



PRAVARA INSTITUTE OF MEDICAL SCIENCES

(DEEMED TO BE UNIVERSITY)

Loni, Tal. Rahata, Dist. Ahmednagar 413736

NAAC Re-accredited with 'A' Grade

SYLLABUS

UG Programme- BIOCHEMISTRY

MBBS- 1st year

(Competency Based Undergraduate Curriculum will be implemented from August 2019, i.e. MBBS batch admitted for first year in 2019)

1. GOALS

The broad goal of the teaching of undergraduate students in Biochemistry is to provide an understanding of the natural history of infectious disease in order to deal with the etiology, pathogenesis, laboratory diagnosis, treatment and control of infections in the community.

2. OBJECTIVES

Competencies: The undergraduate learner demonstrate:

1. Understanding of role of microbial agents in health and disease
2. Understanding of the immunological mechanisms in health and disease
3. Ability to correlate the natural history, mechanisms and clinical manifestations of infectious diseases as they relate to the properties of microbial agents
4. Knowledge of the principles and application of infection control measures
5. An understanding of the basis of choice of laboratory diagnostic tests and their interpretation, antimicrobial therapy, control and prevention of infectious diseases.

INTEGRATION

The teaching should be aligned and integrated horizontally and vertically in organ systems with emphasis on host-microbe-environment interactions and their alterations in disease and clinical correlations so as to provide an overall understanding of the etiological agents, their laboratory diagnosis and prevention

3. SYLLABUS

Paper: I

Competency No.	Topic & Subtopics
1	Basic Biochemistry
1.1 Describe the molecular and functional organization of a cell and its subcellular component.	Molecular and functional organization of cell and its subcellular components.
2	Enzymes
2.1 Explain fundamental concepts of enzyme, isoenzymes, alloenzymes, coenzyme & co-factors. Enumerate the main classes of IUBMS nomenclature.	Biochemical nature of enzyme, isoenzymes, alloenzymes, coenzyme & co-factors IUBMB enzyme classification.
2.2 Observe the estimation of SGOT & SGPT.	Estimation of SGOT (AST) & SGPT (ALT) with its normal range and clinical significance.
2.3 Describe and explain the basic principles of enzyme activity.	Mechanism of enzyme action, factors affecting enzyme activity, brief concept of enzyme kinetics with special reference to V_{max} & K_m .
2.4 Describe and discuss inhibitors as poisons and drugs and as therapeutic enzymes.	Enzyme inhibition. Various inhibitors as drugs and poisons.
2.5 Describe and discuss the clinical utility of various serum enzymes as markers of pathological conditions.	Diagnostic and therapeutic importance of various serum enzymes in various disorders.
2.6 Discuss use of enzymes in laboratory investigations (Enzyme-based assays)	Analytical uses of Enzymes in laboratory investigations (enzyme based assays).
2.7 Interpret laboratory results of enzyme activities & describe the clinical utility of various enzymes as markers of pathological conditions.	Interpret various serum enzymes of liver & Biliary tract, Pancreas, Cardiac & skeletal muscle in various disorders.
3	Chemistry & Metabolism of Carbohydrates.
3.1 Discuss and differentiate monosaccharides, di-saccharides & polysaccharides giving examples of main carbohydrates as energy fuel, structural element and storage in the human body.	Classification of carbohydrates with examples & functions of monosaccharides giving examples as energy fuel, glycosides and its therapeutic importance, disaccharides with examples & importance, polysaccharides with examples as

	storage form like glycogen, structural elements like glycosaminoglycans in the human body, resistant starch, glycemic index, and dietary fiber. Clinical importance of dextrans
3.2 Describe the processes involved in digestion & assimilation of carbohydrates & storage.	Digestion & absorption, transport & storage of carbohydrates, Lactose intolerance & sucrose deficiency disorders.
3.3 Describe and discuss the digestion & assimilation of carbohydrates from food.	
3.4 Define & differentiate the pathways of carbohydrate metabolism (glycolysis, gluconeogenesis, glycogen metabolism, HMP shunt).	Pathway, energetics, regulation & clinical diseases / disorders of – Glycolysis including Rappaport Leuberger cycle, Gluconeogenesis, Glycogenesis, Glycogenolysis, HMP pathway, Uronic acid pathway, Galactose & Fructose metabolism.
3.5 Describe and discuss the regulation, functions & integration of carbohydrate along with associated diseases/disorders.	
3.6 Describe and discuss the concept of TCA cycle as a amphibolic pathway and its regulation.	TCA cycle pathway, energetic, regulation & its concepts as amphibolic pathway
3.7 to be clubbed with 3.4 & 3.6 Describe the common poisons that inhibit crucial enzymes of carbohydrate metabolism (eg:fluoride, arsenate).	Common poisons that inhibit crucial enzymes of carbohydrate metabolism like: iodoacetate, fluoride & arsenite as poisons that inhibit enzymes of glycolysis Fluoroacetate, arsenite & malonate as poisons that inhibit enzymes of TCA cycle.
3.8 & 3.10 3.8: Describe & interpret laboratory results of analytes associated with metabolism of carbohydrates. (to be clubbed with comp no.no.11.17 – Diabetes Mellitus). 3.10 Interpret the results of blood glucose levels & other Laboratory investigations related to disorders of carbohydrate metabolism.	Interpretation of the results of blood glucose, Glycated hemoglobin & GTT as per WHO guidelines in Diabetes mellitus including gestational diabetes & other laboratory investigation like urinary glucose, urinary ketone bodies. Interpretation of the results of blood & urinary galactose levels in galactosemia. Interpretation of blood G6PD levels.
3.9 Discuss the mechanism & significance of blood glucose regulation in health and disease.	Regulation of blood glucose in fed and fasting state in normal health & changes in diabetes mellitus.
4	Chemistry & Metabolism of Lipids

