action plan, targets, operations, achievements and constraints in various National Heath Programme.
3. Introduction to AYUSH system of medicine
3.1. Introduction to Ayurveda.
3.2. Yoga and Naturopathy
3.3. Unani
3.4. Siddha
3.5. Homeopathy
3.6. Need for integration of various system of medicine
4. Health scenario of India – past, present and future, Public health – India (epidemiology& demography)
5. Demography & Vital Statistics-
5.1. Demography – its concept
5.2. Vital events of life & its impact on demography
5.3. Significance and recording of vital statistics
5.4. Census & its impact on health policy
6. Epidemiology
6.1. Principles of Epidemiology
6.2. Natural History of disease
6.3. Methods of Epidemiological studies
6.4. Epidemiology of communicable & non-communicable diseases, disease transmission, host defense immunizing agents, cold chain, immunization, disease monitoring and surveillance.

Lt Col Varun Bajpai VSM
Executive Registrar
SGPGIMS,Lucknow

BMLS-102: Community Orientation and Clinical Visit

The objective of this particular section of the foundation course is to sensitize potential learners with essential knowledge; this will lay a sound foundation for their learning across the under-graduate program and across their career. Innovative teaching methods should be used to ensure the students' attention and make them more receptive, such as group activities, interactive fora, role plays and clinical bed-side demonstrations. 29

1. The community orientation and clinical visit will include visit to the entire chain of the healthcare delivery system – Sub centre, PHC, CHC, SDH, DH and Medical College, private hospitals, dispensaries and clinics.
2. The student will also be briefed regarding governance at village level including interaction and group discussion with village panchayat and front line health workers.
3. Clinical visit to their respective professional department within the hospital.

BMLS-103: Basic computers and information science

Rationale: The students will be able to appreciate the role of computer technology. The coursefocuses on computer organization, computer operating system and software, and MS windows, Word processing, Excel data worksheet and PowerPoint presentation. Topics to be covered under the subject are as follows:

1. Introduction to computer: Introduction, characteristics of computer, block diagram of computer, generations of computer, computer languages.
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 responsesystems).
3. Processor and memory: The Central Processing Unit (CPU), main memory.
4. Storage Devices: Sequential and direct access devices, magnetic tape, magnetic disk, optical disk, mass storage devices.
5. Introduction of windows: History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resizing, minimizing and maximizing, etc.).
6. Introduction to MS-Word: introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text,saving the document, spell checking, printing the document file, creating and editing oftable, mail merge.
7. Introduction to Excel: introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs.
8. Introduction to power-point: introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.
9. Introduction of Operating System: introduction, operating system concepts, types of operating system
10. Computer networks: introduction, types of network (LAN, MAN, WAN, Internet,Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network.
11. Internet and its Applications: definition, brief history, basic services (E-Mail, File Transfer Protocol, telnet, the World Wide Web (WWW)), www browsers, use of the internet.
12. Application of Computers in clinical settings.

Basic computers and Information Science-Practical

Practical on fundamentals of computers -

1. Demonstration of basic hardware of the computers and laptops
2. Learning to use MS office: MS word, MS PowerPoint, MS Excel
3. To install different software

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Executive Registrar
SGPGIMS,Lucknow

3.6 Modern Technology for handling BMW
3.7 Use of Personal protective equipment (PPE)
3.8 Monitoring & controlling of cross infection (Protective devices)

4. Infection prevention and control – The objective of this section will be to provide a broad understanding of the core subject areas of infection prevention and control and to equip AHPs with the fundamental skills required to reduce the incidence of hospital acquired infections and improve health outcomes. Concepts taught should include –

4.1 Evidence-based infection control principles and practices [such as Sterilization, Disinfection, Effective hand hygiene and use of Personal Protective Equipment (PPE)],
4.2 Prevention & control of common healthcare associated infections,
4.3 Components of an effective infection control program, and
4.4 Guidelines (NABH and JCI) for Hospital Infection Control

5. Antibiotic Resistance-
5.1 History of antibiotics
5.2 How resistance happens and spreads
5.3 Types of resistance- intrinsic, acquired, passive
5.4 Trends in drug resistance
5.5 Actions to fight resistance
5.6 Bacterial persistence
5.7 Antibiotic sensitivity
5.8 Consequences of antibiotic resistance
5.9 Antimicrobial Stewardship – Barriers and opportunities, tools and models in hospitals

6. Disaster preparedness and management – The objective of this section will be to provide knowledge on the principles of on-site disaster management. Concepts to be taught should include-

6.1 Fundamentals of emergency management,
6.2 Psychological impact management,
6.3 Resource management,
6.4 Preparedness and risk reduction,
6.5 Key response functions (including public health, logistics and governance, recovery, rehabilitation and reconstruction), information management, incident command and institutional mechanisms.

Suggested readings:

1. The Essentials of Patient Safety by Charles Vincent
2. Laboratory quality control and patient safety by De Gruyter

Introduction to Quality and Patient safety (including Basic emergency care and life support skills, Infection prevention and control, Biomedical waste management, Disaster management and Antibiotic resistance)-Practical

Quality and Patient safety:

1. Discussion on Concepts of Quality of Care
2. Approaches to Quality Improvement
3. Quality Improvement Tools
4. Discussion on NABH guidelines and its exercises

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Basics of emergency care and life support skills:

1. Vital signs and primary assessment
2. Basic emergency care – first aid and triage

3. Ventilations including use of bag-valve-masks (BVMs)
4. Choking, rescue breathing methods
5. One- and Two-rescuer CPR
6. Using an AED (Automated external defibrillator).
7. Managing an emergency including moving a patient

Students should perform the maneuvers in simulation lab and to test their skills with focus on airways management and chest compressions.

Bio medical waste management and environment safety-

1. Visit to Central Sterile Supply Department (CSSD)
2. Visit to incinerator complex
3. Visit to Immunization section
4. Discussion on Biomedical Waste,
5. Demonstration of Types of waste generated from Health Care Facility
6. Discussion on waste minimization
7. Poster presentation of BMW – Segregation, collection, transportation, treatment and disposal (including color coding)
8. Discussion on Liquid BMW, Radioactive waste, Metals / Chemicals / Drug waste
9. Visit to Central Sterile Supply Department for demonstration of BMW Management & methods of disinfection
10. Modern Technology for handling BMW e.g. Incenerator, Shredder etc.
11. Demonstration of proper use of Personal protective equipment (PPE)
12. Demonstration of monitoring & controlling of cross infection (Protective devices)

Infection prevention and control:

1. Demonstration of evidence-based infection control principles and practices [such as Sterilization, Disinfection, Effective hand hygiene and use of Personal Protective Equipment (PPE)],
2. Discussion on prevention & control of common healthcare associated infections,
3. Preparing Charts & Posters of Components of an effective infection control program, and
4. Guidelines (NABH and JCI) for Hospital Infection Control

Lt Col Varun Bajpai VSM
Executive Registrar
SGPGIMS, Lucknow

4. Data entry efficiency

Suggested Readings:

1. Information technology by Anshuman Sharma (Lakhanpal Publisher)
2. Computer Fundamentals (Concepts. Systems and applications) by P. K. Sinha (University of Tokyo, Japan) BPB Publications

BMLS-104: Introduction to Quality and Patient safety (including Basic emergency care and life support skills, Infection prevention and control, Biomedical waste management,Disaster management and Antibiotic resistance)

Rationale: The subject will introduce the students to the basic concepts of quality in health careand develop skills to implement sustainable quality assurance program in the health system. It will sensitize themin basic emergency care, infection prevention & control with knowledge of bio- medical waste management and antibiotic resistance.

1. Quality assurance and management - The objective of the subject is to help students understand the basic concepts of quality in health care and develop skills to implement sustainable quality assurance program in the health system.

1.1 Concepts of Quality of Care
1.2 Quality Improvement Approaches
1.3 Standards and Norms
1.4 Quality Improvement Tools
1.5 Introduction to NABH guidelines

2. Basics of emergency care and life support skills – Basic life support (BLS) is the foundation for saving lives following cardiac arrest. Fundamental aspects of BLS include immediate recognition of sudden cardiac arrest (SCA) and activation of the emergency response system, early cardiopulmonary resuscitation (CPR), and rapid defibrillation withan automated external defibrillator (AED). Initial recognition and response to heart attack and stroke are also considered part of BLS. The student is also expected to learn about basic emergency care including first aid and triage. Topics to be covered under the subject are as follows:

2.1 Vital signs and primary assessment
2.2 Basic emergency care – first aid and triage
2.3 Ventilations including use of bag-valve-masks (BVMs)
2.4 Choking, rescue breathing methods
2.5 One- and Two-rescuer CPR
2.6 Using an AED (Automated external defibrillator).
2.7 Managing an emergency including moving a patient

At the end of this topic, the students should be able to perform the maneuvers in a simulation lab and test their skills focusing on airway management and chest compressions. At the end of the foundation course, each student should be able to perform and execute/operate on the above mentioned modalities.

3. Bio medical waste management and environment safety – The aim of this section will beto help prevent harm to workers, property, the environment and the general public. Topics to be covered under the subject are as follows:

3.1 Definition of Biomedical Waste
3.2 Waste minimization
3.3 BMW – Segregation, collection, transportation, treatment and disposal (including color coding)
3.4 Liquid BMW, Radioactive waste, Metals / Chemicals / Drug waste
3.5 BMW Management & methods of disinfection

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Executive Registrar
SGPGIMS,Lucknow

Antibiotic Resistance-

1. Discussion on various types of Antibiotics
2. Demonstration of how Resistance Happens and Spreads
3. Discussion on types of resistance- Intrinsic, Acquired, Passive
4. Antibiotic sensitivity testing
5. Display of Consequences of antibiotic resistance
6. Demonstration of Antimicrobial Barriers and opportunities, Tools and models inhospitals

Disaster preparedness and management:

1. Discussion on fundamentals of emergency management,
2. Management psychological impact
3. Discussion on;

3.1 Resource management,

3.2 Preparedness and risk reduction,

BMLS-105: Environmental Science

Rationale:

The student will be made aware of theenvironment in general, natural resources, ecosystems, environmental pollution, and social issues related to environment, human population and the environment and understanding the hospital environment.

1. Introduction: Definition and scope and importance of multidisciplinary nature of environment. Need for public awareness.
2. Natural Resources: Natural Resources and associated problems, use and over exploitation, case studies of forest resources and water resources.
3. Ecosystems: Concept of Ecosystem, Structure, interrelationship, producers, consumers and decomposers, ecological pyramids-biodiversity and importance. Hotspots of biodiversity
4. Environmental Pollution:- Definition, Causes, effects and control measures of air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards

4.1 Solid waste management: Causes, effects and control measure of urban and industrialwastes. Role of an individual in prevention of pollution. Pollution case studies.

4.2 Disaster management: Floods, earthquake, cyclone and landslides.

5. Social blemishes and the Environment From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, water shed management Resettlement and rehabilitation of people; its pros and concerns.

5.1 Case studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

5.2 Case studies, Wasteland reclamation.

5.3 Consumerism and waste products. Environment Protection Act, Air (Prevention andControl of Pollution) Act. Water (Prevention and control of pollution) Act. Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation Public awareness.

5.4 Human Population and the Environment, Population growth, variation among nations. Population explosion–Family Welfare Programme. Environment and humanhealth, Human Rights, Value Education, HIV/AIDS. Women and child Welfare. Role of Information Technology in Environment and human health. Case studies.

