



**YENEPOYA**

(DEEMED TO BE UNIVERSITY)

Recognized under Sec 3(A) of the UGC Act 1956

Accredited by NAAC with 'A' Grade

## **YENEPOYA (DEEMED TO BE UNIVERSITY)**

**Deralakatte, Mangaluru -575018**

### **REGULATIONS AND CURRICULUM GOVERNING**

### **POSTGRADUATE PROGRAM M.Sc. IN**

### **MEDICAL BIOCHEMISTRY**

**(REVISED CURRICULUM – AMENDED UP TO 2020)**

**ATTESTED**

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**NOTIFICATION – 38-ACM/01/2020 dtd. 14.05.2020**

Sub: Amendments in curriculum of M.Sc. Medical Biochemistry

Ref: Resolution of the Academic council at its 38<sup>th</sup> meeting held on 27.04.2020, vide agenda-07

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The Academic Council at its 38<sup>th</sup> meeting held on 27.04.2020 and subsequently the Board of Management at its 49<sup>th</sup> meeting held on 30.04.2020 have accepted the proposal for amendments in the existing syllabus of M.Sc. Medical Biochemistry course.

Existing	Now Amended
<p>6) <i>Eligibility of Student:</i> M.B.B.S.; or B.Sc. with Chemistry /Biology/ Zoology / Botany / Biotechnology from a recognized institution.</p> <p>7) <i>Number of Admissions/ Student-Teacher Ratio:</i> The number of students to be admitted for <i>MSc Medical Biochemistry</i> together with <i>MD Biochemistry</i> shall be 1 P.G. per each eligible PG teacher.</p>	<p>6) <i>Eligibility of Student:</i> Bachelors degree in Life sciences/ Health sciences from a recognized Institution.</p> <p>7) <i>Number of Admissions / Student-Teacher Ratio:</i> The number of students to be admitted for <i>MSc Medical Biochemistry</i> together with <i>MD Biochemistry</i> shall be 2 P.G.s per each eligible PG teacher.</p>

Existing	Now Amended
<p>18) <i>Tuition Fees:</i> <i>Rs 1 lakh / annum</i></p>	<p><i>Rs 75,000/ annum</i></p> <p><i>Addition of fees for 2 electives to the tuition fees; Rs 2000 for each elective; 1 elective per year</i> <i>Total tuition fee to be 77,000/ annum</i></p>

- ii) To correct the typographic errors and match numbering of headings and subheadings given under regulations and curriculum with that given in contents page (Ref: page no. 1 of Regulations and Curriculum for MSc Medical Biochemistry).

iii) The following change was recommended in Methodology for Final year MSc (Medical Biochemistry) (Ref: page no. 4 of Regulations and Curriculum for MSc Medical Biochemistry):

Existing methodology	Now Amended
<p><b>6. Specialized training in Clinical Biochemistry:</b> 1 month posting in the clinical biochemistry laboratory to learn sample collection, quality control methods, setting up of a clinical biochemistry laboratory, specialized assays, statistical analysis of data.</p>	<p>To increase the duration of training as: <b>6. Specialized training in Clinical Biochemistry:</b> 1 month posting in each year of 2<sup>nd</sup> and 3<sup>rd</sup> year MSc, in the clinical biochemistry laboratory to learn sample collection, quality control methods, setting up of a clinical biochemistry laboratory, specialized assays, statistical analysis of data.</p>

iv) The following change was recommended in Final year MSc Medical Biochemistry (2<sup>nd</sup> and 3<sup>rd</sup> years) Theory syllabus.

Existing topic	Now Amended
Nil	<b>Addition of topic-</b> Environmentally sustainable good laboratory practices (as the last topic under Theory Paper III- Clinical Biochemistry and Nutrition)

v) The following changes were recommended in Final year MSc Medical Biochemistry (2<sup>nd</sup> and 3<sup>rd</sup> years) Practical syllabus.

