SANKALCHAND PATEL UNIVERSITY

FACULTY OF MEDICINE
BACHELOR OF MEDICINE AND BACHELOR OF SURGERY
(M.B.B.S.)

BIOCHEMISTRY

CURRICULUM / SYLLABUS & ASSESSMENT

(AS PER COMPETENCY BASED MEDICAL EDUCATION CURRICULUM FOR THE INDIAN MEDICAL GRADUATE-2024, NATIONAL MEDICAL COMMISSION)

(In force for students admitted in year (2024-25) and thereafter)

Teaching & Evaluation Scheme for Faculty of Medicine

Semester/Year: First Year M.B.B.S.

Program Name: Bachelor of Medicine and Bachelor of Surgery

Effective from Academic Year: 2024-2025

Program Code: MB01

Course Code	Subject Name	Hrs/Week			UA		IA		Total	
		L	P	Total	Max	Min	Max	Min	Max	Min
2BI101	Biochemistry-I	2	-	2	100	80	-	-	200	150
2BI102	Biochemistry-II	2	-	2	100		-	-		
2BI103	Biochemistry Practical	-	9	9	100	40	-	-	100	
2BI104	Biochemistry IA Theory	-	-	-	-	-	100	40	200	100
2BI105	Biochemistry IA Practical	-	-	-	-	-	100	40		

Note:

1. Minimum to pass in Internal Assessment:50% combined in theory and practical, and must secure at least 40% separately in Theory and Practical of Internal Assessment to be eligible for appearing for University Examinations

2. Pass Criteria =

- **A candidate shall obtain a cumulative 50% marks in University conducted examination including theory and practical and not less than 40% separately in Theory and in Practical in order to be declared as passed in that subject.**
- **In subjects that have two papers, the learner must secure a minimum 40% marks in aggregate (both theory papers together) to pass in the said subject**

UA = University Assessment, IA = Internal Assessment

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BIOCHEMISTRY

COURSE CONTENT

PREAMBLE

Medical biochemistry is a field that delves into the chemical composition, structure, and function of molecules within living organisms, emphasizing their roles in maintaining health and the alterations that occur in disease. It integrates principles of chemistry and biology to study vital biomolecules like proteins, lipids, carbohydrates, and nucleic acids, which participate in crucial processes such as metabolism, enzyme activity, genetic regulation, and cellular signaling. This discipline is pivotal in understanding the biochemical basis of diseases, enabling the development of innovative diagnostics, effective treatments, and preventive strategies. By bridging the gap between molecular science and clinical practice, medical biochemistry plays a key role in advancing healthcare and improving patient outcomes.

Medical biochemistry is crucial for understanding:

- **Disease Mechanisms:** How biochemical abnormalities contribute to the development and progression of diseases.
- **Diagnosis:** The use of biochemical tests to identify and diagnose diseases.
- **Treatment:** The development of new therapies based on biochemical principles.

Goal:

The learner after teaching learning in Biochemistry should be able to:

- Understand and explain Biochemical and molecular processes involved in health and disease.
- Enlist and describe the cell organelles with their molecular and functional organization.
- Understand basic enzymology and emphasize on its clinical applications wherein regulation of enzymatic activity is disturbed.
- Describe Importance of nutrition in health and disease.
- Describe digestion and assimilation of nutrients and consequences of malnutrition.
- Describe function and interrelationships of various biomolecules and consequences of deviation from the normal.
- Describe and integrate metabolic pathways of various biomolecules with their regulatory mechanisms relevant to clinical conditions.
- Describe Biochemical basis and rationale of clinical laboratory tests, Perform biochemical analytical tests relevant to clinical screening and diagnosis using conventional techniques / instruments and interpret investigative data.
- Explain the biochemical basis of inherited disorders with their associated sequel.
- Describe mechanisms involved in maintenance of water, electrolyte and acid base balance and consequences of their imbalances.
- Outline basics genetics, explain the molecular mechanisms of gene expression and regulation, basic principles of biotechnology and latest techniques and their applications in medicine.
- Demonstrate the skills of solving scientific and clinical problems and decision making.

