

SYLLABUS FOR MD LABORATORY MEDICINE

1. ORGANIZATION OF THE LABORATORY

The post graduates is expected to have knowledge on

i) Spatial organization: flooring, ventilation, air-conditioning, sanitation, drainage ii) disposal of waste in differently coloured bags iii) Lab. Safety: Prevention of Physical, Chemical & Biological Hazards. First Aid in Lab. Accidents. iv) Understanding of different levels of Biosafety; BSL I, BSL, II and BSL III etc., v) Financing, Budgeting and cost accounting of investigations vi) Management of Laboratory stores vii) Special reference to glassware, chemicals (AL, LR) & dangerous poisonous chemicals viii) Personal Management and Training of technical staff ix) Streamlining of in-put and output of lab investigations, specimen collection and dispatch of report (TOT) x) Taking cognizance of POC testing in the wards xi) Computerization of laboratory services (LIS. HIS) xii) Legal aspect of laboratory services.

2. QUALITY CONTROL & QUALITY ASSURANCE

i) Sources of errors in laboratory results a) Pre-instrumental b) Instrumental c) Post-instrumental. ii) Methods of detection of errors iii) Types of error iv) Corrective measures to minimize the errors v) Method of documentation of the whole procedures vi) Onward transmission of the knowledge and skill to the other laboratory vii) Preparation of internal 'control' viii) Proficiency testing programme ix) Participation in E.Q.A.P. & Preparation of Biological Standards x) Procurements of 'Standards' and 'Control' for Hematology, Cl. Chemistry and immunoassays xi) Quality assurance in Microscopy xii) To check the calibration of Pipettes, speed of centrifuge, Temperature of Freezer, incubator, oven etc.

3. INSTRUMENTATION

To know the: i) Principle ii) Parts iii) Working manual and iv) Preventive maintenance of the following instruments.

A. Minor Instruments: i) Different types of Shakers, roller Mixer, Cyclomixer etc. ii) Thermometer iii) Different kinds of refrigerators (4°, -20°C, -80°C) iv) Incubators (including BOD incubator) v) Ovens vi) Water-baths vii) Distillation plant viii) Deionizer plant ix) RO System x) Auto pipettes xi) pH Meter xii) Auto-dispensers xiii) Analytical Balance xiv) Table top centrifuge etc.

B. Major Instruments: i) Photoelectric Colorimeter ii) Spectrophotometer iii) Centrifuge machines (table top, high speed, cold centrifuge) iv) Blood Cell Counter v) ELISA Reader & Washer vi) Autoanalysers vii) Flame-photometer & Electrolyte analyzer viii) Blood Gas Analyzer ix) Microscopes: Light, Fluorescent, Dark ground, Phase contrast x) Electrophoresis apparatus, xi) Densitometer, xii) Culture hood & Biosafety hood xiii) Thermocycler and Gel doc. xiv) Microbial culture system, xv) TB culture system xvi) Urine analysis system xvii) BOD Incubator xviii) Immunoassay analyzer xix) -20° and -80° deep freezer xx) Refrigerated centrifuge machine etc.

C. The principle and working manual of following techniques: i) Chromatography of different kinds particularly HPLC and GLC ii) Flowcytometry iii) Scanning and Transmission Electron microscopy. iv) Beta & Gamma Counting etc.

4. PHYSICAL CHEMISTRY & CLINICAL BIOCHEMISTRY

a). Physical Chemistry

Theory (Knowledge): Mol wt, Atomic wt, Eq. wt, Log table & Periodic table. Water of crystallization, Colloid, Crystalloid, Osmolality, Osmolarity, Normality, Specific gravity etc.

Practical (Skill): i) Preparation of standard, normal & molar solution ii) Preparation of buffers iii) Preparation of Laboratory reagents iv) Handling of corrosives, poisonous chemicals.

b) Clinical Biochemistry:

Theory (Knowledge): i) Carbohydrate Chemistry: Identification, Metabolism and disorders of metabolism; Diabetes Mellitus, Hypoglycemia ii) Structure, function and physiological roles of different proteins. Metabolism. Hypo- and Hyper-proteinemia iii) Amino acids & related metabolites, Aminoaciduria iv) Glycoproteins, proteoglycans and collagen v) Porphyrins vi) Lipids, lipoproteins, apoproteins. vii) Enzymology: diagnostic values of enzymes & isozymes in health and disease viii) Acid-base and Electrolyte imbalance and regulation ix) Tumor-markers x) DNA-RNA chemistry; xi) Vitamins, & Trace elements and other important metals xii) Biochemistry of various body fluids.

