

1. Vision

The vision of **Biochemistry Department** is to train the undergraduate medical student using education program designed to create an "Indian Medical Graduate" (IMG) possessing requisite knowledge, skills, attitudes, values and responsiveness, so that she or he may function appropriately and effectively as a physician of first contact of the community while being globally relevant.

To achieve this we are following global competencies extracted from the Graduate Medical Education Regulations, 2018.

Goals of our training program

The aim is that at the end of undergraduate program, the Indian Medical Graduate should be able to:

- (a) Recognize "health for all" as a national goal and health right of all citizens and by undergoing training for medical profession fulfill his/her social obligations towards realization of this goal.
- (b) Learn every aspect of National policies on health and devote her/him to its practical implementation.
- (c) Achieve competence in practice of holistic medicine, encompassing promotive, preventive, curative and rehabilitative aspects of common diseases.
- (d) Develop scientific temper, acquire educational experience for proficiency in profession and promote healthy living.
- (e) Become exemplary citizen by observance of medical ethics and fulfilling social and professional obligations, so as to respond to national aspirations.

2. Learning objectives (Overall)

- There was a log drawn need for the Medical graduate to adapt to the changing demography, socio-economic context, perceptions, values and expectations of stakeholders. The proposed Graduate Medical Education Regulations 2019 has made this job easier which is also overall goals of Department of Biochemistry.
- Our department thrusts in making medical education more learner-centric, patient-centric, gender sensitive, outcome -oriented and environment appropriate. We believe in an outcome driven curriculum which conforms to global trends.
- An attempt has been made to allow students from diverse educational streams and backgrounds to transition appropriately through a Foundation Course.
- Dedicated time has been allotted for self directed learning and co-curricular activities.
- A significant attempt has been made in the outcome driven undergraduate curriculum to provide the orientation and the skills necessary for life-long learning to enable proper care of the patient. The curriculum being followed in Biochemistry reinforces this aspect by necessitating certification of certain essential skills.
- To give adequate importance to ethical values, responsiveness to the needs of the patient and acquisition of communication skills we are following a dedicated curriculum time in the form of a longitudinal program based on Attitude, Ethics and Communication (AETCOM) competencies.

- In department of Biochemistry, , we encourage integrated teaching between traditional subject areas using a problem-based learning approach starting with clinical or community cases.
 - All efforts have been made to de-emphasize compartmentalization of various subjects so as to achieve both horizontal and vertical integration in different phases. In our teaching program great emphasis has been placed on collaborative and interdisciplinary teamwork, professionalism, altruism and respect in professional relationships.
 - Formative and internal assessments have been streamlined to achieve the objectives of the curriculum. Curricular governance and support have been strengthened, increasing the involvement of Curriculum Committee and Medical Education Departments/Units.
- We are certain that following the 'competency based undergraduate curriculum' prepared by the Medical Council of India would definitely serve the cause of medical education in creating a competent Indian Medical Graduate to serve the community.

3. Competencies: Cognition, Psychomotor skill, Communication affective attitude

A) Cognition

- At the end of the session, student should have Knowledge of all theory topic competencies from BI 1.1 to BI 10.5. She should also Know-How with respect to all theory topics

B) Psychomotor skill

- All competencies for practical topics, the student should have the skill to perform independently.
- The Certifiable competencies require the students to have all attributes of knowledge, skill, and show how and perform independently.

A) Communication affective attitude

In the AETCOM module (attitude, ethics and communication), Department of Biochemistry is covering module 1.1. This module covers the AETCOM aspects of "What it means to be a Doctor?"

- The students will be exposed to patients admitted in the wards of our hospital and given the opportunity to communicate with a non- medical agenda.
- During small group discussions with teachers (faculty, residents), they will be asked their own personal reasons for choosing to become doctors.
- The students will be divided in small groups (n=20) and given topics for preparing a skit with the theme being "What it means to be a Doctor?"
- Speakers from outside the college will be invited to speak to the students about their personal experience of being a Doctor. It will be an interactive session with question answers.