General Experiments			
Expt No.	Days	Existing topic	Now Amended
7	3	Periodate oxidation of sugars	Deletion
8	2+2	Chromatography of carbohydrates: (using honey and other sugars) a) Paper b) Thin layer	Deletion of terms— using honey and other sugars
9	3	Analysis of honey	Deletion
13	4	Preparation of glucose- 1-phosphate from potato	Deletion
17	4	Reactions of lipids, saponification value, iodine number	Deletion
18	3	Isolation of cholesterol from goat brain/ Reactions of cholesterol	Deletion
19	3	Isolation of phospholipids from egg yolk	Deletion
20	3	TLC of lipids in plasma and rat brain	Deletion of terms – and rat brain

21	2	Analysis of Milk Estimation of Lactose- Folin wu method Alkaline phosphatase activity	Deletion	
22	3	Isolation and estimation of DNA from spleen: effect of temperature on DNA	Modifying as: Isolation and estimation of DNA from tissues/blood: effect of temperature on DNA	
7	4	Estimation of Antioxidant activity Ferric reducing ability of plasma (FRAP) method DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) method	Addition	
	2	Spectrofluorometric analysis – screening for serum fluorescent advanced glycation end products (AGEs).	Addition	
<b>Experiments for Demonstration</b>				
<i>Molecular biology experiments:</i>				
	3	Polymerase Chain Reaction- PCR (conventional and real time)	Addition	
	4	Blotting techniques –Western and Southern	Addition	
	1	microRNA (miRNA)	Addition	
	2	Complementary DNA (cDNA)	Addition	
<i>Mass spectrometry-based Proteomics and Metabolomics:</i>				
	3	LCMS/ MS	Additions	
	2	High pressure liquid chromatography		
	2	Fourier-transform infrared spectroscopy (FTIR)	Addition	
<b>Clinical investigations</b>				
Expt. no	Days	Existing topics	Now Amended	
23	2 1 1	Blood sugar : • Folin- Wu method • O – Toluidine method • Glucose oxidase method	Deletion of O-Toluidine method	
24	2 2 2	Blood Urea - Diacetyl monoxime method ❖ Urease Nesslerization method ❖ Enzymatic method	Deletion of Urease Nesslerization method	



27	3	Serum proteins	Deletion of
	2	❖ Lowry's method (including preparation of Folin's reagent)	Albumin -Dye binding method
	1	❖ Biuret (Total and A/G)	Zinc sulphate turbidity
	1	❖ Albumin-Dye binding method	
	2	❖ Zinc sulphate turbidity	
	2	❖ Electrophoresis a) Agar Gel	
	2	b) Polyacrylamide	
		❖ Gel filtration	
29	2	Urine nitrogen by Kjeldahl method	Deletion
42	2	LDH a) Spectrophotometric method	Deletion of Isoenzyme separation
		b) Isoenzyme separation	
43	3	Lipid Profile: Total lipids	Deletion of Total lipids, phospholipids and Lipoprotein electrophoresis
	4	Cholesterol-Free & Ester	
	2	Triglyceride	
	2	Phospholipids	
	2	LDL and HDL	
	2	Lipoprotein electrophoresis	
44	1	Plasma Vitamin A	Deletion
46	2	Plasma Vitamin E	Deletion
<b>Clinical Investigations to be added</b>			
	10	Screening tests for Inborn errors of metabolism (IEM)	Addition
	10	Toxicology screening tests (Kit methods)	Addition
	2	ELISA (TSH)	Addition
<b>Cell Fractions and Enzymes</b>			
<b>Expt. No.</b>	<b>Days</b>	<b>Existing topics</b>	<b>Proposed change</b>
49	15	Factors effecting enzyme activity	Deletion of-
		a) Enzyme concentration	e) Inhibitors
		b) Substrate concentration	
		c) pH	
		d) Temperature	
		e) Inhibitors	
50	15	Purification of enzymes	Deletion
	3	Cytotoxicity and survival assays invitro	Addition
<b>Training in Clinical Biochemistry Lab</b>			
	<b>Duration in days</b>	<b>Existing topics</b>	<b>Now Amended</b>
	15	Plasma Iron and Iron binding	Modify as: Routine and specialized assays in clinical