6. Understanding the Hospital Environment
7. Understanding the environment in the following clinical laboratories:

7.1 Microbiology
7.2 Biochemistry
7.3 Histopathology
7.4 Hematology
8. Clinical laboratory hazards to the environment from the following and means to prevent:
8.1 Infectious material
8.2 Toxic Chemicals
8.3 Radioactive Material
8.4 Other miscellaneous wastes

Suggested Readings

1. Agarwal, K. C. 2001 Environment Biology, Nidi Publ. Ltd. Bikaner.
2. Jadhav, H &Bhosale, V.M. 1995. Environment Protection and Laws. Himalaya PubHouse, Delhi 284 p.
3. Rao M. N. &Datta A.K. 1987. Waste water treatment. Oxford & IBH Publ. Co. Pvt. Ltd.345 p.
4. Daniel D. Chiras 2010. Environmental Science. 1st Indian Edition, Jones and Bartlett India Pvt. Ltd. 4262/3, Ansar Road, Daryaganj, New Delhi.
5. Principle of Environment Science by Cunninghan, W.P.
6. Essentials of Environment Science by Joseph.
7. Environment Pollution Control Engineering By Rao, C.S.

Environmental Science-Practical

1. Any Activity related to the public awareness about the environment:
1.1 Preparation of Charts/Models
1.2 Visit to any effluent treatment plant
1.3 Seeding a plant/s and take care of it/them.
2. Preparation of models/charts in relation to natural resources of drinking water.
3. Preparation of Models of Ecosystem on biodiversity.
4. Effects of environmental pollution on humans through poster presentation.
5. Any Activity related to wild life preservation.
6. Visit to any hospital/ clinical laboratory and understanding the environment therein.
7. Any activity related biomedical waste management in a hospital or clinical laboratory

BMLS-106: Communication and soft skills

Rationale: The students will be able to appreciate communication skills as these are important to everyone - they are how we give and receive information and convey our ideas and opinions with those around us.

Soft skills is a term often associated with a person's "EQ" (Emotional Intelligence Quotient), which is the cluster of personality traits that characterize one's relationships with other people. These skills can include social graces, communication abilities, language skills, personal habits, cognitive or emotional empathy, and leadership traits.

A person's soft skill EQ is an important part of their individual contribution to the success of an organization. Organizations which deal with customers face-to-face are generally more successful if they train their staff to use these skills. Screening or training for personal habits or traits such as dependability and conscientiousness can yield significant return on investment for an organization. For this reason, soft skills are increasingly sought out by employers in addition to standard qualifications.

Topics taught in this module include:

1. Basic Language Skills: Grammar and Usage.

2. Business Communication Skills. With focus on speaking - Conversations, discussions, dialogues, short presentations, pronunciation.
3. Teaching the different methods of writing like letters, E-mails, report, case study, collecting the patient data etc. Basic compositions, journals, with a focus on paragraph form and organization.
4. Basic concepts & principles of good communication
5. Special characteristics of health communication
6. Types & process of communication
7. Barriers of communication & how to overcome

Soft Skills - with important sub-elements:

1. Communication Styles
2. Team work
3. Leadership Skills
4. Effective & Excellent Customer Service
5. Decision Making & Problem Solving
6. Managing Time and Pressures
7. Self-Management & Attitude

Communication and Soft Skills-Practical

1. Précis writing and simple passage from a prescribed text books. Atleast100 words should be chosen and few questions from the passage may be said to answer.
2. To practice all forms communication i.e. drafting report, agenda notes, précis writing, telegram, circular, representations, press, release, telephonic communication, practice of writing resume and writing application of employment.

Suggested readings:

1. Effective Communication and Soft Skills by Nitin Bhatnagar Pearson Education India,2011
2. Communication N Soft Skills Paperback – 2014 by Niraj Kumar, Chetan Srivastava

Lt Col Varun Bajpai VSM
Executive Registrar
SGPGIMS,Lucknow

BMLS-107: Human Anatomy and Physiology

Rationale: Students will be able to learn the terminology of the subject and basic knowledge of cells, tissues, blood and to understand anatomy and physiology of human body. This subject will develop an understanding of the structure and function of organs and organ systems in normal human body.

1. Introduction to human Anatomy and Physiology

2. Cell and cell organelles

2.1 Structure and classification
2.2 Function
2.3 Cell division (Mitosis and Meiosis)

3. Tissues

3.1 Definition
3.2 Classification with structure and Functions
3.2.1 Epithelial tissues
3.2.2 Connective tissues
3.2.3 Muscular tissues
3.2.4 Nervous tissue

4. Blood

4.1 Composition
4.2 Function of blood

5. Muscular skeletal system

5.1 Introduction
5.2 Classification
5.3 Structure and function of skeletal system, muscles and joints
5.4 Various movements of body

6. Respiratory system

6.1 Introduction
6.2 Structure
6.3 Function
6.4 Mechanism of breathing and respiration
6.5 Various terms involved in respiratory System
6.5.1 Vital capacity
6.5.2 Total Volume
6.5.3 Reserve volume
6.5.4 Total lung capacity

Suggested readings:

1. Anatomy & Physiology- Ross and Wilson
2. Anatomy and Physiology: Understanding the Human Body by Clark
3. Anatomy and Physiology for nurses by Evelyn Pearce
4. Anatomy and Physiology for nurses by Sears
5. Anatomy and Physiology for nurses by Pearson
6. Anatomy and Physiology by N Murgesh

Lt Col Varun Bajpai VSM
Executive Registrar
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Human Anatomy & Physiology – Practical

1. Demonstration of various parts of body
2. Demonstration of tissues of body
3. Demonstration of parts of digestive system
4. Demonstration of parts of respiratory system
5. Demonstration of parts of skin
6. Demonstration of parts of excretory system
7. Demonstration of various parts of circulatory system (Demonstration from models)
8. Examination of blood film for various blood cells from stained slides
9. Blood pressure estimation
10. Demonstration of various parts of nervous system (brain and spinal cord)(Model)
11. Structure of eye and ear (demonstration from models)
12. Demonstration of reflex action
13. Demonstration of structural differences between skeletal, smooth and cardiac muscles (permanent mounts)
14. Demonstration of various bones and joints
15. Demonstration of various parts of reproductive system (Male and female from modelsand charts)
16. To study circulatory system from charts and transverse section (TS) of artery and vein from permanent slides.
17. To study digestive system from charts and TS of liver, spleen and pancreas from permanent slides.
18. Study of Urinary system (charts)
19. Study of Genital system (male & female) from charts and TS of testis and ovary from permanent slides.
20. To study nervous system (From models / charts)
21. To study various body fluids.

Note: Demonstrations can be done with the help of models, charts and histological slides

BMLS-108: Basics of medical Lab Sciences and laboratory management

Fundamental of Medical laboratory Sciences
The Need and concept of medical labs
Types of medical labs
Components of medical lab
Basic workflow of medical lab
Role of medical lab scientist.
Management of MLS

Lt Col Varun Bajpai VSM
Executive Registrar
SGPGIMS,Lucknow

Second Semester

BMLS-201: Medical Terminology, Record keeping (including anatomical terms) and Orientation to Medical Laboratory Science (MLS)

Rationale: This subject introduces the elements of medical terminology. Emphasis is placed on building familiarity with medical words through knowledge of roots, prefixes, and suffixes. Topics include: origin, word building, abbreviations and symbols, terminology related to the human anatomy, reading medical orders and reports, and terminology specific to the student's field of study. Spelling is critical and will be counted when grading tests. The students will be oriented to the role of medical laboratory professional in healthcare system, scope, purpose, career opportunities in Medical Laboratory science. They will also be introduced to healthcare systemand public health in India.

Topics to be covered under the subject are as follows: Medical Terminology, Record keeping

1. Derivation of medical terms.
2. Define word roots, prefixes, and suffixes.
3. Conventions for combined morphemes and the formation of plurals.
4. Basic medical terms.
5. Form medical terms utilizing roots, suffixes, prefixes, and combining roots.
6. Interpret basic medical abbreviations/symbols.
7. Utilize diagnostic, surgical, and procedural terms and abbreviations related to theintegumentary system, musculoskeletal system, respiratory system, cardiovascular system, nervous system, and endocrine system.
8. Interpret medical orders/reports.
9. Data entry and management on electronic health record system.

Orientation to Medical Laboratory Science (MLS)

1. Medical Lab Science – Introduction
2. Career opportunities in MLS
3. Role of a Medical lab. professional in Health care system
4. Common laboratory associated hazards and biosafety measures including radiationhazards
5. Subject specific role of a Medical lab. professional:
6. Microbiology
   - 6.1. Role of microbes in human health
   - 6.2. Overview of the role of Medical Laboratory Professional in Medical Microbiology
   - 6.3. Bio-safety in Microbiology
7. Haematology
   - 7.1. Introduction to Haematological diseases
   - 7.2. Overview of the role of Medical lab. professional in Haematology
   - 7.3. Bio-safety in Haematology
8. Histopathology
   - 8.1. Introduction to Tumor pathology
   - 8.2. Overview of the role of Medical lab. professional in Histopathology
   - 8.3. Bio-safety in Histopathology
9. Biochemistry
   - 9.1. Introduction to metabolic disorders
   - 9.2. Overview of the role of Medical lab. professional in Clinical Biochemistry
   - 9.3. Bio-safety in Clinical Biochemistry

Suggested readings:

1. An Introduction to Medical Lab Technology by F J Baker and Silverton
2. Medical Laboratories Management- Cost effective methods by Sangeeta Sharma, Rachna Agarwal, Sujata Chaturvedi and Rajiv Thakur

Medical Terminology, Record keeping (including anatomical terms) and Orientation to Medical Laboratory Science (MLS)-Practical

1. General discussion on Medical Terminology and understanding basics of various diseases.
2. Coding
3. Assembling of patient files
4. Sensitization on career opportunities and role of MLS in Hospital Care
5. Visit to working;
   - 5.1 Microbiology
   - 5.2 Haematology
   - 5.3 Biochemistry and
   - 5.4 Histopathology laboratories

BMLS-202: Principals of Management with special reference to Medical Laboratory Science (MLS) Management:

The course is intended to provide knowledge about the basic principles of Management listedbelow, in addition to MLS management:

1. Introduction to management
2. Strategic Management
3. Foundations of Planning
4. Planning Tools and Techniques
5. Decision Making, conflict and stress management
6. Managing Change and Innovation
7. Understanding Groups and Teams
8. Leadership
9. Time Management
10. Cost and efficiency

Medical Laboratory Science ManagementRationale:

The students will be made aware of the basic ethics, good lab practices including awareness/ safety in a clinical lab. In addition they will understand sample accountability, quality management system, biomedical waste management, calibration and validation of clinical laboratory instruments, Laboratory Information system (LIS), Hospital Information system (HIS) and financial management.

