

**STUDY GUIDE
FIRST YEAR
BIOCHEMISTRY**



STUDY GUIDE

BIOCHEMISTRY

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BIOCHEMISTRY DEPARTMENT IN A GLANCE

Biochemistry is the dynamic, exciting science in which chemistry is applied to the study of the atoms and molecules which comprise living organisms. This includes organic molecules and their chemical reactions. It has revolutionized our understanding of and provides a backbone to modern medicine.

Biochemistry Department at AFM&DC has a unique approach to the biochemical sciences that cultivates critical thinking as well as depth of knowledge by exposing its students to the full spectrum of modern biochemistry. The comprehensive teaching and assessment plan is strategically designed according to the UHS and PM&DC syllabi and guidelines to achieve maximum results.

The strength of Biochemistry Department is its conducive environment and committed staff. The vibrant teaching staff is highly qualified with post graduates degrees and certifications along with vast teaching experience. The department's aim is establishment of research culture and encouragement of student participation in it.

Biochemistry department has a well equipped laboratory and is managed by qualified and experienced technical staff. Practical training of the subject has been devised and the focus has been shifted to diagnostic biochemistry, in accordance with the UHS syllabi.

The department follows a proficient and result oriented teaching and assessment plan which includes new and interesting teaching strategies. Learning is made easy by increasing interactive student teacher sessions. Students are evaluated in cognitive, psychomotor and applied domains by conduction of regular formative and summative assessments like multiple choice questions, quizzes, written tests, assignments, presentations and OSPE

and oral viva. At the end of each academic year a university standard send-up examination is conducted.



Biochemistry Department Team- AFMDC

Positions	Name
Head of Department	Prof. Dr. Muhammad Ashraf
Associate Professor	Dr. Saira Saad
Assistant Professor	Dr. Sabeen Khalid
Demonstrators	Dr. Sajjad Ghani
	Dr. Muhammad Jameel
	Dr. Fayyaz
Laboratory Incharge	Miss. Quratulain
Computer operator	Mr. Ramzan
Lecture hall attendant	Mr. Saleem

TIME LINE for SYLABUS COMPLETION
GHANTT CHART of FIRST YEAR LECTURES

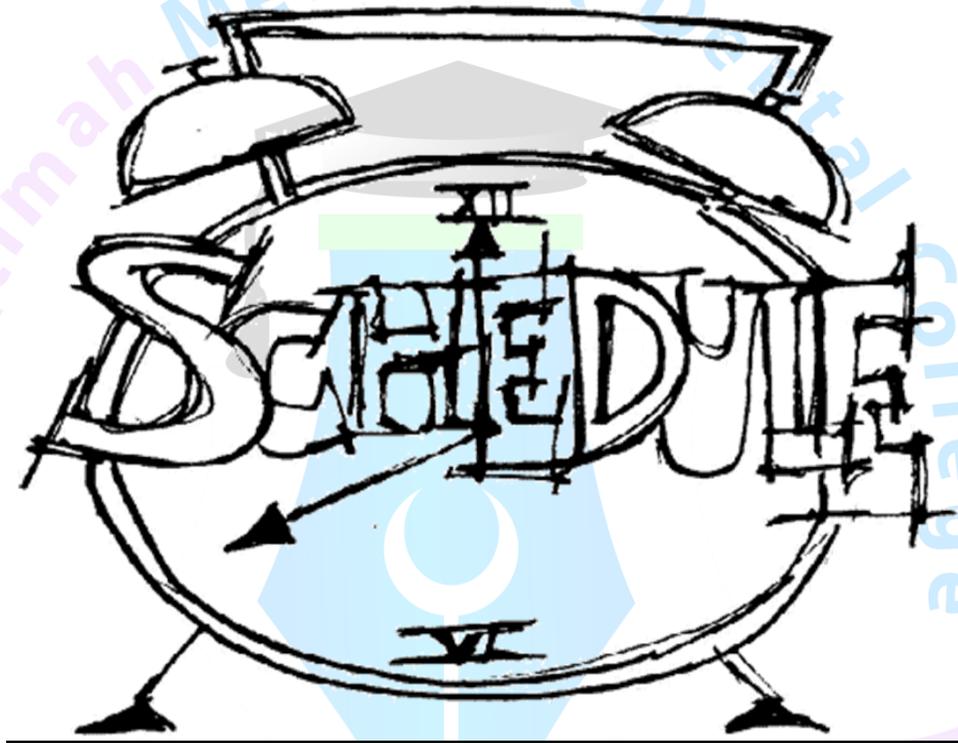
Topic	Dec	Jan	Feb	March	April	May	June	July	Aug	SEP
Water & pH, Electrolytes	█									
Carbohydrate Chemistry		█								
Protein chemistry		█	█							
ECM			█							
Haem, Hb & porphyrias			█	█						
Fat soluble Vitamins				█	█					
Water soluble vitamins					█	█				
Lipid chemistry				█	█					
Enzymes					█	█				
Nucleotide Chemistry						█	█			
Minerals							█			
Cell Signal Transduction								█	█	
Nutrition									█	█