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In ECE (Early Clinical exposure), we have to cover 10 sessions per student in the given academic year (September 2019- August 2020). Four clinical exposure and six class room discussion of relevant clinical cases will be done.

- Clinicians from medical, paediatrics, surgical, gynaecology, ophthalmology, and ENT and Dermatology department will be invited to give lecture about their topic to the students.
- Students will be taken to the OPD and wards to see and interview the same cases.
- The students will write a report and reflect in their log books.
- For Class room ECE sessions, Clinician will come to lecture theatre, discuss case and show photographs of the patient.
- There will be discussion on presentation of signs and symptoms of disease. Treatment options will be outlined.

4. Course

Course of UG MBBS graduate in first semester Biochemistry curriculum.

Main Topic	Competencies (Theory)
Basic Biochemistry	1. Describe the molecular and functional organization of a cell and its sub-cellular components
Enzymes	<ol style="list-style-type: none"> 1. Explain fundamental concepts of enzyme, isoenzyme, alloenzyme, coenzyme & co-factors. Enumerate the main classes of IUBMB nomenclature 2. Describe and explain the basic principles of enzyme activity 3. Describe and discuss enzyme inhibitors as poisons and drugs and as therapeutic enzymes 4. Describe and discuss the clinical utility of various serum enzymes as markers of pathological conditions. 5. Discuss use of enzymes in laboratory investigations (Enzyme-based assays)
Chemistry and metabolism of carbohydrates	<ol style="list-style-type: none"> 1. Discuss and differentiate monosaccharides, di-saccharides and polysaccharides giving examples of main carbohydrates as energy fuel, structural element and storage in the human body 2. Describe the processes involved in digestion and assimilation of carbohydrates and storage. 3. Define and differentiate the pathways of carbohydrate metabolism (glycolysis, gluconeogenesis, glycogen metabolism, HMP shunt).

	<ol style="list-style-type: none"> Describe and discuss the regulation, functions and integration of Carbohydrate along with associated diseases/disorders. Describe and discuss the concept of TCA cycle as a amphibolic pathway and its regulation Describe the common poisons that inhibit crucial enzymes of carbohydrate metabolism (eg; fluoride, arsenate) Discuss and interpret laboratory results of analytes associated with metabolism of carbohydrates. Discuss the mechanism and significance of blood glucose regulation in health and disease. Interpret the results of blood glucose levels and other laboratory investigations related to disorders of carbohydrate metabolism. Discuss the metabolic processes that take place in specific organs in the body in the fed and fasting states.
Chemistry and metabolism of lipids	<ol style="list-style-type: none"> Describe and discuss main classes of lipids (Essential/non-essential fatty acids, cholesterol and hormonal steroids, triglycerides, major phospholipids and sphingolipids) relevant to human system and their major functions. Describe the processes involved in digestion and absorption of dietary lipids and also the key features of their metabolism Explain the regulation of lipoprotein metabolism & associated disorders. Describe the structure and functions of lipoproteins, their functions, interrelations & relations with atherosclerosis Interpret laboratory results of analytes associated with metabolism of lipids Describe the therapeutic uses of prostaglandins and inhibitors of eicosanoid synthesis.
Chemistry and metabolism of proteins	<ol style="list-style-type: none"> Describe and discuss structural organization of proteins. Describe and discuss functions of proteins and structure-function relationships in relevant areas eg, hemoglobin and selected hemoglobinopathies Describe the digestion and absorption of dietary proteins. Describe common disorders associated with protein metabolism Interpret laboratory results of analytes associated with metabolism of proteins
Chemistry and metabolism of nucleotides	<ol style="list-style-type: none"> Describe and discuss the metabolic processes in which nucleotides are involved. Describe the common disorders associated with nucleotide metabolism

