



**MBBS
Year-II
2023**

STUDY GUIDE

**National University of Medical Sciences
Pakistan**

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1.VISION/MISSION STATEMENTS

Vision statement:

To ensure the development and sustenance of internationally acclaimed quality standards and practices for NUMS Higher Education that benefits and lives up to the stakeholders as needs and expectations.

Mission statement:

To provide an excellent learning and teaching environment, inculcating ethical values and social responsibilities in under-graduate and post-graduate medical and dental students and nursing and allied health sciences students to enhance the level of comprehensive health care in the Army/Country.

2.GUIDELINES AND INTRODUCTION

Department of Biochemistry

Introduction:

Biochemistry is the mainstay of modern medicine and advances in biochemistry have revolutionized our understanding of life. Biochemistry department at CMH Lahore Medical College & Institute of Dentistry excels in imparting clinically relevant knowledge of biochemistry to future medical doctors and allied health specialists. A highly qualified, well trained and proficient team of senior and junior faculty members is geared to take up the challenging academic assignments and student participation is actively encouraged to enhance productivity. The department is currently imparting undergraduate education in MBBS, BDS, Nursing, MIT and DPT programs. The department is also approved by CPSP for postgraduate FCPS training in Biochemistry. The department is fully equipped with teaching aids and laboratory facilities, and follows an efficient teaching methodology which includes interactive formal lectures, tutorials, flipped classroom, small group discussions and practical classes. Hand-on training in diagnostic biochemistry (renal function tests, liver function tests, cardiac profile, blood glucose, bone markers and urinalysis) is also provided to students. A comprehensive modular schedule forms the basis of academic teaching and performance evaluation, and provides rigorous examination drill to the students.

Career counseling and research orientation are also given to every new batch of incoming students. Students are encouraged to take up research projects. Establishment of research on firm grounds is a departmental priority and excellent progress is being made in this matter. The department is successfully running continuous professional development programs including Journal Club, Faculty Skills Enhancement (FSE) and Train & Share Initiative (TSI) to augment the learning of the faculty members and students in order to achieve excellence at the individual, departmental and organizational levels. The 'Faculty Skills Enhancement' (FSE) workshops are regularly organized by the department of Biochemistry under the auspices of School of Health Professions Education (SHaPE). The workshops are conducted by eminent external facilitators for and are open for participation by all institutional faculty members. The 'Train & Share Initiative' (TSI) is an intradepartmental program of the Biochemistry department that has been set up recently with an aim to develop a continuous cycle of learning, sharing and

improvement. Regular bimonthly journal club meetings are held for the development of research skills including but not limited to critical appraisal, research methodology, manuscript writing and research dissemination, improvement of existing research practices and formulation of future research ideas. Extracurricular activities are also a key part of the departmental philosophy and faculty members are actively engaged in CMH Life line Society, Character Building Society, Indoor games Society to name a few. Biochem News & Views is a monthly digital newsletter launched recently to inform about the curricular and co-curricular activities taking place in the department.

The department is headed by Prof. Dr. Syed Imran Ali Shah who did his medical graduation from the top-ranking King Edward Medical University and then did MPhil in Medical Biochemistry from University of Health Sciences. He then went on to complete his PhD from the prestigious Imperial College London. He has over 16 years of experience in medical teaching and health sciences research. He holds several local and international certifications, accreditations and memberships. He has been awarded international honors for his accomplishments, including participation in Nobel Laureates Meeting (Germany), Research internship (Japan), Commonwealth scholarship (UK) and Royal reception by Queen Elizabeth II to name a few. Prof. Shah has published 100+ papers in renowned medical and allied health journals and presented his work at leading conferences in the USA and Europe. He has also co-authored books on medical biochemistry.

GUIDELINES

a. Preamble

Integration has been accepted as an important educational strategy in medical education. NUMS believes in continuous curriculum revision through regular reviews and feedback of stakeholders. This curriculum is updated as per recently revised standards of Pakistan Medical Commission (PMC) which sets Correlation as a minimum level of integration in MBBS. This curriculum is outcome based, patient centered, community relevant, promotes health and prevents disease. It has been revised by the faculty of basic and clinical sciences from constituent/affiliated colleges in collaboration with NUMS Academic Directorate and NUMS department of Health Professions Education.

b. Curricular organization and structure

- 1) NUMS MBBS curriculum will be delivered in a System Based Modular Format in the first three years and through clinical rotations/clerkships in years IV & V.
- 2) System based modules will link basic science knowledge to clinical problems. Students will be taught in an integrated manner so that subjects shall be presented as a meaningful whole. Students will have better understanding of basic sciences when they repeatedly learn in relation to clinical examples.
- 3) There will be three blocks, each will have modules, duration of which depends upon the number and complexity of the objectives to be achieved in that module.
- 4) The curriculum will be delivered by modular teams of multidisciplinary basic science faculty and relevant clinical faculty. The planning and delivery will be coordinated by year coordinators who will guide module coordinators of their respective years for efficient implementation
- 5) The syllabus will be integrated horizontally around systems of the body in which Anatomy, Physiology and Biochemistry will be taught with clinical relevance. Additional chunks of content will be added in a module that exactly does not fit in the central theme of the module.
- 6) Longitudinal themes (Behavioral Sciences and Research Methodology & EBM) are an integral part of year I & II

- 7) Islamiat and Pakistan Studies are compulsory subjects taught throughout the year in first and second year respectively
- 8) Apart from attending daily scheduled sessions, students should engage in self-directed learning to achieve the desired objectives
- 9) Professional Exams are discipline based. In first Prof, Anatomy, Physiology and Biochemistry and in second prof, Anatomy, Physiology, Biochemistry and Islamiat/Pakistan Studies will be assessed

c. Curriculum perspective

NUMS curriculum is evolved taking into consideration Constructivist and behaviorist with some element of Cognitivist approach. It allows students to construct their own knowledge based on what they already know and to use that knowledge in purposeful activities requiring decision making, problem solving, and judgments.

d. Level of integration: Correlation i.e level 7 of Harden's level of Integration. The emphasis remains on disciplines or subjects with subject-based courses taking up most of the curriculum time. Within this framework, an integrated teaching session or course is introduced in addition to the subject-based teaching. This session brings together areas of interest common to each of the subjects. Though the teaching is discipline based, topics are correlated and taught with clinical context for better understanding and application of concepts.

e. Competencies The focus of this curriculum is on the roles of a general physician as identified by PMC. These are skillful, knowledgeable, community health promoter, critical thinker, professional and role model, researcher and leader. Competencies focused in year I and II are: -

- 1) Medical Knowledge
- 2) Procedural skills
- 3) Problem solving

- 4) Communication skills
- 5) Professionalism
- 6) Research

f. Outcomes

By the end of years I & II, students should be able to:

- 1) Correlate the developmental and anatomical knowledge of different organ systems of human body to their physiological and biochemical basis.
- 2) Comprehend the significance of behavioural sciences for medical students
- 3) Analyze multiple perspectives of Islamic studies or ethics and Pakistan studies
- 4) Discuss the basic principles of research

g. Academic Calendar Year II

BLOCKS	BLOCK-IV 12+1=13 weeks			BLOCK-V 08 +1=09weeks		BLOCK-VI 11+1=12 weeks		
Duration	05 Weeks	07 Weeks	1 Wk	08 Weeks	1 Wk	06 weeks	05 Weeks	1 Wk
MODULES	Digestive System & Metabolism	Genitourinary System	EOB	Neurosciences	EOB	Maxillofacial & Special Senses	Endocrinology	EOB
Disciplines	Anatomy, Physiology, Biochemistry, relevant clinical disciplines							
Across the year	Behavioral Sciences, Research Methodology and Pakistan Studies							

h. Proposed Contact Hours Distribution Year-II

SUBJECTS	FIRST YEAR
Anatomy <ul style="list-style-type: none"> • Embryology • Histology • Gross Anatomy • General Anatomy 	250
Physiology	225
Biochemistry	150
Medicine & Allied	30
Surgery & Allied	30

Behavioral Sciences	30
Research Methodology	10
Pakistan Studies	25
Self-Directed Learning	100
Co-curricular activities	50
TOTAL HOURS	900

i. Educational Strategies (These are proposed, but institutes can use other evidence-based teaching methodologies that suit their context)

- 1) Interactive Lectures
- 2) Small group discussion
- 3) Lab practical
- 4) Skill lab
- 5) Problem based learning/ Case based learning
- 6) Tutorials
- 7) Integrated sessions using any of the above strategies
- 8) Self-directed learning (SDL) and directed self-learning(DSL)

j. Resources. To be filled in by the institute

- a. Faculty
- b. Facilities
- c. Administration for Course
- d. Administrative structure
- e. Communication with students

k. Internal Assessment

Formative assessment (low stake) is at faculty discretion like mid module test and other class tests. There will be three end of blocks and one pre-annual examination in year I, which contributes towards the weighting of internal assessment i.e 20% in first professional MBBS Examination.

l. Annual Professional Examination.

The University will take the first professional Examination as per PMC guidelines at the end of the academic year. Annual Theory & Practical Examination will be of 200 marks for Anatomy, Physiology and Biochemistry and 50 marks theory paper each of Islamiat and Pakistan Studies. The passing score is 50% in theory and practical separately.

m. Evaluation of the Course. To be filled in by the institute.

- a. Student portfolio shall be maintained in the departments in which students will give their feedback either by name or anonymously. Feedback may be taken at the end of module, online and informal student feedback during the running module
- b. Faculty suggestions if any, for improvement of training may be incorporated in the next rotation

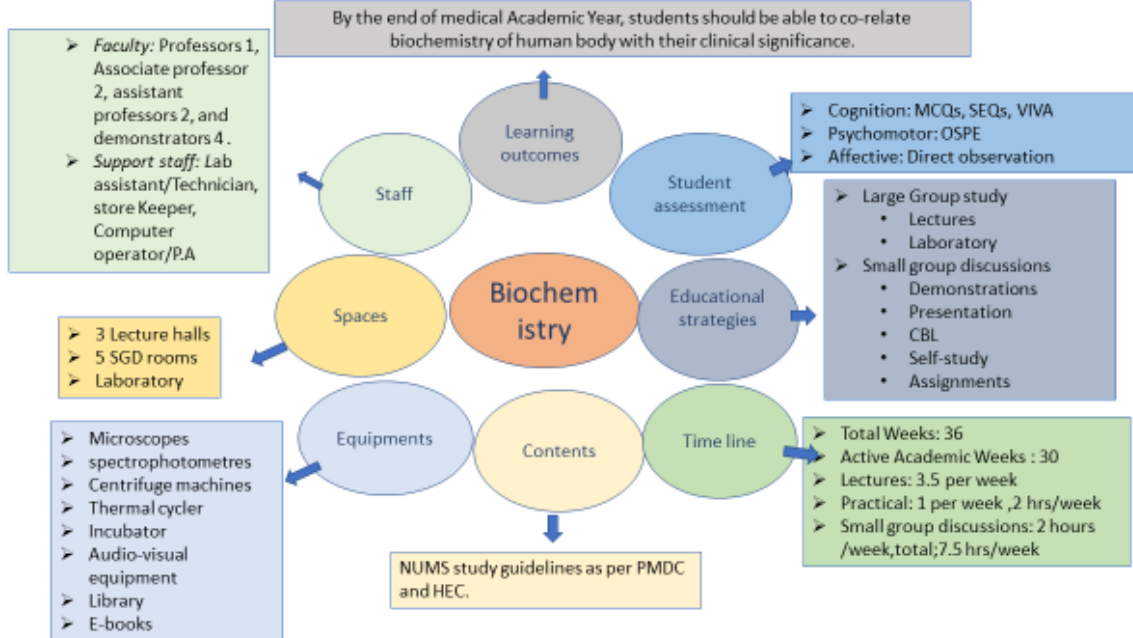
n. Implementation of curriculum

*The university will give details of all content including learning outcomes, assessment blueprints, and table of specifications, distribution of which across the whole years and rotations is upon the discretion of the medical college/institute

3.CURRICULUM MAP

CURRICULUM MAP OF BIOCHEMISTRY DEPARTMENT

Curriculum Map Biochemistry Department (MBBS)