Practical (Skill): Students must be familiar with profiles of various investigations, e.g., Cardiac. Renal, Liver profile etc. i) Manual method of estimation of sugar, urea, bilirubin, protein (total and fractional), creatinine, cholesterol, uric acid, amylase, acid and alkaline phosphatases ii) Automated methods of estimation of: a) above chemicals b) SGOT, SGPT, LDH, CPK, Calcium, Phosphate etc. iii) Measurement of Blood pH & Arterial blood gases iv) Electrolytes estimation (Na, K, Ca, Cl.) v) Lipids, apo-proteins and lipoproteins vi) Tumor markers vii) Chemical analysis of body fluids (CSF, Peritoneal/pleural/synovial fluid) viii) Practical exercises on Quality assurance in a clinical biochemistry laboratory.

Counseling: Pre-test and Post-test counseling of the patients; Medical auditing.

c. Endocrine Chemistry

Theory (Knowledge) & Practical (Skill): i) Hormones: chemistry, metabolism, physiology and pathology ii) Endocrine Function Tests (Theory & Practical, specially thyroid hormones cortisol, testosterone, oestrogens, oestradiol etc.) iii) Hormone Assay, RIA iv) Ligand Binding Assays

Counseling: Pre-test and Post-test counseling of the patients

5. CLINICAL PATHOLOGY (CLINICAL MICROSCOPY OF BODY FLUIDS)

Theory (Knowledge) and Practical (Skill): Physical, Chemical and Microscopic examination of various excretory / secretory fluids e.g. (i) Urine (ii) CSF (iii) Peritoneal, pleural, pericardial, synovial, (v) Amniotic (vi) Semen (vii) Sputum and (viii) feces etc.

Counseling: Pre test and Posttest counseling of the patients

6. CLINICAL HAEMATOLOGY & TRANSFUSION MEDICINE

A. Clinical Hematology

Theory (Knowledge): i) Detection and typing of anemia ii) Polycythemia iii) Neutrophilia, Eosinophilia, Basophilia, Lymphocytosis, Neutropenia, Lymphopenia, Agranulocytosis iv) Leukemia diagnosis, classification, clinicopathological correlation v) Thrombocytosis, thrombocytopenia, platelet function vi) Investigation of bleeding disorders vii) Investigation of prothrombotic state viii) Automation in hematology ix) Bone marrow physiology and pathology.

Practical (Skill): i) Collection, transport and processing of blood samples for different hematological investigations ii) Performance of routine hemogram: Hb, TLC, DLC, ESR. iii) Preparation staining and interpretation of peripheral blood smear, Reticulocyte count, buffy coat preparation iv) Aspiration of bone marrow, preparation of touch smear and bone biopsy. Staining and interpretation of marrow v) Cytochemistry of blood smear and bone marrow smear and their interpretation vi) Serum iron, folate and B12 estimation vii) Hemolytic studies e.g. osmotic fragility, sickling test, estimation of HbF, HbA₂, Comb's test viii) Leukocyte function test ix) Screening coagulation and DIC studies. BT, CT, PT, APTT, Clot stability ix) Investigation of prothrombotic states. Protein C, Protein S, Antithrombin III, Lupus anticoagulant x) Demonstration of common blood parasites x) understanding and acting on 'Flagging' in automated blood cell-counter.

Counseling: Pre-test and Post- test counseling of the patients.