1. Ethical Principles and standards for a clinical laboratory professional
   - 1.1 Duty to the patient
   - 1.2 Duty to colleagues and other professionals
   - 1.3 Duty to the society
2. Good Laboratory Practice (GLP) Regulations and Accreditation
   - 2.1 Introduction to Basics of GLP and Accreditation
   - 2.2 Aims of GLP and Accreditation
   - 2.3 Advantages of Accreditation
   - 2.4 Brief knowledge about National and International Agencies for clinical laboratory

Lt Col Varun Bajpai (Retd)
Executive Registrar
SGPGIMS,Lucknow

accreditation
3. Awareness / Safety in a clinical laboratory
3.1 General safety precautions
3.2 HIV: pre- and post-exposure guidelines
3.3 Hepatitis B & C: pre- and post-exposure guidelines
3.4 Drug Resistant Tuberculosis
4. Patient management for clinical samples collection, transportation and preservation
5. Sample accountability
5.1 Purpose of accountability
5.2 Methods of accountability
6. Sample analysis
6.1 Introduction
6.2 Factors affecting sample analysis
7. Reporting results
7.1 Basic format of a test report
7.2 Reported reference range
7.3 Clinical Alerts
7.4 Abnormal results
7.5 Turnaround time
7.6 Results from referral laboratories
7.7 Release of examination results
7.8 Alteration in reports
8. Quality Management system
8.1 Introduction
8.2 Quality assurance
8.3 Quality control system
8.4 Internal and External quality control
9. Biomedical waste management in a clinical laboratory
10. Introduction and importance of calibration and Validation of Clinical Laboratory instruments
11. Laboratory Information system (LIS), Hospital Information system (HIS) and financial Management
11.1 Introduction
11.2 Functions of a laboratory management system
11.3 Standards for laboratory management system
11.4 Introduction and awareness of financial management in a clinical laboratory
12. Ethics in Medical laboratory Practice
12.1 Understanding the term _Ethics'
12.2 Ethics in relation to the following:
12.2.1 Pre-Examination procedures
12.2.2 Examination procedures
12.2.3 Reporting of results
12.3 Preserving medical records
12.4 Access to Medical laboratory Records
13. Procurement of equipment and Inventory Control
13.1 Audit in a Medical Laboratory
13.2 Introduction and Importance
13.3 Responsibility
13.4 Planning
13.5 Horizontal, Vertical and Test audit

Lt Col Varun Bajpai VSM
Executive Registrar
SGPGIMS,Lucknow

13.6 Frequency of audit
13.7 Documentation

Suggested readings:

1. Medical Laboratories Management- Cost effective methods by Sangeeta Sharma, Rachna Agarwal, Sujata Chaturvedi and Rajiv Thakur

Principals of Management with special reference to Medical Laboratory Science (MLS) Management: Practical

1. Clinical sample collection e.g.
1.1 Blood
1.2 Urine
1.3 Stool
1.4 Saliva
1.5 Sputum
1.6 Semen analysis
2. Sample accountability
2.1 Labeling of sample
2.2 Making entries in Laboratory records
3. Reporting results
3.1 Basic format of a test report
3.2 Release of examination results
3.3 Alteration in reports
4. Quality Management system
4.1 Quality assurance
4.2 Internal and External quality control
4.3 Quality improvement
5. Biomedical waste management in a clinical laboratory - Disposal of used samples, reagents and other biomedical waste
6. Calibration and Validation of Clinical Laboratory instruments
7. Ethics in medical laboratory practice in relation to the following:
7.1 Pre-Examination procedures
7.2 Examination procedures
7.3 Reporting of results
7.4 Preserving medical records
7.5 Access to medical laboratory records
8. Audit in a Medical Laboratory -Documentation

BMLS-203: Medical Law and Ethics

Rationale: Legal and ethical considerations are firmly believed to be an integral part of medical practice in planning patient care. Advances in medical science, growing sophistication of the modern society's legal framework, increasing awareness of human rights and changing moral principles of the community at large, now result in frequent occurrences of healthcare professionals being caught in dilemmas over aspects arising from daily practice.

Medical ethics has developed into a well-based discipline which acts as a "bridge" between theoretical bioethics and the bedside. The goal is "to improve the quality of patient care by identifying, analyzing, and attempting to resolve the ethical problems that arise in practice". Physicians are bound by, not just moral obligations, but also by laws and official regulations that form the legal framework to regulate medical practice. Hence, it is now a universal consensus that legal and ethical considerations are inherent and inseparable parts of good medical practice

across the whole spectrum. Few of the important and relevant topics that need to be focused on are as follows:

1. Medical ethics - Definition - Goal - Scope
2. Introduction to Code of conduct
3. Basic principles of medical ethics – Confidentiality
4. Malpractice and negligence - Rational and irrational drug therapy
5. Autonomy and informed consent - Right of patients
6. Care of the terminally ill- Euthanasia
7. Organ transplantation
8. Medico legal aspects of medical records – Medico legal case and type- Records and document related to MLC - ownership of medical records - Confidentiality Privilege communication
9. Release of medical information - Unauthorized disclosure - retention of medical records - other various aspects.
10. Professional Indemnity insurance policy
11. Development of standardized protocol to avoid near miss or sentinel events
12. Obtaining an informed consent.
13. Ethics in the profession of Medical Laboratory Science

Suggested readings:

1. Medical Law and Ethics by Bonnie F Fremgen
2. Medical Law and Ethics by Jonathan Herring

BMLS-204: Professionalism and Values

Rationale: This module will deliver the concepts of what it means to be a professional and how a specialized profession is different from a usual vocation. It also explains how professionalism is relevant in terms of the healthcare system and how it affects the overall patient environment.

1. Professional values – Integrity, Objectivity, Professional competence and due care, confidentiality
2. Personal values – ethical or moral values
3. Attitude and behavior – professional behavior, treating people equally
4. Code of conduct, professional accountability and responsibility, misconduct
5. Differences between professions and importance of team efforts
6. Cultural issues in the healthcare environment

Suggested Readings

1. R. R. Gaur, R. Sangal, G.P. Bagaria, 2009, a Foundation Course in Value Education.
2. E.F. Schumacher, 1973, Small is Beautiful: A study of Economics as if people mattered, Blond & Briggs, Britain.
A. Nagraj, 1998, Jeevan VidyaekParichay, Divya Path Sansthan, Amarkantak.
3. P.L.Dhar, R.R.Gaur, 1990, Science and Humanism, Common wealth Publishers.
4. A.N. Tripathy, 2003, Human Values, New Age International Publishers
5. E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists &Engineers, Oxford University Press
6. B. P. Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
7. Perspectives in Environmental Studies by Kaushik, A.
8. Elements of Environment Science &Eng. By Meenakshi.
8. Elements of environment Eng. by Duggal

BMLS 205:- Medical Sociology

Introduction:

Meaning - Definition and scope of sociology

Its relation to Anthropology, Psychology, Social Psychology

Methods of Sociological investigations - Case study, social survey, questionnaire, interview and opinion poll methods.

Importance of its study with special reference to health care professionals

Social Factors in Health and Disease:

Meaning of social factors

Role of social factors in health and disease

Socialization:

Meaning and nature of socialization

Primary, Secondary and Anticipatory socialization Agencies of socialization

Social Groups:

Concepts of social groups, influence of formal and informal groups on health and sickness. The role of primary groups and secondary groups in the hospital and rehabilitation setup.

Family:

The family, meaning and definitions, Functions of types of family, Changing family patterns, Influence of family on individual's health, family and nutrition, the effects of sickness in the family and psychosomatic disease and their importance to physiotherapy

Community:

Rural community: Meaning and features - Health hazards to rural communities, health hazards totribal community.

Urban community - Meaning and features - Health hazards of urbanities

Culture and Health:

Concept of Health

Concept of culture

Culture and Health

Culture and Health Disorders

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BMLS-206. Human Anatomy and physiology II

1. Cardiovascular system

1.1 Anatomy and physiology of heart
1.2 Blood circulation
1.3 Arteries and veins
1.4 Conductive system of heart
1.5 Cardiac cycle
1.6 Introduction to ECG

2. Lymphatic system

2.1 Introduction
2.2 Structure and function
2.2.1 Lymph nodes
2.2.2 Spleen
2.2.3 Thymus gland, Tonsils

3. Structure and function of sense organ

3.1 Eye
3.2 Ear
3.3 Nose
3.4 Tongue

4. Body fluids and their significance:

Important terms, types of body fluid, total body water, avenues by which water leaves and enters body, general principles for fluid balance, cardinal principle, How body fluids maintain Homeostasis, Electrolytes & ions Function of electrolytes, How electrolyte imbalance leads to fluid imbalance

5. Digestive system:

Organization; accessory organs; structure & function (Mouth, Tongue, Teeth, Esophagus, Pharynx, Stomach, Intestine, Rectum, Anus); Digestive glands; physiology of digestion of carbohydrates, lipids & proteins Liver: structure and function

6. Urinarysystem:Mainparts,Structure&functionofkidney,structureof nephron, physiology of excretion & urine formation,urine,additional excretory organs

7. Genital system: Structure of male and female reproductive system, Gametogenesis in male & female, menstrual cycle. Placenta and extra embryonic membranes.

8. Nervous system: Parts, function & structure; brain, spinal cord, spinal & cranial nerves; all& none principle, role of neurotransmitters in transmission of nerve impulse

9. Endocrine system: Endocrine & exocrine glands, their location, structure & functions

BMLS-207: Clinical Biochemistry

Rationale: The main objective of the subject is to impart the knowledge of apparatus, units, equipment, and volumetric analysis in the laboratory of clinical Biochemistry.

1. Introduction to Medical lab. Technology

1.1 Role of Medical lab Technologist
1.2 Ethics and responsibility
1.3 Safety measures
1.4 First aid

2. Cleaning and care of general laboratory glass ware and equipment

2.1 Steps involved in cleaning soda lime glass
2.2 Steps involved in cleaning borosil glass
2.3 Preparation of chromic acid solution
2.4 Storage

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3. Distilled water
3.1 Method of preparation of distilled water
3.2 Type of water distillation plants
3.3 Storage of distilled water
4. Units of Measurement.
4.1 S.I unit and CGS units
4.2 Conversion
4.3 Strength, molecular weight, equivalent weight
4.4 Normality, Molarity, Molality
4.5 Numerical
5. Calibration of volumetric apparatus
5.1 Flask
5.2 Pipettes
5.3 Burettes
5.4 Cylinders
6. Analytical balance
6.1 Principle
6.2 Working
6.3 Maintenance
7. Concept of pH
7.1 Definition
7.2 Henderson Hassel batch equation
7.3 Pka value
7.4 pH indicator
7.5 Methods of measurement of pH
7.5.1 pH paper
7.5.2 pH meter
7.5.3 Principle, working, maintenance and calibration of pH meter
8. Volumetric analysis
8.1 Normal and molar solutions
8.2 Standard solutions
8.3 Preparation of reagents
8.4 Storage of chemicals
9. Osmosis
9.1 Definition
9.2 Types of osmosis
9.3 Factors affecting osmotic pressure
9.4 Vant Hoff`s equation
9.5 Applications of osmosis
9.6 Dialysis
10. Spectrophotometry and colorimetry
10.1 Introduction
10.2 Theory of spectrophotometry and colorimetry
10.3 Lambert`s law and Beer`s law
10.4 Applications of colorimetry and spectrophotometry
11. Photometry
11.1 Introduction
11.2 General principles of flame photometry
11.3 Limitations of flame photometry
11.4 Instrumentation

11.5 Applications of flame photometry
11.6 Atomic absorption spectroscopy – Principle & applications
12. Chromatography
12.1 Introduction
12.2 Types of chromatography
12.3 Paper Chromatography: Introduction, principle, types, details for qualitative and quantitative analysis, application
12.4 Thin layer chromatography: Introduction, experimental techniques, application of TLC, limitations, High performance thin layer chromatography
12.5 Column chromatography: Introduction, principle column efficiency, application of column chromatography
12.6 Gas chromatography: Introduction principle, instrumentation, application
12.7 Ion exchange chromatography: Introduction, Definition and principle, cation and anion exchangers, application
12.8 Gel Chromatography: Introduction Principle and method, application and advantages
13. Electrophoresis:
13.1 Introduction
13.2 Principle
13.2.1 Instrumentation
13.2.2 Applications
13.3 Types of electrophoresis
13.3.1 Paper electrophoresis
13.3.2 Gel electrophoresis

Clinical Biochemistry – Practical

1. Cleaning of the laboratory glass ware (Volumetric and non-volumetric)
2. Preparation of distilled water
3. To demonstrate the principle, working & maintenance of spectrophotometer.
4. To demonstrate the principle, working & maintenance of colorimeter.
5. To demonstrate the principle, working & maintenance of flame photometer.
6. To demonstrate the principle, procedure of paper chromatography.
7. To demonstrate the principle & procedure of Gas chromatography.
8. To demonstrate the principle & demonstration of TLC.
9. To demonstrate the principle & procedure of column chromatography.
10. To demonstrate the principle & procedure of Electrophoresis.