	Capacity Plasma sodium and potassium Urinary 17 ketosteroids Urinary V.M.A estimation. Stone analysis	biochemistry lab, sample collection methods, quality control methods, statistical analysis of data and setting up of clinical biochemistry laboratory. Days- 30 each in 2 <sup>nd</sup> and 3 <sup>rd</sup> years	
<b>Postings in Microbiology and Hematology lab sections</b>			
	Duration in days	Existing	Now Amended
	Nil	Nil	Addition of posting in microbiology section of central lab to observe routine culture methods and serological testing for common blood borne diseases. Duration: 7 days
	Nil	Nil	Addition of posting in blood bank and hematology sections of central lab to observe routine methods and testing. Duration: 7 days

vi) The following changes were recommended in the curriculum of Final year MSc (Medical Biochemistry) (Ref: page no. 3 of Curriculum for MSc Medical( Biochemistry):

Existing criteria	Now Amended	Duration
Nil	Addition of "Basic Course in Bio-medical Research", online course available on SWAYAM portal (recommended by MCI for Medical Postgraduates 2019 batch onwards).	8 weeks

Existing	Proposed change	Duration
Nil	Addition of electives; any two electives can be selected by student from the list of nine electives; one elective in each year of final MSc course (i.e. in 2 <sup>nd</sup> and 3 <sup>rd</sup> years).	7 days for each elective

Objectives: They are given for each elective as follows-

Sl. no.	Elective subject	Learning objectives	Learning outcomes	Faculty mentors	Assessment methods
1	Basics of animal ethics and handling	1.To explain the basics of animal ethics and CPCSEA guidelines. 2. To list the basic handling procedures for rodents.	To use the guidelines and employ proper procedures while working with experimental animals.	Dr. Megha Rani, Dept. of Pharmacology	Concept mapping, Short questions

2	Diabetic care	<p>1.To define American Diabetes Association guidelines for diagnosis and monitoring of diabetes mellitus.</p> <p>2. To recognize common complications in diabetic patients.</p> <p>3.To list examples of diet and treatment modalities suggested for diabetic care.</p>	To apply the information gathered about proper diabetic care to educate the community.	Dr. Shaheen Banu Shaikh, Diabetic clinic	e-Portfolio, Short projects
3	Geriatrics	<p>1. To describe theories of aging.</p> <p>2. To detect common abnormalities in geriatric individuals from their lab reports.</p>	To plan and recommend modifications in lifestyle, diet and supplement usage for healthy aging in populations.	Dr. Prithvi Nandalike, Dept. of Geriatric medicine	Create e-posters, Seminars Problem solving exercises
4	Community Nutrition	<p>1. To demonstrate use of nutritional assessment methods.</p> <p>2. To outline national nutritional policies.</p> <p>3. To identify common nutritional problems in India.</p>	To employ the nutritional assessment methods in different populations for identifying nutrition-related problems and to plan strategies to solve the problems	Dr. Shubankar Adhikari and Poulomi Chatterjee, Dept. of Community medicine	Create short educational videos, Short answer questions
5	Environmental studies	<p>1. To describe the activities of the Centre for Environment studies.</p> <p>2. To collect information about the ground water testing methods used.</p>	To devise ways to overcome problems associated with poor water quality and to plan environment-friendly activities.	Dr. Bhagya Sharma, Centre for Environment studies	Short project, e-poster
6	Bioinformatics	<p>1. To explain goals of Bioinformatics.</p> <p>2. To describe the tools used for sequencing and analysis.</p>	To plan and employ the tools for solving research problems.	Dr. Shyam Prasad Rao, Dept. of Bioinformatics	Short answer questions
7	Stem cell research	<p>1. To explain goals of stem cell research.</p> <p>2. To discuss methods used for isolation characterization and differentiation of stem cells.</p>	To discover the potential of stem cells for therapeutic purposes.	Dr. Sudhir Shenoy, Dept of Stem cell research	Objective type questions, Assignments