Winter break

Mid session exam

Summer vacations

Sendupexam



TIME TABLE

Date	1	2	3	4	5	6
	08:00-09:00	09:00-10:00	10:00-11:00	11:00-12:45	12:45-13:15	13:15-15:00
Monday	Lec-Bio			Practical		
Tuesday		Lec-Bio		Practical		
Wednesday			Lec-Bio	Tutorial		
Thursday				Tutorial		Practical
Friday	08:00-08:45	08:45-09:30	09:30-10:15	10:15-11:30	11:30-13:00	13:00-15:00
	Lec-Bio			Tutorial		

LEARNING OBJECTIVES OF BIOCHEMISTRY

FIRST YEAR M.B.B.S

TOPIC	SUBTOPICS	LEARNING OBJECTIVES
BASIC ASPECTS		<ul style="list-style-type: none"> Discuss elements of life, atomic and molecular composition of life, functional groups and polarity of molecules.
		<ul style="list-style-type: none"> Identify forces stabilizing biological molecules like salt bridges, disulphide linkages, hydrophobic interactions, hydrogen bonds, van der waals forces.
		<ul style="list-style-type: none"> Discuss special properties of water like hydrogen bonding, solvent properties, specific heat capacity, latent heat of vaporisation, surface tension, metabolic water.
		<ul style="list-style-type: none"> Give an Introduction to macromolecules i.e Carbohydrates, lipids, proteins and nucleic acids. Define common features of polymeric molecules.
WATER AND PH	Water	<ul style="list-style-type: none"> Describe dissociation of water and pH scale, pH of various biological fluids. Derive pH and log values. Define Buffers, titration curve, concept of K_a and pK_a and Isoelectric pH.
	pH	<ul style="list-style-type: none"> Discuss importance of pH for biological systems. Define Bohr effect and Optimum pH of enzymes. Discuss Henderson Hasselbalch equation and its applications.
	Buffers	<ul style="list-style-type: none"> Discuss body buffer systems: bicarbonate, ammonia, phosphate and proteins) and their mechanism of action.
	Techniques	<ul style="list-style-type: none"> Define pH metry, isoelectric focusing, isoelectric pH and protein solubility. Relate pH and drug absorption.
CELL BIOCHEMISTRY	Types	<ul style="list-style-type: none"> Give organization and composition of eukaryotic and prokaryotic cells.
	Cell membrane	<ul style="list-style-type: none"> Explain biochemical composition of cell membrane. Discuss membrane asymmetry, glycocalyx, blood group antigens. Identify importance of cholesterol in membranes.
	Transport across cell membrane	<ul style="list-style-type: none"> Describe diffusion (simple and facilitated), osmosis and osmotic pressure, transport of charged molecules and Gibbs-Donnan