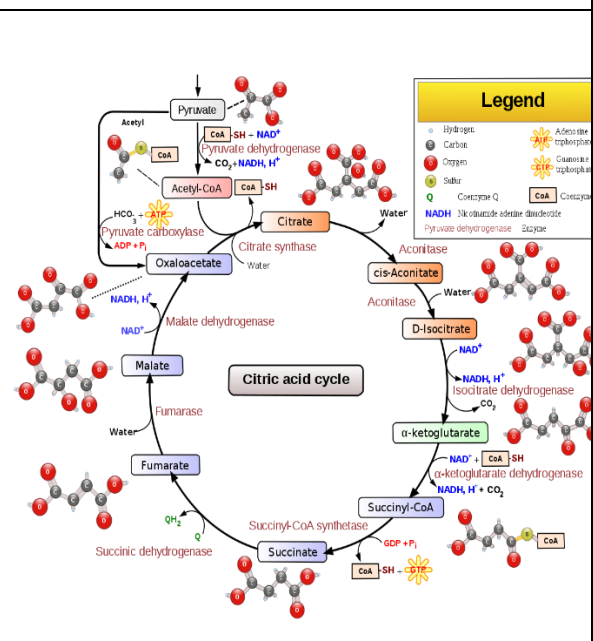
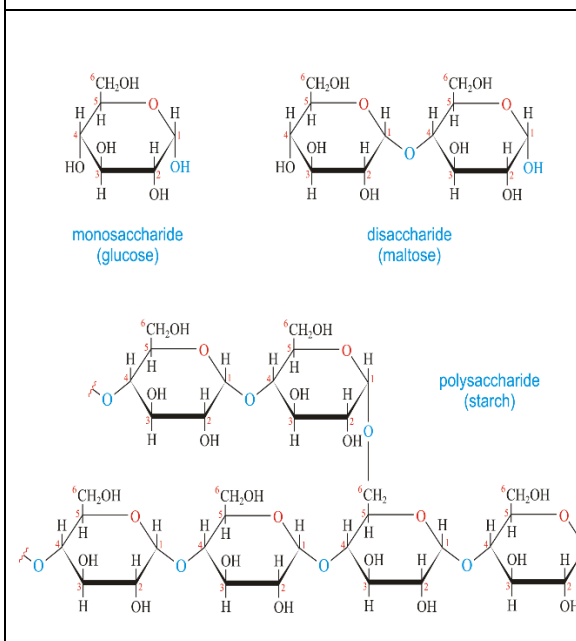
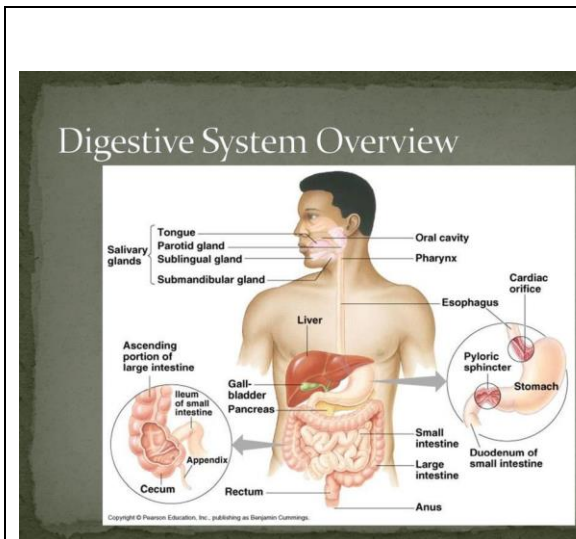


BLOCK-IV MODULES

MODULE NO.	MODULE TOPICS
8.	Digestive System & Metabolism
9.	Genitourinary System

BLOCK IV

MODULE 8: Digestive System and Metabolism (5 weeks) (GIT, Nutrition, Carbohydrate Chemistry and Metabolism, Integration)



BIOCHEMISTRY					
S.No	Topic/ Theme	Learning Outcomes	Learning Objective/ Course Content	Instructional Strategies	Assessment Tool
1.	Biochemistry of Digestive Tract	Relate the biochemical knowledge of Gastrointestinal secretions to relevant disorders	<ul style="list-style-type: none"> Describe the composition, functions, daily secretion, stimulants and depressants of Saliva Gastric Juice, HCl Pancreatic Juice, Bile juice & Succus entericus, GIT hormones (gastrin, secretin, CCK) Discuss the digestion and absorption of Carbohydrates, Proteins, Lipids & Nucleic acids in human body Describe the biochemical disorders of GIT, e.g. achlorhydria, peptic ulcers, lactose intolerance, cholelithiasis and related disorders 	Lectures/SGD	MCQ SAQ/SEQ
2.	Nutrition	<ul style="list-style-type: none"> Appraise the nutritional requirements of each food constituent for better understanding of relevant disorders Outline nutritional requirement in different 	<ul style="list-style-type: none"> Give the caloric requirements of the human body Define Balanced Diet and elaborate various DRIs (EAR, DA, AI, UL), AMDR Explain the nutritional requirements in Pregnancy, Lactation, new-born and nutritional disorders, hypertension, 	<ul style="list-style-type: none"> LECTURES RES SGD PBL CBL 	<ul style="list-style-type: none"> MCQ SAQ/SEQ

		<p>commonly occurring disorders</p> <p>Review hazards of under and over nutrition</p>	<p>diabetes, cirrhosis, end stage renal disease</p> <ul style="list-style-type: none"> • Describe Protein turnover, amino acid Pool, Nitrogen Balance, BMR, BMI, Respiratory quotient, Protein Quality and Glycemic Index. • Describe the nutritional requirement and biomedical importance of CHO, lipid & protein in human body • Define Malnutrition. Discuss Protein Energy Malnutrition in particular • Compare and contrast between Marasmus and Kwashiorkor 		
3.	Carbohydrate Chemistry	Analyze the significance of different carbohydrates in medicine	<ul style="list-style-type: none"> • Classify Carbohydrates and explain their Biochemical functions • Discuss the structure and functions of Monosaccharides and enumerate their various derivatives • Explain the structure and functions of Disaccharides with examples • Describe Oligosaccharides and their combination with other macromolecules • Enumerate important 	<ul style="list-style-type: none"> • Lectures/ • SGD 	<ul style="list-style-type: none"> • MCQ • SAQ/SEQ


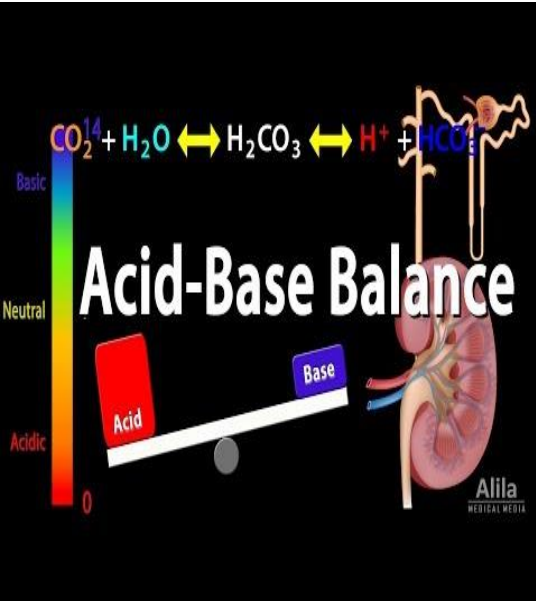
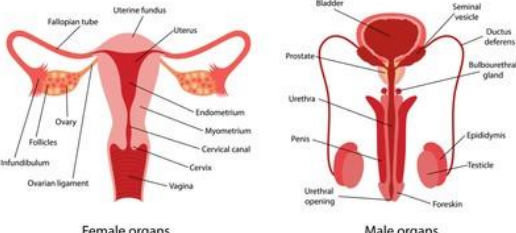
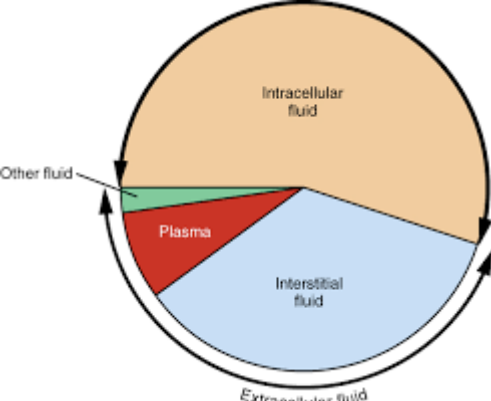
			examples of Polysaccharides and give their biochemical role		
4.	Metabolism of Carbohydrates	Apply the knowledge of carbohydrate metabolism for understanding relevant metabolic disorders	<ul style="list-style-type: none"> • Outline the Phases reactions of Glycolysis and regulation of Glycolysis • Describe the bioenergetics of Aerobic and Anaerobic glycolysis and their biochemical importance • Discuss fate of Lactic acid & Pyruvate • Draw Cori's cycle • Outline the Citric Acid Cycle-Reactions • Describe the energetics, regulation, importance and amphibolic nature of citric acid cycle. • Discuss Gluconeogenesis & state the three important bypass reactions & significance of gluconeogenesis • Compare and contrast Glycolysis & gluconeogenesis • Discuss the Glycogen Metabolism & Write down the reactions of Glycogenesis and glycogenolysis. • Outline the importance of UDP-Glucose & regulation of Glycogen 	<ul style="list-style-type: none"> • Lectures/ • SGD 	<ul style="list-style-type: none"> • MCQ • SAQ/SEQ

