

Paper II: Technical subject

1. Biochemistry

- 1.1 Structure and function of cells
- 1.2 Principle of Biochemistry
 - 1.2.1 Buffer: definition, types, composition of buffer present in body fluids
 - 1.2.2 Photometric measurement of light, Beer's law and Lambert's law and their limitations
 - 1.2.3 Automation in biochemistry; wet and dry chemistry analyzer
 - 1.2.4 Principles and applications of: Photometry, Spectrophotometry (UV, visible, IR), Fluorimetry, spectroscopy, turbidimetry, nephelometry, spectrofluorimetry, atomic emission, reflectometry, mass spectrometry, nuclear magnetic resonance, dry and wet chemistry analyzer, CLIA
 - 1.2.5 Collection, handling and storage of sample, influence of temperature, nutrition, drugs, posture
 - 1.2.6 Separation techniques including various chromatography techniques and electrophoresis
 - 1.2.7 Use of radioisotopes in biochemical analysis
 - 1.2.8 Recent advances in clinical biochemistry
- 1.3 Chemistry of Amino acids and Proteins
 - 1.3.1 Structure, function and metabolism of protein
 - 1.3.2 Biochemical basis, investigation and interpretation of amino acid metabolism disorder
 - 1.3.3 Methods to determine the amino acid sequence of proteins
 - 1.3.4 Procedures and application of:
 - Electrophoresis: paper, polyacrylamide gel, agarose gel and cellulose acetate
 - Chromatography : principle, types, uses
 - Ultra centrifugation, ultrafiltration
 - Estimation of proteins by various methods
- 1.4 Chemistry of Carbohydrates
 - 1.4.1 Carbohydrates - introduction, classification, properties (physical, chemical), metabolism, hormones influencing metabolism, isomers, uses, carbohydrate derivatives, medicinally important carbohydrates
 - 1.4.2 Inborn errors associated with carbohydrate metabolisms
 - 1.4.3 Diabetes mellitus
 - Aetiology, biochemical abnormalities, symptoms and complications
 - diagnostic and monitoring criteria for diabetes
 - Glucose tolerance test procedures and interpretation
 - Principle and procedure of estimation of glucose and hemoglobin A1c by various methods
- 1.5 Chemistry of Lipids
 - 1.5.1 Lipids: definition, classification, uses, digestion and absorption, transport and storage and metabolism of lipids and hormonal regulation
 - 1.5.2 Ketogenesis and its regulation, ketoacidosis and its clinical significance
 - 1.5.3 Lipoprotein: Introduction, classification, definition and types
 - 1.5.4 Biochemical basis of atherosclerosis
 - 1.5.5 Dyslipidemia and its laboratory investigation