8	Prevention of substance abuse	<ol style="list-style-type: none"> <li>1.To indicate adverse effects of tobacco/ nicotine on various body systems.</li> <li>2.To state the National laws/ regulations governing substance abuse.</li> <li>3. To discuss modalities used in tobacco cessation clinic.</li> </ol>	To plan and design projects to improve effectiveness of substance abuse prevention programs.	Dr. Maji Jose, Centre for Prevention of substance abuse	Create short educational videos, Short answer questions
9	Gender equity and maternal health care	<ol style="list-style-type: none"> <li>1. To describe the barriers due to gender inequality in maternal health care.</li> <li>2. To list the complications during perinatal period and discuss ways to avoid them.</li> </ol>	To formulate strategies to promote gender equity and maternal health care	Dr Saiqa R Shah, Dr Raghavendra U, Dept of Biochemistry	Create short educational videos, e-posters Short answer questions

This is for implementation from the academic year 2020-21.

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**REGISTRAR**  
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To,

The Principal, Yenepoya Medical College

Copy to:

1. Professor & HoD, department of Biochemistry
2. Controller of Examinations
3. File copy



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# Regulations and Curriculum for MSc Medical Biochemistry

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## **Preamble**

The prime concern of the Institute is to develop patterns of teaching in postgraduate medical education so as to demonstrate a high standard of medical education to all medical colleges and other allied institutions globally. This educational experience is imparted in an atmosphere of research.

## **Regulations**

- 5) Eligibility for a Recognized Post Graduate Teacher:
- (c) Qualification:
    - MD Biochemistry
    - Or
    - MSc Medical Biochemistry with Medical PhD
  - (d) Teaching Experience:
    - 5 years of UG (MBBS) teaching after acquiring PG degree
- 6) Eligibility of Student:  
Bachelors degree in Life sciences/ Health sciences from a recognized Institution
- 7) Number of Admissions / Student-Teacher Ratio:  
. The number of students to be admitted for MSc Medical Biochemistry together with MD Biochemistry shall be 2 P.G.s per each eligible PG teacher.
- 8) Duration of the Course:
- 3 years
  - First Year (one Academic year from July to June) is the Preliminary Course (Orientation Course) – teaching of Biochemistry, Physiology and Anatomy at the I M.B.B.S. level with the syllabus of latest M.C.I. regulations, except that there will be University Examination only in Theory and not in Practicals at the end of the one year course.  
Students shall attend all Lectures , tutorials, and practicals along with 1st M.B.B.S students during the preliminary Course (Orientation Course)s
  - Second and Third Year of the Course is the Post Graduate Course proper.
- 12) Nature of the Course:  
Candidates joining M.Sc. Medical Biochemistry course shall work as full time P.G. student and he/she will not be paid any stipend during the training period and he/she will be given full time responsibility, assignments and participation in all facets of the educational process.
- 13) Log Book:  
P.G. student shall maintain a record (log) book of the work carried out by them and will be checked & assessed by his/her P.G. teacher & H.O.D.

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- 14) Work in Central Clinical Laboratory:  
P.G. students shall work in Central Clinical Laboratory & would carry out routine, emergency & special investigations during training period.
  - 15) Academic Activities::  
They shall participate in all P.G. academic activities; viz, Seminars, Group discussion, Journal club, etc.
  - 16) Teaching-training program:  
They will be required to participate in the teaching and training programs of U.G. students.
  - 17) Attendance:  
They will be granted a term provided they will put 80% attendance during the academic term.

## Curriculum

### **Goal**

The broad goal of teaching and training of postgraduate students in Medical Biochemistry is to enable a student acquire sound knowledge in the subject and develop practical skills to contribute effectively in the fields of **academics, health care and research**.

At the end of his/her training, the student shall be able to take up a career in **Teaching Institution, Diagnostic Laboratory or Research**.

### **Objectives**

At the end of the training in Biochemistry, the PG student is expected to demonstrate sound **Knowledge** and **Skills** in the field of **Medical Biochemistry**.

### **Knowledge**

#### **1. Concepts and principles of general biochemistry.**

This includes molecular motif of a living cell, structural and functional hierarchy of biomolecules and their structure-function relationships, biochemistry of human nutrition, metabolism, metabolic interrelationships, metabolic homeostasis, molecular and cell biology, body defense against xenobiotics and pathogens, principles of various laboratory estimations, instrumentations and rationale underlying biochemical laboratory investigations.