Suggested Readings

1. Text book of Medical Laboratory Technology by P. B. Godker
2. Medical Laboratory Technology by K.L. Mukherjee volume III
3. Practical Clinical Biochemistry by Harold Varley
4. Principal of Biochemistry by M. A. Siddiqi
5. Instrumental Analysis by Chatwal Anand
6. Text book of Medical Biochemistry by Chatterjee, Shinde
7. Principal of Biochemistry by Lehninger
8. Biochemistry by Voet&Voet
9. Biochemistry by Stryer

BMLS-208: Basics of Hematological Diseases

Rationale: The students will be made aware of various diseases like anemia, quantitative disorders of Leucocytes, morphological alterations in blood cells, bleeding disorders.

1. Anemia

a) Introduction
b) Classification
c) Microcytic hypochromic anemia
d) Macrocytic anemia
e) Normocytic normochromic anemia

2. Quantitative disorders of Leukocytes Cause and significance

a) Granulocytic and Monocytic Disorders
b) Lymphocytic Disorders

3. Morphologic Alterations in Neutrophils

a) Toxic granulation
b) Cytoplasmic vacuoles
c) Döhle bodies
d) May–Hegglin anomaly
e) Alder–Reilly anomaly
f) Pelger–Huët anomaly
g) Chédiak–Higashi syndrome

4. Bleeding disorders

a) Introduction Causes of bleeding disorders
b) Vascular defect
c) Platelet defect
d) Factor deficiency
e) Inhibitors
f) Hyper fibrinolysis
g) Types of bleeding disorders
h) Inherited bleeding disorders
i) Acquired bleeding disorders

5.Thrombosis

a) Introduction
b) Causes of thrombosis

6.Monitoring of Anticoagulants

a) Oral anticoagulants by INR
b) Heparin

Suggested Readings

a) Textbook of Medical Laboratory Technology by Praful B. Godkar
b) Medical Laboratory Technology by K L Mukherjee Volume-I
c) Practical Haematology by J.B. Dacie
d) Clinical Diagnosis & Management by Laboratory methods (20thedition) by John Bernard Henry
e) Atlas of Haematology by G.A. McDonald
f) De Gruchy's clinical Haematology in medical practice
g) Wintrobe's Clinical Haematology– 2013 by John P. Greer, Daniel A. Arber, Bertil E. Glader, Alan F. List

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Basics of Hematological Diseases – Practical

1. Parts of microscope; its functioning and care
2. Parts of centrifuge; its functioning and care
3. Cleaning and drying of glassware
4. Preparation of various anticoagulants
5. Collection of venous and capillary blood
6. Cleaning of glass-syringes and its sterilization
7. Preparation of the stains and other reagents
8. Preparation of peripheral blood film (PBF)
9. Staining of PBF
10. Hemoglobin estimation methods (Sahli's, Oxyhaemoglobin, and cyanmethaemoglobin)
11. Differential leukocyte count (DLC)
12. Recognition and staining of various types of blood cells (normal and abnormal)
13. Preparation of thick and thin blood smear for malarial parasite (Leishman/Giemsa/JSB)
14. RBC counting
15. WBC counting
16. Platelet counting
17. Routine Examination of urine

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Third Semester

BMLS-301: Research Methodology and Biostatistics

Rationale: The objective of this module is to help the students understand the basic principles ofresearch and methods applied to draw inferences from the research findings. The students will also be made aware of the need of biostatistics and understanding of data, sampling methods, in addition to being given information about the relation between data and variables.

Research Methodology:

1. Introduction to research methods
2. Identifying research problem
3. Ethical issues in research
4. Research design
5. Basic Concepts of Biostatistics
6. Types of Data
7. Research tools and Data collection methods
8. Sampling methods
9. Developing a research proposal

Biostatistics:

1. Need of biostatistics
2. What is biostatistics: beyond definition
3. Understanding of data in biostatistics
4. How & where to get relevant data
5. Relation between data & variables
6. Type of variables: defining data set
7. Collection of relevant data: sampling methods
8. Construction of study: population, sample, normality and its beyond (not design of study, perhaps)
9. Summarizing data on the pretext of underlined study
10. Understanding of statistical analysis (not methods)

Suggested readings

1. Statistical Methods by S.P. Gupta
2. Methods in biostatistics for medical students by B.K.Mahajan
3. RPG Biostatistics by HimanshuTyagi

Research Methodology and Biostatistics – Practical

1. To practice problems on various biostatistics tools.

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BMLS-302: GENERAL PATHOLOGY AND MICROBIOLOGY

Rationale: The objective of this module is to help the students understand the basic concept of pathogenesis of various ailments. Basic concept of nomenclature and classification of microbial organism is to be addressed

GENERAL PATHOLOGY

1. Cell Injury and Cellular Adaptations.
   a) Normal Cell
   b) Cell Injury- types of cell injury, etiology of cell injury, morphology of cell injury, Cellular swelling.
   c) Cell death: types- autolysis, necrosis, apoptosis & gangrene.
   d) Cellular adaptations-atrophy, hypertrophy, hyperplasia & dysplasia.
2. Inflammation
   a) Acute inflammation - vascular event, cellular event, inflammatory cells.
   b) Chronic Inflammation - general features, granulomatous inflammation, tuberculoma.
3. Hemodynamic Disorders:
   Edema, hyperemia, congestion, hemorrhage, circulatory disturbances, thrombosis, Ischemia & infarction.
4. Neoplasia :
   Definition, how does it differ from hyperplasia, difference between benign tumor and malignant tumor.
5. Healing
   Definition, different phases of healing, factors influencing wound healing.

GENERAL MICROBIOLOGY

1. General characters and classification of Bacteria.
2. Characteristics of Bacteria Morphology - Shape, Capsule, Flagella, Inclusion, Granule, Spore.
3. Growth and Maintenance of Microbes Bacterial division, Batch Culture, Continuous culture, bacterial growth- total count, viable count, bacterial nutrition, oxygen requirement, CO2 requirement, temperature, pH, light.
4. Sterilization and Disinfection. Physical agents- Sunlight, Temperature less than 1000C, Temperature at 1000C, steam at atmospheric pressure and steam under pressure, irradiation, filtration. Chemical Agents- Alcohol, aldehyde, Dyes, Halogens, Phenols, Ethylene oxide.
5. Culture Media Definition, uses, basic requirements, classification, Agar, Peptone, Transport Media, Sugar Media, Anaerobic Media, Containers of Media, Forms of Media \
6. Staining Methods Simple, Grams staining, Ziehl-Neelsen staining or AFB staining, Negative Impregnation
7. Collection and Transportation of Specimen General Principles, Containers, Rejection, Samples- Urine, Faeces, Sputum, Pus, Body fluids, Swab, Blood.
8. Care and Handling of Laboratory Animals Fluid, Diet, Cleanliness, Cages, ventilation, Temperature, Humidity, handling of Animals, Prevention of disease.
9. Disposal of Laboratory/Hospital Waste
10. Non-infectious waste, Infected sharp waste disposal, infected non-sharp waste disposal

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Books Recommended:

- Text Book of Pathology by Dr. Harshmohan
- Robbin s Pathologic Basis of Disease
- Practical Pathology by Tejinder Singh
- Medical Lab Techniques by Prof V H Talib
- Anathanarayana & Panikar Medical Microbioloty
- Roberty Cruckshank Medical Microbiology The Practice of Medical Mircrobiology
- Chatterjee Parasitology Interpretation to Clinical medicine.
- Rippon Medical Mycology
- Emmons Medical mycology
- Basic laboratory methods in Parasitology, 1st Ed, J P Bros,
- Basic laboratory procedures in clinical bacteriology, 1st Ed, J P Brothers
- Medical Parasitology Ajit Damle

BMLS-303: Applied Clinical Biochemistry–I

Rationale: The students will be taught about Hazards & safety measures in a clinical biochemistry lab, Quality control and quality assurance, Laboratory organization, management Principles of assay procedures and Radioactivity.

1. Hazards & safety measures in clinical Biochemistry laboratory
2. Quality control and quality assurance in a clinical biochemistry laboratory
3. Laboratory organization, management and maintenance of records
4. Principles of assay procedures, Normal range in blood, Serum, Plasma and Urine and reference values for:

4.1 Glucose
4.2 Proteins
4.3 Urea
4.4 Uric acid
4.5 Creatinine
4.6 Bilirubin
4.7 Lipids

5. Principles, procedures for estimation & assessment of the following including errors involved and their corrections

5.1 Sodium, Potassium and Chloride, Iodine
5.2 Calcium, Phosphorous and Phosphates

6. Instruments for detection of Radioactivity
7. Applications of Radioisotopes in clinical biochemistry.
8. Enzyme linked immune sorbent assay

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Applied Clinical Biochemistry–I - Practical

1. Estimation of Glucose in Urine and in Blood.
2. Estimation of Protein in Urine and Blood.
3. Estimation of Urea in blood.
4. Estimation of uric acid in blood.
5. Estimation of serum Bilirubin
6. Estimation of Total Cholesterol in blood.
7. Estimation of HDL Cholesterol.
8. Estimation of LDL Cholesterol.
9. Estimation of TG
10. Estimation of Creatinine in Blood
11. Estimation of serum calcium, Inorganic phosphate

Suggested Readings

1. Text book of Medical Laboratory Technology by P.B. Godkar.
2. Medical Laboratory Science, Theory & Practical by A. Kolhatkar.
3. Practical Clinical Biochemistry by Harold Varley.
4. Biochemistry, U. Satyanarayan& U. Chakrapani.
5. Text book of Medical Biochemistry by Chatterjee&Shinde.
6. Principal of Biochemistry by Lehninger
7. Biochemistry by Voet&Voet
8. Biochemistry by Stryer

BMLS-304: Biochemical Metabolism

Rationale: This subject shall give information about all the major metabolic pathways occurring in our body. The students will learn the details about metabolism of carbohydrates, proteins, lipids, nucleic acids, enzymes & the deficiency diseases related to them.