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- 1.5.6 Prostaglandin: synthesis and metabolism, use of prostaglandin and their inhibitors in medicine
- 1.5.7 Inborn errors: lipid storage diseases
- 1.6 Liver Function Test
 - 1.6.1 Anatomy and physiology of liver
 - 1.6.2 Hemoglobin and bilirubin metabolism
 - 1.6.3 Liver function test : principle, procedures and interpretations
 - 1.6.4 Biochemical investigation in acute and chronic liver disease
 - 1.6.5 Biochemical basis of derangement in liver function test in various diseases
 - 1.6.6 Important plasma proteins and their laboratory estimation
- 1.7 Kidney Function Test
 - 1.7.1 Anatomy and physiology of kidney
 - 1.7.2 Renal function test: principle, procedure and interpretation
 - 1.7.3 Biochemical investigation in acute and kidney disease
 - 1.7.4 Proteinuria, acute and chronic renal insufficiency, concept of nephritic syndrome & nephrotic syndrome
 - 1.7.5 Glomerular filtration rate and clearance
 - 1.7.6 Estimation of GFR and creatinine clearance
 - 1.7.7 Activity and effects of diuretics on different laboratory tests
 - 1.7.8 Recent advances in diagnosis of renal diseases
 - 1.7.9 Urine analysis for different diseases, methods used, interpretation
- 1.8 pH, Acid Base Balance
 - 1.8.1 Concept of pH and buffers. Handerson-Hasselbalch equation
 - 1.8.2 Acid base regulation and its disorders, assessment of acid base status
 - 1.8.3 Pathophysiology of Fluid and electrolyte balance and imbalance
 - 1.8.4 Measurement of electrolytes by various methods
 - 1.8.5 Blood gas analysis and interpretation
- 1.9 Pancreatic Function Test
 - 1.9.1 Anatomy and physiology of pancreas
 - 1.9.2 Pancreatic function test, their list and clinical significance
- 1.10 Cardiac Function Test
 - 1.10.1 Biochemical basis, investigation & interpretation of myocardial infarction
 - 1.10.2 Estimation and interpretation of LDH, CPK, GOT, Troponin, CPK MB
- 1.11 Endocrinology
 - 1.11.1 Anatomy and physiology of various endocrine glands
 - 1.11.2 Formation, regulation, function and laboratory estimation of various clinically important hormones, effect of hypo and hyperfunction
 - 1.11.3 Biochemical investigation of endocrine disorders
 - 1.11.4 Metabolism, clinical features and laboratory investigation of excess and deficiency of calcium, phosphate and magnesium
 - 1.11.5 Hormones of pancreas and gastro intestinal tract, their formation, uses, excess and deficiency states and relevant laboratory tests
 - 1.11.6 Principle and procedure of estimation of various hormones in infertility
 - 1.11.7 Clinical use of hormone for differential diagnosis of various diseases
- 1.12 Tumor Marker
 - 1.12.1 Technical details of methods of estimation of AFP, B-hCG, CEA, CA-125, CA 19-9, CA 15-3, PSA and other tumor markers

- 1.13 Drugs
 - 1.13.1 Theory of drug absorption, metabolism, excretion, pharmacokinetics, pharmacodynamics and pharmacogenetics
 - 1.13.2 Monitoring therapeutic levels of drugs
 - 1.13.3 Individual determinations for important drugs
 - 1.13.4 Drugs of abuse and modalities of DAU testing
- 1.14 Enzymes : Definition, classification and properties of enzyme, regulation of enzymatic activity, Method of estimation of clinically important enzymes
- 1.15 Vitamins, Minerals, Nutrition
 - 1.15.1 Chemistry, source, requirements, absorption, metabolism, biochemical role, excess and deficiency manifestations of various vitamins and minerals, Lab. estimation of the clinically important vitamins and minerals
- 2. Microbiology**
 - 2.1 General microbiology
 - 2.1.1 Microbial genetics
 - 2.1.2 Pathogenesis of bacterial infection
 - 2.1.3 Normal flora of skin, mouth, respiratory tract, intestine, urethra, vagina and conjunctiva
 - 2.1.4 Preparation and storage of culture media
 - 2.1.5 Mechanism of action of antimicrobial drugs
 - 2.1.6 Nosocomial infections: Epidemiology, different bacterial and viral infections, infections in pediatric patients, surveillance and control programmes, , role of microbiology lab in prevention and control, device associated intravascular infections, control of nosocomial infections
 - 2.1.7 Quality control in procedure, culture media, equipments
 - 2.1.8 Infectious waste management
 - 2.1.9 Different ways of sterilization
 - 2.1.10 Bio-safety levels and bio-safety guidelines, bio-security
 - 2.2 Systemic microbiology
 - 2.2.1 Pathogenesis, epidemiology, transmission and laboratory diagnosis of different microbial infection of respiratory tract, genitor-urinary tract, central nervous system, gastrointestinal tract, skin, ear and eye
 - 2.3 Bacteriology
 - 2.3.1 Properties, epidemiology, morphology, methods of isolation, differentiation, pathogenesis, staining property, cultural characteristics, biochemical reaction, laboratory diagnosis of gram positive and gram negative organisms, acid fast bacilli, spirochetes and Miscellaneous fastidious organisms like Mycoplasma, Chlamydia, Rickettsia
 - 2.3.2 Bacteriological examination of water, milk, food, air and pharmaceutical products
 - 2.3.3 Collection, transport and processing of different specimens for microbiological examination
 - 2.3.4 Organisms encountered in CSF, blood culture, sputum, pus, urine, stool, body fluid aspirate and methods of isolation of such organisms
 - 2.4 Virology
 - 2.4.1 General features of viral infection and carcinogenesis
 - 2.4.2 Pathogenesis, lab diagnosis, prevention, treatment and control of HIV infection
 - 2.4.3 Properties, pathogenesis and diagnosis of the medically important virus

