**Department of Biochemistry**

 **IGMC, Shimla**

 **Competency Based Under Graduate Curriculum-2019**

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|  | **Topic**  | **Domain****K/S/A/C** | **Level****K/KH/****SH/P** | **Core****(Y/N)** |  **Teaching-Learning****Methods** | **Assessment****Methods** | **Number****required****to certify****P** | **Vertical****Integration** | **Horizontal****Integration** |  |  |
| **Basic Biochemistry**  |  |
| BI1.1 | Describe the molecular and functional organization of a cell and its subcellular components.**Learning objectives** At the end of the session the phase I student must be able to* Describe the composition of lipid bilayer
* Discuss the role of integral and peripheral proteins.
* Describe the fluid mosaic model of membrane structure
* Discuss the concepts of passive diffusion, facilitated diffusion, active transport, endocytosis , and exocytosis,phagocytosis
* Discuss ion channels, Na+ − K+-ATPase pump , receptors, gap junctions
 | K | KH | Y |  Lecture/small group discussion  | Written assessment /viva voce |  |  | Physiology  |  |  |
| **Enzymes**  |  |  |
| BI2.1 | Explain fundamental concepts of enzyme, isoenzyme, alloenzyme, coenzyme & co-factors. Enumerate the main classes of IUBMB nomenclature.**Learning objectives** At the end of the session the phase I student must be able to* Explain the characteristic of enzyme
* Define active and allosteric site of enzyme.
* Define isoenzyme , alloenzyme , coenzyme and cofactors.
* Discuss the role of coenzymes and cofactors.
* Enumerate main classes of IUBMB nomenclature of enzymes.
* Discuss mechanism of each class with suitable examples.

. | K | KH | Y | Lecture,case presentation Practical, Lecture  |  |  |  |  |  |  |
| BI2.2 | Observe the estimation of SGOT & SGPT**Learning objectives** At the end of the session the phase I student must be able to* Describe the principle involved in estimation of SGOT & SGPT.
* Discuss the significance of estimation of SGOT & SGPT
 | K | KH | Y | Demonstration  | Viva voce |  |  |  |  |  |
| BI2.3 | Describe and explain the basic principles of enzyme activity**Learning objectives** At the end of the session the phase I student must be able to* Enumerate six types of mechanisms of enzyme catalysis .
* Discuss the mechanism of each enzyme catalysis .
* Explain Michelis –Menten theory, Fischer Template,Koshland induced fit theory.
* Explain the effect of enzyme concentration, substrate concentration product concentration , pH, temperature on enzyme activity .
* Explain two examples each of allosteric ,covalent regulation of enzymes.
* Discuss the mechanism of repression, induction ,feed back inhibition stabilization ,compartmentalization .
* Explain two examples of repression, induction , feed back inhibition stabilization ,compartmentalization .
* Discuss conversion of a proenzyme to the active enzyme.
* Explain two examples of proenzyme conversion to the active enzyme.
* Explain two examples of allosteric effectors .
 | K | KH | Y | Lecture ,case discussion  | Written/viva voce  |  |  |  |  |  |
| BI2.4 | Describe and discuss enzyme inhibitors as poisons and drugs and as therapeutic enzymes**Learning objectives** At the end of the session the phase I student must be able to* Describe the mechanism of the competitive, non competitive, uncompetitive , suicide ,irreversible inhibition.
* Discuss the poisonous role of inhibitors with suitable examples
* Discuss the uses of enzymes as drugs with suitable examples.
* Discuss the therapeutic uses of enzymes
 | K | KH | Y | Lecture, Small groupdiscussion | Written/Viva voce |  | Pathology, GeneralMedicine |  |  |  |
| BI2.5 | Describe and discuss the clinical utility of various serum enzymes as markers of pathological conditions.**Learning objectives** At the end of the session the phase I student must be able to* Describe serum enzymes of clinical utility.
* Discuss the role of CPK-MB,AST, LDH enzymes in Myocardial Infarction.
* Discuss the role of AST, ALT ,ALP ,GGT ,nucleotidase in liver diseases.
* Discuss the role of CPK-MM,AST,aldolase in muscle diseases.
* Discuss the role of ALP in bone diseases.
* Discuss the role of acid phosphatise in prostate cancer
 | K | KH | Y | .Lecture, Small groupdiscussion | Written/Viva voce |  | Pathology, GeneralMedicine |  |  |  |
| B12.6 | Discuss use of enzymes in laboratory investigations (Enzyme-basedassays)**Learning objectives** At the end of the session the phase I student must be able to* List the enzymes used in estimation of glucose, cholesterol, Triglycerides, Uric acid.
* Discuss the role of glucose oxidase in estimation of glucose.
* Discuss the role of cholersterol oxidase in estimation of cholesterol.
* Discuss the role of glycerol kinase in estimation in triglyceride.
* Discuss the role of uricase in estimation of uric acid.
 | K | KH | Y | Lecture, Small groupdiscussion | Written/Viva voce |  | Pathology, GeneralMedicine |  |  |  |
| BI2.7 | Interpret laboratory results of enzyme activities & describe the clinical utility of various enzymes as markers of pathological conditions.**Learning objectives** At the end of the session the phase I student must be able to* Describe the names of plasma functional and non functional enzymes
* Discuss the diagnostic significance of plasma functional and non functional enzymes
 | K | KH | Y | Lecture, Small groupdiscussion |  |  | Pathology, GeneralMedicine |  |  |  |
| **Topic: Chemistry and Metabolism of Carbohydrates Number of competencies: (10)** |  |
| BI3.1  | Discuss and differentiate monosaccharides, di-saccharides and polysaccharides giving examples of main carbohydrates as energy fuel, structural element and storage in the human body**Learning objectives**At the end of the session the phase I student must be able to* Describe the roles of carbohydrates as energy fuel ,structural element and storage in cell.
* Classify carbohydrates.
* Differentiate monosaccharides .dissacharides ,oligosaccharides and polysaccharides .
* Discuss the structures of monosaccharides ,dissacharides and polysaccharides .
 | K | KH | Y |  Lecture, Small groupdiscussion | Written /Viva voce  |  |  |  |  |  |
| BI3.2 | Describe the processes involved in digestion and assimilation of carbohydrates and storage**Learning objectives**At the end of the session the phase I student must be able to* Describe the key enzymes of digestion of carbohydrates and their location.