#### **2. Fundamentals of biostatistics**

### **Skills**

1. Conduct Biochemical laboratory investigations and experimentations relevant to clinical management and biomedical research. Analyze, interpret and evaluate the data. Rationalize their application in clinical management and experimental research.
  2. Plan & conduct lecture, practical demonstrations, tutorial classes and small group discussions on clinical problems for undergraduates students of medical and allied disciplines.
  3. Be familiar with literature survey, computer skills.
  4. Critically review & comment on research papers and give oral presentation.
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5. Prepare research protocols, conduct experimental studies analyze and solve clinical and experimental problems.

- Basic Course in Bio-medical Research”, online course available on SWAYAM portal (recommended by MCI for Medical Postgraduates 2019 batch onwards). 8 weeks

Electives; any two electives can be selected by student from the list of nine electives; one elective in each year of final MSc course (i.e. in 2<sup>nd</sup> and 3<sup>rd</sup> years) 7 days for each elective

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6	Bioinformatics	1. To explain goals of	To plan and employ	Dr. Shyam	Short answer



		Bioinformatics. 2. To describe the tools used for sequencing and analysis.	the tools for solving research problems.	Prasad Rao, Dept. of Bioinformatics	questions
7	Stem cell research	1. To explain goals of stem cell research. 2. To discuss methods used for isolation characterization and differentiation of stem cells.	To discover the potential of stem cells for therapeutic purposes.	Dr. Sudhir Shenoy, Dept of Stem cell research	Objective type questions, Assignments
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## Methodology

Following methods are used to facilitate learning and training of PG students during II and III year (Post Graduate Course proper).

- 1. Post graduate lectures, tutorials, seminars:** To update on various aspects of basic and clinical biochemistry & impact of molecular biology on advances in medicines.
- 2. Journal club:** To develop (a) skills of analysis, evaluation and presentation of research papers (b) familiarity with approaches and methodologies of research and (c) to update on new development/emerging trends in biochemistry.
- 3. Practical exercises:** under the supervision of a faculty.
- Participation in UG laboratory practical teaching and problem based tutorials as a team with faculty of the department to gain in depth learning, teaching and tutoring experience.
- 6. Specialized training in Clinical Biochemistry:**  
1 month posting in each year of 2<sup>nd</sup> and 3<sup>rd</sup> year MSc, in the clinical biochemistry laboratory to learn sample collection, quality control methods, setting up of a clinical biochemistry laboratory, specialized assays, statistical analysis of data
- Environmentally sustainable good laboratory practices  
(as the last topic under Theory Paper III- Clinical Biochemistry and Nutrition)

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# Syllabus

## I year (Preliminary Course)

### Theory

1. Chemistry of Biomolecules
2. Enzymes
3. Cell Structure
4. Digestion and Absorption
5. Metabolism
  - Carbohydrate Metabolism
  - Lipid Metabolism
  - Amino Acid Metabolism
  - Biological Oxidation, Oxidative Phosphorylation
  - Heme Metabolism
  - Purine and Pyrimidine Metabolism
  - Acid Base Balance and Disorders
  - Detoxification
  - Vitamins
  - Minerals
  - Genetics
    - DNA Replication, Transcription, Translation, Mutation, Regulation of Gene Expression, Recombinant DNA Technology
6. Hemoglobin
7. Plasma Proteins
8. Liver Function Test, Kidney Function Test
9. Nutrition
10. Biochemical Techniques

### Practical Syllabus

#### A. Qualitative Experiments

1. Reactions of carbohydrates
2. Reactions of Proteins
3. Reactions of non-protein nitrogenous (NPN) substances
4. Identification of substance of physiological importance
5. Qualitative analysis of normal urine
6. Analysis of urine for abnormal constituents

#### B. Quantitative experiments

1. Colorimetry
2. Estimation of blood sugar

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3. Estimation of blood urea
  4. Estimation of serum inorganic phosphate
  5. Estimation of total serum protein and albumin
  6. Estimation of urine creatinine.