- 2.4.4 Laboratory procedures for isolation of virus
- 2.5 Mycology
 - 2.5.1 General properties and classification of fungi
 - 2.5.2 Morphology, pathogenesis and diagnostic laboratory tests for superficial, deep and systemic mycosis
 - 2.5.3 Laboratory procedure for identification of fungal pathogens in clinical specimens
- 2.6 Parasitology
 - 2.6.1 Study of morphology, life cycle, important developmental stages, symptoms, pathogenesis, epidemiology, diagnosis, treatment, prevention of medically important parasites
 - 2.6.2 Demonstration of parasites in clinical specimens , including methods of sample collection and preparation
- 3. Hematology**
 - 3.1 Identification and rectification of different types of errors in hematology laboratory
 - 3.2 Concept of laboratory audit and accreditation
 - 3.3 Quality assurance in hematology, concept of NEQAS, EQAS
 - 3.4 Reference preparation of hemoglobin and blood cells, preparation of quality control material for autoanalysers
 - 3.5 Principle, function and maintenance of automated hematology analysers and other instruments used in hematology laboratory
 - 3.6 Biomedical waste management relevant to hematology laboratory
 - 3.7 Standardization of instruments in hematology laboratory
 - 3.8 Hematopoiesis (erythro, leuco as well as thrombopoiesis) – origin, development, function and fate of blood cells, regulation of hematopoiesis
 - 3.9 Structure and function of normal hemoglobin
 - 3.10 Anemia: definition, classification (morphological as well as etiological), and clinical features and causes of various types, laboratory investigation
 - 3.11 Classification of acute and chronic leukemia, including the WHO classification, laboratory investigation of leukemia
 - 3.12 Collection and preservation of blood for various hematological investigations, mechanism of action, advantages and disadvantages of various anticoagulants
 - 3.13 Principle and procedure of common hematological tests by different methods, errors involved and their rectification
 - 3.14 Different stains used in hematology, their preparation, storage, uses, advantages, disadvantages
 - 3.15 Examination of blood films for parasites
 - 3.16 Blood cell morphology in health and disease, effect of storage on blood cell morphology
 - 3.17 Indication, sites and procedure of bone marrow aspiration and biopsy
 - 3.18 Definition of pancytopenia, causes, laboratory approach to a case of pancytopenia
 - 3.19 Molecular basis of hemoglobinopathies and thalasseмииs, clinical manifestation and laboratory diagnosis of abnormal hemoglobins and thalasseमीs, reagents preparation, principle and procedure of test used in their diagnosis
 - 3.20 Leukocyte abnormalities and pathological variations of white cell values
 - 3.21 Leukemoid reactions and its importance
 - 3.22 Definition, classification and laboratory investigation of hemolytic anemia