* Discuss the steps involved in diagestion of carbohydrates.
* Discuss the structure of glycogen and its importance as a carbohydrate reserve.
 | K | KH | Y | Lecture, Small groupdiscussion | Written /Viva voce |  |  |  |  |  |
| BI3.3 | Describe and discuss the digestion and assimilation of carbohydrates from food.**Learning objectives**At the end of the session the phase I student must be able to* Describe the role of various enzymes on coverting complex carbohydrates, and disaccharides into monosaccharides.
* Explain the absorption of glucose with the help of glucose transporters.
* Discuss the role of glucose transporters in absorption of glucose .
* Discuss the role of uniport system in release of glucose from intestine into blood.
* Discuss the transporters involved in absorption of fructose and galactose.
 | K | KH | Y | Lecture, Small groupdiscussion | Written /Viva voce |  |  |  |  |  |
| BI3.4 | Define and differentiate the pathways of carbohydrate metabolism, (glycolysis, gluconeogenesis, glycogen metabolism, HMP shunt.**Learning objectives**At the end of the session the phase I student must be able to* Describe the pathway of glycolysis and its control.
* Explain glycolysis under anaerobic conditions.
* Describe the reaction of pyruvate dehydrogenase and its regulation.
* Explain inhibition of pyruvate metabolism leads to lactic acidosis. Explain the importance of gluconeogenesis in glucose homeostasis.
* Describe the pathway of gluconeogenesis,
* Discuss glycolysis and gluconeogenesis are regulated reciprocally.
* Describe glycogenesis and glycogenolysis .
* Discuss the processes of glycogenesis and glycogenolysis regulation in response to hormone action.
* Describe the various types of glycogen storage diseases.
* Describe the pentose phosphate pathway and its roles as a source of NADPH
* Discuss the synthesis of ribose for nucleotide synthesis in HMP Shunt pathway.
 | K | KH | Y | Lecture, Small groupdiscussion | Written /Viva voce |  | General Medicine  |  |  |  |
| BI3.5 | Describe and discuss the regulation, functions and integration of carbohydrate along with associated diseases/disorders**Learning objectives**At the end of the session the phase I student must be able to* Describe Regulation of mainline metabolic pathways by hormones.
* Describe Metabolic interconnections and tissue specific metabolism.
* Discuss maintenance of plasma glucose concentration within narrow limits in the fed and fasting states.
* Discuss metabolic adaptations to metabolism in short-span fasting, prolonged fasting and starvation.
* Discuss Diabetes mellitus: metabolic alterations, biochemical basis of diabetic ketoacidosis and chronic complications of Diabetes.
 | K | KH | Y | Lecture, Small groupdiscussion  | Written /Viva voce |  | General Medicine  |  |  |  |
| BI3.6 | Describe and discuss the concept of TCA cycle as a amphibolic pathway and its regulation**Learning objectives**At the end of the session the phase I student must be able to* Describe the reactions of the citric acid cycle and the reactions that lead to the production of reducing equivalents that are oxidized in the mitochondrial electron transport chain to yield ATP.
* Explain the importance of vitamins in the citric acid cycle.
* Explain citric acid cycle provides both a route for catabolism of amino acids and also a route for their synthesis.
* Describe the main anaplerotic pathways that permit replenishment of citric acid cycle intermediates.
* Discuss the withdrawal of oxaloacetate for gluconeogenesis is controlled.
* Describe the role of the citric acid cycle in fatty acid synthesis.
* Explain how the activity of the citric acid cycle is controlled by the availability of oxidized cofactors.
* Explain hyperammonemia can lead to loss of consciousness
 | K | KH | Y | Lecture, Small groupdiscussion | Written /Viva voce |  |  |  |  |  |
| BI3.7 | Describe the common poisons that inhibit crucial enzymes of carbohydrate metabolism (eg; fluoride, arsenate)**Learning objectives** At the end of the session the phase I student must be able to* Describe key enzymes of carbohydrate metabolism.
* Explain the role the of fluoride ,arsenic on carbohydrate metabolism
 | K | KH | Y | Lecture, Small groupdiscussion | Written /Viva voce |  |  | Physiology |  |  |
| BI3.8 | Discuss and interpret laboratory results of analytes associated with metabolism of carbohydrates.**Learning objectives** At the end of the session the phase I student must be able to* Define normal, random and post prandial blood glucose
* Explain the causes of hyperglycemia and hypoglycaemia.
* Define glucose tolerance .
* Describe indications ,contraindications, preparation of patient for glucose tolerance test.
* Discuss normal glucose tolerance test curve.
* Discuss causes leading to abnormal glucose tolerance test curve.
* Discuss the disorders leading to glycosuria and glucosuria .
* Describe the formation of glycated haemoglobin and its normal value.
* Discuss the role of glycated haemoglobin in Diabetes Mellitus
 | K | KH | Y | Lecture, Small groupdiscussion | Written /Viva voce |  | Pathology ,General Medicine  |  |  |  |
| BI3.9 | Discuss the mechanism and significance of blood glucose regulation in health and disease**Learning objectives** At the end of the session the phase I student must be able to* Describe factors maintaining the blood glucose.
* Describe hyperglycaemic and hypoglycaemic hormones .
* Explain the role of hyperglycaemic and hypoglycaemic hormones in maintain blood glucose.
* Describe regulation of blood glucose in fasting , post prandial state .
 | K | KH | Y | Lecture, Small groupdiscussion | Written /Viva voce |  | General medicine  |  |  |  |
| BI3.10 | Interpret the results of blood glucose levels and other laboratory investigations related to disorders of carbohydrate metabolism.**Learning objectives** At the end of the session the phase I student must be able to* Define and know the normal, random and post parandial blood glucose
* Explain the causes of hyperglycemia and hypoglycaemia.
* Define glucose tolerance , indications and contraindications, preparation of patient for glucose tolerance test.
* Describe normal glucose tolerance test curve.
* Discuss causes leading to abnormal glucose tolerance test curve.
* Define glucosuria and glycosuria.
* Discuss the disorders leading to glycosuria and glucosuria .
* Discuss the formation of glycated haemoglobin and its normal value.