	3. Discuss the laboratory results of analytes associated with gout & Lesch Nyhan syndrome
Biochemical role of Vitamins and Minerals	<ol style="list-style-type: none"> 1. Describe the biochemical role of vitamins in the body and explain the manifestations of their deficiency 2. Describe the functions of various minerals in the body, their metabolism and homeostasis. 3. Enumerate and describe the disorders associated with mineral metabolism
Biological oxidation and ATP generation	1. Describe the biochemical processes involved in generation of energy in cells.
Water, electrolyte, pH and buffers	<ol style="list-style-type: none"> 1. Describe the processes involved in maintenance of normal pH, water & electrolyte balance of body fluids and the derangements associated with these. 2. Discuss and interpret results of Arterial Blood Gas (ABG) analysis in various disorders.
Heme chemistry and Metabolism	<ol style="list-style-type: none"> 1. Describe the functions of heme in the body and describe the processes involved in its metabolism and describe porphyrin metabolism. 2. Describe the major types of haemoglobin and its derivatives found in the body and their physiological/ pathological relevance.
Biochemical functions and tests of Kidney, Liver, Adrenals, Thyroid	<ol style="list-style-type: none"> 1. Describe the functions of the kidney, liver, thyroid and adrenal glands 2. Describe the tests that are commonly done in clinical practice to assess the functions of these organs (kidney, liver, thyroid and adrenal glands). 3. Describe the abnormalities of kidney, liver, thyroid and adrenal glands
Molecular	<ol style="list-style-type: none"> 1. Describe the structure and functions of DNA and RNA and outline the cell cycle 2. Describe the processes involved in replication & repair of DNA and the transcription & translation mechanisms 3. Describe gene mutations and basic mechanism of regulation of gene expression. 4. Describe applications of molecular technologies like recombinant DNA technology, PCR in the diagnosis and treatment of diseases with genetic basis.
Xenobiotics	1. Describe the role of xenobiotics in disease.
Anti-oxidants, Free radicals and anti-oxidative stress	<ol style="list-style-type: none"> 1. Describe the anti-oxidant defence systems in the body 2. Describe the role of oxidative stress in the pathogenesis of conditions such as cancer, complications of diabetes mellitus and atherosclerosis.

Diet, Nutrition	<ol style="list-style-type: none"> 1. Discuss the importance of various dietary components and explain importance of dietary fibre. 2. Describe the types and causes of protein energy malnutrition and its effects. 3. Provide dietary advice for optimal health in childhood and adult, in disease conditions like diabetes mellitus, coronary artery disease and in pregnancy 4. Describe the causes (including dietary habits), effects and health risks associated with being overweight/ obese. 5. Summarize the nutritional importance of commonly used items of food including fruits and vegetables (macro-molecules and its importance)
ECM and glycoproteins	<ol style="list-style-type: none"> 1. List the functions and components of the extracellular matrix (ECM). 2. Discuss the involvement of ECM components in health and disease.
Protein Targetting	<ol style="list-style-type: none"> 1. Describe protein targeting and sorting along with its associated disorders.
Cancer and Apoptosis	<ol style="list-style-type: none"> 1. Describe the cancer initiation, promotion oncogenes & oncogene activation. Also focus on p53 & apoptosis. 2. Describe various biochemical tumor markers and the biochemical basis of cancer therapy.
Immunology	<ol style="list-style-type: none"> 1. Describe the cellular and humoral components of the immune system & describe the types and structure of antibody 2. Describe & discuss innate and adaptive immune responses, self/non-self recognition and the central role of T-helper cells in immune responses. 3. Describe antigens and concepts involved in vaccine development

Course of UG MBBS graduate in first semester Biochemistry curriculum (Practical)

	Demonstrations
	Describe commonly used laboratory apparatus and equipments, good safe laboratory practice and waste disposal.
	Describe the preparation of buffers and estimation of pH.
	Describe the chemical components of normal urine
	Describe screening of urine for inborn errors & describe the use of paper chromatography

	Describe the principles of Colorimetry
	Demonstrate the estimation of serum total Cholesterol and HDL Cholesterol
	Demonstrate the estimation of Triglycerides
	Demonstrate the estimation of Calcium and Phosphorus
	Demonstrate the estimation of SGOT/ SGPT
	Demonstrate the estimation of Alkaline phosphatase
	Describe & discuss the composition of CSF.
	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 ELISA Immunodiffusion Autoanalyser Quality control DNA isolation from blood/ tissue
	Problem based learning
	Explain the basis and rationale of biochemical tests done in the following conditions: - diabetes mellitus, - dyslipidemia, - myocardial infarction, - renal failure, gout, - proteinuria, - nephrotic syndrome, - edema, - jaundice, - liver diseases, pancreatitis, disorders of acid- base balance, - thyroid disorders
	Combined in Lecture content
	Calculate energy content of different food items, identify food items with high and low glycemic index and explain the importance of these in the Enumerate advantages and/or disadvantages of use of unsaturated, saturated and trans fats in food.