- 3.23 Hemostatic mechanism and theories of blood coagulation, physico-chemical properties of coagulation factors
 - 3.24 Etiopathogenesis, classification and investigation of bleeding disorders, including various factor assays, platelet function tests and test for Von Willebrand factor
 - 3.25 Disseminated intravascular coagulation: definition, pathophysiology, clinical features, laboratory investigation
 - 3.26 Thrombotic disorders – classification, pathogenesis, clinical features and laboratory investigations, investigation of antiphospholipid antibody syndrome, principle and procedure of tests for lupus anticoagulants
 - 3.27 Classification of plasma cell disorders, Laboratory investigation of multiple myeloma
 - 3.28 Principle, preparation of stain and staining procedure of various cytochemical stains for leucocytes: Myeloperoxidase, Periodic acid Schiff, Sudan Black B (SBB), neutrophilic alkaline phosphatase, alpha naphthol acetate esterase, naphthol AS acetate esterase, cholinesterase
 - 3.29 Use of flow cytometry in hematology, procedure of immunophenotyping on blood and bone marrow samples in leukemia and lymphoma
 - 3.30 Processing blood and bone marrow samples for cytogenetic study, molecular biology and detection of Philadelphia chromosome
 - 3.31 Principles of various Molecular methods used in hematology
 - 3.32 Haematological tests and their Principle and interpretation of:
 - 3.32.1 Reticulocyte count, reticulocyte production index
 - 3.32.2 Sickling test, HbS solubility test
 - 3.32.3 Osmotic fragility test
 - 3.32.4 Coombs' test
 - 3.32.5 Kleihauer acid Elution test, Alkali denaturation test
 - 3.32.6 Ham's test, Sucrose lysis Test
 - 3.32.7 Electrophoresis – HbF & Hb A2 estimation
 - 3.32.8 Demonstration of HbH
 - 3.32.9 Test for G6PD deficiency
 - 3.32.10 Serum iron, TIBC, ferritin
 - 3.32.11 Plasma hemoglobin, serum haptoglobin, urine for hemosiderin, urine myoglobin
 - 3.32.12 BT, CT, PT, APTT
 - 3.32.13 Platelet function test, Ristocetin co factor assay
 - 3.32.14 Urine Bence Jones protein
 - 3.32.15 Mixing study, Factor VIII, IX assay, urea solubility test, fibrinogen assay, Factor VIII: C inhibitor study, Test for D dimer
 - 3.32.16 Antithrombin III, protein C and protein S assay
 - 3.32.17 Serum Vitamin B12, serum folate, red cell folate estimation
 - 3.32.18 Iron and reticulin stain in bone marrow
- 4. Blood Banking**
- 4.1 History of transfusion medicine
 - 4.2 Indications for blood and component transfusion
 - 4.3 Donor registration, donor selection, blood collection from donors, adverse donor reaction, pre-donation counselling, bleeding of the donor, post donation care, post donation counseling
 - 4.4 Blood collection room equipment, their principles, and use, emergency medicines

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- 4.5 Preservation of donated blood, mechanism of action and composition of blood preservation solution and additive solutions, changes during storage
- 4.6 Blood components – indications, preparation, storage, transport
- 4.7 Principles of immune system, central to transfusion medicine, immunology of red blood cells
- 4.8 Major and minor blood groups, clinical significance and methods of identification in laboratory
- 4.9 Red cell allo and autoantibody formation and function, platelets and leucocytes antigen and antibodies
- 4.10 Blood grouping and compatibility testing – major, minor, Coomb's cross match, factors influencing the results of blood grouping
- 4.11 Coomb's test (direct, indirect) – application, procedure, Rh antibody titre
- 4.12 Gel testing for antibody screening and identification
- 4.13 Hazards of blood transfusion
- 4.14 Hemolytic transfusion reaction: immediate and delayed; immune and non-immune, their pathophysiology, clinical signs and symptoms and laboratory investigation; strategies to prevent transfusion reactions
- 4.15 Management of Blood Bank Issue Counter
- 4.16 Screening of blood units for TTI, ELISA, rapid and other tests for diagnosis of transfusion transmitted infections, nucleic acid testing
- 4.17 Hemapheresis - definition, types of pheresis, machines and techniques
- 4.18 Stem cell processing and storage for transplantation
- 4.19 Procedure of HLA matching for bone marrow transplant
- 4.20 Procedure of chimerism testing/engraftment analysis after bone marrow transplant
- 4.21 Basics of tissue banking and cord blood banking
- 4.22 Preparation of antisera and their quality control
- 4.23 Plasma fractionation and preparation of component of clinical use (albumin,, immunoglobulin and coagulation factors)
- 4.24 Factors preparation by recombinant DNA technology
- 4.25 Disposal of wastes and biologically hazardous substance in the blood bank
- 4.26 Medico legal aspects of blood transfusion
- 4.27 Quality control of blood grouping reagents, QC of anti-human globulin reagent, bovine albumin, normal saline, blood bags and different blood products
- 4.28 Calibration, validation and maintenance of blood bank equipment, QC of blood bank techniques, external and internal quality assessment
- 4.29 Hemovigilance in blood banking
- 4.30 Use of automation in blood banking
- 5. Clinical pathology:**
 - 5.1 Collection, transport, preservation and processing of various clinical specimens
 - 5.2 Urine examination, physical, chemical and microscopic, urine analysis by Strip method, automated urine analysis
 - 5.3 Pregnancy test- method and interpretation
 - 5.4 Semen examination - routine and special tests
 - 5.5 Routine stool examination, concentration and floatation method, test for reducing sugar and occult blood
 - 5.6 Sputum examination: collection, processing, physical examination, microscopic examination using various stains
 - 5.7 Gastric juice analysis : indications, method of collection, analysis