<p style="text-align: center;">4.1</p> <p>Describe & discuss main classes of lipids (Essential/non-essential fatty acids, cholesterol & hormonal steroids, triglycerides, major phospholipids & sphingolipids) relevant to human system & their major functions.</p>	<p>Definition & classification of lipids including classification of fatty acids, their nomenclature, numbering, functions & biological importance of various lipids like fatty acids, cholesterol, hormonal steroids, triglycerides, major phospholipids & sphingolipids.</p>
<p style="text-align: center;">4.2</p> <p>Describe the processes involved in digestion & absorption of dietary lipids & also the key features of their metabolism.</p>	<p>Digestion, absorption & transport of lipids along with abnormalities like lipid Malabsorption.</p> <p>Metabolism of fatty acids (β-oxidation of even and odd carbon fatty acids), regulation, energetic & disorders associated with oxidation of fatty acids, Formation & fate of Ketone bodies, its significance, regulation & associated disorders like ketosis.</p> <p>In brief de novo fatty acid biosynthesis- site & organs, precursors, enzyme complex, product formed & regulatory steps.</p> <p>Biosynthesis of triacylglycerol and fate of triacylglycerol formed in liver & adipose tissue, its significance & regulation, Metabolic role of adipose tissue & disorders of lipid transport & storage like fatty liver.</p> <p>In brief Cholesterol biosynthesis- site & organs, precursors, key enzymes, product formed & regulatory step, metabolic fate & excretion.</p>
<p style="text-align: center;">4.3</p> <p>Explain the regulation of lipoprotein metabolism & associated disorders.</p>	<p>Metabolism of various lipoproteins & hyperlipoproteinemia's hypolipoproteinemias- abetalipoproteinemias & Tangiers disease.</p>
<p style="text-align: center;">4.4</p> <p>Describe the structure & functions of lipoproteins, their functions, interrelations & relations with atherosclerosis.</p>	<p>Classification structure & functions of lipoproteins- (To be clubbed with 4.1)</p> <p>Metabolic interrelationship between various lipoproteins, Role of lipoproteins in transport of cholesterol & reverse cholesterol transport, atherosclerosis. (To be clubbed with 4.3)</p>
<p style="text-align: center;">4.5 & 4.7</p> <p>Interpret laboratory results of analytes associated metabolism of lipids.</p>	<p>Various lipid profile tests with their biological reference intervals. Interpret lipid profile results in various disorders like hyper/hypolipoproteinemias,</p>