			<p>metabolism</p> <ul style="list-style-type: none"> • Describe the disorders of Glycogen metabolism (Glycogen Storage Diseases) • Compare and contrast Glycogenesis and glycogenolysis • Describe Hexose Mono Phosphate Shunt, its reactions and importance • Explain Glucuronic acid pathway, its reactions and importance • Describe the metabolism of Fructose, Galactose and Lactose 		
5.	Integration and regulation of Metabolic Pathways in Different Tissues- Metabolism	Compare the role of different body organs in integration of metabolism in health and disease	<ul style="list-style-type: none"> • Discuss regulatory effects of Insulin and Glucagon on CHO metabolism. • Describe the regulation of Blood Glucose in human body • Explain Hyperglycemia, hypoglycemia and their regulating factors • Describe the Diabetes Mellitus, its Laboratory findings, Diagnosis and biochemical complications • Describe Feed fast cycle and explain its adaptation by different tissues to 	<ul style="list-style-type: none"> • LECTURE • RES • SGD • PBL • CBL 	<ul style="list-style-type: none"> • MCQ • SAQ/SEQ

			<p>changing energy conditions of the body</p> <ul style="list-style-type: none"> • Describe the Integration and regulation of Metabolic Pathways in Different Tissues 		
	Practicals	Perform and interpret the results	<ul style="list-style-type: none"> • Estimation and clinical interpretation of Glucose in blood • Estimation and clinical interpretation of plasma enzyme Amylase • Experiments on Carbohydrates qualitative analysis-I • Molisch test • Experiments on Carbohydrates qualitative analysis-II • Benedicts test • Fehlings test • Experiments on Carbohydrates qualitative analysis-III • Iodine test • Seliwanoff test 	Practical	

BLOCK IV

MODULE 9: Genitourinary System (3 weeks) (Body fluids, Water and Electrolyte Balance, Acid Base Balance, Biochemistry of Reproductive System)

<p>Water & Electrolyte Balance</p> 	<p>$CO_2 + H_2O \rightleftharpoons H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$</p> <p>Acid-Base Balance</p> 
<p>Human reproductive system</p>  <p>Female organs: Fallopian tube, Uterine fundus, Uterus, Endometrium, Myometrium, Cervical canal, Cervix, Vagina, Ovary, Infundibulum, Follicles, Ovarian ligament</p> <p>Male organs: Bladder, Seminal vesicle, Ductus deferens, Bulbourethral gland, Prostate, Urethra, Epididymis, Testicle, Foreskin, Urethral opening, Penis</p> <p>shutterstock.com · 1146442772</p>	

Preamble

This module includes basic understanding of histo-morphological embryological and physiological basis of genitourinary system Learning process involves delivering the content with clinical relevance. Learning process involves delivering the content with clinical relevance. At the very outset medical student should understand the importance of genitourinary system in the fields of Medicine. The research methodology and Behavioral Sciences will be taught as a part of the longitudinal theme.

Aim of this module is to enable the students to correlate the physiological and biochemical concepts related to genitourinary system with their anatomical knowledge and apply their relevant knowledge of this module in subsequent years of clinical training and practice

TOPICS	OUTCOMES	Disciplines
	By the end of this module, student should be able to:	
	<ul style="list-style-type: none">• Appraise the impact of water & electrolyte and Acid base balance imbalances on human health• Appraise the impact of gonadal hormones on sexual behavior, sexual morphogenesis and effect of balances/ imbalances on humen.• Interpret the results of specific gravity of urine• Justify the use of different solutions in clinical practice• Demonstrate the working and application of pH metery• Interpret the Urine report• Interpret RFTs	Biochemistry

BIOCHEMISTRY**Body Fluids +
Water &
Electrolyte**

Appraise the impact of water and electrolyte imbalances on human health

- Discuss biochemistry of water, fluid haemostasis, electrolyte balance and acid base haemostasis
- Describe Ionization of water & weak acids, bases, pH pK values, pH scale, Dissociation constant & titration curve of weak acids
- Apply Henderson-Hasselbalch Equation
- Explain the mechanism of Buffering and pH homeostasis
- Enumerate various types of particles and solutions in relation to the importance of selectively permeable membranes
- Describe the importance of selectively permeable membranes, osmosis, osmotic pressure, surface tension, viscosity & their importance related to body fluids
- Explain the Distribution of body water in various compartments
- Enlist different functions of water in human body
- Explain Regulation of water balance in body.
- Explain clinical conditions of Hyper and hyponatremia, hypo/hyperkalemia and hypo/hyper magnesemia
- Describe the role of buffer system, lungs &

- LECTURES
- PBL
- CBL
- SGD

MCQ/
SAQ/SEQ

		kidney in PH maintenance in human body		
Acid base balance	Appraise the impact of Acid base balance imbalances on human health	<ul style="list-style-type: none"> ➤ Comprehend Acid base disorders and blood pressure ➤ Discuss various Disorders of acid base balance ➤ Describe Anion Gap and its clinical significance 	<ul style="list-style-type: none"> • Lecture/SGD/ CBL 	MCQ/ SAQ/ SEQ
Biochemistry of Reproductive System	Appraise the basic principles of sex hormones along with the biochemical basis and related abnormalities	<ul style="list-style-type: none"> ➤ Explain the Site of synthesis, stimulus for secretion, mechanism of action, receptors, intracellular effects, target cells, tissues and biochemical role & hypo/hyper secretion Androgens & Estrogens. 	<ul style="list-style-type: none"> • LECTURES • SGD • PBL • CBL 	• MCQ SAQ/SEQ
Practical	Urine analysis (physical, chemical and microscopic examination)	<ul style="list-style-type: none"> ➤ Physical Examination of Urine ➤ Chemical examination of urine 	Practical	OSPE
	Justify the use of different solutions in clinical practice	<ul style="list-style-type: none"> ➤ Types of Solutions, their preparation and clinical significance 		
	Demonstrate the working and application of pH metery	<ul style="list-style-type: none"> ➤ The techniques and instrumentation of pH metery 		
	Interpret the Urine report	<ul style="list-style-type: none"> ➤ Urine report 		