- 5.8 Examination of body fluids (CSF, pleural, pericardial, synovial) : Physical examination, Biochemical examination and Microscopic examination (Cytological examination and Microbiological examination)
- 6. Histo-cytopathology**
- 6.1 Organization of histology laboratory
 - 6.2 Various histological equipments, their uses and care
 - 6.3 Reception and recording of tissue specimen
 - 6.4 Preservation and transport of specimens and slides
 - 6.5 Theory of routine and special stains and their practical implication
 - 6.6 Nomenclature of tumors
 - 6.7 Synoptic reporting system
 - 6.8 Museum technique, preparation, setting up and arrangement of museum
 - 6.9 Preparation of cell blocks
 - 6.10 Fine needle aspiration: definition, techniques involved in preparation of smear & staining
 - 6.11 Processing of various cytology specimen
 - 6.12 Cellular and acellular constituents of sputum , cervical smear and body fluids
 - 6.13 Concept of cytoscreening, purpose of cytoscreening
 - 6.14 Immunochemistry: principle, procedure, uses, quality control, immunohistochemical markers of malignant neoplasms
 - 6.15 Principle, method and use of insitu hybridization
 - 6.16 Enzyme histochemistry: principle, reagent and specimen preparation, procedure and application
- 7. Immunology**
- 7.1 History of immunology, innate and acquired immunity, mechanisms of innate immunity inflammation-inflammatory cells, mediators, inflammatory response types, antigens, cells and organs of immune system, evolution of immunity.
 - 7.2 Immunoglobulin: structure and function; regulation of immune response
 - 7.3 Advances in the development of vaccines
 - 7.4 Theory of hypersensitivity reactions, their types, mechanism, examples
 - 7.5 Complement system and its roles in disease
 - 7.6 Autoimmune diseases: mechanism of common diseases, principle and procedure for test for autoimmune diseases
 - 7.7 Transplantation Immunology
 - 7.8 Major histocompatibility complex, their types, genetics, role of MHC in organ transplant, MHC association with diseases, principle of transplantation, graft rejection
 - 7.9 Preparation, preservation and titration of complement
 - 7.10 Monoclonal and polyclonal antibodies preparation, application in biomedical research, clinical diagnosis and treatment
 - 7.11 Diagnostic procedure of common immunological/serological tests
 - 7.12 Immunological reaction and their various types, agglutination, precipitation, flocculation, complement fixation, ELISA
 - 7.13 Quality control and evaluation of kits used in laboratory
 - 7.14 Immunological methods in clinical laboratories: Method and application of the following: Double diffusion in agar, Single radial immuno diffusion, Electrophoresis and immunoelectrophoresis, Chromatography, Ion exchange, Affinity (gel), RIA, Elisa, Western blotting, Detection of immune complexes, nephelometry, Immunoflouresence, Agglutination test direct and indirect, Haemagglutination and haemagglutination inhibition, Complement assays-CFT, Detection of cellular immunity-delayed hypersensitivity skin test, Assays for

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lymphocytes-T and B cells, Flow cytometry, Mixed lymphocyte culture, NK cells neutrophil function test and Histocompatibility testing for organ transplant

8. Molecular Biology

- 8.1 Chromosomes structure, chromosomal abnormalities, mutations and important genetic diseases
- 8.2 Procedure of karyotyping and other methods of chromosomal analysis in various specimens
- 8.3 Collection, storage & processing of tissues, including bone marrow for karyotyping
- 8.4 Recombinant DNA technology: necessary elements
- 8.5 Separation of DNA and RNA
- 8.6 Application of genetics in medicine
- 8.7 Poymerase chain reaction: principle, types, procedure, uses in medicine
- 8.8 Insitu hybridization: principle, types, procedure, uses in medicine
- 8.9 Gel electrophoresis: principle, procedure, uses
- 8.10 Recent advances in molecular biology relevant to medicine