	diabetes mellitus, nephrotic syndrome, disorders of thyroid etc.
4.6 Describe the therapeutic uses of prostaglandins & inhibitors of eicosanoid synthesis.	Various eicosanoid classes (prostaglandins, leukotrienes & thromboxanes), their functions. Key features of synthesis of eicosanoids & inhibitors of eicosanoid synthesis, therapeutic uses of prostaglandins.
4.7 Interpret laboratory results of Analytes associated with metabolism of lipids.	Same as 4.5
6.6 Describe the biochemical processes involved in generation of energy cells.	Electron transport chain, mechanism of oxidative Phosphorylation (Chemiosmotic theory), substrate level Phosphorylation, Uncouplers & inhibitors of electron transport chain, shuttle systems for transport of extra-mitochondrial NADH.
7.5 Describe the role of Xenobiotics in disease.	Mechanisms of biotransformation of Xenobiotics & associated diseases.
7.6 Describe the anti-oxidant defense systems in the body.	Enzymatic & non-enzymatic antioxidant defense systems in the body.
7.7 Describe the role of oxidative stress in the pathogenesis of conditions such as cancer, complications of diabetes mellitus & atherosclerosis.	Free radical, biological sources of reactive oxygen species (ROS) & oxidative damage, oxidative stress, roll of oxidative stress in cancer, diabetes mellitus & atherosclerosis.
8	Nutrition
8.1 Discuss the importance of various dietary components & explain importance of dietary fiber.	Importance of carbohydrates, lipids, proteins & vitamins, quality of proteins, various types of dietary fibers and their importance in the diet.
8.2 Describe the types and causes of protein energy malnutrition & its effects.	Protein energy malnutrition, kwashiorkor and Marasmus their causes and effects.
8.3 Provide dietary advice for optimal health in childhood & adult, in disease conditions like diabetes mellitus, coronary artery disease & in pregnancy.	Balanced diet in adult, in childhood & in pregnancy for optimal health, dietary advice in diabetes mellitus & coronary heart disease.
8.4 Describe the causes (including dietary habits), effects and health risks associated with being overweight/obesity.	Causes, effects and health risk associated with overweight/obesity.
8.5 Summarize the nutritional importance of commonly used items of food	Nutritional importance of commonly used items of food like cereals, pulses,

including fruits & vegetables (macro-molecules & its importance)	eggs, meat, fish, fruits & vegetables and their normal dietary requirements.
9	Extracellular Matrix
9.1 List the functions & components of the extracellular matrix (ECM).	Types & functions of the extracellular matrix (ECM), Components and functions of proteoglycans, glycoproteins & major proteins of ECM
9.2 Discuss the involvement of ECM components in health & disease.	Disorders associated with components of ECM like Osteogenesis imperfect, Marfan's Syndrome, Mucopolysaccharidoses, Scurvy & Menkes Disease.
9.3 Describe protein targeting & sorting along with its associated disorders (It is non-core:N)	Types of protein targeting and sorting, disorders due to defects in mitochondrial targeting signals & defects in peroxisomal matrix protein import.
10	Oncogenesis and Immunity.
10.1 Describe the cancer initiation, promotion oncogenes & oncogene activation. Also focus on p53 & apoptosis.	Characteristics of cancer cell, molecular basis of cancer (carcinogenesis), various carcinogens & initiator, promoter of carcinogens, oncogenes and proto-oncogenes, tumor suppressor genes (retinoblastoma, RB 7 p53), mechanisms of apoptosis in physiologic and pathologic conditions.
10.2 Describe various biochemical tumor markers and the biochemical basis of cancer therapy.	Biochemical tumor markers, biochemical basis of chemotherapy, radiotherapy, hormonal therapy, targeted drug therapy and immunotherapy.
10.3 Describe the cellular and humoral components of the immune system & describe the types and structure of antibody.	Cells of the immune system, types of immune systems (innate & adaptive), cellular and humoral components of innate and adaptive immune systems, B cell development & the formation of antibodies, types, structure and mechanism of action of antibodies (Immunoglobulins), primary & secondary response.
10.4 Describe & discuss innate and adaptive immune response, self/non-self-recognition & the central role of T-helper cells in immune responses.	Innate and adaptive immune systems immunological memory, T lymphocytes development, role of helper T cells (CD4+T cells) and cytotoxic T cells/killer cells/ CD8+ T cells in immune responses, Brief concept of MHC Disorder- Immunodeficiency, autoimmunity & hypersensitivity.

10.5 Describe antigens and concepts involved in vaccine development.	Antigens, concept involved in vaccine development & their types.
11	Biochemical Laboratory Tests.
11.1 Describe commonly used laboratory apparatus and equipments, good safe laboratory practice and waste disposal	Common lab equipments and apparatus like test tubes, pipettes & other glassware, auto pipettes, centrifuge, balances, over, water bath good safe laboratory practice, management of needle stick injury & latest guidelines of disposal of biomedical waste.
11.15 Describe & discuss the composition of CSF	Physical characteristics & chemical composition of CSF
11.23 Calculate energy content of different food items, identify food items, identify food items with high & low glycemic index and explain the importance of these in the diet.	Energy contents of lipids, carbohydrates & proteins in common food items.
11.24 Enumerate advantages and/or disadvantages of use of unsaturated, saturated & trans fats in food.	Advantages of unsaturated fats, disadvantages of saturated & trans fats in food.
AETCOM 1.4	The Foundation Communication
For long answer question and scenario based/ application questions, topics will not be repeated	