Summary of Time Allotted, Teaching and Learning Methods

Curricular component	Time allotted in hours
Lectures	82
Small group teaching / tutorials / integrated learning /practical	157
Self-directed learning	10
Early Clinical Exposure	09
AETCOM	08
Total	**266**

To be noted:

- It is recommended that didactic teaching be restricted to less than one third of the total time allotted for that discipline.
- Greater emphasis is to be laid on hands-on training, symposia, seminars, small group discussions, problem-oriented and problem-based discussions and self- directed learning.
- Students must been courage to take active part in and shared responsibility for their learning.

BIOCHEMISTRY SYLLABUS

(WITH NMC COMPETENCY NUMBER, AS PER COMPETENCY BASED MEDICAL EDUCATION CURRICULUM

FOR THE INDIAN MEDICAL GRADUATE-2024, NATIONAL MEDICAL COMMISSION)

BIOCHEMISTRY (Topics = 14, Competencies = 84)

(Topics 1 to 13 are for Theory and Topic 14 is for Practical)

Number	COMPETENCY The student should be able to
Topic 1: Basic Biochemistry - Number of competencies:(01)	
BC1.1	Describe the molecular and functional organization of a cell and its sub- cellular components and composition and functions of Biologica membranes.
Topic 2: Enzyme - Number of competencies:(05)	
BC2.1	Explain fundamental concepts of enzyme, isoenzyme and coenzyme. Enumerate the main classes of IUBMB nomenclature.
BC2.2	Describe and explain the basic principles of enzyme activity
BC2.3	Describe and discuss enzyme Inhibition and role of enzymes or drugs as Inhibitors, and enzymes as therapeutic agents.
BC2.4	Describe and discuss the clinical utility of various serum enzymes in laboratory and their use as markers of various pathological conditions.
BC2.5	Interpret laboratory results of enzymes in various disorders.
Topic 3: Chemistry and Metabolism of Carbohydrates - Number of competencies:(06)	
BC3.1	Discuss and differentiate monosaccharides, di-saccharides and polysaccharides with examples, their importance as energy fuel structural element, and storage molecule in human body.
BC3.2	Describe the digestion, absorption and transport of carbohydrates from food along with its disorders.
BC3.3	Define and briefly describe the pathways of carbohydrate metabolism and their

	regulation (glycolysis, gluconeogenesis, TCA, and significance of glycogen metabolism and HMP shunt), with associated disorders.
BC3.4	Describe and discuss the regulation, functions and integration of minor Carbohydrate Metabolism pathway briefly along with associated diseases /disorders.
BC3.5	Discuss the mechanism and significance of blood glucose regulation (Glucose homeostasis) in health and disease. Describe the types, Biochemical changes, complications and laboratory investigations related to diabetes & other carbohydrate metal disorders.
BC3.6	Interpret the results of analytes associated with metabolism of carbohydrates and other laboratory investigations related to disorders of carbohydrate metabolism.
Topic 4 : Chemistry and Metabolism of Lipids - Number of competencies: (08)	
BC4.1	Describe and discuss main classes of lipids and their functions.
BC4.2	Describe the digestion and absorption of dietary lipids and its (associated disorders.
BC4.3	Describe and discuss the fatty acid oxidation, metabolism of ketone bodies along with their clinical significance.
BC4.4	Describe metabolism of Triglycerides and cholesterol metabolism along with its regulation and clinical significance.
BC4.5	Describe the metabolism of lipoproteins with brief overview of lipoprotein structure, their interrelations & relations with atherosclerosis.
BC4.6	Discuss Biological role and therapeutic applications of Eicosanoids and their Inhibitors.
BC4.7	Describe Fatty liver, cholelithiasis and obesity.
BC4.8	Interpret laboratory results of analytes associated with metabolism of lipids