B. Transfusion Medicine

Theory (Knowledge): It is expected that students should possess knowledge of the following aspects of Transfusion Medicine.

i) Basic immunohematology ii) ABO and Rh grouping iii) Clinical significance of other blood groups iv) Transfusion therapy including the use of whole blood, RBC concentrates and Blood component therapy v) Rationale of pre-transfusion testing vi) Transfusion transmitted Infections vii) Adverse reactions to transfusion of blood and blood components viii) Quality control in blood bank

Practical (Skill): i) Selection and bleeding of donors ii) ABO and Rah grouping iii) Resolving ABO grouping problems by secretor status in saliva and expanded panel iv) Familiarity with Antibody screening by; a) LISS (Low-ionic salt solution) b) Enzymes c) AHG (Anti-Human Globulin) v) Steps to be taken if the above are positive vi) Demonstrate familiarity with Cross-matching by; a) LISS (Low-ionic salt solution) b) Enzymes c) AHG (Anti-Human Globulin) vii) Steps to be taken if there is incompatibility viii) Preparation of blood components i.e. Cryoprecipitate, Platelet concentrate, Fresh Frozen Plasma, Single

Donor Plasma, Red Blood Cell concentrates ix) Demonstrate familiarity with Antenatal and Neonatal work a) Direct ant globulin test b) Antibody screening and titer c) Selection of blood for exchange transfusion x) Demonstrate familiarity with principle and procedures involved in ; a) Resolving ABO grouping problems b) Identification of RBC antibody c) Investigation of transfusion reaction d) Testing of blood for presence of ; (i) HBV (Hepatitis B Virus Markers) (ii) HCV (Hepatitis C Virus Markers) (iii) HIV (Human Immunodeficiency Virus markers) (iv) VDRL xi) Investigation of hemolytic jaundice of adult and new born
Counseling: Pretest and Posttest counseling of the patients.

7. CLINICAL MICROBIOLOGY

Theory (Knowledge): i) Medically important microbes in general. Enterobacteriaceae and other gram negative bacilli like *Salmonella*, *Shigella*, *E coli* etc. Gram-positive cocci & bacilla and Mycobacteria, in particular, their general behavior, life history, metabolism, genetics and mode of infection, ii) Epidemiology of infectious diseases, iii) Hospital Acquired Infections/Nosocomial infections, iv) Medically important parasites, v) Medically important viruses, vi) Medically important fungi, vii) Systemic Microbiology: Gastroenteritis and bacterial food poisoning, Septicemia, wound infection, burn associate infections, U.T.I., R.T.I., C.N.S. infection including meningitis, encephalitis, STDs/ AIDS, opportunistic infections, congenital infections and infections in vulnerable groups e.g. AIDS patients, Cancer patients, Geriatrics, Premature babies, Pregnancy & post transplantation etc. (viii) Immunity to microbial diseases, (ix) Vaccines for infectious diseases, (x) Laboratory acquired infections, (xi) Diagnosis & Prevention of infection, (xii) Lab. Safety: Blood borne disease including-Viral Hepatitis & HIV, Air borne infections, Universal precautions, Principles of Bio-safety, (xiii) Medico-Legal aspects of infectious diseases including postmortem findings and evidence based opinion on criminal cases in regard to infections/vaccines.

Practical (Skill): i) Methods of collection, transportation and techniques used for clinical samples: a) Blood b) Bone marrow, Splenic, Liver, Lymph Node aspirates c) CSF, Pus from closed cavities & open wounds d) Urine e) Stool f) Semen g) Sputum h) Saliva i) Swabs (nasal, pharyngeal, rectal, conjunctival etc.) ii) Demonstration of microorganisms by Microscopy (bright field, dark ground, phase contrast, fluorescence etc.) iii) Commonly used stains in microbiology: Grams, Giemsa, Romanowsky, A.F.B, Kinyoun's, Albert's special stains for spores, capsules, inclusion bodies, parasites & fungi etc. iv) Culture Media: their preparation, inoculation, and uses v) Antibiotic sensitivity testing including automation in Microbiology and Interpretation of antibiograms vi) Serological techniques e.g. Widal, VDRL, CFT, ID, ELISA, IFA, RIA etc. In-vitro demonstration of CMI, Complement cycles, Blast transformation, Monoclonal antibodies, skin test and others vii) Biochemical tests for microbial identification viii) Serotyping of microbes ix) Bed side tests: FNA, intradermal tests, cord blood, lumbar puncture etc. x) Animal inoculation studies xi) Egg inoculation, cell culture studied for the diagnosis of viral & other microbial infection xii) Human parasites including Protozoa, Nematodes, Cestodes and Trematodes and their diagnosis by gross, microscopic and serological & culture techniques. Diagnosis of amoebiasis, giardiasis, Leishmaniasis, Toxoplasmosis & Malaria xiii) fungal infections in human and their diagnosis xiv) Hospital infection surveillance xv) Maintenance of strains.