Paper: - II

Competency No.	Topic & Subtopics
5	Chemistry and Metabolism of Proteins.
5.1 Describe & discuss structural organization of proteins.	General nature of amino acid, classification & importance of amino acids with examples, peptide bond formation, biologically important peptides, difference levels of protein structure including disulfide & weak bonds with examples and clinical significance.
5.2	Definition, various classifications with examples and functions of proteins, plasma proteins,

Describe & discuss functions of proteins & structure function relationships in relevant areas e.g. hemoglobin & selected hemoglobinopathies.	structure –function relationship of proteins like Myoglobin, normal & abnormal hemoglobin.
5.3 Describe the digestion & absorption of dietary proteins.	Digestion, absorption & transport of dietary proteins with related disorders like Hartnup disease, cystinuria & glycinuria.
5.4 Describe common disorders associated with protein metabolism.	Role of transamination & deamination reactions in metabolism of amino acids in the formation of ammonia with their clinical significance. Transport of ammonia, pathway of urea cycle, its significance, regulation & metabolic disorders associated with urea cycle. Metabolic pathways for Glycine, Phenylalanine & Tyrosine, Sulphur containing amino acids (Methionine, Cysteine & Cysteine & branch chain amino acids (Valine, Isoleucine & Leucine), their role in biosynthesis of variety of specialized biomolecules, associate metabolic disorder. For Tryptophan- Only important biomolecules formed & clinical significance.
5.5 Interpret laboratory results of analytes associated with metabolism of proteins.	Interpret laboratory results of protein metabolism for example: Levels of various metabolites in blood or urine in metabolic disorders lie-urea cycle disorders, phenylketonuria, Tyrosinemia, Alkaptonuria, Hartnups disease, MSUD, cyctinuria & homocystinuria.
6	Metabolism and Homeostasis.
6.1 Discuss the metabolic processes that take place in specific organs in the body in the fed and fasting states.	Integration of carbohydrate, protein and lipid metabolism at cellular and tissue or organ level with its significance, Metabolic processes with role of specific organs in fed, fasting and starvation states.
6.2 Describe & discuss the metabolic processes in which nucleotides are involved.	Important steps in de novo biosynthesis of Purine & Pyrimidine nucleotides & their regulation, enzymes of the nucleotide biosynthesis that are inhibited by anticancer drugs, salvage pathway for the synthesis of Purine nucleotides with its significance, catabolism of Purine and Pyrimidine nucleotides.
6.3 Describe the common disorders associated with nucleotide metabolism.	Disorder of nucleotide metabolism like gout, Lesch-Nyhan syndrome, orotic aciduria, with diagnostic tests & biochemical mechanism of nutritional & drug therapy.
6.4	Lab results of analytes related with gout & Lesch-Nyhan syndrome. Levels of uric acid in blood &

Discuss the laboratory results of analytes associated with gout & Lesch-Nyhan syndrome.	urine and presence of urate crystals in synovial fluid in gout, levels of uric acid in blood.
6.5	Vitamins
Describe the biochemical role of vitamins in the body and explain the manifestations of their deficiency.	Sources, biochemical functions, daily requirement and deficiency manifestations of fat soluble vitamins (Vitamin A, D, E & K). Sources, biochemical functions and deficiency manifestations of water soluble vitamins (Thiamine, Riboflavin, Niacin, Pantothenic acid, Pyridoxine, Biotin, Folic acid, Cobalamin & vitamin C).
6.6	Biological Oxidation
Describe the biochemical processes involved in generation of energy cells.	Electron transport chain, mechanism of oxidative Phosphorylation (Chemiosmotic theory), substrate level Phosphorylation, Uncouplers & inhibitors of electron transport chain, shuttle systems for transport of extra-mitochondrial NADH.
6.7	Regulation of blood pH and Water and Electrolyte Balance
Describe the process involved in maintenance of normal pH, water & electrolyte balance of body fluids and the derangements associated with these.	Acids, bases & buffers, mechanism of action of buffer, dietary sources of acids, bases, normal pH of body fluids. Role of blood buffers, respiratory system & kidney in regulation of blood pH. Disorders associated with blood pH (acidosis and alkalosis) & their compensatory mechanisms, anion gap & its clinical importance. Total body water & its compartmental distribution, various electrolytes-sodium, potassium & chloride, their distribution & clinical conditions related to their plasma level alterations, maintenance of normal water and electrolyte balance & disorders associated with water and electrolyte imbalance.
6.8	Blood Gas Analysis
Discuss & interpret results of Arterial Blood Gas (ABG) analysis in various disorders.	Interpretation of results of arterial blood gas (ABG) analysis in acidosis and alkalosis.
6.9	Mineral Metabolism
Describe the functions of various minerals in the body, their metabolism & homeostasis.	Dietary food sources, daily requirement, biochemical functions, metabolism & homeostasis of: Calcium, phosphorus & magnesium, trace elements (copper, fluoride, iodine, iron, manganese, selenium & zinc).
6.10	
Enumerate & describe the disorders associated with mineral metabolism.	Clinical conditions related to plasma level alterations of: Calcium, phosphorus & magnesium Trace elements (copper, fluoride, iodine, iron, manganese, selenium & zinc).