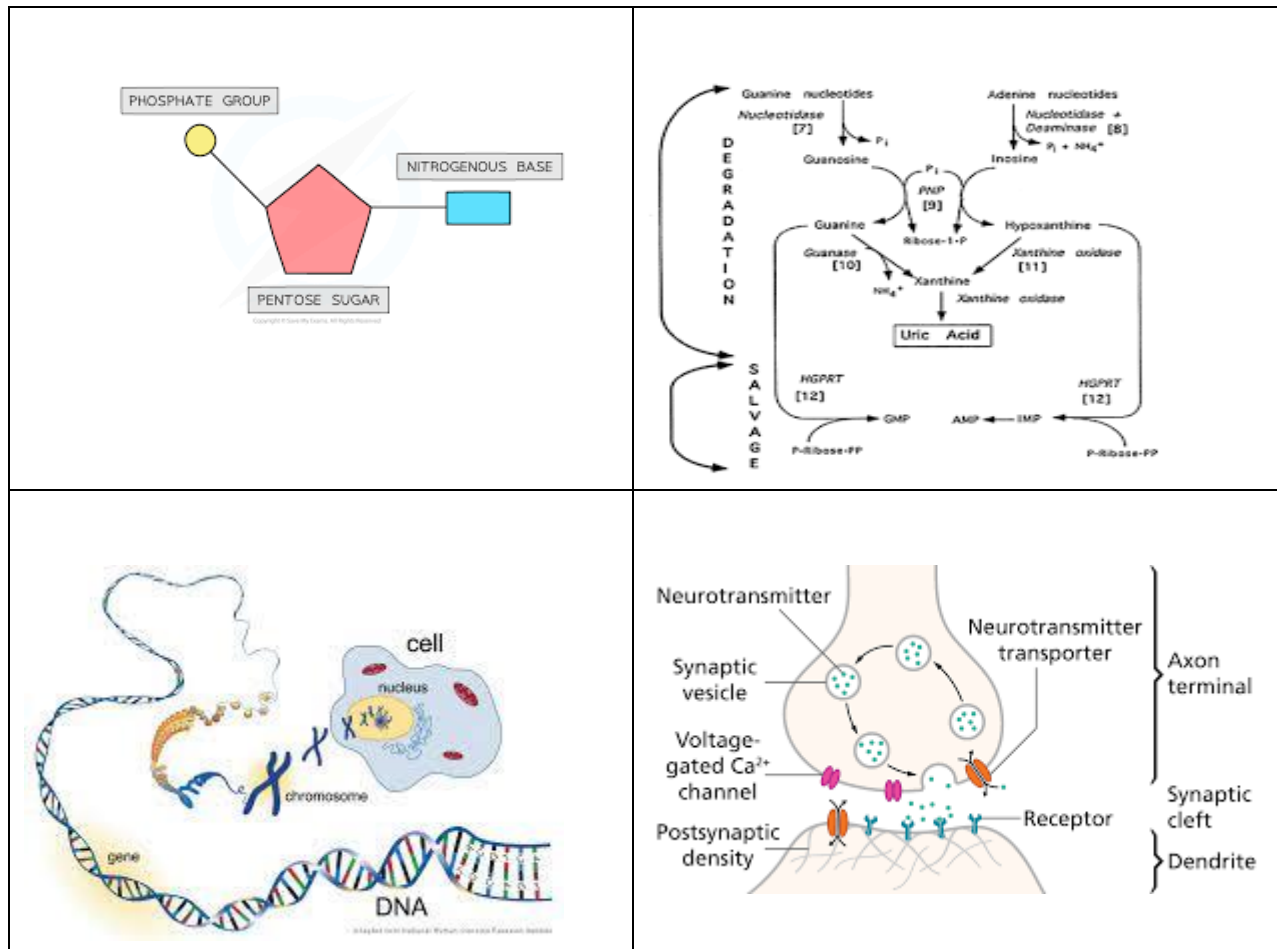
BLOCK-V MODULES

MODULE NO.	MODULE TOPICS
10.	Neuroscience

BLOCK V

MODULE 10: Neuroscience (8 weeks)

(Nucleotide Chemistry, Nucleotide Metabolism, Genetics, Neurotransmitters)



Preamble

The Neurosciences module is 08 weeks' module that focuses on the study of nervous system. It is a cross-disciplinary field that evolves around the development and functioning of the nervous system along with the mechanisms that underlie neurological disease. This module provides exposure to the field in depth and breadth. Through this module, students will develop an integrated, scientific knowledge that will help them in clinical setting, plus creative and problem-solving skills.

TOPICS	OUTCOMES
Biochemistry of Nervous System & Genetics	<ul style="list-style-type: none">• Relate the significance of different nucleotide in medicine• Apply the knowledge of nucleotide metabolism for understanding relevant metabolic disorders• Apply the knowledge of molecular medicine, genetics, and biotechnology in health and disease• Relate the importance of various neurotransmitters to its clinical significance

BIOCHEMISTRY					
S.No.	Topic/ Theme	Learning outcomes	Learning Objective/ Content	Instructional strategies	Assessment tool
1	Nucleotide Chemistry	Relate the significance of different nucleotides in medicine	<ul style="list-style-type: none"> ➤ Demonstrate the understanding of Chemistry and structure of nucleotides and their biochemical role ➤ Explain Nucleotides, structure, their derivatives and their biochemical role ➤ Discuss the synthetic derivatives of purine and pyrimidines, their role in health and disease ➤ Describe Nucleic acids, their types, structure and functions 	<ul style="list-style-type: none"> • LECTURES • PBL • CBL • SGD 	<ul style="list-style-type: none"> • MCQ • SAQ/SEQ
2.	Nucleotide Metabolism	Apply the knowledge of nucleotide metabolism for understanding relevant metabolic disorders	<ul style="list-style-type: none"> ➤ Outline the Synthesis of Purine nucleotides and deoxyribonucleotides ➤ Explain the Salvage pathway of nucleotides ➤ Describe the degradation of purines with related diseases and discuss the formation of Uric acid & Hyperuricemia ➤ Explain synthesis & degradation of pyrimidines and state related diseases 	<ul style="list-style-type: none"> • LECTURES • PBL • CBL • SGD 	<ul style="list-style-type: none"> • MCQ • SAQ/SEQ