1. Carbohydrate Metabolism

1.1 Introduction, Importance and Classification
1.2 Digestion and Absorption
1.3 Metabolism:-Glycolysis, Citric acid cycle, Gluconeogenesis, Glycogenolysis,Glycogenesis
1.4 Disorders of carbohydrate metabolism.

2. Protein Metabolism

2.1 Introduction, Importance and classification
2.2 Important properties of proteins
2.3 Digestion & absorption of Proteins
2.4 Protein synthesis
2.5 Metabolism of proteins
2.6 Disorders of protein metabolism and Urea Cycle

3. Lipid

3.1 Introduction & Classification
3.2 Digestion & absorption of fats
3.3 Lipoproteins
3.4 Fatty acid biosynthesis & fatty acid oxidation

4. Nucleic Acid

4.1 Introduction
4.2 Functions of Nucleic acid

4.3 Functions of energy carriers

5. Enzymes

5.1 Introductions, Importance & Classifications
5.2 Properties of enzymes
5.3 Mechanism of enzyme action
5.4 Factors affecting enzyme action
5.5 Enzyme kinetics & enzyme inhibiters

Suggested Readings

1. Practical Clinical Biochemistry by Harold Varley
2. Text book of Medical Laboratory Technology by P. B. Godker
3. Medical Laboratory Technology by Mukherjee
4. Principal of Biochemistry by M. A. Siddiqi
5. Instrumental Analysis by Chatwal Anand
6. Text book of Medical Biochemistry by Chaterjee, Shinde
7. Principal of Biochemistry by Lehninger
8. Biochemistry by Voet&Voet
9. Biochemistry by Stryer

Biochemical Metabolism – Practical

1. To determine the presence of carbohydrates by Molisch test.
2. To determine the presence of reducing sugar by Fehling solutions
3. To determine the presence of reducing sugar by Benedicts method.
4. To determine starch by Iodine test.
5. Determination of Glucose in serum & plasma
6. Estimates of blood Glucose by Folin& Wu method
7. Determination of Urea in serum, plasma & urine.
8. Determination of Creatinine in serum or plasma
9. Determination of serum Albumin
10. Determination of Cholesterol in serum or plasma

BMLS-305: Blood Banking

Rationale: Blood banking will make students learn about blood grouping & blood transfusion. The students will learn about the concept of blood grouping, compatibility testing in blood transfusion & screening of donated blood for various infectious diseases.

Blood Banking

1. Introduction to Blood Banking
2. History and discovery of various blood group systems
3. ABO blood group system
4. Rh and other major blood group system
5. Sources of error in blood grouping and their elimination.
6. ABO grouping: Forward and reverse grouping.Causes of discrimination between forward and reverse grouping
7. Rh grouping
8. Compatibility test in blood transfusion

8.1 Collection of blood for cross matching from a blood bag
8.2 Major cross matching
8.3 Minor cross matching
8.4 Use of enzymes in blood bank specially Papain

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9. Complications and hazards of blood transfusion
10. Laboratory investigations of transfusion reactions and mismatched blood transfusion.
11. Precautions while procurement and storage of grouping antisera
12. Various anticoagulants used to collect blood for transfusion purposes
13. Selection of donor and procedure for collection of blood from a healthy donor
14. Preparation of various fractions of blood for transfusion and therapeutic purposes suchas:
14.1 Packed red cells, washed red cells and FROZEN Red cells
14.2 Platelet Rich Plasma (PRP), Platelet concentrate and frozen platelets.
14.3 Fresh plasma (FP), Fresh Frozen Plasma (FFP) and cryoprecipitate
15. Brief introduction of blood substitute/artificial blood
16. Haemopheresis: pertaining to Leucocytes, platelets and plasma.
17. Quality control in blood bank

Blood Banking Practical

1. To prepare Acid Citrate Dextrose (ACD) and Citrate Phosphate Dextrose (CPD)Solutions
2. Screening of blood donor: physical examination including medical history of the donor
3. Collection and preservation of blood for transfusion purpose
4. Screening of blood for Malaria, Microfilaria, HBs Ag, Syphilis and HIV
5. To determine the ABO & Rh grouping
5.1 Direct or preliminary grouping
5.2 Indirect or proof grouping
5.3 Rh grouping and determination of Du in case of Rh negative
6. To perform Direct and Indirect Coomb's test
7. To perform cross matching
7.1 Major cross matching
7.2 Minor cross matching
8. Preparation of various fractions of blood.

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Fourth Semester

BMLS-402: Systematic Bacteriology and Virology

Systematic Bacteriology

Rationale: This subject will give information about the different types of bacterial culture procedures, staining procedures and biochemical tests used for identification of bacteria. The students will learn the morphology cultural characteristics, biochemical characteristics & laboratory diagnosis of various bacteria.

1. Bacterial culture
1.1 Instruments used to seed culture media
1.2 Culture procedures – seeding a plate
2. Staining techniques in bacteriology
2.1 Significance of staining in bacteriology
2.2 Principle, Reagent preparation, procedures and interpretation of the following
2.2.1 Simple staining
2.2.2 Negative staining
2.2.3 Gram stain
2.2.4 Albert's stain
2.2.5 Neisser's stain
2.2.6 Ziehl –Neelsen staining
2.2.7 Capsule staining
2.2.8 Flagella staining
2.2.9 Spore staining
2.2.10 Fontana stain for spirochetes
3. Principle, procedures and interpretation of the following biochemical tests foridentification of different bacteria.
3.1 Catalase
3.2 Coagulase
3.3 Indole
3.4 Methyl Red
3.5 VogesProskauer
3.6 Urease
3.7 Citrate
3.8 Oxidase
3.9 TSIA
3.10 Nitrate reduction
3.11 Carbohydrate fermentation
3.12 Huge and Leifson
3.13 Bile solubility
3.14 H 2 S production
3.15 Demonstration of motility
3.16 Decarboxylases
3.17 CAMP
3.18 Hippurate hydrolysis
3.19 Nagler's reaction
3.20 Cholera-red reaction
4. Definition, Classification, Various characteristics (morphological, cultural and biochemical), pathogenesis and laboratory diagnosis of the following bacteria
4.1 Staphylococcus

4.2 Streptococcus
4.3 Pneumococcus
4.4 Neisseria gonorrhea and Neisseria meningitis
4.5 Haemophilis
4.6 Corynebacterium
4.7 Enterobacteriaceae: Escherichia coli, Klebsiella, Citrobacter, Enterobacter, Proteus, Salmonella, Shigella, Yersinia enterocolitica and Yersinia pestis
4.8 Vibrio, Aeromones and Plesiomonas
4.9 Clostridia of wound infection
4.10 Mycobacterium tuberculosis complex, Atypical Mycobacteria and M. leprae
4.11 Spirochetes – Treponema, Borrellia and leptospira
4.12 Bordetella and brucella
4.13 Mycoplasma and Ureaplasma
4.14 Rickettsia
4.15 Chlamydia
4.16 Actinomyces
4.17 Pseudomonas and Burkholderia
4.18 Brief introduction about non sporing anaerobic cocci and bacilli

Suggested Readings:

1. Practical Medical Microbiology by Mackie & McCartney Volume 1 and 2
2. Text book of Microbiology by Ananthanarayanan
3. Medical Microbiology by Paniker& Satish Gupte
4. Medical laboratory Technology Vol. I, II, III by Mukherjee

Systematic Bacteriology – Practical

1. To demonstrate the instruments used to seed culture media
2. To learn techniques for Inoculation of bacteria on culture media
3. To isolate specific bacteria from a mixture of organisms.
4. To demonstrate simple staining (Methylene blue)
5. To prepare India ink preparation to demonstrate negative staining.
6. Bacterial identification: To demonstrate reagent preparation, procedure and interpretationfor
6.1 Gram stain
6.2 Albert stain
6.3 Neisser's staining
6.4 Z-N staining
6.5 Capsule staining
6.6 Demonstration of flagella by staining methods
6.7 Spore staining
6.8 To demonstrate spirochetes by Fontana staining procedure
7. To prepare the reagent and demonstrate following biochemical tests with positive & negative control bacteria:
7.1 Catalase
7.2 Coagulase
7.3 Indole
7.4 Methyl Red (MR)
7.5 VogesProskauer (VP)
7.6 Urease
7.7 Citrate
7.8 Oxidase

7.9 TSIA
7.10 Nitrate reduction
7.11 Carbohydrate fermentation
7.12 Huge and Leifson
7.13 Bile solubility
7.14 H2S production
7.15 Demonstration and motility
7.16 Decarboxylases
7.17 CAMP
7.18 Hippurate hydrolysis
7.19 Nagler's reaction

8. To demonstrate various characteristics (morphological, cultural and biochemical) ofbacteria commonly isolated from clinical samples i.e.

8.1 Staphylococcus
8.2 Streptococcus
8.3 Corynebacterium
8.4 Escherichia coli
8.5 Klebsiella
8.6 Citrobacter
8.7 Enterobacter
8.8 Proteus
8.9 Salmonella
8.10 Shigella
8.11 Vibrio cholera
8.12 Mycobacterium tuberculosis
8.13 Pseudomonas

Virology

Rationale

The student will be taught about introduction, general characteristics, life cycle and laboratory diagnosis of various medically important

Virology:

1. Introduction to medical virology
2. Introduction to medically important viruses
3. Structure and Classification of viruses.
4. Multiplication of viruses
5. Collection, transportation and storage of sample for viral diagnosis
6. Staining techniques used in Virology
7. Processing of samples for viral culture (Egg inoculation and tissue culture)
8. Rapid diagnosis of viral infections with special reference to HIV, HBV and HCV

8.1 EIA
8.2 Immunofluorescence
8.3 PCR

BMLS-403- Systemic Pathology

1) RBC and Bleeding disorders

a) Anaemia – Definition and classification,
b) Haemolytic anaemia,

c) Iron deficiency anemia,
d) Thrombocytopenia,
e) Coagulation disorders – Terminology, Uses of Bleeding Time, PT and a PTT

2) WBC disorders

a) Leukocytosis,
b) Leukemia – acute and chronic,
c) Causes of splenomegaly

3) Disease of the GIT:

a) Causes of
b) Peptic ulcer
c) Carcinoma stomach
d) Intestinal obstruction
e) acute appendicitis
f) Colonic carcinoma

4) Diseases of Liver, Biliary tract and Pancreas:

a) Jaundice – classification based on pathophysiology
b) Cirrhosis – Definition and causes
c) Hepatitis – Types of viral hepatitis and transmission
d) Portal hypertension – Symptoms
e) Hepatic failure

5) **Endocrine System:**

a) Diagnostic criteria of diabetes mellitus,
b) Major subtypes of diabetes mellitus,
c) Differences between type I and Type II diabetes mellitus,
d) Complications of diabetes mellitus

6) **Blood vessels:**

a) Atherosclerosis Risk factors; of Human atherosclerosis
b) Hypertension – diagnostic criterion, types and causes
c) Varicose veins
d) Thrombophlebitis and Phlebothrombosis

7) The Heart:

a) Heart failure
b) congenital heart diseases causing left to right shunt and vice versa
c) Myocardial infarction – causes, laboratory changes and complications
d) Cor-pulmonale
e) Rheumatic fever

8)Diseases of the Lung:

a) Chronic obstructive pulmonary disease; Asthma – pathogenesis
b) Pneumonia – lobar and bronchopneumonia
c) Lung carcinoma – Incidence and Causes

9)The Kidney and Lower urinary tract:

a) Acute Renal failure – definition and causes of Prerenal, renal and post-renal
b) ARF
c) Chronic renal failure – definition and causes
d) Acute nephritic syndrome – definition and causes
e) Nephrotic syndrome – definition and causes;
f) Acute tubular necrosis – definition and causes
g) Urolithiasis – types of stones

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10) **Female genital tract:**

a) Endometriosis – Definition
b) Adenomyosis – Definition
c) Leiomyoma

11) Male genital tract:

a) Carcinoma penis – causes
b) Testicular tumors – Classification terminology
c) Prostatic Hyperplasia – Causes, symptoms and PSA screening

12) Nervous system:

a) Intracerebral, Subarachnoid and Subdural haemorrhage
b) Meningitis and Encephalitis – Bacterial and viral causes and CSF findings;
c) Epilepsy – Causes;
d) Acute brain failure – Coma;
e) Epilepsy – Classification terminology;
f) CNS tumors – Classification terminology

- Demonstration of various pathological condition by showing specimen and slides.
- Demonstration of blood slides

Recommended Reading:

- Text Book of Pathology by Dr. Harshmohan
- Robbin s Pathologic Basis of Disease
- Practical Pathology by Tejinder Singh

BMLS-404: Immunology and Bacterial Serology

Rationale: This section will cover the basic aspects of immunity, antigens, antibodies, various serological reactions, techniques and their utility in laboratory diagnosis of human diseases. It will also cover medically important fungi, infections caused by them and their laboratory diagnosis.