**C. Demonstration experiments**

1. Glucose tolerance test
2. Paper Chromatography
3. Electrophoresis
4. Estimation of urine albumin

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## II and III Year

### Theory

#### Paper I - Chemistry and Techniques

Methods of qualitative analysis of biomolecules : Principles, experimental procedure and applications of : Chromatography, paper, thin layer, ion exchange, affinity, gel filtration, gas-liquid, HPLC. Principles, procedures and application of : Electrophoresis, paper, polyacrylamide gel, agarose gel, and cellulose acetate. Ultracentrifugation, ultrafiltration.

Quantitative methods: Principles and applications of : Photometry, Spectrophotometry, fluorometry, ion selective procedures, flame photometry.

Isotopes : Detection and measurement of radioactive isotopes. Application of isotopes in research and clinical biochemistry.

Concept of pH and buffers. Henderson - Hasselbalch equation. Principles and procedures of determination of pH.

Chemistry of amino acids and proteins : Structure and properties of amino acids. Protein structure and conformation. Methods to determine the amino acid sequence of proteins. Chemistry of conjugated proteins, nucleoproteins, lipoproteins, immunoglobulins, glycoproteins. Structure- function relationship of proteins: hemoglobin, myoglobin and collagen. Protein - protein interactions.

Chemistry of carbohydrates : Monosaccharides, disaccharides, homopolysaccharides and heteropolysaccharides.

Chemistry of lipids: Classification, fatty acids, PUFA, compound lipids, cholesterol.

Nucleic acids : Chemistry and structure of bases, nucleosides, nucleotides, RNA and DNA. DNA sequence determination. Properties of nucleic acids. Recombinant DNA technique, cloning procedures, vectors, plasmids, phages, cosmids, and restriction map and PCR technique. Southern, Northern, Western blotting procedures. Restriction fragment polymorphism. In-situ hybridization. Genomic library and cDNA library mutations, mutagens, carcinogens, in vitro mutagenesis. Transgenic animals and microinjection technique. Gene therapy.

Basic concepts of immunology: Chemistry of immunoglobulins, primary and secondary immune responses, auto immune phenomenon, anaphylaxis, Clonal selection, B cells, T cells, helper T cells, NK cells, macrophages, interleukins, cytokines, HLA antigens, monoclonal antibodies, Hybridoma technology, immunodiffusion, immuno- electrophoresis, radio immune assay (RIA), enzyme linked immunosorbent assay (ELISA), fluorescent in situ hybridization (FISH) techniques. (NK cells – Natural Killer Cells).

Bioenergetics and biological oxidation: Concept of free energy change, high energy compounds, ATP generation, redox potential, electron transport chain, oxidative phosphorylation, inhibitors, uncouplers, ionophores.

Cell fractionation, biochemical activities of different fractions, marker enzymes.



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Enzymes: Classification, nomenclature, enzyme specificity, kinetics of enzyme activity, coenzymes and cofactors, regulation of enzyme activity, isoenzymes, proenzymes, multienzyme complexes, tandem enzymes, covalent modification, active site of enzymes, methods of locating the amino acid residues in the active sites, mechanism of enzyme action. Enzyme inhibitions: competitive, non-competitive, Allosteric, suicide.

Purification of enzymes from cells, characterization and criteria of purity. Purification of proteins.

### **Paper II(Intermediary Metabolism)**

Methods of investigation of metabolic pathways. Primary secondary and tertiary metabolisms.

Carbohydrate metabolism: Details of metabolic pathways involving carbohydrates in mammals. Embden-Meyerhof pathway, hexose monophosphate shunt pathway, other minor pathways, fructose and Galactose metabolisms. Digestion and absorption. Blood glucose homeostasis, hormones influencing carbohydrate utilisation, insulin, glucagon, glucocorticoids, epinephrine and glucose tolerance test, Diabetes mellitus.

Amino acid metabolisms : Protein digestion an absorption of amino acids, metabolism of individual amino acids, one carbon units, polyamines, nitric oxide, plasma proteins, transport proteins.