		<p>equilibrium.</p> <ul style="list-style-type: none"> • Outline Pores (aquaporins), channels and carriers.
		<ul style="list-style-type: none"> • Explain active transport (primary and secondary), membrane pumps, cotransport and countertransport.
		<ul style="list-style-type: none"> • Describe phagocytosis, pinocytosis, endocytosis and exocytosis.
	Cell markers	<ul style="list-style-type: none"> • Enlist Cell markers.
	Techniques	<ul style="list-style-type: none"> • Discuss freeze/thaw cycles, homogenization, permeabilization, sonoporation, centrifugation, salting out, chromatography, dialysis, electrophoresis and southern blotting.
		<ul style="list-style-type: none"> • Discuss ELISA, X-ray crystallography, NMR spectroscopy and mass spectrometry.
	Clinical module	<ul style="list-style-type: none"> • Discuss lysosomal storage disorders (mucopolysaccharidoses and sphingolipidoses), disorders of golgi apparatus (I-cell disease), mitochondrial disorders (mitochondrial encephalopathy lactic acidosis and stroke MELAS, Leber's hereditary optic neuropathy LHON), peroxisomal disorders (zellweger syndrome, adrenoleukodystrophy ALD).
SIGNAL TRANSDUCTION	Types	<ul style="list-style-type: none"> • Discuss types of signals. • Define gap junctions, autocrine, paracrine and endocrine signals.
	Receptors	<ul style="list-style-type: none"> • Enlist various types of receptors. • Explain ligand gated ion channels, G-protein coupled receptors, Catalytic receptors and intracellular receptors. • Discuss receptor tyrosine kinases. • Classify G-proteins.
	Second messengers	<ul style="list-style-type: none"> • Elaborate Adenylyl cyclase and cAMP cascade.
		<ul style="list-style-type: none"> • Explain Phospholipase and IP3, DAG cascade. • Discuss calcium calmodulin cascade.
		<ul style="list-style-type: none"> • Describe paroxysmal nocturnal hemoglobinuria, hereditary spherocytosis, cystic fibrosis, methicillin resistant staphylococcus aureus (MRSA), metastasis (loss of cellular polarization and membrane asymmetry), Cholera toxin, pertussis toxin, liposome drug delivery system, drugs affecting cell membrane (nitrates, polymyxin B sulfate, gramicidin).
CHEMISTRY OF	Amino acids	<ul style="list-style-type: none"> • Discuss structure, characteristics and

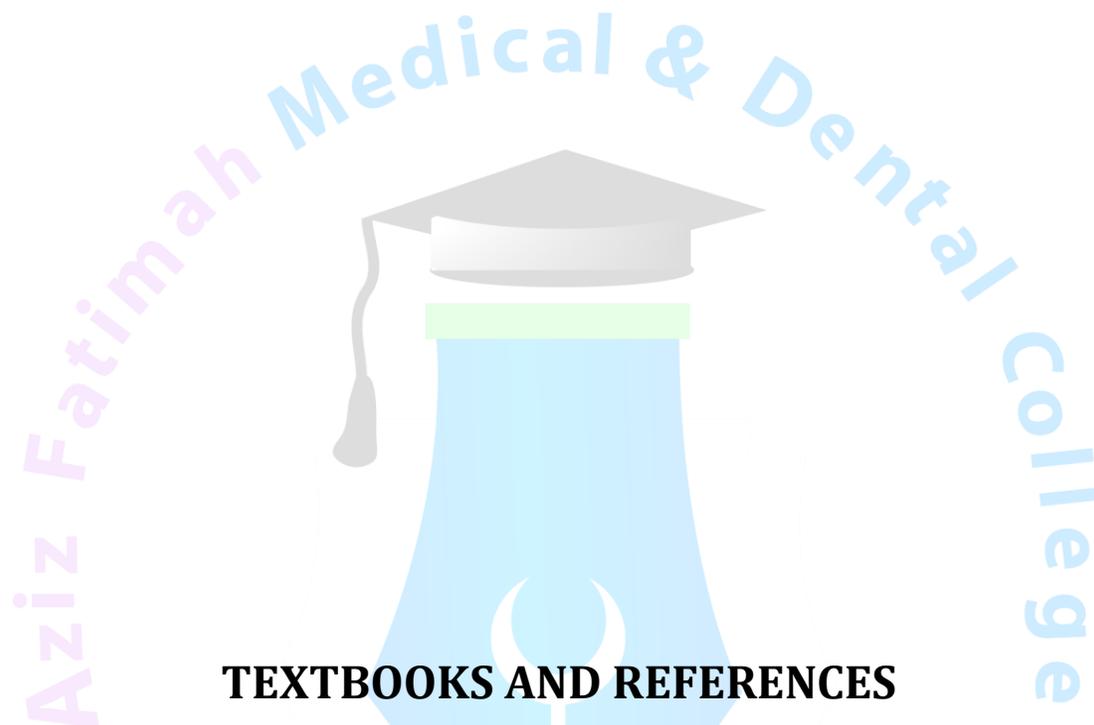
AMINO ACIDS AND PROTEINS		<p>classification of amino acids based on R group, polarity, and nutritional value.</p> <ul style="list-style-type: none"> • Identify the properties of carboxylic acid and amino groups. • Identify role of glycine and glutamate as neurotransmitters. • Elaborate the role of histidine in gastric acid production and allergic response. • Discuss amino acids as buffers. • Define titration curve, monoprotic, diprotic and triprotic acids.
	Peptide bond	<ul style="list-style-type: none"> • Outline properties of peptide bond. • Discuss biologically active peptides like Carnosine, anserine, glutathione, bradykinin, kallidin, angiotensin, oxytocin, vasopressin, enkephalin etc.
	Protein separation techniques	<ul style="list-style-type: none"> • Chromatography (adsorption, partition, gel filtration, ion-exchange), electrophoresis and isoelectric focusing.
	Proteins	<ul style="list-style-type: none"> • Discuss composition, functions and classification of proteins. • Highlight primary structure of proteins.
		<ul style="list-style-type: none"> • Describe secondary, tertiary, quaternary and quinary structure of proteins.
	Immunoglobulins	<ul style="list-style-type: none"> • Discuss structure, types and biomedical significance of immunoglobulins.
	Plasma proteins	<ul style="list-style-type: none"> • Discuss structure, types and biomedical significance of plasma proteins. • Discuss alpha1 antitrypsin deficiency.
	Protein misfolding	<ul style="list-style-type: none"> • Discuss Charcot Marie Tooth disease CMT, transmissible spongiform encephalopathy TSE/Creutzfeldt-Jakob disease and Alzheimers. • Describe Beta amyloid and tau protein.
PORPHYRINS AND HEME PROTEINS	Heme	<ul style="list-style-type: none"> • Enlist Heme proteins. • Describe biosynthesis of heme.
	Hemoglobin	<ul style="list-style-type: none"> • Discuss structure of myoglobin. • Describe structure and types of hemoglobin. • Explain oxygen binding of myoglobin and hemoglobin (oxygen dissociation curves for both). • Enlist factors affecting and regulating the oxygen-binding capacity of hemoglobin.
	Hemoglobinop	<ul style="list-style-type: none"> • Discuss methemoglobin and