6.11	Hemoglobin - Chemistry and Metabolism
Describe the functions of heme in the body & describe the processes involved in its metabolism & describe porphyrin metabolism.	Structure & functions of hemoglobin, role of 2,3-bisphosphoglycerate (BPG) in oxygen binding & delivery biosynthesis of heme (iron containing porphyrin), its regulation, functions in the body, disorders of heme biosynthesis (various types of porphyria's), catabolism of heme, various types of jaundice.
6.12 Describe the major types of hemoglobin & its derivatives found in the body and their physiological/pathological relevance.	Types of normal human hemoglobin, types of normal & abnormal derivatives of hemoglobin, various hemoglobinopathies: Sickle cell anemia, Thalassemia.
6.13, 6.14, 6.15	Functions of Organ and Organ Function Tests
6.13 Describe the functions of the kidney, liver, thyroid & adrenal glands.	1. Functions of liver, disorders & liver functions tests.
6.14 Describe the tests that are commonly done in clinical practice to assess the functions of these organs (Kidney, liver, thyroid & adrenal glands)	2. Functions of kidney, disorders & kidney function tests. 3. Function of Thyroid, disorders & thyroid function tests.
6.15 Describe the abnormalities of kidney, liver, thyroid & adrenal glands.	4. Function of Adrenals, disorders & Adrenal function tests.
7	Molecular Biology
7.1 Describe the structure & functions of DNA and RNA and outline the cell cycle.	Structure & functions of nucleotides, biologically important nucleotides & their importance, major types of synthetic analogs of nucleotides (antimetabolites) and their importance, major types of synthetic analogs of nucleotides (antimetabolites) and their clinical significance, structure & functions of DNA & RNA, Phases of cell cycle.
7.2 Describe the processes involved in replication & repair of DNA and the transcription & translation mechanisms	Replication of DNA in Eukaryotes, inhibitors of DNA replication & different types of repair systems of DNA. Transcription in Eukaryotes & posttranscriptional modifications, inhibitors, reverse transcription & its significance. Genetic code and wobble hypothesis, Translation in Eukaryotes, inhibitors, chaperons, protein folding & posttranslational modifications.

<p>7.3 Describe gene mutations & basic mechanism of regulation of gene expression.</p>	<p>Causes and types of genetic mutations with examples. Regulation of Eukaryotic gene expression.</p>
<p>7.4</p>	<p>Genetic Engineering</p>
<p>Describe applications of molecular technologies like Recombinant DNA technology, PCR in the diagnosis and treatment of diseases with genetic basis.</p>	<p>Recombinant DNA technology, restriction endonucleases, process of construction of recombinant DNA and its applications in medicine, DNA library, blot transfer techniques- southern blotting, northern blotting & western blotting, mechanism of polymerase chain reaction & its application in medical diagnosis & treatment of genetic diseases.</p>
<p>7.5 Describe the role of Xenobiotics in disease.</p>	<p>Mechanisms of biotransformation of Xenobiotics & associated diseases.</p>
<p>7.6 Describe the anti-oxidant defense systems in the body.</p>	<p>Enzymatic & non-enzymatic antioxidant defense systems in the body.</p>
<p>7.7 Describe the role of oxidative stress in the pathogenesis of conditions such as cancer, complications of diabetes mellitus & atherosclerosis.</p>	<p>Free radical, biological sources of reactive oxygen species (ROS) & oxidative damage, oxidative stress, roll of oxidative stress in cancer, diabetes mellitus & atherosclerosis.</p>
<p>11</p>	<p>Biochemical Laboratory Tests.</p>
<p>11.1 Describe commonly used laboratory apparatus and equipments, good safe laboratory practice and waste disposal</p>	<p>Common lab equipments and apparatus like test tubes, pipettes & other glassware, auto pipettes, centrifuge, balances, over, water bath good safe laboratory practice, management of needle stick injury & latest guidelines of disposal of biomedical waste.</p>
<p>11.5</p>	<p>Urine Analysis</p>
<p>Describe screening of urine for inborn errors & describe the use of paper chromatography. Club paper chromatography of amino acid & TLC from competency no 11.16</p>	<p>Urine: Screening of inborn errors. Paper chromatography for diagnosis of inborn errors.</p>
<p></p>	<p>Equipments</p>
<p>11.16 & 11.19 11.16 - Observe use of commonly used equipment's/techniques in biochemistry laboratory including:</p>	<p>Principle, application & working of following lab equipment's/technique: pH meter, paper chromatography of amino acids, protein electrophoresis, TLC, PAGE, Electrolyte analysis by ISE, ABG analyzer, ELISA, immunodiffusion, auto analyzer, quality control, DNA isolation from blood/tissue.</p>