* Discuss the role of glycated haemoglobin in Diabetes Mellitus.
 | K | KH | Y | Lecture, Small groupdiscussion | Written /Viva voce |  | General medicine |  |  |  |
| 1. **Chemistry and Metabolism of Lipids**

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| BI4.1 | Describe and discuss main classes of lipids (Essential/non-essential fatty acids, cholesterol and hormonal steroids, triglycerides, major phospholipids and sphingolipids) relevant to human system and their major functions**Learning objectives:** At the end of the session the phase I student must be able to* Classify lipids .
* Describe structure of saturated and unsaturated fatty acids.
* Describe how eicosanoids are formed by modification of the structure of unsaturated fatty acids
* Discuss the eicosanoid classes and indicate their functions.
* Describe the general structure of triacylglycerols and indicate their function.
* Describe the general structure of phospholipids and glycosphingolipids and indicate the functions of the different classes.
* Describe the salient features of cholesterol.
* Discuss the importance of cholesterol as the precursor of many biologically important steroids including steroid hormones, bile acids and vitamins D.
 | K | KH | Y | Lecture, Small groupdiscussion | Written /Viva voce |  | General Medicine  |  |  |  |
| BI4.2 | Describe the processes involved in digestion and absorption of dietary lipids and also the key features of their metabolism**Learning objectives:** At the end of the session the phase I student must be able to* Describe the steps of lipid digestion , absorption and transport of lipids
* Describe fatty acids transportation in the blood.
* Discuss fatty acid activation and entry into the matrix of the mitochondria for breakdown to obtain energy.
* Describe the the β- oxidation pathway by which fatty acids are metabolized to acetyl-CoA.
* Explain production of large quantities of ATP from the reducing equivalents produced during β-oxidation and further metabolism of the acetyl-CoA .
* Describe the alpha and omega oxidation of fatty acids.
* Discuss the importance of alpha and omega oxidation of fatty acids.
* Give examples of diseases associated with impaired fatty acid oxidation
* Describe the reaction catalyzed by acetyl-CoA carboxylase and
* Discuss the mechanisms by which its activity is regulated to control the rate of fatty acid synthesis.
* Describe the structure of the fatty acid synthase multienzyme complex,.
* Describe long-chain fatty acids synthesis by the repeated condensation of two carbonunits, with formation of the 16-carbon palmitate being favored in most tissues.
* Describe the sources of reducing equivalents (NADPH) for fatty acid synthesis.
* Discuss fatty acid synthesis regulation by nutritional status and control mechanisms for activity of acetyl-CoA carboxylase.
* Describe the stages in the biosynthesis of cholesterol from acetyl-CoA.
* Discuss the role of HMG-CoA reductase in controlling the rate of cholesterol synthesis
* Discuss that cholesterol balance in cells is tightly regulated and the factors involved in maintaining the correct balance.
* Name three ketone bodies.
* Describe the reactions by which ketone bodies are formed in liver mitochondria.
* Discuss that ketone bodies are important fuels for extrahepatic tissues
* Discuss the conditions in which their synthesis and use are favored.
* Describe the regulation of ketogenesis .
* Discuss overproduction of ketone bodies leads to ketosis and pathological conditions when this occurs.
 | K | KH | Y | Lecture, Small groupdiscussion | Written /Viva voce |  | General Medicine  |  |  |  |
| BI4.3 | Explain the regulation of lipoprotein metabolism & associated disorders**Learning objectives:** At the end of the session the phase I student must be able to* Discuss the the formation of chylomicron, chylomicron remnant ,VLDL-C,IDL-C,LDL-C.
* Discuss hepatic VLDL secretion regulation by the diet and hormones.
* Describe HDL formation and its metabolism.
* Discuss the role of HDL in lipoprotein metabolism.
 | K | KH | Y | Lecture, Small groupdiscussion | Written /Viva voce |  |  |  |  |  |
| BI4.4 | Describe the structure and functions of lipoproteins, their functions, interrelations & relations with atherosclerosis**Learning objectives:** At the end of the session the phase I student must be able to* Enumerate the four major groups of plasma lipoproteins
* Describe the structure and functions of four major groups of lipoproteins.
* Describe major types of apolipoprotein found in the f our ipoprotein classes
* Discuss the roles of LDL and HDL in promoting and retarding respectively, the development of atherosclerosis.
 | K | KH | Y | Lecture, Small groupdiscussion | Written/viva voce  |  | General medicine |  |  |  |
| BI4.5 | Interpret laboratory results of analytes associated with metabolism of lipids**Learning objectives:** At the end of the session the phase I student must be able to* List the hyperlipoproteinemias and state the laboratory findings associated with each.
* List the hypolipoproteinemias and state the laboratory findings associated with each.
 | K | KH | Y | Lecture, Small groupdiscussion | Written/viva voce  |  | General medicine  |  |  |  |
| BI4.6 | Describe the therapeutic uses of prostaglandins and inhibitors of eicosanoid synthesis.**Learning objectives:** At the end of the session the phase I student must be able to* Classify eicosanoids
* Describe biosynthesis of eicosanoids .
* Discuss therapeutic role of eicosanoids.
* Explain the role of inhibitors on eicosanoids synthesis.
 | K | KH | Y | Lecture ,.small group discussion  | Written/Viva Voce  |  | General medicine  |  |  |  |
| BI4.7 | Interpret laboratory results of analytes associated with metabolism of lipids.**Learning objectives:** At the end of the session the phase I student must be able to* List the hyperlipoproteinemias
* Discuss the laboratory findings associated with each.
* List the types of hypolipoproteinemias
* Discuss the laboratory findings associated with each.
* Discuss the cause of ketonemia and ketonuria .
 | K | KH | Y | Lecture ,small group discussion | Written/Viva Voce |  | General Medicine  |  |  |  |
| **Chemistry and Metabolism of Proteins**  |  |  |
| BI5.1 | Describe and discuss structural organization of proteins.**Learning objectives:** At the end of the session the phase I student must be able to* Describe the classification of amino acids based on the structure ,side chain ,metabolism and nutritiona requirement
* Explain the primary, secondary, tertiary and quaternary structure of proteins.
* Describe super secondary motifs.
* Discuss the forces that stabilize each order of protein structure.
 | K | KH | Y |  |  |  |  |  |  |  |
| BI5.2 | Describe and discuss functions of proteins and structure-function relationships in relevant areas eg, hemoglobin and selected hemoglobinopathies**Learning objectives:** At the end of the session the phase I student must be able to* Describe the structure of collagen .
