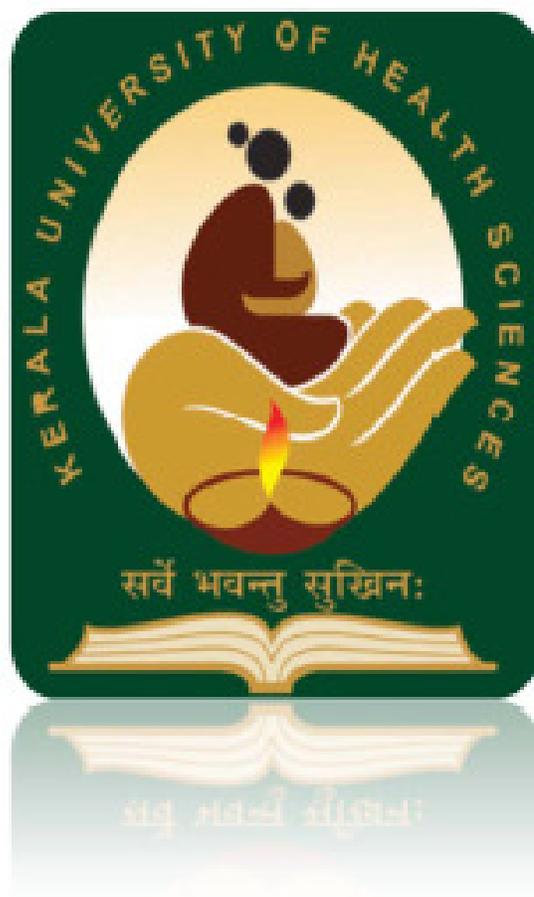


**KERALA UNIVERSITY OF HEALTH SCIENCES**

**THRISSUR - 680 596, KERALA**



***REGULATIONS, CURRICULAM AND SYLLABUS OF  
BACHELOR OF SCIENCE IN MEDICAL BIOCHEMISTRY***

***(B.Sc MEDICAL BIOCHEMISTRY)***

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## **SECTION 1:**

### **OBJECTIVES OF THE COURSE**

1. Acquisition of adequate theoretical and practical knowledge foundation in the basic medical subjects.
2. Aware of the principles underlying the organization of a clinical biochemistry laboratory.
3. Able to do routine and special investigative procedures in clinical biochemistry laboratory practice.
4. Provide a good theoretical and practical education who plan to work within the field of Medical biochemistry.
5. Develop knowledge and skill in accordance with the society's demand in Medical biochemistry.
6. Qualify the students for official approval as Medical biochemist.
7. Able to operate and maintain equipments used in laboratory diagnostics.
8. Able to establish and manage a clinical or research laboratory.
9. Acquisition of moral and ethical codes and conduct of professional practice in a dedicated manner with the patient welfare as the primary responsibility.

## **SECTION 2:**

### **REGULATIONS GOVERNING B.Sc MEDICAL BIOCHEMISTRY COURSE**

#### **2.1 Name of the course:**

Name of the course shall be “**Bachelor of Science in Medical Biochemistry**”.

## **2.2 Minimum qualification for admission and selection of students.**

Candidates who have passed higher secondary examination of the board of higher secondary education, kerala or equivalent there to, 50% marks in biology separately and 50% marks in physics, chemistry and biology together are eligible.

### **Selection:**

The selection is based on the marks obtained for the qualifying examination and the quotas, reservation etc. shall be fixed by the Government from time to time.

## **2.3 Duration of the course**

The duration of the course shall be four academic years. Each academic year spread over a period of 240 working days. The students should undergo hospital laboratory posting in reputed hospitals during the period of the course.

## **2.4 Medium of instruction**

Medium of instruction and examinations shall be in English

## **2.5 Teaching /learning methods**

1. Lecture and practical classes.
2. Regular clinical laboratory posting to pick up practical skill and practice techniques on laboratory responsibility and supervision.
3. Students should present seminars in various clinical subjects in Medical Biochemistry to attain presentation skill.

## **2.6: Attendance requirements**

No candidates can be admitted to any year of university examination unless he or she has a minimum of 80% of attendance. There is one time provision for condonation upto 10% on Medical grounds. The condonation can be given by the principal / head of the institution and should be ratified by the university.