	Practical
	Identify abnormal constituents in urine, interpret the findings and correlate these with pathological states.
	Demonstrate estimation of glucose.
	Demonstrate estimation of Albumin. Calculate albumin: globulin (AG) ratio
	Demonstrate the estimation of serum creatinine and creatinine clearance
	Demonstrate the estimation of serum bilirubin
	Demonstrate estimation of urea
	Demonstrate estimation of Total protein

5. Teaching Learning methods

Competency	Demo	Lecture /Small group discussion	DOAP	Certifiable competency
BI 1.1 Cell organisation		✓		
BI 2.2-2.7 Enzymes		✓		
BI 3.1-3.10 Carbohydrate chemistry and metabolism		✓		
BI 4.1-4.7 Lipid chemistry and metabolism		✓		
BI 5.1-5.7 Protein chemistry and metabolism		✓		
BI 6.1 Integration of metabolism		✓		
BI 6.2-6.4 Nucleotide metabolism		✓		
BI 6.7-6.8 Ph and ABG		✓		
BI 6.9-6.10 Mineral Metabolism		✓		

BI 6.11-6.12 Haemoglobin		✓		
BI 6.13-6.15 Organ function test		✓		
BI 7.1-7.4 DNA transcription,translation and recombinant DNA		✓		
BI 7.5 XENOBIOTICS		✓		
BI 7.6-7.7 Free Radical		✓		
BI 8.1-8.5 Diet and nutrition Obesity/CAD/DM		✓		
BI 9.1-9.2 Extracellular Matrix		✓		
BI 9.3 Protein targeting		✓		
BI 10.1-10.2 Cancer and cancer marker		✓		
BI 10.3-10.5 Immunology		✓		
Teaching learning methods of Topics covered in Practical Biochemistry classes				
COMPETENCIES	DEM O	LECTURE/SG D	DOA P	CERTIFIABLE COMPETENCI ES
BI 11.1 Laboratory apparatus and good laboratory practices	✓	✓		
BI 11.2 Ph determination	✓	✓	✓	
BI 11.3,11.4 Urine Examination	✓	✓	✓	✓
BI 11.5 Paper Chromatography		✓		
BI 11.6 Colorimetry	✓	✓	✓	
BI 11.7 Creatinine estimation/clearence	✓	✓	✓	
BI 11.8	✓	✓	✓	✓

Serum protein/albumin				
BI 11.9 Total cholesterol/HDL		✓		
BI 11.10 Triglycerides		✓		
BI 11.11 Calcium and phosphorus		✓		
BI 11.12 Serum Bilirubin	✓	✓	✓	
BI 11.13 SGOT/SGPT Demo	✓	✓		
BI 11.14 Alkaline Phosphatase	✓	✓		
BI 11.15 CSF Composition		✓		
BI 11.16 Equipment and technique Ph,PAGE,electrophoresis,ISE ABG analyser,ELISA,Immunodiffusion,autoanalyzer Quality control,DNA isolation.	✓	✓		
BI 11.17 Biochemical test for diabetes, dyslipidemia, Myocardial infarction, renal failure, proteinuria, nephrotic syndrome, edema, jaundice, liver disease and acid base balance disorder and thyroid disorder.	✓	✓		
BI 11.18 Principles of spectrophotometry	✓	✓		
BI 11.19 Basic principles of functioning of biochemistry instrument		✓		
BI 11.20 Correlation of abnormal urine findings with pathological condition	✓	✓	✓	✓
BI 11.21 Demonstration of estimation of glucose, creatinine, urea, and total protein	✓	✓	✓	✓
BI 11.22	✓	✓	✓	✓

A:G ratio and creatinine clearance calculation				
BI 11.23 Calculate energy content of different food items		✓		
BI 11.24 Advantage /disadvantage of MUFA,PUFA		✓		

6. Assessment:

Formative Assessment- One assessment per month.