* Explain genetic and nutritional disorders of collagen maturation the close linkage between protein structure and function .
* Explain between protein structure and function for the prion disease
* Describe the most important structural similarities and differences between myoglobin and hemoglobin.
* Discuss the covalent linkages and other close associations between heme and globin in oxymyoglobin and oxyhemoglobin.
* Explain why the physiologic function of hemoglobin requires that its O2- binding curve be sigmoidal rather than hyperbolic.
* Explain the role of a hindered environment on the ability of hemoglobin to bind carbon monoxide.
* Define P50 and indicate its significance in oxygen transport and delivery.
* Describe the structural and conformational changes in hemoglobin that accompany its oxygenation and subsequent deoxygenation.
* Explain the role of 2,3-bisphosphoglycerate (BPG) in oxygen binding and delivery.
* Describe the structural consequences to HbS of lowering pO2.
* Identify the metabolic defect that occurs as a consequence of α- and β-thalassemia
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce  |  | Pathology ,general medicine  | Physiology  |  |  |
| BI5.3 | Describe the digestion and absorption of dietary proteins**Learning objectives:** At the end of the session the phase I student must be able to* Nitrogen metabolism; essential, non-essential and semi-essential amino acids, protein turnover and amino acid pool.
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | Pediatrics  |  |  |  |
| BI5.4 | Describe common disorders associated with protein metabolism.**Learning objectives:** At the end of the session the phase I student must be able to* Describe formation of ammonia involving transamination and deamination .
* Describe transamination ,oxidative ,non-oxidative deamination.
* Describe transport of ammonia
* Discuss steps of urea cycle to understand congenital and acquired causes of hyperammonemia.
* Enumerate the causes of hyperammonemia.
* Describe the pre renal, renal and post renal causes of increase in urea.
* Define uremic syndrome
* Describe the clinical features of uremic syndrome.
* Describe the metabolic defects , clinical features lab diagnosis associated with phenylketonuria, alkaptonuria, maple syrup urine disease, isovaleric acidaemia, methyl malonic aciduria, histidinaemia, homocystinuria, cystinuria, cystinosis. Hartnup disease, blue diaper syndrome and familial renal iminoglycinuria.
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | Pediatrics  |  |  |  |
| BI5.5 | Interpret laboratory results of analytes associated with metabolism of proteins.**Learning objectives:** At the end of the session the phase I student must be able to* Enumerate plasma proteins with their normal blood levels.
* Discuss the causes of hyperproteinemia and hypoproteinemia.
* Report normal level of blood urea .
* Discuss causes leading to increase in blood urea.
* Report normal level of creatinine
* Discuss the role of creatinine in assessing kidney function
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | General Medicine  |  |  |  |
| **Metabolism and homeostasis**  |  |  |  |  |  |  |
| BI6.1  | Discuss the metabolic processes that take place in specific organs in the body in the fed and fasting states.**Learning objectives:** At the end of the session the phase I student must be able to* Describe the metabolism of carbohydrates, lipids, and amino acids in liver
* Describe the metabolism of carbohydrates, lipids, and amino acids in adipose tissue
* Describe the metabolism of carbohydrates, lipids, and amino acids in muscle
* Describe the metabolism of carbohydrates, lipids and amino acids in brain
* Discuss supply of metabolic fuels in the fed and fasting states
 | K | KH | Y | .Lecture ,.small group discussion | Written /Viva voce |  | General Medicine  |  |  |  |
| BI6.2 | Describe and discuss the metabolic processes in which nucleotides are involved.**Learning objectives:** At the end of the session the phase I student must be able to* Compare and contrast the roles of dietary nucleic acids and of de novo biosynthesis in the production of purines and pyrimidines
* Discuss the sequence of reactions that convert IMP to AMP and GMP and subsequently to their corresponding nucleoside triphosphates.
* Describe the formation from ribonucleotides of deoxyribonucleotides (dNTPs).
* Discuss the role of salvage pathway in formation of purines
* Discuss the regulatory role of PRPP in hepatic purine and feedback inhibition by AMP and by GMP.
* Discuss the relevance of coordinated control of purine and pyrimidine nucleotide biosynthesis
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  |  |  |  |  |
| BI6.3 | Describe the common disorders associated with nucleotide metabolism.**Learning objectives:** At the end of the session the phase I student must be able to* Describe uric acid solubility
* Enumerate causes of gout
* Discuss Lesch-Nyhan syndrome and von Gierke disease.
* Describe pathologic signs and symptoms.
* Discuss clinically significant disorders of pyrimidine catabolism.
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  |  | Physiology  |  |  |
| BI6.4 | Discuss the laboratory results of analytes associated with gout & Lesch Nyhan syndrome.**Learning objectives:** At the end of the session the phase I student must be able to* Write the normal level of uric acid
* Discuss Biochemical defect and uric acid level in Lesch-Nyhan syndrome and von Gierke disease.
* Discuss role of uric acid in gout.
* Discuss the causes of hyperuricemia and hypouricemia.
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | General Medicine |  |  |  |
| BI6.5 | Describe the biochemical role of vitamins in the body and explain the manifestations of their deficiency**Learning objectives:** At the end of the session the phase I student must be able to* Describe the metabolism of water and fat soluble vitamins.
* Discuss the principal functions of water and fat soluble vitamins.
* Discuss deficiency diseases associated with inadequate intake and the toxicity of excessive intakes of the vitamins.
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | General Medicine |  |  |  |
| BI6.6 | Describe the biochemical processes involved in generation of energy in cells**Learning objectives:** At the end of the session the phase I student must be able to* Describe oxidation of fuel substrates (fats, carbohydrates,amino acids) liberated in mitochondria as reducing equivalents,.
* Describe the four protein complexes involved in the transfer of electrons through the respiratory chain .
* Explain the roles of flavoproteins,
* Discuss electron transport through the respiratory chain and generation of proton gradient across the inner mitochondrial membrane.
* Discuss ATP formation by the process of oxidativephosphorylation.
* Define first and second laws of thermodynamics
* Explain free energy, entropy, enthalpy, exergonic, and endergonic.
* Discuss the role of ATP and other nucleotide triphosphates in the transfer of free energy from exergonic to endergonic processes as the “energy currency” of cells.