	anemias	methemoglobinemias, sickle cell anemia/hemoglobin S disease, hemoglobin C disease, hemoglobin SC disease and thalassemias.
	Heme degradation	<ul style="list-style-type: none"> Describe degradation of heme along with synthesis, hepatic uptake, conjugation and excretion of bilirubin. Identify fate of bilirubin in intestine.
	Jaundice	<ul style="list-style-type: none"> Discuss causes of hyperbilirubinemias along with the acquired and congenital disorders. Describe Jaundice and Kernicterus.
CHEMISTRY OF LIPIDS		<ul style="list-style-type: none"> Classify lipids and give their general biological functions.
	Fatty acids	<ul style="list-style-type: none"> Explain structure and importance of fatty acids, unsaturated fatty acids, their properties and significance. Describe isomerism in fatty acids. Highlight importance of $\Omega 3$, $\Omega 6$ fatty acids, trans fats and nutritionally essential fatty acids. Discuss the physical and chemical properties of fatty acids.
	TAGs	<ul style="list-style-type: none"> Describe the structure, properties and significance of triacylglycerols.
	Compound lipids	<ul style="list-style-type: none"> Discuss structure, properties and significance of phospholipids. Describe lung surfactant, platelet activating factor and cardiolipin. Identify enzymes involved in degradation of phospholipids.
		<ul style="list-style-type: none"> Enlist types of glycolipids along with their significance and degradation.
	Eicosanoids	<ul style="list-style-type: none"> Discuss origin, half life, potency, functions and clinical significance of prostaglandins, thromboxanes and leukotrienes.
	Cholesterol	<ul style="list-style-type: none"> Describe the role and properties of cholesterol and its related compounds (bile acids).
	Lipid peroxidation	<ul style="list-style-type: none"> Describe lipid peroxidation and its significance. Enlist natural and synthetic antioxidants and their mechanism of action.
	Clinical diseases	<ul style="list-style-type: none"> Discuss leukodystrophies and sphingolipidoses. Discuss role of Aspirin in prevention of myocardial infarction. Elaborate the role of Leukotriene receptor antagonists in asthma.
	CHEMISTRY OF	