3.	Molecular Genetics	Apply the knowledge of molecular medicine, genetics, and biotechnology in health and disease	<ul style="list-style-type: none"> ➤ Describe DNA Structure & types ➤ State organization of Eukaryotic DNA ➤ Explain replication of prokaryotic DNA & Eukaryotic DNA ➤ Explain Super coiling of DNA ➤ Describe DNA Repair Mechanisms ➤ Explain Xeroderma Pigmentosum ➤ Discuss various Genetic Diseases ➤ Give Structure of three types of RNA ➤ Outline Prokaryotic and Eukaryotic transcription ➤ Explain Reverse transcription ➤ Describe translation, Post Translational Modification & translation of genetic code ➤ Write a note on Mutations ➤ Outline regulation of Gene expression ➤ Write a note on PCR& Southern blotting techniques ➤ Explain Probes ➤ Explain Prenatal Diagnosis ➤ Discuss Gene therapy & gene expression 	<ul style="list-style-type: none"> • LECTUR ES • PBL • CBL • SGD 	<ul style="list-style-type: none"> • MCQ • SAQ/SEQ
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			<ul style="list-style-type: none"> ➤ Summarize DNA Cloning ➤ Explain Restriction fragment length polymorphism 		
4.	Neurotransmitters	Relate the importance of various neurotransmitters to its clinical significance	<ul style="list-style-type: none"> ➤ Write a note on Catecholamines, their chemistry, synthesis and degradation ➤ Explain synthesis and role of Acetyl choline, Dopamine, Serotonin and Histamine ➤ Discuss the Dopaminergic neurotransmission (Including site of synthesis, stimulus for secretion, mechanism of action, receptors, intracellular effects, target cells, tissues and biochemical role/functions) ➤ Explain synthesis and biochemical role of Glutamate, GABA & NO 	<ul style="list-style-type: none"> • LECTURES • PBL • CBL • SGD 	<ul style="list-style-type: none"> • MCQ • SAQ/SEQ
	Practicals	Perform and interpret the results of given examination	<ul style="list-style-type: none"> ➤ Collection and preservation of clinical specimens ➤ Estimation and clinical interpretation of Uric Acid in blood ➤ DNA Extraction ➤ PCR 	Practical	OSPE

BLOCK-VI MODULES

MODULE NO.	MODULE TOPICS
11.	Maxillofacial and Special Senses
12.	Endocrinology

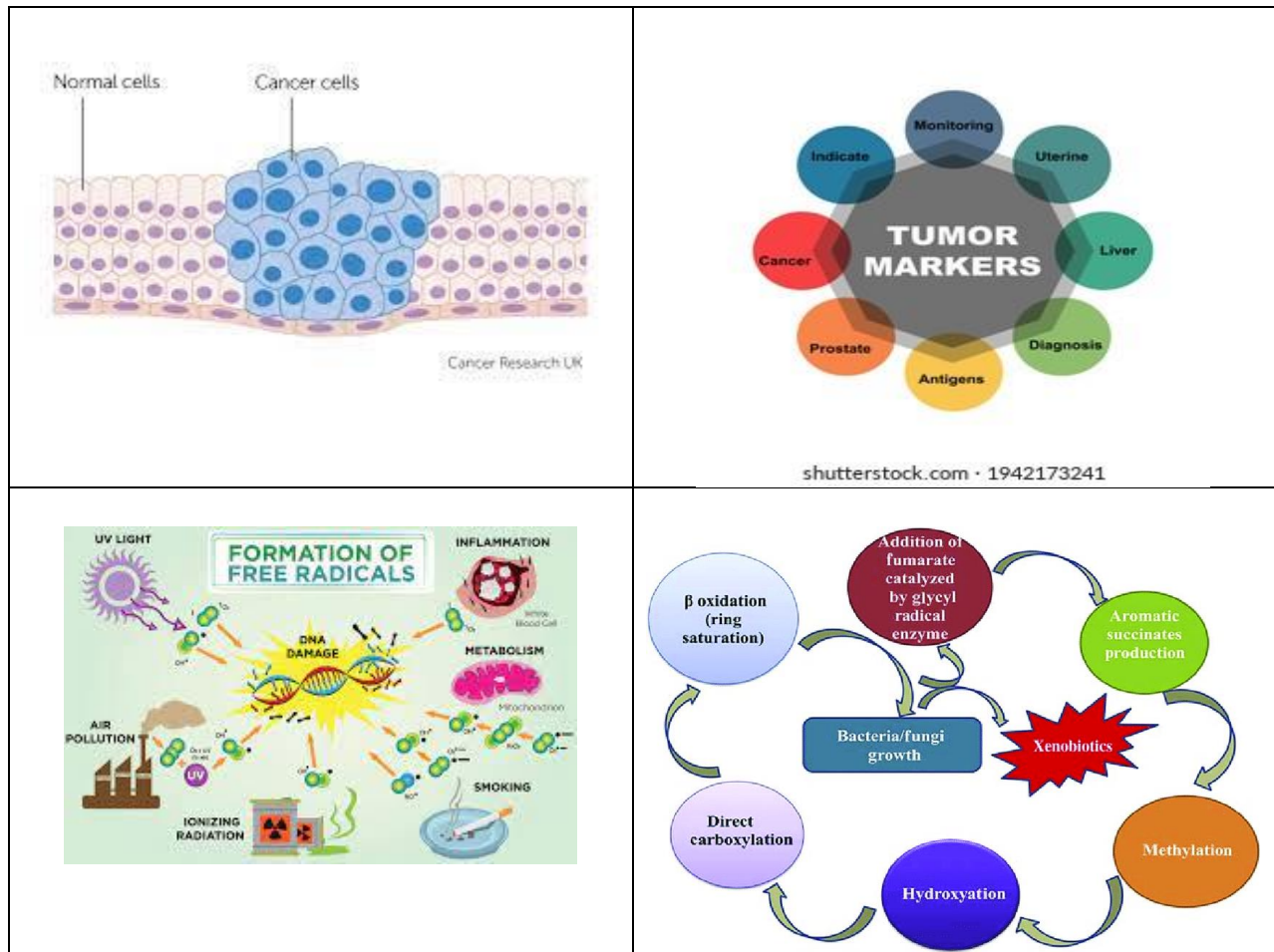
BLOCK VI

(12 weeks)

MODULE 11: Maxillofacial and special senses

(6 weeks)

(Cancer and Tumour markers, Aging and Free Radicals, Xenobiotics)



Preamble

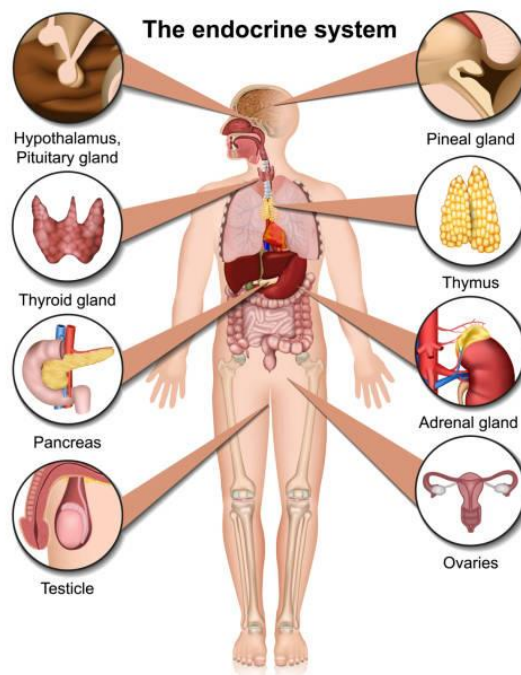
The Maxillofacial & Special Senses module for 2nd year MBBS aims to integrate both basic and clinical sciences. In basic sciences, students will be able to explain developmental, gross and microscopic anatomy of the Head Region & Special Senses along with relevant physiology and biochemistry. Learning process involves delivering the content with clinical relevance. The research methodology and Behavioral Sciences will be taught as a part of the longitudinal theme.