Internal Assessment – 40 % Marks separately in theory and practical

(To be able to appear in the 1st professional Exam)

- Minimum 50% in theory and practical combined for declaration of final result by university.

Summative exam- theory, practical & viva voce pattern with distribution of marks is as follows

	Theory	Practical and viva
IST TERM	Total marks= 100 One paper (20% MCQs) i.e. 80 Marks theory paper and 20 marks for MCQs)	Total marks= 100 (80 marks practical and 20 marks grand viva (from theory)
IInd Term	Total MARKS=100 One paper (20% MCQs) i.e 80 Marks theory paper and 20 marks for MCQs)	Total marks= 100 (80 marks practical and 20 marks grand viva (from theory)
Sent up	Total MARKS=200 Two paper (20% MCQs) i.e 80 Marks theory paper and 20 marks for MCQs) for each	Total marks= 100 (80 marks practical and 20 marks grand viva (from theory)
Professional exam	Total MARKS=200 Two paper (20% MCQs) i.e 80	Total marks= 100 (80arks practical and 20 marks grand viva (from theory)

	Marks theory paper and 20 marks for MCQs) for each	
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MCQs (20 marks per theory paper): Mandatory, all five types of MCQs covering all broad areas of biochemistry (60% applied and 40% recall). No negative marking and time allotted: 30 minutes.

Theory paper (100 marks for each, wherever applicable), all questions must be structured.

At least 80% questions should be from the must know area. The distribution will be as follows:

- Section A (20 marks) will be MCQs (as mentioned above)
12 Single response-01 mark each
2 reason assertion-02 marks each
1 Matching- 04 marks
- Section B (40 marks): Clinical case based long structured question (10 marks), structured, short notes (2.5X4=10 marks), Explain Why (10 marks) and compare and contrast (10 marks)
- Section C: Clinical case based long structured question (10 marks), structured short notes (10 marks), Explain Why (10 marks) and compare and contrast (10 marks)

Practicals: 80 marks practical and 20 marks grand viva (from theory). The competencies that need to be certified will be covered by OSPEs. At least 80% questions should be from the must know area. The distribution will be as follows:

- OSPEs (40 marks)
- Section B (40 marks): Serum analysis (20 marks for professional exam, for the rest of the examinations as mentioned above 15 marks and 5 marks will be for the practical file), urine analysis (10 marks), and Bench viva (10 marks).

7. Recommended Readings

Suggested books to read: Latest editions

- Textbook of Biochemistry for Medical Students 9th Edition: D M Vasudevan
- Textbook of Medical Biochemistry 4th Edition: Dinesh Puri
- Textbook of Medical Biochemistry, 2nd edition: Dr SK Gupta
- Lippincott's Illustrated Reviews Biochemistry (South Asian Edition)
- Harpers Illustrated Biochemistry 31st Edition (LANGE Basic Science)
- Undergraduate Practical Manual in Medical Biochemistry provided to students in LHMC, MAMC and UCMS

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At least 80% questions should be from the must know area. The distribution will be as follows:

- Section A (20 marks) will be MCQs (as mentioned above),
- Section B (40 marks): Clinical case based long structured question (10 marks), structured, short notes (10 marks), Explain Why (10 marks) and compare and contrast (10 marks)
- Section C: Clinical case based long structured question (10 marks), structured short notes (10 marks), Explain Why (10 marks) and compare and contrast (10 marks)

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- *Lippincott's Illustrated Reviews Biochemistry latest edition: Denise R. Ferrier*
- *Harpers Illustrated Biochemistry latest Edition (LANGE Basic Science)*
- *Undergraduate Practical Manual in Medical Biochemistry, Deptt of Biochemistry, L.H.M.C (Provided to students in LHMC)*