Lipid metabolism: Digestion and absorption, transport and storage, fatty acid synthesis, fatty acid oxidation pathways. Biosynthesis of phospholipids, glycolipids. Cholesterol metabolism. Plasma lipoprotein metabolism. Role of adipose tissue and liver in lipid metabolism. Hormonal regulation of lipid metabolism. Prostaglandins, prostacyclins, leukotriens thromboxanes, and very long chain fatty acids.

Regulation of metabolisms: TCA cycle, integration of metabolisms, common terminal pathway, regulation, amphibolic role. Hormonal regulations of metabolic pathways, Cori's cycle, Alanine cycle, adaptation during starvation.

Purine and pyrimidine metabolisms: synthesis and degradation of bases and nucleotides, regulation, gout, Lesch-Nyhan syndrome.

DNA: Replication, DNA damage and repair processes, mutations, amplification of genes, somatic recombination, Telomeres, inhibitors of replication.

Transcription: Details of transcription, transcriptional control of gene expression, Operon concept, promoters, enhancers, silencers, hormone responsive elements, transcription factors, post-transcriptional modifications of RNA, exons, introns, splicing, Ribozymes, inhibitors of transcription.

Translation : Genetic code, tRNA, ribosomes, protein biosynthesis, post-translational modifications, inhibitors of translation, signal sequences, chaperones and heat shock proteins, anticancer drugs.

Protein degradation: Cathepsins, Proteosomes, Caspases. Muscle contraction.

### **Paper – III**

#### **Clinical Biochemistry and Nutrition**

Vitamins: Fat soluble and water soluble vitamins, chemistry, absorption, metabolism, biochemical roles, requirement, deficiency manifestations.

Mineral metabolism: Macrominerals, sodium, potassium, chloride, magnesium, calcium, phosphorus. Trace elements: iron, copper, manganese, zinc, cobalt, molybdenum, selenium, iodine and fluoride.

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Nutritional requirements: Energy requirements, balanced diet, nutritional disorders, obesity, starvation, PUFA, dietary fibres, cholesterol.

Protein requirements: Nitrogen balance, nutritive value, biological value, chemical score, protein energy malnutrition, Kwashiorkor and Marasmus.

Membranes: Chemical composition, structure, biological properties, functions, membrane transport systems, ion channels, endocytosis, exocytosis, defects.

Endocrinology: Mechanism of action of hormones, hormone receptors, signal transduction, G-proteins, second messengers, cyclic AMP, cyclic GMP, calcium, Inositol triphosphate, diacyl glycerol, nitric oxide, Biosynthesis of adrenal and thyroid hormones, metabolic regulation by hormones, hormonal regulation of gene expression, hormonal disorders, biochemical investigation of endocrine disorders, thyroid and adrenal function tests.

Erythrocytes: chemical make up, metabolic pathways, haemoglobin, hemoglobinopathies, porphyrias, heme synthesis and degradation, bilirubin metabolism, jaundices, laboratory findings in jaundices.

Composition of blood plasma in health and diseases, normal values.

Acid base balance and electrolyte balance, related disorders.

Biochemical investigations of liver, kidney and gastric functions, malabsorption disorders, inherited metabolic disorders.

Cell biology: cell cycle, check points, regulation, Oncogenes, tumour suppressor genes, Apoptosis, tumour markers.

Reactive oxygen species and defence mechanisms, antioxidants and enzyme systems.

Diagnostic enzymology: LDH, CPK, AST, ALT, ALP, ACP, GGT, Amylase, 5' nucleotidase, etc.

Acute phase proteins: Alpha-1 anti-trypsin, Alpha-2 macroglobulin, Haptoglobin, Ceruloplasmin etc.

Alzheimer's disease, Prions, beta amyloid.

AIDS: HIV, genes and gene products, diagnosis, precautions.

Laboratory management: Precision, accuracy, specificity, sensitivity, percentage error, quality control, precautions in handling hazardous materials.