<ul style="list-style-type: none">• 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 <p style="text-align: center;">11.19</p> <p>Outline the basic principles involved in the functioning of instruments commonly used in a biochemistry laboratory & their applications.</p>	<p>(paper chromatography of amino acid, TLC clubbed with 11.5)</p>
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PRACTICALS

Competency No.	Topics & Subtopics
11.2 Describe the preparation of buffers and estimation of pH.	Preparation of buffer-acidic & alkaline. Measurement of pH paper & pH meter
11.3 Describe the chemical components of normal urine.	Chemical constituents of normal urine.
11.4 & 11.20 11.4: Perform urine analysis to estimate & determine normal & abnormal constituents. 11.20: Identify abnormal constituents in urine; interpret the findings & correlate these with pathological states.	Physical characteristics & organic constituents of urine. Collection of random & 24 hour urine sample. Urine report : physical characteristics & abnormal constituents, urine dipsticks Interpretation of Urine Abnormalities.
11.5 Describe screening of urine for inborn errors & describe the use of paper chromatography. Club paper chromatography of amino acid & TLC from competency no 11.16	Urine: Screening of inborn errors. Paper chromatography for diagnosis of inborn errors.
11.6 Describe the principles of Colorimetry. (Club spectrophotometry from competency no 11.18)	Colorimeter-Principle, Beer and Lambert's law & applications. Principles of spectrophotometry.
11.7,11.8,11.21 & 11.22 11.7- Demonstrate the estimation of serum creatinine & creatinine clearance. 11.8- Demonstrate estimation of serum proteins, albumin & A;G ratio. 11.21- Demonstrate estimation of glucose, creatinine, urea & total protein in serum. 11.22- Calculate albumin: globulin A;G ratio & creatinine clearance.	Estimation of serum creatinine, urine creatinine & calculation of creatinine clearance & their clinical interpretation. Estimation of serum proteins, albumin & calculation of A/G ratio & their clinical interpretation. Estimation of plasma glucose, serum urea & their clinical interpretation.
11.9 Demonstrate the estimation of serum total cholesterol and HDL cholesterol.	Estimation of serum total cholesterol and HDL cholesterol, their ratio their clinical interpretation.
11.10 Demonstrate the estimation of triglycerides.	Estimation of serum triglycerides & their clinical interpretation.

11.11 Demonstrate estimation of calcium & phosphorous.	Estimation of serum calcium & phosphorus their clinical interpretation.
11.12 Demonstrate the estimation of serum bilirubin.	Estimation of serum bilirubin: Total, direct & indirect, their clinical interpretation.
11.13 & 2.2 11.13- Demonstrate the estimation of SGOT/SGPT.	Estimation of SGOT (AST)/SGPT(ALT) & their clinical interpretation.
Competency No.	Topics & Subtopics
11.14 Demonstrate the estimation of alkaline phosphatase.	Estimation of serum ALP & their clinical interpretation.
11.15 Describe & discuss the composition of CSF	Physical characteristics & chemical composition of CSF
11.16 & 11.19 11.16- Observe use of commonly used equipment's/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 11.19 Outline the basic principles involved in the functioning of instruments commonly used in a biochemistry laboratory & their applications.	Principle, application & working of following lab equipment's/technique: pH meter, paper chromatography of amino acids, protein electrophoresis, TLC, PAGE, Electrolyte analysis by ISE, ABG analyzer, ELISA, immunodiffusion, auto analyzer, quality control, DNA isolation from blood/tissue. (paper chromatography of amino acid, TLC clubbed with 11.5)
11.17 Explain the basis & rationale of biochemical tests done in the following conditions; - Diabetes mellitus, - Dyslipidemia, - Myocardial infarction, - Renal failure, gout, - Proteinuria,	Basis and rational of biochemical tests required in the following condition: - Diabetes mellitus-blood & urine glucose, microalbumin, Ketone bodies & glycated hemoglobin-(Club with 3.8 & 3.10) - Dyslipidemia-lipid profile (Club with 4.5 & 4.7)