CARBOHYDRATES		<ul style="list-style-type: none"> • Discuss isomerism in monosaccharides.
		<ul style="list-style-type: none"> • Discuss chemical and physical properties of carbohydrates.
		<ul style="list-style-type: none"> • Discuss monosaccharides of biochemical importance.
		<ul style="list-style-type: none"> • Discuss disaccharides of biochemical importance.
		<ul style="list-style-type: none"> • Discuss oligosaccharides of biochemical importance.
		<ul style="list-style-type: none"> • Discuss homopolysaccharides of biochemical importance.
		<ul style="list-style-type: none"> • Discuss heteropolysaccharides of biochemical importance.
ENZYMES	Introduction	<ul style="list-style-type: none"> • Classify enzymes. • Discuss properties of enzymes.
	MOA	<ul style="list-style-type: none"> • Discuss mechanism of enzyme action.
		<ul style="list-style-type: none"> • Describe the factors affecting reaction rate.
		<ul style="list-style-type: none"> • Discuss Michealis –Menten and Lineweaver Burk plot and equation.
	Inhibition	<ul style="list-style-type: none"> • Identify various types of enzyme inhibition.
	Regulation	<ul style="list-style-type: none"> • Describe regulation of enzyme activity
	Iso enzymes	<ul style="list-style-type: none"> • Discuss isoenzymes and their clinical significance.
VITAMINS	Introduction	<ul style="list-style-type: none"> • Give definition, classification and requirement for humans of various vitamins. • Enlist factors affecting the vitamin content of food.
	Water soluble vitamins	<ul style="list-style-type: none"> • Discuss important dietary sources, RDA, intestinal absorption, transport, storage and diseases associated with water soluble vitamins
	Fat soluble vitamins	<ul style="list-style-type: none"> • Discuss important dietary sources, RDA, intestinal absorption, transport, storage and diseases associated with fat soluble vitamins.
MINERALS		<ul style="list-style-type: none"> • Give introduction to minerals and trace elements. • Discuss Calcium and phosphorus metabolism. • Discuss Phosphorus, magnesium and sulfur. • Discuss Sodium, potassium and chloride. • Discuss Iron metabolism. • Discuss Iodine and copper.
		<ul style="list-style-type: none"> • Discuss Zinc, selenium, chromium, cadmium, manganese, and fluoride.
	Diseases	<ul style="list-style-type: none"> • Describe Iron deficiency anemia, hemochromatosis, Wilson disease, tetany, hypercalcemia.

		<ul style="list-style-type: none"> • Highlight Iodine deficiency and goiter. • Describe muscle weakness, neurologic defects and abnormal collagen in copper deficiency. • Discuss Cardiomyopathy (Keshan disease) in selenium deficiency. • Identify growth retardation and impaired wound healing in Zinc deficiency.
NUCLEOTIDES AND NUCLEIC ACIDS		<ul style="list-style-type: none"> • Discuss chemistry of purines and pyrimidines. • Explain structure, function and types of DNA along with packaging of DNA.
		<ul style="list-style-type: none"> • Discuss structure, function and types of RNA.
		<ul style="list-style-type: none"> • Outline the biomedical significance of Purine and pyrimidine analogs as drugs.
NUTRITION		<ul style="list-style-type: none"> • Discuss balanced diet. • Define dietary reference intakes, acceptable macronutrient distribution ranges, EAR, RDA, AI and UL.
		<ul style="list-style-type: none"> • Discuss energy metabolism • Define and discuss metabolic rate , factors affecting metabolic rate and basal metabolic rate BMR. • Calculate caloric requirement of a person.
		<ul style="list-style-type: none"> • Explain biomedical significance of proteins in nutrition.
		<ul style="list-style-type: none"> • Identify biomedical significance of lipids in nutrition.
		<ul style="list-style-type: none"> • Discuss biomedical significance of carbohydrates in nutrition.
		<ul style="list-style-type: none"> • Enlist the nutritional requirements in pregnancy, lactation, infancy and old age.
		<ul style="list-style-type: none"> • Explain obesity and metabolic syndrome.
	Clinical correlations	<ul style="list-style-type: none"> • Discuss Protein energy malnutrition (Marasmus and Kwashiorkor). • Describe the effects of deficiency of essential fatty acids, anorexia nervosa and bulimia nervosa. • Explain how hemorrhoids, chronic constipation and diverticular disease of colon is caused due to low fiber diet.
EXTRACELLULAR MATRIX (ECM)	Collagen	<ul style="list-style-type: none"> • Discuss composition and functions of ECM • Describe structure, biosynthesis and degradation of collagen.
	Elastin	<ul style="list-style-type: none"> • Describe structure, biosynthesis and degradation of elastin. • Identify role of alpha-1 antitrypsin in elastin