## **Practical Syllabus ( and Work Schedule)**

### **General Experiments**

- |  |           |
|--|-----------|
| 1) Acids Bases and Buffers : Factors determining Buffer capacity | (3 days)  |
| 2) Colorimetry : Beer's Law                                      | ( 1 day)  |
| 3) Spectrophotometry   | ( 1 day)  |
| 4) Molar extinction coefficient                                  | (1 day)   |
| 5) pK of glycine using pH meter                                  | ( 3 days) |
| 6) General reactions of carbohydrates                            | ( 2 days) |
| 7) Estimation of Antioxidant activity                            |           |
| Ferric reducing ability of plasma (FRAP) method                  |           |
| DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) method             | (4 days)  |
| 8. Chromatography of carbohydrates :                             |           |
| a) Paper   | (2days)   |



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37. Plasma calcium	( 2 days)
38. Plasma inorganic phosphate	( 2 days)
39. Bilirubin : Total & Direct	( 2 days)
40. ALT	( 3 days)
41. AST	
42. Acid phosphatase	
43. Alkaline phosphatase	( 3 days)
44. Serum amylase	( 2 days)
45. GGT	( 2 days)
46. LDH a) Spectrophotometric method	( 2 days)
47. Lipid Profile : Cholesterol -Free & Ester	( 4 days)
Triglyceride	( 2 days)
LDL and HDL	( 2 days)
48. Plasma Vitamin C	( 3 days)
49. Screening tests for Inborn errors of metabolism (IEM)	10 days
50. Toxicology screening tests (Kit methods)	10 days
51. ELISA (TSH)	2 days
<b>Cell Fractions and Enzymes</b>	
52. Subcellular fractionation	( 1 week)
53. Factors effecting enzyme activity	( 15 days)
a) Enzyme concentration	
b) Substrate concentration	
c) pH	
d) Temperature	
54. Cytotoxicity and survival assays invitro	3 days
<b>Training in Clinical Biochemistry Lab</b>	<b>(15 days)</b>

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Routine and specialized assays in clinical biochemistry lab, sample collection methods, quality control methods, statistical analysis of data and setting up of clinical biochemistry laboratory. Days- 30 each in 2<sup>nd</sup> and 3<sup>rd</sup> years

#### **Postings in Microbiology and Hematology lab sections**

Addition of posting in microbiology section of central lab to observe routine culture methods and serological testing for common blood borne diseases. (7 days)

Addition of posting in blood bank and hematology sections of central lab to observe routine methods and testing. (7 days)

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# University Examination Pattern

## 1. At the end of I year (Preliminary Course)

Same as I MBBS as per latest M.C.I. regulations, except that there will be University Examination only in Theory and not in Practicals at the end of the one year course.

## 2. At the end of III year (Final Year)

### Theory

**Paper I:** 3 hrs, Marks-100.

**Paper II:** Duration- 3 hrs, Marks-100.

**Paper III:** Duration- 3 hrs, Marks-100.

### Oral examination

General viva voce and practical bench viva.

**Practicals: Duration- 2 days, Marks-300.**

### Books Recommended

1. Biochemistry Ed Lubert Stryer. W.H. Freeman and Company, New York.
2. Principles of Biochemistry. Ed Lehninger, Nelson and Cox. CBS publishers and distributors.
3. Harper's Biochemistry. Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell. Appleton and Lange, Stamford, Connecticut.
4. Textbook of Biochemistry with Clinical Correlations. Ed. Thomas M. Devlin. Wiley-Liss Publishers.
5. Genes VI. Ed Benjamin Lewin. Oxford University Press.
6. Tietz Textbook of Clinical Chemistry. Ed Burtis and Ashwood. W.B. Saunders Company.
7. Principles and techniques of practical biochemistry. Ed Keith Wilson and John Walker. Cambridge University Press.
8. Biochemistry. Ed Donald Voet and Judith G. Voet. John Wiley & sons, Inc.
9. Molecular Cloning- A Laboratory Manual. J. Sambrook, E.F. Fritsch and T. Maniatis. Cold Spring Harbor Laboratory Press.
10. Molecular Cell Biology, H. Lodish, A. Berk, S.L. Zipursky, P. Matsudaira, D. Baltimore, J. Darnell
11. Bio-technology 1st edition. U. Satyanarayan. Books & Allied Publisher (p) Ltd. Kolkatta.