1. History and introduction to immunology
2. Immunity
   2.1 Innate
   2.2 Acquired immunity
   2.3 Basic concepts about their mechanisms
3. Definition, types of antigens and determinants of antigenicity
4. Definition, types, structure and properties of immunoglobulin
5. Antigen-Antibody reactions
   5.1 Definition
   5.2 Classification
   5.3 General features and mechanisms
   5.4 Applications of various antigen antibody reactions
6. Principle, procedure and applications of under mentioned in Medical Microbiology:
   6.1 Complement fixation test
   6.2 Immuno- fluorescence
   6.3 ELISA
   6.4 SDS-PAGE
   6.5 Western blotting
7. Principle, procedure and interpretation of various serological tests:
   7.1 Widal

7.2 VDRL
7.3 ASO
7.4 CRP
7.5 Brucella tube agglutination
7.6 Rose-Waaler
8. Complement system:
8.1 Definition
8.2 Basic concepts about its components
8.3 Complement activation pathways
9. Immune response:
9.1 Introduction
9.2 Basic concepts of Humoral and Cellular immune responses
10. Hypersensitivity:
10.1 Definition
10.2 Types of hypersensitivity reactions
11. Basic concepts of autoimmunity and brief knowledge about autoimmune diseases
12. Automation in diagnostic serology
13. Vaccines:
13.1 Definition
13.2 Types
13.3 Vaccination schedule
13.4 Brief knowledge about _Extended programme of immunization' (EPI) in India

Suggested Readings:

1. Practical Medical Microbiology by Mackie & McCartney Volume 1 and 2
2. Text book of Microbiology by Ananthanarayanan
3. Medical Microbiology by Paniker& Satish Gupte
4. Medical laboratory Technology Vol. I ,II, III by Mukherjee
5. Medical Laboratory manual for tropical countries Vol II Microbiology by Monica Cheesbrough
6. Immunology by Riot
7. Basic & Clinical Immunology by P. Daniel Fudenberg. H. Hugh and Stites

Immunology and Bacterial Serology – Practical

1. Collection of blood sample by vein puncture, separation and preservation of serum
2. Performing Haemolysin titration for Rose-Waaler test
3. Preparation of Phosphate buffers, Verinol buffer, ASO buffer, Richardson's buffer, Buffers of different pH and Molarity, Tris buffer, Standardization of cell concentration by Spectrophotometer
4. Performance of Serological tests i.e.
4.1 Widal,
4.2 Brucella Tube Agglutination,
4.3 VDRL (including Antigen Preparation),
4.4 ASO (Anti-Streptolysin _O')
4.5 C-Reactive Protein (Latex agglutination)
4.6 Rheumatoid factor (RF) Latex agglutination
4.7 Rose Waaler test,
5. Demonstration of antigen/antibody determination by Immuno fluorescence (IF), Immunodiffusion, precipitation in Agarose gel (Ouchterlony), CCIEP, ELISA, SDS - PAGE and Western blotting.

6. Thyroid Microsomal antigen (TMA)- Agglutination reactions
7. Electrophoresis
8. Gel diffusion
9. Nephlometery
10. HLA
10.1 Typing Serology & Cross match
10.2 Molecular Typing
11. Nitro blue Tetrazolium Chloride Test (NBT)
12. FACS for CD4 and CD8
13. ELISA for lab. diagnosis of AIDS
14. Polymerase Chain Reaction and its advanced versions
15. Gel electrophoresis
16. Western blotting
17. Isolation of DNA and RNA
18. Estimation of DNA and RNA
19. Determination of molecular weight and quantification of DNA using agarose gel electrophoresis

BMLS-405: Applied Clinical Biochemistry- II

Rationale: The students will learn how to analyze various clinical patients 'samples, for estimation of different components which are the cause of the disease or are the diagnostic/prognostic markers. This subject gives information about various clinically important enzymes & automation techniques.

1. Automation in clinical biochemistry
2. Method of estimation and assessment for:
2.1 Glucose tolerance test
2.2 Insulin tolerance test
2.3 Xylose excretion test.
3. Gastric analysis.
4. Clearance test for renal function.
5. Qualitative test for:
5.1 Urobilinogens
5.2 Barbiturates
5.3 T3, T4 and TSH
5.4 Ketosteroids
6. Enzymes:
6.1 Principles
6.2 Clinical significance and
6.3 Procedures for estimation
6.3.1 Acid phosphatase
6.3.2 Alkaline phosphatase
6.3.3 Lactate dehydrogenase
6.3.4 Aspartate transaminase
6.3.5 Alanine transaminase
6.3.6 Creatine phosphokinase
7. Qualitative analysis of Renal calculi.
8. Chemical examination of Cerebrospinal fluid.
9. Brief knowledge about rapid techniques in clinical biochemistry

Suggested Readings

1. Text book of Medical Laboratory Technology by P.B. Godkar.
2. Medical Laboratory Science, Theory & Practical by A. Kolhatkar.
3. Practical Clinical Biochemistry by Harold Varley.
4. Biochemistry, U. Satyanarayan& U. Chakrapani.
5. Text book of Medical Biochemistry by Chaterjee&Shinde.
6. Principal of Biochemistry by Lehninger
7. Biochemistry by Voet&Voet
8. Biochemistry by Stryer

Applied Clinical Biochemistry-II – Practical

1. Estimation of Glucose tolerance test (GTT).
2. Estimation of Insulin tolerance test (ITT).
3. Determination of Uric acid in Urine.
4. Determination of Creatinine clearance.
5. Determination of Urea clearance.
6. Determination of Serum acid phosphatase.
7. Determination of Serum Alkaline phosphatase.
8. Determination of Serum Lactate dehydrogenase.
9. Determination of T3, T4 and TSH

Lt Col Varun Bajpai VSM
Executive Registrar
SGPGIMS,Lucknow

Fifth Semester

BMLS-501: Mycology, Medical Parasitology and Entomology

Rationale The student will be taught about introduction, general characteristics, life cycle and laboratory diagnosis of various medically important parasites.

1. Introduction to Medical Parasitology with respect to terms used in Parasitology.
2. Protozoology/ Protozoal parasites:

2.1 General characteristics of protozoa.

2.2 Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of Entamoeba sp.

2.3 Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of Intestinal and vaginal flagellates i.e. Giardia, Trichomonas sp.

2.4 Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of blood and tissue flagellates i.e. Plasmodium and Toxoplasmasp.

3. Helminthology/ Helminthic parasites:

3.1 General characteristics of Cestodes, Trematodes and Nematodes

3.2 Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of :

3.2.1 Taeniasolium and saginata
3.2.2 Echinococcus granulosus
3.2.3 Hymenolepis nana
3.2.4 Schistosoma haematobium and mansoni
3.2.5 Fasciola hepatica and buski
3.2.6 Trichuris trichura
3.2.7 Trichinella spirales
3.2.8 Strongyloides stercoralis
3.2.9 Ancylostoma duodenale
3.2.10 Enterobius vermicularis
3.2.11 Ascaris lumbricoides
3.2.12 Wuchereria bancrofti
3.2.13 Dracunculus medinensis

4. Diagnostic procedures:

4.1 Examination of Stool for parasites
4.1.1 For intestinal protozoal infections
4.1.2 General rules for microscopic examination of stool samples
4.1.3 Collection of stool samples
4.1.4 Preparation of material for unstained and stained preparations
4.1.5 Staining methods i.e. Iodine staining and permanent staining
4.1.6 For Helminthic infections
4.1.6.1 Introduction, direct smear preparation and examination
4.1.6.2 Concentration techniques i.e. Flotation and sedimentation techniques
4.1.6.3 Egg counting techniques
4.1.7 Examination of blood for parasites
4.1.7.1 Preparation of thin and thick blood film
4.1.7.2 Leishman staining
4.1.7.3 Examination of thick and thin smear
4.1.7.4 Field's stain
4.1.7.5 JSB stain

5. Examination of blood film for Malarial parasite and Microfilariae
6. Collection, Transport, processing and preservation of samples for routine parasitological

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investigations
7. Morphology, life cycle and lab-diagnosis of Giardia and Entamoeba
8. Morphology, life cycle and lab-diagnosis of Roundworms and Hookworms
9. Morphology, life cycle and lab-diagnosis of T. solium and T. saginata
10. Morphology, life cycle and lab-diagnosis of Malarial parasite with special reference to P.vivax and P. falciparum
11. Laboratory diagnosis of hydrated cyst and cysticercosis
12. Concentration techniques for demonstration of Ova and Cysts (Principles and applications)

Suggested Readings

1. Parasitology in relation to Clinical Medicine by K D Chatterjee
2. Medical Entomology by A.K. Hati, Pub. Allied Book Agency
3. Medical Parasitology by D.R. Arora
4. Clinical Parasitology by Paul Chester Beaver

Mycology:

1. Introduction to Medical Mycology
2. Basic concepts about superficial and deep Mycoses
3. Taxonomy & classification and general characteristics of various medically important fungi
4. Normal fungal flora
5. Morphological, cultural characteristics of common fungal laboratory contaminants
6. Culture media used in mycology
7. Direct microscopy in Medical mycology laboratory
8. Processing of clinical samples for diagnosis of fungal infections i.e.Skin,nail,hair,pus,sputum, CSF & other body fluids
9. Techniques used for isolation and identification of medically important fungi
10. Methods for identification of yeasts and moulds
11. Dimorphism in fungi
12. Antifungal susceptibility tests
13. Preservation of fungal cultures
14. Routine myco-serological tests and skin tests

Medical Parasitology and Entomology – Practical

1. Routine stool examination for detection of intestinal parasites with concentrationmethods:
1.1 Saline preparation
1.2 Iodine preparation
1.3 Floatation method
1.4 Centrifugation method
1.5 Formal ether method
1.6 Zinc sulphate method
2. Identification of adult worms from models/slides:
2.1 Tapeworm
2.2 Tapeworm segments
2.3 Ascaris (Round worm)
2.4 Hookworms
2.5 Pinworms
3. Malarial parasite:
3.1 Preparation of thin and thick smears

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Executive Registrar
SGPGIMS,Lucknow

3.2 Staining of smears
3.3 Examination of smears for malarial parasites (P. vivax and P. falciparum)

Suggested Readings

1. Practical Medical Microbiology by Mackie &MacCartney Volume 1 and 2
2. Text book of Microbiology by Ananthanarayanan
3. Medical Microbiology by Panikar& Satish Gupte
4. Medical laboratory Technology Vol. I ,II, III by Mukherjee
5. Medical Laboratory manual for tropical countries Vol. II Microbiology by Monica Cheesbrough
6. Medical Mycology by Dr. JagdishChander

BMLS 502: Applied Haematology-

Rationale: The students will be made aware of the methods of estimating different components of blood. Students will learn the basic concepts of staining and coagulation in Haematology laboratory.