Topic 5: Chemistry & Metabolism of Proteins and Immunology - Number of competencies:(09)	
BC5.1	Discuss briefly structure of amino acids and classify amino acids on the basis of Nutritional and Metabolic significance.
BC5.2	Discuss classification of proteins, structural organization, functions and clinical aspects.
BC 5.3	Describe the digestion and absorption of dietary proteins
BC 5.4	Describe plasma proteins and their functions and brief overview of normal and abnormal electrophoretic pattern of serum proteins, acute phase proteins.
BC 5.5	Describe the structure, functions and disorders of Immunoglobulins with brief description of cellular and humoral Immunity.
BC 5.6	Describe the formation, transport, detoxification of Ammonia, Ammonia toxicity and its clinical significance.
BC 5.7	Describe the specialized products formed from the amino acids Glycine, Phenylalanine, Tyrosine, Tryptophan, and Methionine, branched chain amino acids and Arginine and the inborn errors associated with them Discuss new-born screening.
BC5.8	Describe the structure and functions of haem in the body and describe the processes involved in its metabolism with emphasis on jaundice and describe porphyrin metabolism.
BC5.9	Describe the major types of Hemoglobin and its types, derivatives & variants found in the body and their physiological / pathological relevance
Topic 6: Extracellular Matrix - Number of competencies: (03)	
BC6.1	Enumerate the functions and components of the extracellular matrix (ECM).
BC6.2	Discuss the involvement of ECM components in health and disease.
BC6.3	Describe protein targeting & sorting along with its associated disorders.
Topic 7: **Integration of Metabolism and Biological Oxidation - Number of competencies: (02)**	
BC7.1	Describe the integration of various metabolic processes in the body (Carbohydrate, Lipid, and Protein).

BC7.2	Describe the Biochemical processes involved in generation of energy in cells.
Topic 8: Vitamins and Nutrition - Number of competencies: (06)	
BC8.1	Describe the Biochemical role of vitamins in the body and explain the manifestations of their deficiency
BC8.2	Discuss the importance of various dietary components and explain importance of dietary fibre.
BC8.3	Describe the types and causes of protein energy malnutrition and its effects.
BC8.4	Provide dietary advice for optimal health in childhood and adult in disease conditions like diabetes mellitus, coronary artery disease and in pregnancy.
BC8.5	Describe the causes (including dietary habits), effects and health risks associated with being overweight/ obese / metabolic syndrome
BC8.6	Summarize the nutritional importance of commonly used items of food including fruits and vegetables (macro-molecules & its importance).
Topic 9: Minerals, electrolytes, Water and Acid base balance - Number of competencies: (03)	
BC9.1	Describe the dietary sources, absorption, transport, and metabolism, Biochemical functions of Iron, Calcium and copper with its associated clinical disorders.
BC9.2	Discuss Magnesium, Zinc and Phosphorus along with its clinical significance and discuss the functions of trace elements
BC9.3	Describe the processes involved in maintenance of normal pH, water & electrolyte balance of body fluids and the derangements associated with them
Topic 10: Molecular Biology - Number of competencies:(07)	
BC10.1	Describe nucleotides and nucleic acids and their clinical significance.
BC10.2	Describe briefly synthesis of purines in the body with special stress on salvage pathway.
BC10.3	Describe the degradation of purines and its significance with associated disorders.