## **2.7: Internal assessment marks**

The internal assessment marks in theory or practicals shall be on the basis of assessment made by the teachers from the candidate's performance in the:

- Three (3) sessional examinations conducted by the department and average of two best performances shall be taken into consideration for the award of internal marks.
- Laboratory work, percentage of attendance, assignments, seminars, projects etc should also be added in the finalized internal marks. (A class log book is to be maintained duly signed by the appropriate teachers.)
- The marks secured by the candidates in each paper shall be forwarded to the University at the end of the academic year for the University examinations. The failed candidates will be allowed a separate internal assessment for both theory and practical.

## **2.8 Clinical posting and project.**

Every candidate admitted to B.Sc Medical Biochemistry course should undergo 6 months of compulsory hospital posting. One month of hospital posting is to be carried out in each of the 1<sup>st</sup>, II<sup>nd</sup> and III<sup>rd</sup> year and 3 months in the IV<sup>th</sup> year during which a mini-project must also be done. Each student can choose a topic for the project in any one of the subject (from the syllabus) which would be approved by his or her supervising teacher. Supervising teacher should have minimum 3 years full time teaching experience. The students should be under the guidance of the supervising charge, carry out the work on the topic selected and prepare a project report including results and references. The project report duly certified by the supervising staff, head of the department of Medical Biochemistry and principal one month prior to the fourth year university practical exam.

## 2.9: Curriculum and credit hours

### I YEAR

<b>PAPER</b>	<b>SUBJECT</b>	<b>THEORY (hrs)</b>	<b>PRACTICAL (hrs)</b>	<b>TUTORIAL (hrs)</b>	<b>TOTAL (hrs)</b>
Paper I	Anatomy	120	120	20	260
Paper II	Physiology	120	120	20	260
Paper II	General Biochemistry	120	120	20	260
Paper IV	Special English, Community medicine, health education, biostatistics and computer application	200	50		250
Paper V	General Methodolgy	120	120	20	260
	Clinical posting				150
<b>Total</b>		<b>680</b>	<b>530</b>	<b>80</b>	<b>1440</b>

## II YEAR

PAPER	SUBJECT	THEORY (hrs)	PRACTICAL (hrs)	TUTORIAL (hrs)	TOTAL (hrs)
Paper VI	Metabolism I, Carbohydrate, lipid and amino acid metabolism	200	225	40	465
Paper VII	Analytical methods and instrumentation	200	120	40	360
Paper VIII	Enzymology	200	225	40	465
Clinical posting					150
<b>Total</b>		<b>600</b>	<b>570</b>	<b>120</b>	<b>1440</b>

## III YEAR

PAPER	SUBJECT	THEORY (hrs)	PRACTICAL (hrs)	TUTORIAL (hrs)	TOTAL (hrs)
Paper IX	Metabolism II	200	285	40	525
Paper X	Clinical Biochemistry	200	285	40	525
Paper XI	Metabolism – III (Nucleic acid metabolism and recombinant DNA technology )	200	-	40	240
Clinical posting					150
<b>Total</b>		<b>600</b>	<b>570</b>	<b>120</b>	<b>1440</b>

## IV YEAR

PAPER	SUBJECT	THEORY (hrs)	PRACTICAL (hrs)	TUTORIAL (hrs)	TOTAL (hrs)
Paper XII	Immunology, Immunochemistry	200	180	40	420
Paper XIII	Diagnostic Biochemistry and laboratory management	200	330	40	570
Paper XIV	Project and hospital laboratory posting				450
Total		400	510	80	<b>1440</b>

### **2.10: Schedule of examination**

There will be two examination in a year (regular and supplementary), to be conducted as per notifications issued by the university from time to time. First, second, third and final year examinations of the B.Sc Medical Biochemistry course shall be held at the end of first, second, third and fourth year respectively. All students will temporarily continue to the next year irrespective of the result of the examination. Supplementary examination shall be conducted by the university within 6 months from the date of announcement of result for the benefit of unsuccessful candidates.

Candidates need to appear for only those papers or subjects in which he or she has failed and includes theory, practical and viva of the failed subjects for securing complete pass in the examination. Particulars of the subjects for various examinations and distribution of marks are shown separately in the scheme of examination.