* Explain malate aspartate ,gkycerol phosphate shuttle system
* Differentiate oxidative phosphorylation from substrate level phosphorylation.
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  |  |  |  |  |
| BI6.7 | Describe the processes involved in maintenance of normal pH, water & electrolyte balance of body fluids and the derangements associated with these.**Learning objectives:** At the end of the session the phase I student must be able to* Discuss pH expression and the Henderson–Hasselbalch equation and the behaviour of buffers.
* Describe Three-tier defense against imminent pH alterations and causes of various types of acid-base disorders.
* Discuss Compensatory mechanisms in each type of acid-base disorder
* Discuss the biochemical alterations in acid-base parameters in arterial blood in both the compensated and the un-compensated case.
* Enumerate Electrolyte concentration of body fluid compartments
* Discuss the physioiogicai functions and regulation of sodium, potassium and chioride in the body.
* Discuss the causes of hyponatremia hypernatremia,hypokalemia and ,hyperkalemia,hypochloremiarmia and hyper chloremia with their clinical manifestations.
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | General Medicine | Physiology |  |  |
| BI6.8 | Discuss and interpret results of Arterial Blood Gas (ABG) analysis in various disorders**Learning objectives:** At the end of the session the phase I student must be able to* Describe the importance of ABG.
* List the parameters of ABG with their normal levels.
* Discuss pH, bicarbonate, pCo2 levels in arterial blood in metabolic acidosis
* Discuss pH, bicarbonate, pCo2 levels in arterial blood in metabolic alkalosis
* Discuss of pH, bicarbonate, pCo2 levels in arterial blood in respiratory acidosis
* Discuss of pH, bicarbonate, pCo2 levels in arterial blood in respiratory alkalosis .
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | General Medicine |  |  |  |
| BI6.9 | Describe the functions of various minerals in the body, their metabolism and homeostasis.**Learning objectives:** At the end of the session the phase I student must be able to* Discuss Sources, dietary requirement ,absorption, factors causing decreased andincreased absorption of Calcium.
* Discuss factors regulating blood calcium , functions of calcium.
* Discuss Requirement, sources, factors for absorption of Phosphorus.
* Describe factors regulating blood phosphorus ,functions and clinical applications of calcium.
* Discuss Sources, dietary requirement of iron.
* Describe absorption, factors affecting absorption of iron ,transport, uptake by cells and storage of iron .
* Discuss Sources, dietary requirement ,absorption, factors affecting absorption and transport of copper.
* Describe dietary sources,requirement functions of Zinc,Magnesium, Sulfur,Fluoride, Selenium,Manganese, Molybdenum, Cobalt, Nickel, Chromium.
* Discuss functions of Lithium.
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | General Medicine | Physiology |  |  |
| BI6.10 | Enumerate and describe the disorders associated with mineral metabolism**Learning objectives:** At the end of the session the phase I student must be able toExplain the the causes of derangements of calcium and phosphorus metabolism * Describe the clinical manifestations of hypocalcemia, hypercalcemia,hypophosphatemia, hyperphosphotemia.
* Discuss the biochemical mechanisms associated Wilson's Disease, Aceruloplasminemia, Copper Deficiency Anemia: Cardiovascular Diseases: Menke's Kinky Hair Syndrome,hypopigmentation of copper deficiency, copper toxicity
* Describe causes and clinical features of iron deficiency anemia.
* Describe deficiency manifestations of Zinc,Magnesium, Sulfur,Fluoride,Selenium,Manganese, Molybdenum, Cobalt, Nickel, Chromium.
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | General Medicine |  |  |  |
| BI6.11 | Describe the functions of haem in the body and describe the processes involved in its metabolism and describe porphyrin metabolism.**Learning objectives:** At the end of the session the phase I student must be able to* Describe the structure and function of heme
* Describe the two amphibolic intermediates from which heme is synthesized.
* Name the key regulated enzyme of hepatic heme biosynthesis.
* Describe the steps of heme synthesis.
* Describe enzymes of heme biosynthesis are mitochondrial and cytosolic. Enzymes of heme synthesis .
* Discuss the regulation and inhibitors of heme synthesis
* Discuss the causes and clinical pictures of the various porphyrias.
* Describe steps in the conversion of heme to bilirubin .
* Discuss entero hepatic circulation of bilirubin
* Explain the biochemical nature of jaundice
* Enumerate causes of jaundice Explain
* Differentiate between direct bilirubin and indirect bilirubin
 | K | KH | Y |  | Lecture ,.small group discussion |  | Pathology ,General Medicine | Physiology |  |  |
| BI6.12 | Describe the major types of haemoglobin and its derivatives found in the body and their physiological/ pathological relevance.**Learning objectives:** At the end of the session the phase I student must be able to* List types of hemoglobin
* Discuss types of hemoglobin derivatives with their physiological/pathological relevance
 | K | KH | Y | Lecture ,.small group discussion.” | Written /Viva voce |  | Pathology ,General Medicine | Physiology |  |  |
| BI6.13 | Describe the functions of the kidney, liver, thyroid and adrenal glands**Learning objectives:** At the end of the session the phase I student must be able to* Describe synthetic ,metabolic,detoxification,storage ,homeostasis functions of liver.
* Discuss the functions of kidney, liver, thyroid and adrenal glands
 | K | KH | Y |  Lecture ,.small group discussion |  |  | Pathology ,General Medicine | Physiology,Human Anatomy  |  |  |
| BI6.14 | Describe the tests that are commonly done in clinical practice to assess the functions of these organs (kidney, liver, thyroid and adrenal glands).**Learning objectives:** At the end of the session the phase I student must be able to* Describe the role of Serum – Bilirubin; total, conjugated, and
* Unconjugated,Urine – Bile pigments, bile salts and urobilinogen,Alanine amino transferase (ALT),Aspartate amino transferase (AST),Alkaline phosphatase (ALP),Gamma glutamyl transferase (GGT),Plasma proteinsfor assessing liver functions.
* Discuss Complete urine analysis, Plasma urea and creatinine, Plasma electrolytes, Glomerular filtration rate,.
* Discuss Clearance tests, Proteinuria, Reabsorption studies ,Secretion tests, dilution tests,Renal acidification Concentration, serum urea and serum creatinine tests for assessing kidney functions.
* Explain role of Free T4, T3, TSH ,Radioactive iodine uptake, TRH response test ,thyroid antibodies for assessment of thyroid functions.