1. Collection of Blood, Basic steps for drawing a blood specimen by veinipuncture. Complications of venipuncture, Patient after care,. Specimen rejection criteria for blood specimen, Hemolysis of blood, Blood collection by skin puncture (Capillary Blood), Arterial puncture.
2. Anti Coagulants, EDTA, Citrate, Oxalate, Heparin, sodium fluoride.
3. Separation of serum, Separation of plasma, Changes in blood on keeping,
4. Haemoglobinometry: Different methods to measure Haemoglobin with merits anddemerits
5. Haemocytometery: Introduction, Principle, Reagent preparation, procedure, errors involved and means to minimize errors.

5.1 RBC Count,
5.2 Total leucocytes count(TLC)
5.3 Platelet Count.
5.4 Absolute Eosinophil count

6. Principle mechanism and different methods with merit and demerits for the measuring Erythrocyte Sedimentation Rate(ESR) and its significance
7. Different methods with merit and demerits for packed cell volume/Hematocrit value
8. Preparation of blood films

8.1 Types, Methods of preparation (Thick and thin smear/film) and utility
8.2 Staining techniques in Hematology (Romanowsky's stains):Principle, composition, preparation of staining reagents and procedure of the following
8.3 Giemsa'sstain
8.4 Leishman'sstain
8.5 Wright'sstain
8.6 Field's stain
8.7 JSB stain.

9. Differential leucocytes count(DLC)
10. Anemia:

10.1 Morphological & etiological. Classification, Distribution of body Iron, Iron Absorption, causes of iron deficiency, lab findings. Causes of megaloblastic anemia, Lab findings. Caused of hemolytic anemia and lab findings.

11. Cell composition of normal adult Bone marrow Aspiration, Indication, Preparation & Staining,
12. Special Stain for Bone Marrow -Periodic Acid, Schiff, Sudan Black, Myeloperoxidase. Classification, Blood Picture, Differentiation of Blast Cells.

13. Preparation and examination of thin and thick film
14. Staining of blood film Leishman s stain, Giemsa Stain, Supravital Stain
15. Maintenance of specimen identification, Transport of the specime, Effect of storage on Blood Cell Morphology,
16. Universal precautions

17. Hemostasis - Definition, Basic concept and principle, Basic steps involved in Hemastosis.
18. Coagulation -
18.1 Basic Physiology, coagulation factors, Mechanism of blood coagulation, Extrinsic Pathway,Intrinsic Pathway, Regulators of blood coagulation.
18.2 Testing of blood coagulation -
18.3 Bleeding Time, Duke's method,Clotting Time- Capillary tube method & Lee white's method, PT, aPTT, TT, Clot retraction time,Determination of fibrinogen.
19. Quality Assurance for routine Heamostasis Laboratory-
19.1 Introduction.Sample collection technique (Phelbotomy), Sample preparation, Anticoagulant used, Importance of use of Sodium Citrate.
20. Bleeding disorders-
20.1 Qualitative Platelet disorders, Thrombocytopenias - causes including
20.2 Aplastic anemia.
20.3 D I C,
20.4 IT P,
20.5 Hemophilia

21. Safety precautions in Haematology
Biomedical waste management in Haematology laboratory (Other than Radioactivematerial)

Applied Haematology- Practical

1. Hb Estimation
1.1 Sahli'smethod
1.2 Cyanmethahaemoglobin method
1.3 Oxyhaemoglobin method
2. Total leukocyte count
3. Platelets count
4. Absolute Eosinophil count
5. Preparation of smear and staining with Giemsa and Leishman stain.
6. ESR(Wintrobe and Westergren method)
7. Packed cell volume(Macro & Micro)
8. Cytological examination of CSF and other body fluids
9. Physical and Microscopic examination of seminal fluid including sperm count
10. Perform normal DLC
11. Preparation of M/40 Calcium chloride
11.1 Brain thromboplastin and standardization
11.2 Cephalic
11.3 Adsorbed plasma
12. Perform BT, CT, Hess test, PT and APTT
12.1 Review the morphology of Normal and abnormal RBCs
12.2 Review the morphology of normal and immature WBCs
12.3 WBCs anomalies
12.4 Calculating INR and determining the ISI of thromboplastin

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13. Quantitative Factor assays:
13.1 Factor VIII
13.2 Factor IX
13.3 Factor VII
13.4 Factor X
13.5 Factor V
14. Quantification of inhibitors (Bethesda method)
15. APLA : Lupus Anticoagulant (LA)
16. Anti-cardiolipin antibodies (ACA)
17. Perform Euglobulin clot lysis test (ELT)
18. Urea clot solubility test for factor XIII.

BMLS-503: Histopathology and Cytopathology

Rationale: In this section, students will be made aware of terminology used in histotechnology, various instruments and their maintenance and also learn the processing of various samples for histopathological investigations.

Introduction to Histotechnology

1. Compound microscope:
1.1 Optical system, magnification and maintenance
1.2 Microscopy:
1.3 Working principle
1.4 Applications of various types of microscopes i.e darkfield, polarizing, phase contrast, interference and fluorescent microscope
2. Fluorescent microscope
3. Care and maintenance of laboratory equipment used in histotechnology
4. Safety measures in a histopathology laboratory
5. Basic concepts about routine methods of examination of tissues
6. Collection and transportation of specimens for histological examination
7. Basic concepts of fixation
8. Various types of fixatives used in a routine histopathology laboratory
8.1 Simple fixatives
8.2 Compound fixatives
8.3 Special fixatives for demonstration of various tissue elements
9. Decalcification
9.1 Criteria of a good decalcification agent
9.2 Technique of decalcification followed with selection of tissue, fixation, and decalcification, neutralization of acid and thorough washing
9.3 Various types of decalcifying fluids: Organic & Inorganic Acid, chelating agents, Useof Ion-exchange resigns and Electrophoretic decalcification and treatment of hard tissues which are not calcified
10. Processing of various tissues for histological examination
10.1 Procedure followed by Dehydration, Clearing, Infiltration and routine timingschedule for manual or automatic tissue processing.
10.2 Components & principles of various types of automatic tissue
10.3 Processors
10.4 Embedding:
- Definition
- Various types of embedding media

11. Section Cutting
11.1 Introduction regarding equipment used for sectioning

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11.2 Microtome Knives, Sharpening of Microtome Knives, Honing, Stropping, varioustypes of microtome and their applications
11.3 Freezing Microtome and various types of Cryostats.
11.4 Faults in paraffin section cutting with reason and remedy, spreading the sections and attachment or mounting of sections to glass slides.
12. Staining, Impregnation and Mountants
12.1 Theory of Staining, Classifications of Dyes, Principles of Dye Chemistry
12.2 Stains and Dyes and their uses
12.3 Types of Stains, Chemical Staining Action, Mordants and Accentuators, Metachromasia
12.4 Use of Controls in Staining Procedures
12.5 Preparation of Stains, solvents, aniline water and buffers etc.
12.6 Commonly used mountants in histotechnology lab
12.7 General Staining Procedures for Paraffin Infiltrated and Embedded tissue
12.8 Nuclear Stains and Cytoplasmic stains
12.9 Equipment and Procedure for manual Staining and Automatic Staining Technique
12.10 Mounting of Cover Slips, Labeling and Cataloguing the Slides
13. Routine Staining Procedures
13.1 Haematoxylin and Eosin Staining, various types of Haematoxylins
13.2 Mallory'sPhosphotungstic Acid Haematoxylin (PTAH)

Suggested readings

1. Anatomy &Physiology – Ross and Wilson
2. Human Anatomy and Physiology by Pearce
3. Di Fiore's Atlas of Histology
4. Medical Laboratory Technology by KL Mukherjee-Volume III
5. Text book of Pathology by Robbins

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Executive Registrar
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CYTOPATHOLOGY

Rationale: The students will learn about various staining procedures for demonstration of different substances & various cytological investigations. This will include special staining procedures &handling & testing of various cytological specimens.

1. Aspiration cytology:
1.1 Principle
1.2 Indications & utility of the technique with special emphasis on role ofcytotechnologist in FNAC
2. Exfoliative cytology (Papanicolaou technique for the staining of cervical smears)
2.1 Cervical cytology
2.2 Fluid Cytology
2.3 Urine
2.4 CSF
2.5 Body Fluids (Pleural, Pericardial, Ascitic)

Suggested Readings

1. Handbook of Histopathological Techniques by C F A Culling
2. Medical Lab technology by Lynch
3. An Introduction to Medical Lab Technology by F J Baker and Silverton
4. Bancroft's Theory and Practice of Histopathological Techniques by John D Bancroft
5. Diagnostic Cytology by Koss Volume -II

1. Textbook ofMedicalLaboratoryTechnologyby PrafulB. Godkar
2. MedicallaboratoryTechnologyby K.L.Mukherjee Volume-I
3. PracticalHaematology by J.B. Dacie
4. Clinical Diagnosis &Management by Laboratory methods (20thedition)by John Bernard Henry
5. Atlasof Haematologyby G.A.McDonald
6. De Gruchy's Clinical Haematology in medical practice

Applied Histopathology-I - Practical

1. Demonstration of instruments used for dissection
2. Use of antiseptics, disinfectants and insecticides in a tissue culture processing laboratory
3. Reception and labeling of histological specimens
4. Preparation of various fixatives
4.1 Helly's fluid
4.2 Zenker's fluid
4.3 Bouin's fluid
4.4 Corney's fluid
4.5 10% Neutral formalin
4.6 Formal saline
4.7 Formal acetic acid
4.8 Pereyn's fluid
5. Testing of melting point of paraffin wax and perform embedding of given tissue inparaffin block
6. To process a bone for decalcification
7. To prepare ascending and descending grades of alcohol from absolute alcohol
8. Processing of tissue by manual and automated processor method
9. To demonstrate various part and types of microtome
10. To learn sharpening of microtome knife (Honing and stropping technique), and types of disposable blades in use (High and Low Profile).