### **2.11: SCHEME OF EXAMINATION**

**I YEAR**

<b>Paper</b>	<b>Subject</b>	<b>Duration</b>	<b>Max. Marks</b>	<b>Min for Pass</b>
<b>I</b>	<b>Anatomy</b>			
	Theory	2 hrs	50	25
	Practicals	3 hrs	50	25
	Oral		50	
	Internal assessment		50	
	<b>Total</b>		<b>200</b>	<b>100</b>
<b>II</b>	<b>Physiology</b>			
	Theory	2 hrs	50	25
	Practicals	3 hrs	50	25
	Oral		50	
	Internal assessment		50	
	<b>Total</b>		<b>200</b>	<b>100</b>
<b>III</b>	<b>General Biochemistry</b>			
	Theory	2 hrs	50	25
	Practicals	3 hrs	50	25
	Oral		50	
	Internal assessment		200	
	<b>Total</b>		<b>200</b>	<b>100</b>
<b>IV</b>	Special English, Health education, community medicine, Biostatistics and computer application Internal assessment (Theory and practicals)		100	50
<b>V</b>	<b>General methodology</b>			
	Theory	3 hrs	100	50
	Internal assessment		50	-
	Total		150	75

**II YEAR**

<b>Paper</b>	<b>Subject</b>	<b>Duration</b>	<b>Max. Marks</b>	<b>Min for Pass</b>
<b>VI</b>	<b>Metabolism -I</b>			
	Theory	3 hrs	80	40
	Practicals	6 hrs	100	50
	Oral		100	-

	Internal assessment Total		40 320	- 160
<b>VII</b>	<b>Analytical methods and Instrumentation</b> Theory Practicals Oral Internal assessment Total	3 hrs 6 hrs	80 100 100 40 320	40 50 - - 160
<b>VIII</b>	<b>Enzymology</b> Theory Practicals Oral Internal assessment Total	3 hrs 6 hrs	80 100 100 40 320	40 50 - - 160

### III YEAR

<b>Paper</b>	<b>Subject</b>	<b>Duration</b>	<b>Max. Marks</b>	<b>Min for Pass</b>
<b>IX</b>	<b>Metabolism -II</b> Theory Practicals Oral Internal assessment Total	3 hrs 6 hrs	80 100 100 40 320	40 50 - - 160
<b>X</b>	<b>Clinical Biochemistry</b> Theory Practicals Oral Internal assessment Total	3 hrs 6 hrs	80 100 100 40 320	40 50 - - 160
<b>XI</b>	<b>Metabolism – III</b> (Nucleic acid metabolism and recombinant DNA technology) Theory Internal assessment Total	3 hrs	80 40 120	40 - 60

### IV YEAR

<b>Paper</b>	<b>Subject</b>	<b>Duration</b>	<b>Max. Marks</b>	<b>Min for Pass</b>
<b>XII</b>	<b>Immunology and Immunochemistry</b>			
	Theory	3 hrs	80	40
	Practicals	6 hrs	100	50
	Oral		100	-
	Internal assessment		40	-
	<b>Total</b>		<b>320</b>	<b>160</b>
<b>XIII</b>	<b>Diagnostic Biochemistry and Laboratory Management</b>			
	Theory	3 hrs	80	40
	Practicals	6 hrs	100	50
	Oral		100	-
	Internal assessment		40	-
	<b>Total</b>		<b>320</b>	<b>160</b>
<b>XIV</b>	<b>Project</b>			
	Internal assessment		40	20

### **2.12: Criteria for pass**

A candidate shall be declared as pass if he secures 50% of marks in each subject in theory and practical examinations separately. A candidate shall also secure a minimum aggregate of 50% marks in theory section which includes university theory examination and internal assessment and in the practical section a candidate shall secure 50% aggregate marks which include university practical, viva voce and internal assessments.

### **2.13: Conditions under which candidates are permitted to the next higher Class**

A candidate is not permitted to appear in the final year examination unless he or she clear all I<sup>st</sup>, II<sup>nd</sup>, and III<sup>rd</sup>, year B.Sc Medical Biochemistry subjects. A candidate

can however appear for second and third year B.Sc Medical Biochemistry examination without passing previous examination.

#### **2.14: Declaration of class**

Class shall be awarded at the end of each university examination as follows:-

- Distinction – 75% and above
- First class- 60% and above and less than 75%
- Second class- 50% and above and less than 60%

A Candidate passing the university examination in more than one attempt shall be placed in Pass Class only irrespective of the percentage of the marks secured by him or her in the examination.

#### **2.15: Award of rank**

The rank will be declared based on the total marks obtained for the first, second, third and fourth BSc. Medical Biochemistry examination provided the candidate has passed all the subjects in the first attempt.

There shall be no provision for improvement of results in any examinations.