* **Discuss ACTH Stimulation Test,** blood levels of sodium, potassium, cortisol for assessment of adrenal gland function
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | Pathology ,General Medicine | Physiology,Human Anatomy |  |  |
| BI6.15 | Describe the abnormalities of kidney, liver, thyroid and adrenal glands**Learning objectives:** At the end of the session the phase I student must be able to* Describe glomerulonephritis, nephrotic syndrome.
* Describe the causes ,clinical manifestations of jaundice
* Discuss causes of ascites ,fatty liver, cirrhosis
* Discuss abnormalities associated with Addison’s disease ,Cushing’s syndrome, Conn syndrome ,Primary aldosteronism Secondary hyperaldosteronism, congenital adrenal hyperplasia.
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | Pathology ,General Medicine | Physiology,Human Anatomy |  |  |
| **Molecular biology**  |  |  |  |  |  |  |
| BI7.1 | Describe the structure and functions of DNA and RNA and outline the cell cycle**Learning objectives:** At the end of the session the phase I student must be able to* Describe Watson-Crick model of DNA structure
* Explain nucleosomes structure formation of genomic DNA to form chromatin
* Discuss the role of histones
* Describe structure of A,B,Z DNA.
* Describe structure of t-RNA, r RNA,m-RNA
* Discuss the function of t-RNA, r RNA, m-RNA.
* Describe phases of cell cycle.
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  |  |  |  |  |
| BI7.2 | Describe the processes involved in replication & repair of DNA and the transcription & translation mechanisms.**Learning objectives:** At the end of the session the phase I student must be able to* Describe the steps of replication in eukaryotes
* Describe the steps of replication in prokaryotes
* Discuss the role of eukaryotic and prokaryotic DNA polymerases
* Differentiate between eukaryotic and prokaryotic replication
* Describe modification after DNA replication
* Discuss types of DNA repair mechanisms
* Describe the diseases associated with impaired repair mechanism.Describe the molecules involved and the mechanism of RNA synthesis.
* Explain the function of eukaryotic DNA-dependent RNA polymerases
* Explain the steps and molecules that catalyze mRNA splicing
* Describe the modification of m-RNA and m-RNA editing
* Describe the salient features of genetic code
* Discuss the mechanism of the energy-intensive process of protein synthesis.
* Describe post translational modifications .
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | Pediatrics  |  |  |  |
| BI7.3 | Describe gene mutations and basic mechanism of regulation of gene expression**Learning objectives:** At the end of the session the phase I student must be able to* Describe causes of gene mutation.
* Discuss types of mutations with suitable examples
* Describe the effect of mutations
* Discuss operon concept of gene regulation
* Discuss the concept of induction and repression
* Discuss gene rearrangement, gene switching and gene amplification .
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  |  |  |  |  |
| BI7.4 | Describe applications of molecular technologies like recombinant DNA technology, PCR in the diagnosis and treatment of diseases with genetic basis.**Learning objectives:** At the end of the session the phase I student must be able to* Explain the basic procedures and methods involved in recombinant DNA technology
* Discuss the applications of recombinant DNA technology.
* Discuss the steps of PCR
* Discuss the applications of PCR
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | Pediatrics,General Medicine |  |  |  |
| BI7.5 | Describe the role of xenobiotics in disease**Learning objectives:** At the end of the session the phase I student must be able to* Describe the two general phases of xenobiotic metabolism
* Discuss the role of cytochrome P450 species .
* Discuss conjugation reactions catalyzed by various enzymes.
* Describe the metabolic importance of glutathione.
* Discuss carcinogenic effects of xenobiotics .
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  |  |  |  |  |
| BI7.6 | Describe the anti-oxidant defence systems in the body.**Learning objectives:** At the end of the session the phase I student must be able to* Define free radicals
* Describe the main sources of oxygen radicals in the body.
* Discuss the mechanisms and dietary factors that protect against radical damage.
* Describe the damage caused to DNA, lipids and proteins by free radicals.
* Discuss lipid peroxidation caused by free radicals.
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  |  |  |  |  |
| BI7.7 | Describe the role of oxidative stress in the pathogenesis of conditions such as cancer, complications of diabetes mellitus and atherosclerosis.**Learning objectives:** At the end of the session the phase I student must be able to* Describe the diseases associated with radical damage
* Discuss the pathogenesis of cancer due to oxidative stress
* Discuss the pathogenesis of diabetes mellitus due to oxidative stress
* Discuss the pathogenesis of atherosclerosis due to oxidative stress
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | General Medicine ,Pathology  |  |  |  |
| **Nutrition** |  |  |  |  |  |  |
| BI8.1 | Discuss the importance of various dietary components and explain importance of dietary fibre**Learning objectives:** At the end of the session the phase I student must be able to* Describe thenutritional values of proteins
* Describe the nutritional values of carbohydrates
* Describe the nutritional values of fats
* Explain the importance of dietary fibers.
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | General Medicine,Pediatrics,Pathology |  |  |  |
| BI8.2 | Describe the types and causes of protein energy malnutrition and its effects**Learning objectives:** At the end of the session the phase I student must be able to* Describe the consequences of undernutrition: marasmus and kwashiorkor
* Discuss the clinical features of marasmus and kwashiorkor
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | General Medicine,Pediatrics,Pathology |  |  |  |
| BI8.3 | Provide dietary advice for optimal health in childhood and adult, in disease conditions like diabetes mellitus, coronary artery disease and in pregnancy**Learning objectives:** At the end of the session the phase I student must be able to* Describe balanced diet .
* Describe the steps involved in prescription of diet.
* Discuss the prescribed diet given in diabetes mellitus
* Discuss the prescribed diet given in coronary artery disease
* Discuss the prescribed diet given in pregnancy .
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | General Medicine |  |  |  |
| BI8.4 | Describe the causes (including dietary habits), effects and health risks associated with being overweight/ obesity**Learning objectives:** At the end of the session the phase I student must be able to* Describe the causes of overweight /obesity
* Discuss the risk associated with obesity
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | General medicine,Pathology  |  |  |  |
| BI8.5 | Summarize the nutritional importance of commonly used items of food including fruits and vegetables.(macro-molecules & its importance)**Learning objectives:** At the end of the session the phase I student must be able toDescribe the nutritional importance of fruits Describe nutritional value importance of vegetable | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | Community Medicine,General medicine ,Pediatrics |  |  |  |
| **Extracellular Matrix**  |  |  |  |  |  |  |  |
| BI9.1 | List the functions and components of the extracellular matrix (ECM). **Learning objectives:** At the end of the session the phase I student must be able to* Describe the properties and general features of ECM.