Counseling: Pretest and Post test counseling of the patients.

8. CLINICAL IMMUNOLOGY

Theory (Knowledge):

Physiology of Immune System; i) Hypersensitivity Reactions ii) Autoimmune Diseases iii) Transplantation Immunology iv) Host-Parasite interaction

Practical (Skill):

i) Demonstration of T and B cell. ii) Functional evaluation of T and B cell. CD4 & CD8 counting iii) Immunoglobulin estimation iv) Serological techniques like (a) CFT (b) Agglutination test (c) IHA & (d) ELISA with particular, reference to microbial serology, interleukin, ANF, RF, CRP (v) Radioimmunoassay vi) Immunoglobulins in health and disease vii) Complements level determination.

9. CLINICAL PHYSIOLOGY

Theory (Knowledge) and Practical (Skill) of ORGAN FUNCTION TESTS: i) Liver function tests, ii) Kidney function tests, iii) Gastric function tests, iv) Pancreatic function tests, v) Splenic function tests, vi) Tests for malabsorption, vii) Respiratory function tests, viii) Cardiac function tests, and ix) Endocrine function tests.

10. MOLECULAR BIOLOGY: THEORY (KNOWLEDGE) AND PRACTICAL (SKILLS)

Structure of DNA & RNA, Genetic configuration of commonly used Genomic vectors/host and their uses in molecular biology, blotting technology (Southern, Northern, Western), DNA hybridization, RNA hybridization, Polymerase Chain Reaction (PCR) and its variants in various diseases, LCR (Ligase Chain Reaction), NASBA (Nucleic acid sequence based amplification), Micro-array technology, Chromosomal analysis, HLA typing, Principles of Bioassays, Bio-chips, Cell culture technology.

11. ANATOMIC PATHOLOGY

Theory (Knowledge) and Practical (Skill) of Biopsy, Processing of tissue

Theory: Basic and General Pathology like Degeneration Necrosis, Inflammation, Growth disorders, Circulatory disturbance, Hypersensitivity reaction, Deficiency disease. Histopathology techniques, Cytopathology technique, Histochemistry technique, Immunohistochemistry techniques, Electron Microscopy.

Histopathological interpretation of endometrial biopsy, common skin biopsies, lymph node biopsy, common benign and malignant tumors, common liver lesions, common renal lesions, on common surgical specimens like appendectomy, gestational products, common granulomatous lesions etc..

12. CLINICAL MEDICINE

In the course of 3 years residency, the students are expected to interact with clinical disciplines continuously during the ward round, pre-test and post-test counseling of the patients, in clinical round, combined round and clinico pathological conference.

- i) They are encouraged to discuss the panel of investigations with their clinical colleagues.
- ii) They are expected to participate in post-test and pre-test counseling with patients or their relatives, if required and clinico-pathological correlation of laboratory results.
- iii) Constant interaction with the clinical resident are also encouraged to make the latter aware of: a) The pre-analytical sources of error in laboratory result b) Limitation of laboratory results in patient management. 'Meet the Lab' session with clinician in this context is a very useful learning opportunity.

13. RESEARCH METHODOLOGY

Formulation of Research Questions, Types of Study design in medical research, Sample size calculation for various study design, Descriptive Analysis with types of variables etc. Chance, Bias, Confounding and Interaction Basics of Statistical Inference, Statistical tests for Categorical vs Categorical Comparisons, Statistical tests for Categorical vs Quantitative Comparisons, Statistical Analysis of Quantitative vs Quantitative Comparisons, Non-Parametric Tests of Significance, Measures of Association, Statistical Aspects of Clinical Trials, An Introduction to Multivariate Statistical Methods, Statistical Aspects of Diagnostic Tests etc.