#### **2.16: Award of degree**

For awarding class in the final B.Sc Medical Biochemistry degree examination, the total marks obtained in the first, second, third and fourth B.Sc Medical Biochemistry examination will be taken and the final mark list will contain the following details.

	Maximum marks	Minimum marks
Total marks awarded in the first B.Sc Medical Biochemistry		

Total marks awarded in the second B.Sc Medical Biochemistry		
Total marks awarded in the third B.Sc Medical Biochemistry		
Detailed mark list of fourth B.Sc Medical Biochemistry		
Grand total of I, II, III and IV B.Sc Medical Biochemistry examination marks.		

### **2.17: Examiners (Practical)**

There shall be two examiners- one internal and one external. The external examiner should be a lecturer or above with MSc. Medical Biochemistry and minimum three years teaching experience from other institutions in Kerala.

### **2.18: Question paper setters**

Question paper setters shall be posted from among the senior faculties teaching the same course under Kerala University of Health and Allied Sciences.

#### **Question paper pattern**

➤ **Total marks- 100**

**Time- 3 hrs**

Q1. Structured Essay- 2 no. s x 15 marks = 30 marks

Q2. Brief Structured Essay - 2 no. s x 10 marks = 20 marks

Q3. Short notes - 6 no. s x 5 marks = 30 marks

Q4. Comment on- 10 no. s x 2 marks = 20 mark

➤ **Total marks- 80**

**Time- 3 hrs**

Q1. Structured Essay- 2 no. s x 15 marks = 30 marks

Q2. Short answers- 6no. s x 5 marks = 30 marks

Q3. Comment on- 10 no. s x 2 marks = 20 marks

➤ **Total marks- 50**

**Time- 2 hrs**

Q1. Essay- 2 no. s x 10 marks = 20 marks

Q2. Short answers- 2no. s x 5 marks = 10 marks

Q3. Comment on- 10 no. s x 2 marks = 20 marks

**2.19: Theory paper valuation**

The theory paper should be double valued by both external and internal examiners and there will be no revaluation.

**SECTION 3**

**SUBJECT AND COURSE CONTENT**

## I YEAR

### PAPER I –ANATOMY

1. **Introduction:** to the course and the subject of anatomy.
2. **Orientation to:** the systems of the body; anatomical terminologies; learning methodologies in anatomy; embryology.
3. **Microscopic Anatomy:** structure of cell, types of tissues, cell cycle and division, introduction to genetics.
4. **Respiratory system:** embryology, parts of the system, gross and microscopic structures of the lungs, applied aspects.
5. **Circulatory system:** embryology with emphasis on foetal circulation, parts, microscopic anatomy of vessels, gross and microscopic structure of heart, blood vessels- both arteries and veins in relation, attachment and relations of major vessels to the heart, distribution and tributaries of major arteries and veins, applied aspects.
6. **Digestive system:** embryology, location, parts and functions of the system, gross and microscopic structure, location of digestive glands- gross and microscopic structure, applied aspects.
7. **Urogenital system:** a) Reproductive system: developmental considerations of the male and female systems, gross and microscopic parts of both male and female systems, primary and secondary sexual organs and function, applied aspects.  
b) Urinary system: developmental considerations, parts- gross: kidney in detail- gross and microscopic structure, applied aspects.
8. **Musculoskeletal systems:** classification, location of the bones and muscles in the body, muscle attachment to bones – only brief description, gross features of bones and parts, microscopic features of muscle and bone, joints, classification, bones involved, movements and muscles that produce movements, applied aspects.
9. **Nervous systems:** developmental considerations, parts and division into central nervous system, peripheral nervous system, autonomic nervous system, gross

and microscopy of brain and spinal cord, naming of cranial nerves, functions served by each of them, brief account of degeneration and regeneration of nerves, applied aspects.

10. **Endocrinology:** brief outline of location and function of the endocrine glands.
11. **Special senses:** eye, ear, nose, tongue.
12. **Miscellaneous topics:** skin and appendages, microscopic structure, general considerations of upper limb, lower limb, head and neck, thoracic and abdominal cavities, pelvic cavity.

### **Practical**

1. Demonstration of systems of the body.
2. Microscopic demonstration for histology
3. Osteology demonstration
4. Practical and applied anatomy demonstration depending on the topic.