* Discuss the synthesis and degradation of glycosaminoglycans and proteoglycans
* Discuss the structural and functional properties of collagen and elastin, the major proteins of the ECM.
* Describe major features of fibrillin, fibronectin, and laminin, other important proteins of the ECM.
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  |  |  |  |  |
| BI9.2 | Discuss the involvement of ECM components in health and disease**Learning objectives:** At the end of the session the phase I student must be able to* Define mucoplysaccharidosis.
* Discuss metabolic defects associated with mucoploysaccharidosis.
 | K | KH | Y | Lecture ,.small group discussion |  |  | General Medicine  |  |  |  |
| BI9.3 | Describe protein targeting & sorting along with its associated disorders**Learning objectives:** At the end of the session the phase I student must be able to* Describe the steps of protein targeting .
* Discuss the importance of protein targeting.
* Describe the disorders of protein targeting .
 | K | KH | N | Lecture ,.small group discussion | Written /Viva voce |  |  |  |  |  |
| **Oncogenesis and immunity**  |  |  |  |  |  |  |
| BI10.1 | Describe the cancer initiation, promotion oncogenes & oncogene activation. Also focus on p53 & apoptosis**Learning objectives:** At the end of the session the phase I student must be able to* Describe important properties of oncogenes and tumor suppressor genes.
* Describe important aspects of the biochemical and genetic features of cancer cells.
* Discuss the role of p53
* Define apoptosis
* Describe causes of apoptosis
* Discuss intrinsic and extrinsic pathway of apoptosis
* Discuss the role of caspases in apoptosis.
* Describe the character of apoptotic cell
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | Obstetrics &Gynaecology,General Surgery,Pathology |  |  |  |
| BI10.2 | Describe various biochemical tumor markers and the biochemical basis of cancer therapy**Learning objectives:** At the end of the session the phase I student must be able to* Classify tumor markers.
* Discuss their biochemical role as cancer marker.
* Describe the basis of cancer therapy.
 | K | KH | Y | . Lecture ,.small group discussion | Written /Viva voce |  | Obstetrics &Gynaecology,General Surgery,Pathology |  |  |  |
| BI10.3 | Describe the cellular and humoral components of the immune system & describe the types and structure of antibody**Learning objectives:** At the end of the session the phase I student must be able toDescribe the components of immune system.* Discuss the types of cells and antibodies involved in immunity .
* Describe the structure and functions of each type of cells and antibodies.
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | Obstetrics &Gynaecology,General Surgery,Pathology |  |  |  |
| BI10.4 | Describe & discuss innate and adaptive immune responses, self/non-self recognition and the central role of T-helper cells in immune responses**Learning objectives:** At the end of the session the phase I student must be able to* Describe innate and adaptive immunity .
* Discuss self/non self recognition.
* Discuss the role of T helper cells
* Discuss the interaction of T and B cell
 | K | KH | Y |  Lecture ,.small group discussion | Written /Viva voce |  | General Medicine,Pathology | Physiology |  |  |
| BI10.5 | Describe antigens and concepts involved in vaccine development**Learning objectives:** At the end of the session the phase I student must be able to* Explain antigen and immunogen.
* Discuss the types and steps involved in vaccine development
 | K | KH | Y | Lecture ,.small group discussion | Written /Viva voce |  | Pathology,Pediatrics,Microbiology |  |  |  |
| **Biochemical Laboratory Tests**  |  |  |  |  |  |  |
| BI11.1 | Describe commonly used laboratory apparatus and equipments, good safe laboratory practice and waste disposal.**Learning objectives:** At the end of the session the phase I student must be able to* Describe commonly used laboratory apparatus and equipments.
* Discuss good safe laboratory practice.
* Discuss Biomedical waste disposal
 | K | KH | Y | Lecture, Small groupdiscussion | Written/ Viva voce |  |  |  |  |  |
| BI11.2 | Describe the preparation of buffers and estimation of pH.**Learning objectives:** At the end of the session the phase I student must be able to* Describe types of buffers in body
* Discuss the role of these buffers in maintaining blood pH
* Describe the steps of acidic and basic buffer preparation.
* Describe the methods for estimation of pH
 | K | KH | Y | Lecture, Small groupdiscussion | Written/ Viva voce |  |  |  |  |  |
| BI11.3 | Describe the chemical components of normal urine**Learning objectives:** At the end of the session the phase I student must be able to* Describe the chemical components of normal urine
* Discuss the excretion of these chemical components of urine.
 | K | KH | Y | Lecture, Small groupdiscussion | Written/ Viva voce |  |  |  |  |  |
| BI11.4 | Perform urine analysis to estimate and determine normal and abnormal constituents**Learning objectives:** At the end of the session the phase I student must be able to* Perform urine analysis to determine urea ,creatinine, uric acid,ions in normal urine .
* Perform urine analysis determine reducing sugar ,protein,ketone bodies, bile pigments & bile salts in abnormal urine
 | S | P | Y | DOAP session | Skill assessment |  | General Medicine | Physiology |  |  |
| BI11.5 | Describe screening of urine for inborn errors & describe the use of paper chromatography**Learning objectives:** At the end of the session the phase I student must be able to* Define inborn errors of metabolism
* Discuss steps and types of paper chromatography.
* Discuss the calculation of Rf value and its significance.