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11. To perform section cutting (Rough and Fine)
12. To practice attachment of tissue sections to glass slides
13. To learn using tissue floatation bath and drying of sections in oven (60-65C)
14. To perform & practice the Haematoxylin and Eosin staining technique
15. To perform & practice the Mallory's Phospho tungstic Acid Haematoxylin (PTAH)
16. To learn mounting of stained smears

BMLS-504 Medical Genetics and cytogenetic techniques

Genetics

1. Continuity of life-heredity, variation;
2. Mendel's laws of inheritance,
3. Chromosomal basis of inheritance; other patterns of inheritance- incomplete dominance, multi parallelism, quantitative inheritance.
4. Chromosomes - bacterial cell and eukaryotic cell; parallelism between genes and chromosomes; genome, linkage and crossing over; gene mapping; recombination;
5. Molecular genetics: DNA as a genetic material- its structure and replication; structure of RNA and its role in protein synthesis, Vectors, plasmids
6. Human Genetics
7. Microbial genetics
8. FISH
9. Technique for FISH- Cell preparation, Probe application, Visualisation

Suggested readings

1. Practical Haematology by J.B. Dacie
2. Transfusion Science by Overfield, Hamer
3. Medical Laboratory Technology by K.L. Mukherjee Volume-I
4. Mollison's Blood Transfusion in Clinical Medicine, 12th Edition by Harvey G. Klein
5. Genes by Benjamin Lewin
6. Genetics by B.D. Singh
7. Principals of Genetics by Gardner
8. Instant Notes on Genetics by PC Winter, GI Hickey and HL Fletcher

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6th SEMESTER

BMLS-601: Laboratory automation and QC

Automation.

1. Introduction, meaning, advantages, history,
2. Continuous flow analyzers,
3. Single channel continuous flow analyzers-advantages, disadvantages
4. Multi-channel flow analyzer,
5. Discrete auto analyzers - basic features, types,
6. Semi-automated, fully automated, Batch analyzers,
7. Random access analyzers (RAA),
8. Component steps in fully automated analyzers,
9. Auto analyzers based on immunoassay techniques,
10. Micro particle enzyme immunoassay (MEIA),
11. Centrifugal analyzers, ASCA, Dry chemistry analyzers,
12. Dimension RxL clinical chemistry system,
13. The Heterogeneous Immunoassay module components,
14. Mini Vidas analyzers
15. Immulite automated ,immunoassay analyzers,
16. Latest trends in Automation,
17. Biochips,
18. Lab on a chip (LoC)
19. Nanosensors- advantages and disadvantages,
20. PCR & its applications.

Quality Assurance:

1. Introduction to Quality control,
2. Total quality management framework,
3. Quality laboratory processes,
4. Quality assurance, Quality assessment,
5. Quality control,
6. Quality planning and Quality improvement,
7. Costs of conformance and non conformance, appraisal costs, prevention costs,
8. Internal quality control, basic steps, sources of error and their correction methods,
9. CAPA - corrective action & preventive action, Sources of variation in laboratory results,
10. Quality control charts,
11. Levy- Jennings and Cusum charts,
12. West guard Rules
13. External quality control, Quality control programme
14. Intrinsic and extrinsic and random errors,
15. Current trends in laboratory accreditation,
16. ISO certificate,

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BMLS-602: Advanced Haematology and Immunopathology

Rationale

The students will be made aware of different anemia, Leukemia, chromosomal studies, bleeding disorders and radiation hazards

1. Laboratory diagnosis of Iron deficiency anemia
2. Laboratory diagnosis of Megaloblastic anemia & Pernicious anemia
3. Classification and Laboratory diagnosis of Hemolytic anemia
4. Definition, classification and laboratory diagnosis of Leukemia
5. Definition, classification and laboratory diagnosis of Lymphoma
6. Chromosomal studies in various hematological disorders and their significance.
7. Laboratory diagnosis of bleeding disorders with special emphasize to
   - 7.1 Hemophilia A, B & Von-Willebrand disease
   - 7.2 DIC
   - 7.3 Platelet disorder (Qualitative and quantitative)
8. Laboratory approach for investigating thrombosis.
9. Introduction to Immunology
10. Cells of the immune system
11. Types and Mechanisms of immune response
12. Lymphoid organs of the Immune system
13. MHC I & II
14. HLA Typing & Cross matching
15. Transplant Immunology
16. Hypersensitivity: Definition, Types, Mechanisms
17. Autoimmunity
18. Immune tolerance : Basic concepts
19. FCM and its clinical applications
20. Immunofluorescence technique
21. Immunohistochemistry technique

Suggested Readings

1. Text book of Medical Laboratory Technology by Paraful B. Godkar
2. Medical laboratory Technology by KL Mukherjee Volume-I
3. Practical Haematology by JB Dacie
4. Clinical Diagnosis &Management by Laboratory methods (20th edition) by John BernardHenary
5. Atlas of Haematology (5th edition) by G.A. McDonald
6. De Gruchy's clinical Haematology in medical practice
7. Postgraduate Haematology by Hoffbrand

Suggested Readings

1. Immunology by Ivan Roitt, JonathaanBrostoff and David Male
2. Immunology by Kuby
3. Medical Immunology by Daniel P Stites
4. Basic & Clinical Immunology by P. Daniel Fudenberg. H. Hugh and Stites
5. Elements of Biotechnology by PK Gupta
6. Watson Molecular Biology of Gene
7. Advanced Molecular Biology by R Twyman
8. Principal of Biochemistry by Lehninger

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9. Immunology by Ivan Roitt, JonathaanBrostoff and David Male
10. Immunology by Kuby

11. Medical Immunology by Daniel P Stites
12. Basic & Clinical Immunology by P. Daniel Fudenberg. H. Hugh and Stites
13. Elements of Biotechnology by PK Gupta
14. Watson Molecular Biology of Gene
15. Advanced Molecular Biology by R Twyman
16. Principal of Biochemistry by Lehninger

Immunopathology & Molecular Biology – Practicals

1. Peripheral blood mononuclear cell (PBMC) isolation by gradient centrifugation
2. T and B cell separation
3. Immunofluorescence
3.1 Anti- Nuclear Antibody (ANA)
3.2 Anti- Neutrophil Cytoplasmic Antibody (ANCA)
4. AIDS Immunology and Pathogenesis (AIP)

Advanced Haematology – Practical

1. Study and interpretation of Histogram of Automated Blood cell counter
2. To estimate serum iron and total iron binding capacity.
3. Screening tests for enzymes deficiency: Pyruvate Kinase, G6PD
4. To estimate Hb-F, Hb-A2 in a given blood sample.
5. To estimate plasma and urine Hemoglobin in the given specimens.
6. To demonstrate the presence of Hb-S by Sickling and Solubility tests.
7. Perform Hb electrophoresis (alkaline)
8. Perform osmotic red cell fragility.
9. Detection of Fibrin degradation products (FDPs)
10. To perform various platelet function tests such as whole blood clot retraction test, prothrombin consumption index (PCI) Platelet adhesion, aggregation and PF3 availability test.
11. Estimation of Protein C, S

BMLS-603- Histopathology and Cytopathology-II

1. Cryostat sectioning, its applications in diagnostic histopathology.
2. Special Staining Procedures for detection of
2.1 Connective tissue elements, Trichrome staining, muscle fibers, elastic, reticulin fibers, collagen fibers etc.
2.2 Metachromatic staining such as Toludine blue on frozen sections
2.3 Principles of metal impregnation techniques.
2.4 Demonstration & identification of minerals and pigments, removal of pigments/artifacts in tissue
3. Demonstration of Proteins & nucleic acids.
4. Demonstration of Carbohydrates, lipids, fat & fat like substances.
5. Demonstration of bacteria and fungi in tissue section.
6. Tissue requiring special treatment i.e. eye ball, bone marrow, and muscle biopsy, under calcified or unclarified bones, whole brain, and whole lungs including other large organs.
7. Enzyme histochemistry: Diagnostic applications and the demonstration of Phosphatases, Dehydrogenases, Oxidases & Peroxidases.
8. Vital staining.
9. Neuro-pathological techniques.
10. Museum techniques.
11. Electron Microscope:

Lt Col Varun Bajaj, VSM
Executive Registrar
SGPGIMS, Lucknow

11.1 working principle and its components
11.2 Processing, embedding and ultra-microtomy
12. Micrometry and Morphometry
Histological features of some common neoplastic and non neoplastic lesions

Suggested Readings

1. Handbook of Histopathological Techniques by C F A Culling
2. Medical Lab technology by Lynch
3. An Introduction to Medical Lab Technology by F J Baker and Silverton
4. Bancroft's Theory and Practice of Histopathological Techniques by John D Bancroft

Cytology

1. Automation in cytology
2. Liquid based cytology: Principles and preparation, Cytocentrifuge, molecular cytology, CellBlock and Immune-cytochemistry.
3. Cytological features of common neoplastic and non neoplastic lesions

Applied Histopathology-II - Practical

1. To cut frozen section and stain for Haematoxylin and Eosin, Metachromatic stain Toluidine blue-_o' and Oil Red _O' staining for the demonstration of fat
2. To prepare Schiff's reagent in the lab and do Periodic Acid Schiff's (PAS) stain on a paraffin section
3. To prepare ammonical silver bath in the laboratory and stain paraffin embedded section for the demonstration of reticulin fibers.
4. To stain a paraffin section for the demonstration of smooth muscle by Van Gieson's Stain
5. To perform Masson's trichrome stain on a paraffin section for the demonstration of collagen fiber, muscle fiber and other cell elements.
6. To stain the paraffin section for the demonstration of the elastic fibers (EVG).
7. To stain Decalcified paraffin embedded section for the presence of calcium salts (Von Kossa's method).
8. To stain a paraffin section for the following Mucicarmine, Alcian blue.
9. To stain a paraffin section for the demonstration of iron (Perl's stain)
10. To demonstrate the presence of bacteria and fungi in paraffin embedded sections using the following staining procedures:
10.1 Gram's staining
10.2 AFB staining (Ziehl Neilson's staining) for M. tuberculosis and leprae
10.3 Grocott's stain for fungi
10.4 Schmorl's reaction for reducing substances (melanin)
11. To stain for nucleic acid (DNA and RNA)
11.1 Feulgen Staining
11.2 Methyl Green-Pyronin Staining
11.3 Enzymatic methods

Suggested Readings

1. Handbook of Histopathological Techniques by C F A Culling
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Cytopathology – Practical

1. To perform Papnicolaou's stain on cervical smear
2. To perform Guard's staining for demonstration sex chromatin (Barr bodies on a buccalsmear)
3. To perform Shorr's staining for Hormonal assessment
4. To cut frozen sections of Gynaec tissue
5. To perform CSF sample and body fluids by cytospin
6. Should know the various stains used in Cytology lab:l May Grunwald Giemsa, H&E,PAS, Grocott's.

Lt Col Varun Bajpai VSM
Executive Registrar
SGPGIMS,Lucknow

BMLS-604- Molecular Genetic techniques

1. Extraction of Nucleic acid
2. Checking the quality and quantity of nucleic acid
3. Purity of nucleic acid
4. PCR and its uses
5. Type of PCR and its uses
6. RT PCR and its uses
7. Types of RTPCR and its uses
8. Post PCR analysis methods
9. Fragment analysis
10. RFLP
11. Sanger sequencing

Practical;

1. Extraction of DNA and RNA
2. Preparation of agarose gel
3. Checking the quality and quantity of nucleic acids
4. Running PCR
5. Analyzing the post PCR product
6. Running RT PCR
7. RFLP
8. Fragment analysis
9. Sanger sequencing

Lt Col Varun Bajpai VSM
Executive Registrar
SGPGIMS,Lucknow