BC10.4	Describe in brief the major steps involved in Replication, Transcription, and translation.
BC 10.5	Describe the types of DNA repair, gene mutations and associated disorders.
BC10.6	Describe basic mechanism of regulation of gene expression
BC10.7	Describe applications of molecular technologies like recombinant DNA technology and PCR in the diagnosis and treatment of diseases. Briefly discuss microarray, FISH, CRISPR
Topic 11: Organ Function tests and Hormones - Number of competencies:(02)	
BC 11.1	Describe the function tests of kidney, liver, thyroid and adrenal glands and their clinical significance. Interpret the function tests report.
BC11.2	Enumerate the hormones and markers related to reproduction and reproductive health and their clinical interpretation (For e.g. LH, FSH, Prolactin, beta-HCG, Estrogen Progesterone, testosterone and AMH. Discuss importance of prenatal screening.
Topic 12: Xenobiotic, oxidative stress and antioxidants - Number of competencies:(03)	
BC12.1	Describe the role of xenobiotics in disease in health and disease
BC12.2	Describe the anti-oxidant defense systems in the body.
BC12.3	Describe the role of oxidative stress in the pathogenesis of conditions such as cancer, complications of diabetes mellitus and atherosclerosis
Topic 13: Miscellaneous - Number of competencies:(05)	
BC 13.1	Describe oncogenesis, oncogenes & its activation with focus on p53 & apoptosis.
BC 13.2	Describe various Biochemical tumor markers and the Biochemical basis of cancer therapy.
BC13.3	Discuss briefly on HIV and Biochemical changes in AIDS.
BC13.4	Discuss metabolism of alcohol with Biochemical changes and effects of chronic alcoholism.

BC13.5	Describe the role of Artificial Intelligence in clinical Biochemistry laboratory practices.
Topic 14: Biochemical Laboratory test / Practical - Number of competencies: (24)	
BC14.1	Describe commonly used laboratory apparatus equipments, good / safe laboratory practice, Biomedical hazards & waste management.
BC14.2	Describe estimation of pH by pH meter or ABG analyser and interpretation of results with paper case scenarios.
BC14.3	Describe the physical properties, chemical constituents of normal urine and abnormal constituents of urine and Perform urine analysis to determine normal and abnormal constituents (including dipsticks method demonstration).
BC14.4	Identify abnormal constituents in urine, interpret the findings and correlate these with pathological states and prepare a urine report.
BC14.5	Describe screening of urine for inborn errors & describe the use of paper chromatography
BC14.6	Describe the principles of Colorimetry & Spectrophotometry.
BC14.7	Perform estimation of glucose by manual / semi-automated analyzer method and demonstrate glucometer usage. and interpretation of results with clinical scenarios.
BC14.8	Perform estimation of urea and calculate BUN and interpretation of results in clinical scenarios.
BC14.9	Perform the estimation of serum creatinine and calculate creatinine clearance.
BC14.10	Perform estimation of uric acid in serum and interpretation of results with clinical scenarios.
BC14.11	Perform estimation of serum proteins, albumin and A:G ratio
BC14.12	Perform the estimation of serum total cholesterol

BC14.13	Perform the estimation of serum Bilirubin by manual / semi- automated analyzer method.
BC14.14	Describe estimation of calcium and phosphorus and interpretation of results.
BC14.15	Describe the estimation Triglycerides, HDL and calculation of LDL and interpretation of results with clinical scenarios.
BC14.16	Describe the estimation of SGOT (AST) / SGPT (ALT) / Alkaline Phosphatase and interpretation of results with clinical scenarios.
BC14.17	Describe briefly various body fluids & discuss the composition of CSF.
BC14.18	Observe use of commonly used equipments/techniques in Biochemistry laboratory including: • pH meter • Paper chromatography of amino acid • Protein electrophoresis TLC, PAGE • Electrolyte analysis by ISE • ABG analyzer • ELISA • Immunodiffusion • Autoanalyser • DNA isolation from blood/ tissue
	Explain the basis and rationale of Biochemical tests done and interpretation of laboratory results in the following conditions: - Diabetes mellitus, - Obesity, - dyslipidaemia, - Fatty liver - myocardial infarction, - Renal failure,