		<p>degradation.</p> <ul style="list-style-type: none"> • Give major biochemical differences between collagen and elastin.
		<ul style="list-style-type: none"> • Describe structure, biosynthesis and degradation of Fibrillin-1, Fibronectin and Laminin.
	GAGs	<ul style="list-style-type: none"> • Discuss structure, classification, functions and distribution of glycosaminoglycans and proteoglycans.
	Clinical correlations	<ul style="list-style-type: none"> • Discuss Luekocyte adhesion deficiency LAD II, Collagenopathies (Ehlers Danloa syndrome and osteogenesis imperfect) and Mucopolysaccharidoses.
Laboratory Experiments	Lab equipment	<ul style="list-style-type: none"> • Introdouction to use of laboratory facailities / equipment including safety measures
	Solutions	<ul style="list-style-type: none"> • Prepare solutions (molar and normal) from various kinds of laboratory chemicals (solid and liquids) • Preparation of various kinds of buffer solution; • c)Basic methods of laboratory calculations;
		<ul style="list-style-type: none"> • Introduction and conversion of conventional and SI measuring units.
	Buffers	<ul style="list-style-type: none"> • Demonstration of buffer action, and determination of pH (by using indicators and pH meter).
	Carbohydrates	<ul style="list-style-type: none"> • Qualitative analysis of carbohydrates and proteins. • Tests to detect monosaccharides of biomedical significance like glucose fructose and galactose. (Benedict's test, salivanoff's test, Osazoone test)
	Proteins	<ul style="list-style-type: none"> • Tests to detect proteins / peptides / amino acids (Heat coagulation test, sulphoslyclic acid test, Heller's Ring test, and Ninhydrin test)
	Urine	<ul style="list-style-type: none"> • Collection and storage of urine samples for laboratory analysis, and physical and chemical analysis of urine to detect normal and abnormal constituents.
		<ul style="list-style-type: none"> • Writing a urine report and interpretation of urine analysis.



TEXTBOOKS AND REFERENCES

- Champe, P.C. & Harvey, E.A. (2017). Biochemistry (Lippincott's Illustrated Reviews), 7nd edition. J.B Lippincort Co.
- Harper's Biochemistry - 30th Ed
- Texbook of medical Biochemistry by MN Chatterjea - 8th Ed
- Biochemistry by Stryer - 7th Ed
- Marks, D.B., Marks, A.D. & Smith, C.M. (2005). Basic Medical Biochemistry: A Clinical Approach. 2nd edition. Williams and Wilkins Co.: Baltimore.
- Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell. (2005). Harper's Biochemistry. 26th edition. McGraw-Hill

Aziz Fatimah Medical & Dental College



TABLE OF SPECIFICATIONS FOR BIOCHEMISTRY

THEORY PAPER FIRST PROFESSIONAL

CONTENTS		SEQs	MCQs
1.	Biochemistry of the cell, cell membrane & membrane phenomena. Water, pH & buffers.	0.5	3
2.	Extracellular matrix	0.5	2
3.	Chemistry of Carbohydrates	1.0	4
4.	Chemistry of Lipids	1.0	5
5.	Chemistry of Proteins and Amino Acids; Plasma proteins including immunoglobulins	1.0	6
6.	Chemistry of Nucleotide and nucleic acids	0.5	3
7.	Enzymes	1.0	5
8.	Vitamins	1.5	7
9.	Nutrition	0.5	2
10.	Minerals & trace elements	0.5	4
11.	Heme metabolism, porphyrins, porphyrias, jaundice, hemoglobin & Myoglobin, hemoglobinopathies.	1.0	4
TOTAL ITEMS		09 SEQs	45 MCQs
TOTAL MARKS		45 Marks	45 Marks

25% of MCQs and SEQs should be clinically oriented or problem- based.