TOPICS	OUTCOMES
<ul style="list-style-type: none">• Cancer and tumor markers• Xenobiotics, aging and free radicals	<p><i>At the end of this module, students will be able to:</i></p> <ul style="list-style-type: none">• Correlate tumor markers in different malignancies• Outline the genetic basis of cancer• Co relate the effect of reactive oxygen species with cell injury and aging.• Mechanism of mitigation of ROS by human body• Outline the essential feature of aging and genetic factors of aging• Elaborate the role of reactive oxygen species and xenobiotics
Clinical disorders	Relate clinical presentation of relevant clinical disorders with its anatomical and physiological basis

BIOCHEMISTRY					
Sr	Topic/ Theme	Learning outcomes	Learning Objective/ Content	Instructional strategies	Assessment tool
1.	Cancer and tumor markers	Correlate tumor markers in different malignancies Outline the genetic basis of cancer	Comprehend genetic basis of cancer Discuss different tumor markers	<ul style="list-style-type: none"> • LECTURES • PBL • CBL SGD 	<ul style="list-style-type: none"> • MCQ SAQ/SEQ
2.	Aging & free radicals	<ul style="list-style-type: none"> ➤ Outline the essential feature of aging and genetic factors of aging ➤ Co-relate the effect of reactive oxygen species with cell injury and aging ➤ Mechanism of mitigation of ROS by human body 	Different reactive oxygen species (ROS) produced by the human body Mechanism of production of reactive oxygen species (ROS) Effect of ROS on health and disease Mechanism of Scavenging of ROS	<ul style="list-style-type: none"> • LECTURES • PBL • CBL • SGD 	<ul style="list-style-type: none"> • MCQ • SAQ/SEQ
3.	Xenobiotics	Elaborate the role of reactive oxygen species and xenobiotics	Describe xenobiotics Outline phase 1 and phase 2 reactions Discuss the properties of Cytochrome P450, its functions and clinical importance	<ul style="list-style-type: none"> • LECTURES • PBL • CBL SGD 	<ul style="list-style-type: none"> • MCQ SAQ/SEQ
	Practicals		ELISA		

BLOCK VI (12 weeks)

Module 12: Endocrinology (5 weeks)



Preamble

The emphasis of this module is on histo-morphological and embryological structure of endocrinology system as well as the mechanisms involved in regulating hormone levels in an integrated manner. Similarly, this module of endocrine system will enable the students to recognize the clinical presentations of common endocrinological and metabolic disorders and relate clinical manifestations to basic sciences. This Endocrine module will be revisited in the following years. The research methodology and Behavioral Sciences will be taught as a part of the longitudinal theme.

Aim of this module is to enable the students to correlate the physiological and biochemical concepts related to endocrinology system with their anatomical knowledge and apply the relevant knowledge of this module in subsequent years of clinical training and practice.

TOPICS	OUTCOMES	Disciplines
Basics of endocrinology	<ul style="list-style-type: none">• Describe the general principles of endocrine system• Classify the hormones according to their chemical nature & Mechanism of Action• Explain Cell surface receptors with special emphasis on G protein coupled receptors• Discuss Intracellular second messenger signaling cascade Describe the Intracellular ligand receptors	Biochemistry
Hormones of hypothalamus and Pituitary gland	<ul style="list-style-type: none">• Describe the structure, secretion, mode of action and functions of hypothalamic hormones• Explain the Site of synthesis, stimulus for secretion, mechanism of action, receptors, intracellular effects, target cells, tissues and biochemical role & hypo/hyper secretion of Growth Hormone	Biochemistry
Thyroid gland	Explain the Site of synthesis, stimulus for secretion, mechanism of action, receptors,	Biochemistry

	intracellular effects, target cells, tissues and biochemical role & hypo/hyper secretion of Thyroid hormone Interpret thyroid function tests (T3, T4, TSH)	
Calcium regulating hormones	Explain the Site of synthesis, stimulus for secretion, mechanism of action, receptors, intracellular effects, target cells, tissues and biochemical role & hypo/hyper secretion of parathyroid hormone	Biochemistry
Hormones of adrenal cortex	Explain the Site of synthesis, stimulus for secretion, mechanism of action, receptors, intracellular effects, target cells, tissues and biochemical role & hypo/hyper secretion adrenal hormones	Biochemistry
Hormones of Pancreas	Describe the Site of synthesis, stimulus for secretion, mechanism of action, receptors, intracellular effects, target cells, tissues and biochemical role & hypo/hyper secretion pancreatic hormones <ul style="list-style-type: none"> • Perform and interpret the results of Oral Glucose Tolerance Test & its clinical interpretations 	Biochemistry

Biochemistry				
Topic/ Theme	Learning outcomes	Learning Objective/ Content	Instructional strategies	Assessment tool
Basis Endocrine System	<ul style="list-style-type: none"> Describe the general principles of endocrine system Classify the hormones according to their chemical nature & Mechanism of Action Explain Cell surface receptors with special emphasis on G protein coupled receptors Discuss Intracellular second messenger signaling cascade Describe the Intracellular ligand receptors 	<ul style="list-style-type: none"> General principles of endocrine system Classification of hormones Cell surface receptors Intracellular second messenger signaling cascade Intracellular ligand receptors 	<ul style="list-style-type: none"> LECTURES SGD CBL 	<ul style="list-style-type: none"> MCQ SAQ/SEQ
Growth Hormone	<ul style="list-style-type: none"> Explain the Site of synthesis, stimulus for secretion, mechanism of action, receptors, intracellular effects, target cells, tissues and biochemical role & hypo/hyper secretion of Growth Hormone 	Biochemical role of Growth Hormone	<ul style="list-style-type: none"> LECTURES SGD PBL CBL 	<ul style="list-style-type: none"> MCQ SAQ/SEQ
Thyroid hormone	<ul style="list-style-type: none"> Explain the Site of synthesis, stimulus for secretion, mechanism of action, receptors, intracellular effects, target cells, tissues and biochemical role & hypo/hyper secretion of Thyroid hormone 	Biochemical role of Thyroid hormone	<ul style="list-style-type: none"> LECTURES SGD PBL CBL 	<ul style="list-style-type: none"> MCQ SAQ/SEQ