### **PAPER II- PHYSIOLOGY**

1. **Blood** : Composition of blood; Structure and function of RBC; WBC and platelets; blood coagulation; blood groups; Reticuloendothelial system; Structure and function of spleen; Jaundice and Anemia
2. **Cardiovascular system:** Structure and properties of cardiac muscles; nerve supply to heart; Structure and function of blood vessel; Cardiac cycle and pressure changes; heart sounds; cardiac output; heart rate; cardiovascular reflexes; Blood pressure; haemorrhage; ECG; changes in muscular exercises
3. **Respiratory system** : Physiological anatomy; mechanism of respiration; lung volume and capacities; breath sound; types of respiration; artificial respiration; transport of blood gases; regulation of respiration; hypoxia; effects of exercise
4. **Digestive system:** Digestion in mouth, stomach and intestine; digestion of carbohydrates, fats and protein; control of secretion; absorption; structure and function of liver

5. **Excretory system:** Gross and minute structure of kidney; OTR; formation of urine; tubular function, renal function test, micturition.

6. **Muscle:** Structure of muscles; muscle contraction

7. **Nervous system:** Structure of neurons; nerve impulse; structure and function of spinal cord; spinal reflexes and pathways; structure and functions of different parts of brain; autonomic nervous system; neurohumoral transmission; CSF; Physiology of touch , smell, taste, hearing and vision; reflexes

8. **Endocrine system:** Structure and functions of pituitary, thyroid, adrenal glands; Thymus and pancreas

9. **Reproductive system:** Sex determination and development; puberty; structure and function of male and female reproductive system; pregnancy; parturition; lactation; foetal circulation

## PRACTICALS

1. RBC count
2. WBC count
3. Differential count
4. Platelet count
5. Eosinophil count
6. Haemoglobin estimation
7. ESR determination
8. Fragility and blood groups
9. Measurement of blood pressure in man
10. Respiratory movement

11. Methods of artificial respiration
12. TPR chart; Examination of sensory system; motor system; reflexes; cranial nerves
13. ECG
14. Cardiac efficiency test

### **PAPER III- GENERAL BIOCHEMISTRY**

1. **Introduction:** chemistry of living things and cell- eukaryotic and prokaryotic cell structure, cell organelles and biological membranes- its structure and functions.
2. **Carbohydrates:** Classification, Chemistry, Properties of mono- , di- and polysaccharides, Carbohydrate metabolism.
3. **Proteins:** Classification of proteins and amino acids, their properties, structure of proteins and amino acids, plasma proteins, general reactions of amino acids,
4. **Lipids:** classification of lipids, properties of fatty acids, phospholipids and sterols, lipoproteins- characterization, classification.
5. **Enzymes:** general properties, classification
6. **Vitamins and minerals:** (brief description) fat soluble and water soluble, chemistry, functions, dietary sources, daily requirements, deficiency manifestations, minerals and trace elements.
7. **Nucleic acids:** chemistry of purines and pyrimidines, nucleosides, nucleotides, nucleic acids- DNA, RNA, difference between DNA and RNA types of RNA, DNA
8. **Physical chemistry:** methods of expressing concentration, law of mass action and chemical equilibrium, solubility products, colloidal state and Donnan membrane equilibrium, diffusion, dialysis, osmosis, reverse osmosis, surface tension, viscosity and absorption, indicators
  - **Acids and bases:** definition, ionization of acids, ionic product of water,  $H^+$  concentration, strong acids and bases, weak acids and bases, strength of acids, titration curves of acids and bases, Properties of commonly used

- acids and bases- sulphuric acid, nitric acid, phosphoric acid, HCl, acetic acid, KOH, NaOH, sodium carbonate, ammonia
- **P<sup>H</sup>** – definition, P<sup>H</sup> scale, calculation of P<sup>H</sup>, Henderson- Hasselback equations, P<sup>H</sup> measurement
  - **Buffers**- definition, components, mechanism of action, buffer capacity, pK of buffers, preparation of buffers, buffers in biological system, commonly used buffers in lab
  - **Properties of commonly used salts**- ammonium chloride, ammonium sulphate, sodium sulphate, sodium chloride, zinc sulphate.
  - Properties of chloroform, formalin
  - **Properties of commonly used solvents**- methanol, ethanol, xylene, benzene, acetone