BC14.19	- Gout, - Nephrotic syndrome, - Jaundice, - Liver diseases, pancreatitis, disorders of acid- base balance, - Thyroid disorders, - Genetic disorders - Nutritional disorders - Vitamin deficiency disorders, - Disorders of Mineral metabolism, - Disorders of electrolyte metabolism.
BC14.20	Describe & Identify Pre-Analytical (especially order of draw, tourniquet technique), Analytical, Post Analytical errors.
BC14.21	Describe Quality control and identify basic L J charts in Clinical biochemistry lab.
BC14.22	Describe performance of OGTT, Glucose Challenge Test and HbA1c and interpretation of results with clinical scenarios.
BC14.23	Calculate energy content of different food Items, identify food items with high and low glycaemic index and explain the importance of these in the diet.
BC14.24	Observe, Interpret and discuss the baseline, diagnostic, prognostic, and discharge investigations of clinical biochemistry.

ASSESSMENT

Attendance

There shall be a minimum of 75% attendance in theory and 80% attendance in practical /clinical for eligibility to appear for the examinations in that subject.

Internal Assessment

Scheme for calculation of internal assessment marks:

Theory (maximum marks)	**Marks**	**Practical (Maximum Marks)**	**Marks**
1st Terminal Examination	20	1st Terminal Examination	20
2nd Terminal Examination	20	2nd Terminal Examination	20
Preliminary Examination	40	Preliminary Examination	40
Day to day assessment, Seminar, Project, SDL, Group discussion & Others	20	Day to day assessment, Seminar, Project, SDL, Group discussion & Others	20
Total	**100**	**Total**	**100**

- Internal assessment should be based on competencies and skills.
- Regular periodic examinations shall be conducted throughout the course. There shall be three internal assessment examinations in each subject. The third internal examination is the preliminary examination to be conducted on the lines of the university examination.
- A candidate must secure at least 50% marks of the 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.
- Day to day records and log book (including required skill certifications) should be given importance in internal assessment. Internal assessment should be based on competencies and skills.

- Level of participation in self directed learning, assignments, seminars, clinical case presentation, project work will be assessed and importance will be given in internal assessment.
- Internal assessment marks will not be added to University examination marks and will reflect as a separate head of passing at the summative examination.
- The results of internal assessment should be displayed on the notice board within 1-2 weeks of the test.
- The internal and formative assessments provide ideal opportunities for students and teachers to identify learning gaps. Teachers should provide high quality feedback to each student to enable them to bridge these learning gaps.
- Formative assessments also enable the early identification of students who are struggling to achieve the intended learning outcomes. Early and appropriate targeted remediation must be planned for such students.

University Assessment

- University examinations are to be designed with a view to ascertain whether the candidate has acquired the necessary knowledge, minimal level of skills, ethical and professional values with clear concepts of the fundamentals which are necessary for him to function effectively and appropriately as a physician of the first contact.
- Nature of questions in theory examinations shall include different types such as structured essays like Long-Answer Questions (LAQ), Short-Answer Questions (SAQ) and Multiple-Choice Questions (MCQ) shall be accorded minimum 20% weightage of the total marks of each theory paper, Scenario based MCQs shall be accorded more weightage in view of NEXT.
- Practical/clinical examinations shall be conducted in the laboratories and /or hospital wards and a blueprint must be used. The objective will be to assess proficiency and skills to conduct experiments, interpret data and form logical conclusion. Clinical cases kept in the examination must be common conditions that the learner may encounter as a physician of first contact in the community.
- Application based questions should be included for newer CBME components like foundation course, ECE, AETCOM, Integrated topics, student-learner methods etc. in all theory, practical and clinical examinations of all internal assessments and university Assessment.
- Criteria for passing in a subject: A candidate shall obtain a cumulative 50% marks in University conducted examination including theory and practical and not less than 40% separately in Theory and in Practical in order to be declared as passed in that subject. In subjects that have two papers, the learner must secure a minimum 40% marks in aggregate (both theory papers together).