Adrenal hormones	Explain the Site of synthesis, stimulus for secretion, mechanism of action, receptors, intracellular effects, target cells, tissues and biochemical role & hypo/hyper secretion adrenal hormones	Biochemical role of adrenal hormones	<ul style="list-style-type: none"> • LECTURES • SGD • PBL • CBL 	<ul style="list-style-type: none"> • MCQ • SAQ/SEQ
Pancreatic hormones	Describe the Site of synthesis, stimulus for secretion, mechanism of action, receptors, intracellular effects, target cells, tissues and biochemical role & hypo/hyper secretion pancreatic hormones	Biochemical role of Pancreatic hormones	<ul style="list-style-type: none"> • LECTURES • SGD • PBL • CBL 	<ul style="list-style-type: none"> • MCQ • SAQ/SEQ
Parathyroid hormone	Explain the Site of synthesis, stimulus for secretion, mechanism of action, receptors, intracellular effects, target cells, tissues and biochemical role & hypo/hyper secretion of parathyroid hormone	Biochemical role of Parathyroid hormones	<ul style="list-style-type: none"> • LECTURES • SGD • PBL • CBL 	<ul style="list-style-type: none"> • MCQ • SAQ/SEQ
Practicals	Interpret the results of given examination	Thyroid profile OGTT	Practical	OSPE

5.SAMPLE MCQS AND SEQS

Sample MCQs and SEQs

Multiple Choice Question (MCQs)

- A multiple-choice question (MCQ) consist of a stem that states the question or problem followed by a set of possible answers that contain an option that is best answer to the question.
- After reading the questions students should select the appropriate option from the given possible answers.
- The correct answer carries one mark and incorrect carries zero. There is no negative marking.

Sample MCQ

Which of the following is the major factor that protects the duodenal mucosa from the damage by gastric acid?

- A. Pancreatic bicarbonate secretions
- B. The endogenous mucosal barrier of the duodenum
- C. Duodenal bicarbonate secretion
- D. Hepatic bicarbonate secretion

KEY: A

Short essay question (SEQs)

- Short essay questions require students to present written answers that are used to asses basic knowledge of key facts and provide students with an opportunity to demonstrate reasoning and explain their understanding of the subject.

Sample SEQ

An infant presents with yellow discoloration of his skin and sclera. On examination he was anemic and had splenomegaly. His complete blood picture revealed a normocytic anemia but his haemoglobin electrophoresis was normal. A peripheral smear revealed spiculated cells. A diagnosis of pyruvate kinase deficiency is made.

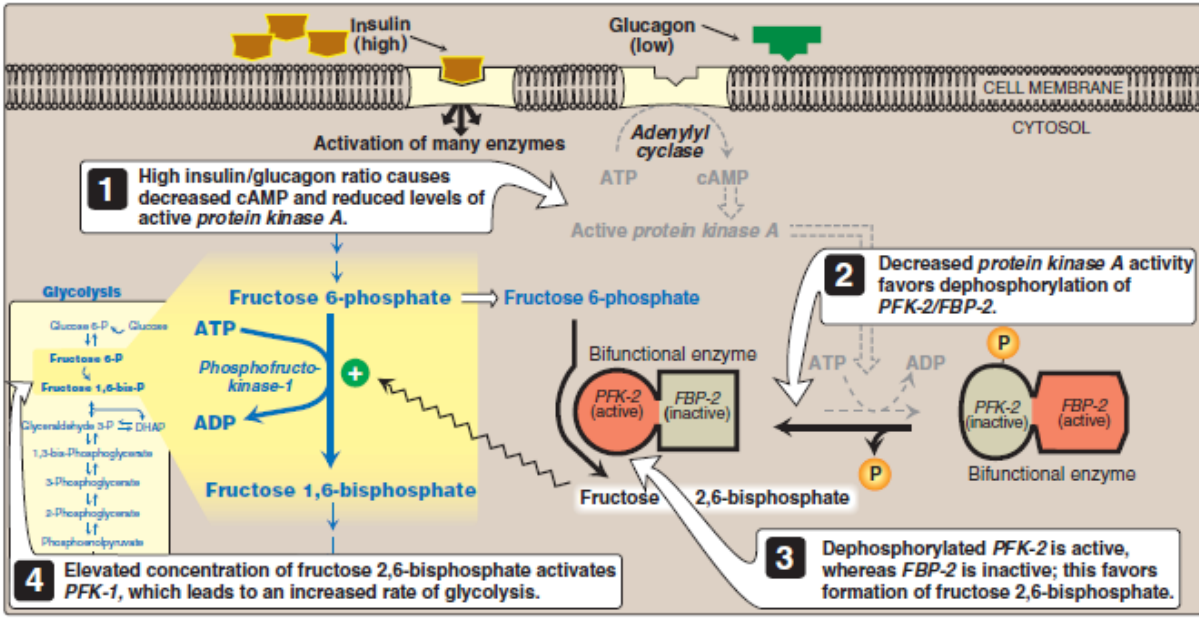
- a. What is the pathogenesis of hemolysis in this patient?**
- b. How is glycolysis regulated by fructose 2,6 biphosphate ?**

Key:

a. What is the pathogenesis of hemolysis in this patient?

The anemia observed in glycolytic enzyme deficiencies is a consequence of the reduced rate of glycolysis, leading to decreased ATP production. The resulting alterations in the red blood cell membrane lead to changes in the shape of the cell and, ultimately, to phagocytosis by the cells of the reticuloendothelial system, particularly macrophages of the spleen. The premature death and lysis of red blood cells results in hemolytic anemia.

b. How is glycolysis regulated by fructose 2,6 biphosphate ?



6.FACULTY LIST

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7.DEPARTMENTAL LIBRARY

Departmental library

1. Textbook of Medical Biochemistry (MN Chatterjea)	8 th Edition
2. Lippincott's Biochemistry	7 th Edition
3. Pre Test Biochemistry and Genetics	4 th Edition
4. Instant Biochemistry (Faiq)	2 nd Edition
5. Biochemistry A Case-Oriented Approach	4 th Edition
6. Textbook of Physiology and Biochemistry	9 th Edition
7. Harper's Illustrated Biochemistry	29 th Edition
8. Hashmi's complete Textbook of Biochemistry	5 th Edition
9. BRS Biochemistry Molecular Biology & Genetics	5 th Edition
10. Kaplan Medical Biochemistry and Genetics	
11. Essentials of Medical Biochemistry voll	7 th Edition
12. Essentials of Medical Biochemistry vol 2	7 th Edition
13. Clinical chemistry : Principles, Methods and Interpretations	3 rd Edition
14. Textbook of Biochemistry with clinical correlations	6 th Edition
15. Clinical chemistry (MARSHALL)	2 nd Edition
16. Organic Chemistry (Vollhardt)	
17. Mathews Van Holde Biochemistry	