## Practical

1. Reactions of carbohydrates:
  - Monosaccharides- glucose, fructose, galactose
  - Disaccharides- maltose, lactose, sucrose
  - Polysaccharides- starch, dextrin
  - Qualitative analysis of unknown carbohydrate solution
2. Reactions of proteins: colour reactions and precipitation reactions
  - Reaction of albumin, peptones, gelatin, casein.
  - Qualitative analysis of unknown protein solution
3. Reactions of lipids
  - Qualitative tests – solubility test
    - Acrolein test
    - Tests for fatty acids
    - Tests for unsaturation of fatty acids

## PAPER IV :

### 1. SPECIAL ENGLISH:

Students of professional courses have a tendency to neglect the language content. The paper 'special English' is introduced with a view to developing the communication skill of the participants in written and spoken English. The emphasis will be fully on the practical aspects of language use, and not on literature. The course content may also help the students to take up overseas examinations in English proficiency like the TOEFL

#### 1. Writing skills

Composition- writing effective paragraphs, ability to describe objects people's process and ideas and narrating incidents-note taking/making summaries. Writing telegrams, advertisements, preparing laboratory reports

Letter writing- business letters-applying for a job, for higher studies, preparing curriculum vitae, subscribing to a journal, requesting for information, ordering equipments, letters to the editor.

#### 2. Foundation English

Revision of basic grammar, common errors in English, language functions in medical writing-use of passive voice particularly in scientific and official writing, expressing obligation-use of must, should, ought; expression of possibility, likelihood, certainty; decrease of comparison, expression of necessity-must, have to, need to; expression of generalisation and emphasis

#### 3. Vocabulary

The language of doctor and patient. General description and medical description and medical terminology- roots, prefixes and suffixes, medical abbreviations.

#### 4. Spoken English

A course in speech in conversation with focus not on phonetics and grammar but on developing their ability to talk about objects and experiences around them

Fixing appointments-getting information-Managing medical representatives-telephoning in hospital. The object is to provide practice in fluent conversation. Focus is on specific expressions typical of familiar situations in medical practice. Technique of discussion at medical meeting, making presentation.

## **2. COMMUNITY MEDICINE**

1. General concepts of health and diseases with reference to natural history of diseases with pre pathogenic and pathogenic phases. The role of socio economic and cultural environment in health and diseases. Epidemiology and scope.
2. Public health administration-an overall view of the health administration setup-central and state level
3. The national health programme.highlighting the role of social,economic and cultural factors in the implementation of the national programme.
4. Health problems of vulnerable groups-pregnant and lactating women, infants and school going children, occupational groups, geriatrics.
5. Occupational health-definition, scope, occupational diseases, prevention of occupational diseases and hazards.
6. Social security and other measures for the protection of occupational hazards accidents and diseases. Details of compensation acts.
7. Family planning- objectives of optimal family planning methods – a general idea of advantages and disadvantages of the method.
8. Mental health- community aspects, role of physiotherapists, therapists in mental health problems such as mental retardation.

9. Communicable diseases- an overall view, classification, principle mode of classification, role of insects and other vectors.

10. International health agencies

Health education

1. Review of benefits, values, norms, habits and taboos among practices. More in human groups and their importance in learning and change process.

2. Review of concepts on perception, attitudes, socialization process, learning and theories of learning, social change and change process, motivation, needs and drives.

3. Principles and process of communication

4. health education – philosophy, main principles and objectives.

Health education vs propagandas

5. methods and tools of health education- individual and group method. A critical evaluation of theories, tool and health education

6. the role of profession in health education – role of other personal in health education, coordination and corporation in health education with other members of the health team.

7. Elements of planning a health education programme.

### **3. BIO STATISTICS**

1. Introduction

2. Application of statistical principles in biology

3. Significance tests 'T' test,  $\chi^2$  to values

4. Probability and statistical inference

5. Statistical surveys and representation of data.

### **4. COMPUTER APPLICATION**

- History of computers, types of computer generation, digital computer organization, binary number system
- Algorithm flow chart
- Operating system, dos commands
- Programming in basics

- Application of computer in health education, training and administration

#### Additional topics

1. Multi terminal operational system(UNIX/ZENIX)
2. MS windows(graphical user interphase)
3. DBMS (DBASE<FoxBASR etc)
4. Word processing professional(word state upto ver 7/MS word)
5. Spread sheet application like LOTUS 123/EXCEL
6. Introduction to computer programming application software