* Describe uses of paper chromatography for detecting inborn errors of metabolism
 | K | KH | Y | Lecture, Small groupdiscussion | Written/ Viva voce |  | General Medicine |  |  |  |
| BI11.6 | Describe the principles of colorimetry**Learning objectives:** At the end of the session the phase I student must be able to* Describe the principle of colorimetry
* Describe components of colorimeter
* Discuss uses of colorimeter
 | K | KH | Y | Lecture, Small groupdiscussion | Written/ Viva voce |  |  |  |  |  |
| BI11.7 | Demonstrate the estimation of serum creatinine and creatinine clearance**Learning objectives:** At the end of the session the phase I student must be able to* Show methods for estimation of serum creatinine
* Perform the estimation of serum creatinine
* Calculate creatinine clearance
 | S | P | Y | Practical | Skills assessment | 1 | General Medicine,Pathology |  |  |  |
| BI11.8 | Demonstrate estimation of serum proteins, albumin and A:G ratio**Learning objectives:** At the end of the session the phase I student must be able to* Show analytical methods for estimation of serum proteins, albumin .Perform the estimation of serum proteins, albumin
* Calculate A:G ratio
 | S | P | Y | Practical | Skills assessment | 1 |  |  |  |  |
| BI11.9 | Demonstrate the estimation of serum total cholesterol and HDL- cholesterol**Learning objectives:** At the end of the session the phase I student must be able to* Show analytical methods for estimation of serum total cholesterol and HDL- cholesterol .
* Perform the estimation of serum total cholesterol and HDL- cholesterol
 | S | P | Y |   |  |  |  |  |  |  |
| BI11.10 | Demonstrate the estimation of triglycerides**Learning objectives:** At the end of the session the phase I student must be able to* Show analytical methods for estimation of TG.
* Perform the estimation of TG
 | S | P | Y | Practical | Skills assessment |  |  |  |  |  |
| BI11.11 | Demonstrate estimation of calcium and phosphorus**Learning objectives:** At the end of the session the phase I student must be able to* Show analytical methods for estimation of TG.
* Perform the estimation of TG
 | S | P | Y | Practical | Skills assessment |  |  |  |  |  |
| BI11.12 | Demonstrate the estimation of serum bilirubin**Learning objectives:** At the end of the session the phase I student must be able to* Show analytical method for estimation of bilirubin.
* Perform the estimation of SGOT/SGPT.
 | S | P | Y |  Practical | Skills assessment |  |  |  |  |  |
| BI11.13 | Demonstrate the estimation of SGOT/ SGPT**Learning objectives:** At the end of the session the phase I student must be able to* Show various analytical methods for estimation of SGOT/SGPT .
* Perform the estimation of SGOT/SGPT
 | S | P | Y |  Practical | Skills assessment |  |  |  |  |  |
| BI11.14 | Demonstrate the estimation of alkaline phosphatase**Learning objectives:** At the end of the session the phase I student must be able to* Show various analytical methods for estimation of ALP.
* Perform the estimation of ALP
 | S | P | Y | Practical | Skills assessment |  |  |  |  |  |
| BI11.15 | Describe & discuss the composition of CSF**Learning objectives:** At the end of the session the phase I student must be able to* Describe the collection of CSF .
* Discuss the composition of CSF with their significance .
 | K | KH | Y | Lecture, Small groupdiscussion | Written/ Viva voce |  |  |  |  |  |
| BI11.16 | Observe use of commonly used equipments/techniques in biochemistry laboratory including:  •pH meter•Paper chromatography of amino acid•Protein electrophoresis•TLC, PAGE•Electrolyte analysis by ISE•ABG analyzer•ELISA•Immunodiffusion•Autoanalyser•Quality control•DNA isolation from blood/ tissue | S | KH | Y |  Demonstration | Skill assessment |  |  |  |  |  |
| BI11.17 | Explain the basis and rationale of biochemical tests done in the following conditions:- diabetes mellitus,- dyslipidemia,- myocardial infarction,- renal failure, gout,- proteinuria,- nephrotic syndrome,- edema,- jaundice,- liver diseases, pancreatitis, disorders of acid- base balance, - thyroid disorders | K | KH | Y |  Lecture, Small groupdiscussion | Written/ Viva voce |  |  |  |  |  |
| BI11.18 | Discuss the principles of spectrophotometry.**Learning objectives:** At the end of the session the phase I student must be able to* Describe the principle of spectrophotometry
* Discuss components & types of spectrophotometer
 | K | KH | Y | Lecture, Small groupdiscussion | Written/ Viva voce |  |  |  |  |  |
| BI11.19 | Outline the basic principles involved in the functioning of instruments commonly used in a biochemistry laboratory and their applications.**Learning objectives:** At the end of the session the phase I student must be able to* Describe the principle of ELISA
* Discuss the functioning ELISA in laboratory and their applications.
 | K | KH | Y | Lecture, Small groupdiscussion | Written/ Viva voce |  |  |  |  |  |
| BI11.20 | Identify abnormal constituents in urine, interpret the findings and correlate these with pathological states.**Learning objectives:** At the end of the session the phase I student must be able to* Show the presence of reducing sugar ,protein,ketone bodies,bile pigments & bile salts in abnormal urine
* Perform benedict’s ,heat coagulation,heller’s test, rothera’s test ,gmelin , hay’s test for detection of above abnormal constituents
 | S | SH | Y |  DOAP sessions | Skill assessment |  |  |  |  |  |
| BI11.21 | Demonstrate estimation of glucose, creatinine, urea and total protein in serum.**Learning objectives:** At the end of the session the phase I student must be able to* Demonstrate analytical methods for estimation of Glucose,creatinine,urea ,total protein .
 |  |  |  |  DOAP sessions | Skill assessment | 1 |  |  |  |  |
| BI11.22 | Calculate albumin: globulin (AG) ratio and creatinine clearance**Learning objectives:** At the end of the session the phase I student must be able to* Write the normal value of A: G ratio and creatinine clearance
* Calculate albumin: globulin (A:G)ratio and creatinine clearance
* Discuss the significance of of A/G ratio and creatinine clearance
 | K | KH | Y | Lecture, Small groupdiscussion | Written/ Viva voce |  | General Medicine |  |  |  |
| BI11.23 | Calculate energy content of different food Items, identify food items with high and low glycemic index and explain the importance of these in the diet**Learning objectives:** At the end of the session the phase I student must be able to* Describe the calorific value of food substances
* Discuss low and high glycemic index food with importance in diet
 | K | KH | Y | Lecture, Small groupdiscussion | Written/ Viva voce |  | General Medicine |  |  |  |
| BI11.24 | Enumerate advantages and/or disadvantages of use of unsaturated, saturated and trans fats in food**Learning objectives:** At the end of the session the phase I student must be able to* Enumerate unsaturated ,saturated, trans fats with examples
* Discuss their advantage and disadvantage
 | K | KH | Y | Lecture, Small groupdiscussion | Written/ Viva voce |  | General Medicine |  |  |  |