<ul style="list-style-type: none"> - Nephrotic syndrome, - Edema, - Jaundice, - Liver diseases, pancreatitis, disorders of acid- base balance, thyroid disorders. 	<ul style="list-style-type: none"> - Myocardial infarction –CK, LDH, Troponin (Club with 2.6 & 2.7) - Renal failure & Nephrotic syndrome, -BUN, Creatinine, urinary protein, cholesterol (Club with 3.8 & 3.10) - Gout-serum uric acid, synovial fluid analysis (Club with 6.3 & 6.4) - Liver diseases & jaundice- LFT's (club with 6.1) Pancreatitis-serum amylase and lipase (Club with 2.5 & 7 2.7) - Disorder of acid base balance- ABG analysis for pH, P_O₂, O₂ Saturation pCO₂, HCO₃ & base excess (BE) (Club with 6.7, 6.8) - Thyroid disorder-serum free & total T# & T4 & serum TSH (Club with 6.1)
Competency No.	Topics & Subtopics
<p style="text-align: center;">11.18</p> <p>Discuss the principles of spectrophotometry. (Clubbed with 11.6)</p>	Spectrophotometer- principle & use.
<p style="text-align: center;">11.19</p> <p>Outline the basic principles involved in the functioning of instruments commonly used in a Biochemistry laboratory & their applications. (Clubbed with 11.6 & 11.16)</p>	Instruments commonly used in Biochemistry laboratory & their applications.
<p style="text-align: center;">11.20</p> <p>Identify abnormal constituents in urine, interpret the findings & correlate these with pathological states. (Clubbed with 11.4)</p>	
<p style="text-align: center;">11.21</p> <p>Demonstrate estimation of glucose, creatinine, urea & total protein in serum (Clubbed with 11.7, 11.8)</p>	
<p style="text-align: center;">11.22</p> <p>Calculate albumin: globulin (A/G) ratio & creatinine clearance. (Clubbed with 11.7, 11.8))</p>	

Paper wise distribution of Topics : Paper – I

	Section	Topics	Competency nos. Bl
Paper - I	A	MCQs on all topics of the paper I	
	B and C	Basic Biochemistry	1.1
		Enzymes	2.1-2.7
		Chemistry and metabolism of carbohydrates	3.1-3.10
		Chemistry and metabolism of lipids	4.1-4.7
		Biological oxidation	6.6
		Xenobiotics	7.5
		Antioxidants and defense system	7.6-7.7
		Nutrition	8.1-8.5
		Extra cellular matrix	9.1-9.3
		Oncology, Oncogenesis and immunity	10.1-10.5
		Biomedical waste	11.1
		Physical characteristics and chemical composition of CSF	11.15
		Energy content of lipids, carbohydrates and protein in common food items, Advantages of unsaturated fats. Disadvantages of saturated and trans fats in food	11.23 and 11.24
		AETCOM – 1.4 – Fundamentals of Communication	
For long answer question and scenario based / application questions, topics will not be repeated			

Paper wise distribution of topics : Paper – II

	Section	Topics	Competency nos. Bl	
Paper - II	A	MCQs on all topics of the paper II		
	B and C		Chemistry and metabolism of proteins	5.1 - 5.5
			Integration and starvation	6.1
			Nucleic acid metabolism	6.2-6.4
			Vitamins	6.5
			Water electrolyte balance and acid base balance	6.7
			Blood Gas Analysis	6.8
			Mineral metabolism	6.9 - 6.10
			Hemoglobin chemistry and metabolism	6.11-6.12
			Organ Function Test	6.13-6.15
			Molecular Biology	7.1-7.3
			Genetic Engineering	7.4
			Urine : Screening of inborn errors	11.5
			Principle, application and working of lab equipments / techniques: pH meter, Paper Chromatography of amino acids, Protein electrophoresis, TLC, PAGE, electrolyte analysis by ISE, ABG analyzer, ELISA, Immunodiffusion, Auto analyzer, Quality control, DNA isolation from blood / tissue	11.16 and 11.19
			For long answer question and scenario based / application questions, topics will not be repeated	

4. EVALUATION

Pattern of **Theory question Paper**

Total Marks- 100; Time -3 hours

Question **SECTION "A" MCQ (20 Marks)**

No.

1. Multiple Choice Questions (Total 20 MCQ of One mark (20x1=20) each) (4 MCQ Should be CASE based)
 a) b) c) d) e) f) g) h) i) j)
 k) l) m) n) o) p) q) r) s) t)

SECTION "B" & "C"

SECTION "B" (40 Marks)

2. Short Answer Questions (Any Four out of Five & two SAQs will be Clinical Application Based) (4x5 =20)
 a) b) c) d) e)
3. Long Answer Questions (Any Two out of Three) (2x10=20)
 a) b) c)

SECTION "C" (40 Marks)

4. Short answer questions (Any Four out of Five) (4x5= 20)
 a) b) c) d) e)
5. Long Answer Questions (Any Two out of Three) (2x10 =20)
 a) b) c)