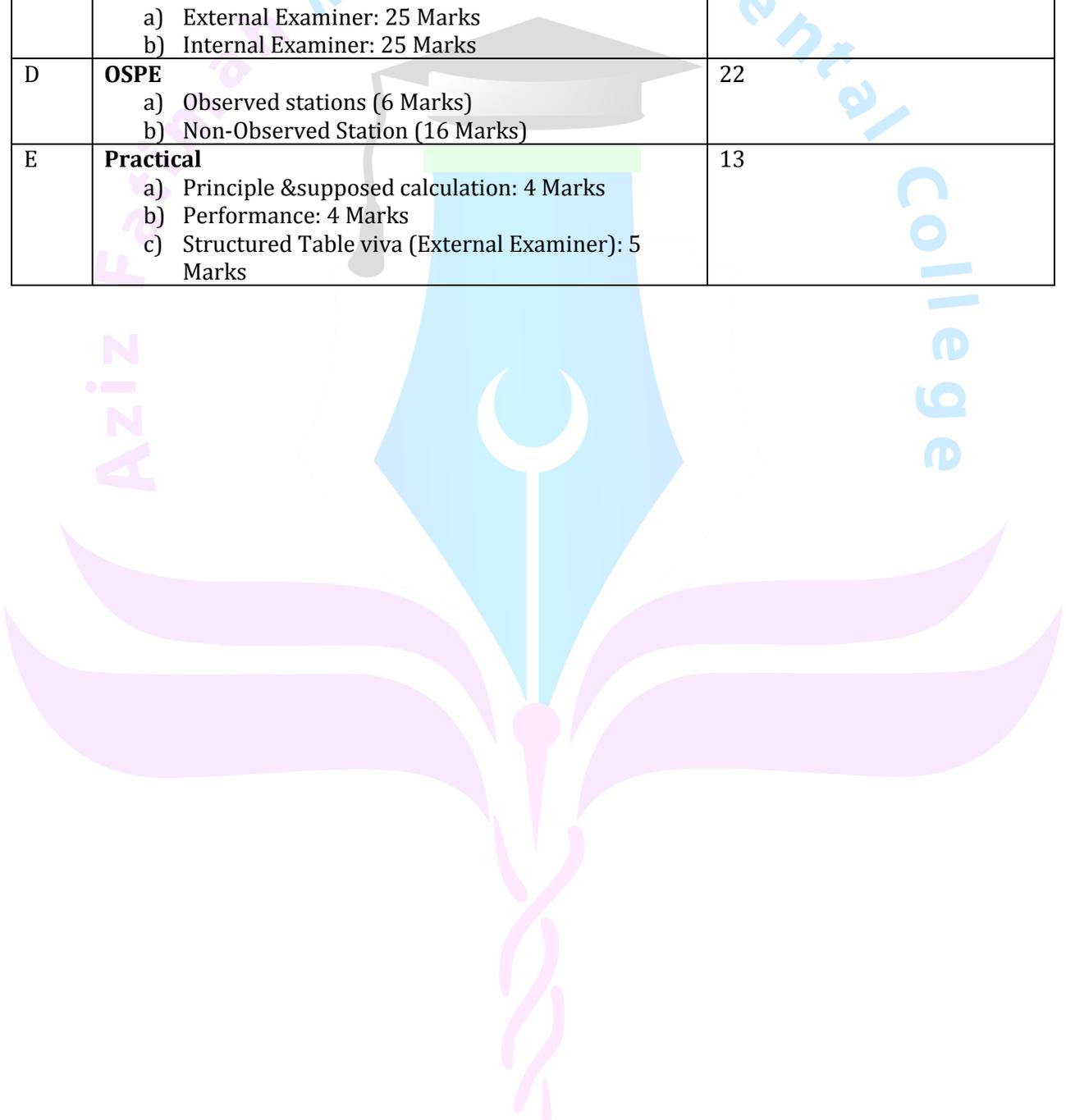
10% marks are allocated for 'Internal Assessment'

Total marks for theory paper: SEQ+ MCQ + Internal Assessment = 45 +45+10=100 Marks

ORAL AND PRACTICAL EXAMINATION FIRST PROFESSIONAL

Oral and practical examination carries 100 marks.

EXAMINATION COMPONENT		MARKS
A	Internal Assessment	10
B	Practical notebook manual (Internal Examiner)	05
C	Viva voce a) External Examiner: 25 Marks b) Internal Examiner: 25 Marks	50
D	OSPE a) Observed stations (6 Marks) b) Non-Observed Station (16 Marks)	22
E	Practical a) Principle & supposed calculation: 4 Marks b) Performance: 4 Marks c) Structured Table viva (External Examiner): 5 Marks	13



Thank You

Medical & Dental College

Aziz Fatima

College