THEORY EXAMINATION PATTERN

There shall be two theory papers of 100 marks each and duration of each paper will be of 3 hours.

Question Paper I and II pattern: Section-A (50 Marks)

Q 1.	Long essay question (Structured / Case Based) (any 1 out of 2) 1x10	10
Q 2.	Short Answer Questions (Structured / Case Based) (any 6 out of 7) 6 x 5 (One Question on AETCOM is compulsory)	30
Q 3.	Objective type Answer Questions (any 5 out of 6) 5 x 2	10
	Total	**50**

Question Paper I and II pattern: Section-A (50 Marks)

Q 4.	Long essay question (Structured / Case Based) (any1 out of 2) 1x10	10
Q 5.	Short Answer Questions (Structured / Case Based) (any 6 out of 7) 6 x 5 (One Question on AETCOM is compulsory)	30
Q 6.	MCQs Questions (any 10 out of 10) 10 x 1	10
	Total	**50**

PRACTICAL EXAMINATION PATTERN: 100 Marks

No	Type of exercise	Marks
Practical 1	Major (Case Based) Exercise and Table viva	40
Practical 2	OSPE - Objective Structured Practical Examination	30
Practical 3	Minor (Case Based) Exercise and Table viva	30
	Total	**100**

Biochemistry Department

Topic Distribution Paper I & II

Paper	Topic	Competency No. BC
I	Basic Biochemistry	1.1
	Enzymes	2.1-2.5
	Chemistry & metabolism of carbohydrates	3.1-3.6
	Chemistry & metabolism of lipids	4.1-4.8
	Biological oxidation	7.2
	Xenobiotics	12.1
	Antioxidants & Defence system	12.2-12.3
	Nutrition	8.2-8.6
	Extracellular matrix	6.1 -6.3
	Oncology , Oncogenesis, Tumor Markers	13.1-13.2
	Biochemistry of HIV & AIDS	13.3
	Immunology	5.5
	Biomedical waste	14.1
	Physical characteristics and chemical ,composition of CSF	14.17
	Biochemical Changes in chronic alcoholism	13.4
	AETCOM- 1.1 -Enumerate and describe professional qualities and roles of a physician -Describe and discuss commitment to lifelong learningas an important part of physician growth	AETCOM- 1.1
II	Chemistry & Metabolism of proteins	5.1 -5.4 & 5.6-5.9
	Integration of metabolism & starvation	7.1
	Nucleic acid chemistry & metabolism	10.1-10.3
	Vitamins	8.1

	Water electrolyte balance & acid base balance	9.3
	Mineral metabolism	9.1 – 9.2
	Haemoglobin chemistry and metabolism	5.8 -5.9
	Organ function test & Hormones	11.1 – 11.2
	Molecular biology	10.4 -10.6
	Genetic engineering	10.7
	AETCOM- 1.1 -Describe and discuss the role of a physician in health care system -Identify and discuss physician's role and responsibility to society and the community that she/ he serves	AETCOM- 1.1

LIST OF RECOMMENDED BOOKS

	Title	Author
Textbook	Textbook of Biochemistry	DM Vasudevan
	Textbook of Medical Biochemistry For Medical Student	Rafi
	Medical Biochemistry	U Satya Narayan
	Textbook of Medical Biochemistry	SK Gupta
	Biochemistry	Pankaja Naik
	Integrated Textbook of Biochemistry	Indumati V
Reference Book	Textbook of Medical Biochemistry	Dinesh Puri
	Harper's illustrated Biochemistry	Robert K Murray
	Lippincott's Biochemistry	Denise R. Ferrier
Practical Manual	Manual of Practical Biochemistry For MBBS	SK Gupta
	Competency Based Practical Biochemistry Textbook	Wilma Delphine Silvia CR
Miscellaneous	Biochemistry Made Easy: Problem Based Approach	Dr. N Haridas
	A Case Oriented Approach Towards Biochemistry	Namrata Chhabra