Practical Mark's Structure
Internal Assessment Examinations I & II

Practical					Total
Seat No.	Quantitative Experiment	Quantitative Experiment/Urine Organic / Urine Report / Quality Control / Interpolation of lab Report/ Interpolation of Special Technique	Spots	Journal / Logbook	
	A	B	C	D	E
Max. Marks	15	15	10	10	50

Practical Mark's Structure (Prelim)
Preliminary & University Examination

Seat No.	Case Based Quantitative Estimation	Urine Report / Quantitative Estimation	Spots (Interpretation of Lab Reports, Graphs, Special Techniques, Special Tests, Quality Control, Nutrition, Conceptual Questions, Pictorial Diagrams)	Journal / Logbook	Practical Total	Viva Voce/ Oral	Practical /Viva Total Marks
	A	B	C	D	E	F	G
Max Mark	25	15	20	10	70	15+15	100

Internal Assessment
Biochemistry

Sr. No.	I - Exam			II - Exam		
	Theory	Practical (Including 05 Marks for Journal & Log Book)	Total Marks	Theory	Practical (Including 05 Marks for Journal & Log Book)	Total Marks
1	100	50	150	100	50	150

Sr. No.	Preliminary Examinations		
	III - Exam		
	Theory	Practical Including 10 Marks for Journal & Log Book	Total Marks
1	200	100	300

1. There will be 3 internal assessment examinations in the academic year. The structure of Preliminary examinations should be similar to the structure of University examination.
2. There will be only additional examination for absent students (due to genuine reason) after approval by the Committee Constituted for the same. It should be taken after preliminary examination and before submission of internal assessment marks to the University.
3. First internal assessment examination will be held in December, second internal assessment examination will be held in March and third internal assessment examination will be held in July.
4. Internal assessment marks for theory and practical will be converted to out of 40. Internal assessment marks, after Conversion, should be submitted to university by 7th of August.
5. The student must secure at least 50% marks for total marks (combined in theory and practical / clinical : not less than 40% marks in theory and practical separately) assigned for internal assessment in a particular subject in order to be eligible for appearing at the final university examination of that subject. Internal assessment marks will reflect as separate head of passing at the summative examination.
6. Remedial internal assessment examination for Non – eligible students: Student who were not eligible due to less than 50% combined or less than 40% in any theory or practical, will re appear as repeater student for Prelim exam which will be conducted before Supplementary Exam. His/her internal assessment will be calculated on the basis of this Examination marks only. Students who will not be eligible in this Examination will appear with regular batch as repeater student.
7. The internal assessment marks of the remedial examination alone shall be considered and concerted into out of 40.
8. Conversion Formula for calculation of marks in internal assessment examinations.

	First IA	Second IA	Third IA (Prelim)	Total	Internal Assessment Marks: Conversion formula (out of 40)	Eligibility to appear for final University examination (after conversion out of 40) (40% Separately in Theory and Practical, 50% Combined)	
Theory	100	100	200	400	$\frac{\text{Total marks obtained}}{10}$	16 (minimum)	Total of Theory + Practical <u>Must</u> be 40.
Practical	50	50	100	200	$\frac{\text{Total marks obtained}}{5}$	16 (minimum)	

9. Conversion formula for calculation of marks in Remedial internal assessment examination

	Remedial Exam (Prelim)	Int. Assess. Marks conversion formula (out of 40)	Eligibility to appear for Supplementary Exam. (after conversion out of 40) (40% Separately in Theory and Practical, 50% Combined)	
Theory	200	$\frac{\text{Total marks obtained}}{5}$	16 (minimum)	Total of Theory + Practical <u>Must</u> be 40.
Practical	100	$\frac{\text{Total marks obtained}}{2.5}$	16 (minimum)	

While preparing Final Marks of Internal Assessment, the rounding off marks shall done as illustrated in following table

Internal Assessment Marks	Final rounded marks
15.01 to 15.49	15
15.50 to 15.99	16

**Internal assessment pattern in Community Medicine:
Only one examination in First MBBS, at end of Teaching; Theory- 50 marks and Practical- 50 marks**

RECOMRNDENED TEXT AND REFEREAL BOOKS

1. Microbiology – Topley & Wilson
2. Medical Microbiology – Green wood
3. Essentials of Medical Microbiology – Apurba Sastry
4. Text book of Microbiology – Ananthanarayanan
5. Text book of Microbiology – Baveja
6. Parasitology – Chatterjee
7. Text book of parasitology – Chakraborty
8. Medical parasitology – Rajesh Karyakarte
9. Immunology – Roit
10. Mycology – Jagdish chandar

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