### **PAPER V: GENERAL METHODOLOGY**

#### **BIOCHEMISTRY**

- Units of measurements
- Laboratory glass wares- glass – composition, properties, varieties, grades of glass wares. General laboratory wares – glass and plastic- PVC, poly carbonate, Teflon etc. Advantages and disadvantages of various disposable lab ware.
- Cleaning of laboratory glass wares, Preparation of cleaning solution for glassware, cleaning and care of laboratory glassware and instruments.
- Reagent grades, storage and handling of chemicals and reagents
- Laboratory safety- general principles, laboratory hazards and safety measures, universal safety precautions.
- First aid in laboratory accidents.
- Calibration of pipettes and other volumetric apparatuses
- Methods of measuring liquids, weighing solids
- Volumetric analysis, preparations of standard solutions and reagents
- Primary standard chemicals and secondary standard chemicals
- Preparations of normal solutions, percentage solutions, molar and molal solutions.
- Dilution of solutions – inter conversion of concentrations- normal, molar, molal and percentage solution. Preparation of reagents for various biochemical analysis, indicators.

- Familiarization with kipp's apparatus, blowing of glass capillary tube and pasture pipettes.
- Preparation and storage of distilled, double distilled and deionised water
- Measurement of  $p^H$

## **PRACTICALS**

- Measurement of liquids and weighing solids
- Calibration of pipettes and other volumetric glasses
- Titration of acids and bases
- Preparation of cleaning solution
- Preparation of buffer solution, pH measurement.

## **PATHOLGY**

- General introduction to clinical laboratory procedures
- Organization of clinical laboratory, its layout and design
- Labeling and registering of specimens
- Analytical balance- parts, principles of use and care
- General knowledge of the principles, use and care of the hot air ovens, incubator, vortex mixer, magnetic stirrer, dessicator, waterbath, refrigerators, centrifuges
- Anti-Coagulants and preservatives, preparation of anti coagulant bottles for blood collection for different parameters, urine preservatives, capillary and venous blood collections, preparation of thin blood smear and bone marrow smear, preparation of normal saline
- General introduction to quality control in different laboratory, record keeping
- Organisation of the cytopathology laboratory, design and layout out of a histopathology laboratory, essential components in histopathology laboratory, their use and care
- Principle of action, use and preparation of various buffers for haematologically use

## **PRACTICALS**

- Blood collection
- Blood Smear preparation
- Urine analysis

## **MICROBIOLOGY**

- History of microbiology
- Classification of microorganisms, morphology of bacteria
- Bacterial growth and nutrition
- Microscopy: optical microscopy, phase contrast microscope, dark field microscope, interference microscope, polarisation microscope and electron microscope
- Staining methods
- Sterilisation and disinfection-methods of sterilisation, disinfectants- different types, methods and applications and cleaning
- preparation of glass wares
- Culture media- introduction, classification, preparation
- Methods of cultivation of bacteria, anaerobic culture methods
- Safety precautions in microbiology laboratory design, specifications, microbiology laboratory associated infection, safety codes of laboratory practice
- Care and managements of laboratory animals- the basic knowledge of the feeding, housing, breeding and care of following animals- rabbit, mouse, guinea pig, rat, sheep, fowl, monkey, etc, collection of blood samples, killing of animals and postmortem examination, different route of animal inoculation
- Automation in microbiology laboratory

## **PRACTICALS**

1. Students should be familiar with the use of simple autoclave, incubators, hot air oven, water bath and steamer
2. Staining methods- simple and differential
3. Hanging drop examination for motility
4. Demonstration of Preparation of culture media, demonstration of culture methods
5. Handling of laboratory animals

## **II YEAR**

### **PAPER VI- METABOLISM - I**

#### **CARBOHYDRATE, LIPID AND AMINO ACID METABOLISM**

1. Metabolism of carbohydrates
  - Digestion and absorption of carbohydrates
  - Major metabolic pathways of glucose- metabolic steps, energetics, functions and regulation of following pathways- glycolysis, fates of pyruvates, gluconeogenesis, glycogen metabolism, cori's cycle, Pasteur effect
  - HMP shunt pathway, Uronic acid pathway, metabolism of fructose and galactose, glycoxylate cycle
  - Inborn errors of metabolism of carbohydrates, glycogen storage diseases, essential fructosuria, pentosuria lactose intolerance, galactosuria, G6PD deficiency.
  - TCA cycle- reaction and significance
  - Bioenergetics: Gibbs free energy, enthalpy, entropy, redox potential coupled reactions, reducing equivalents
  - Electron transport chain- shuttle system, mechanism of oxidative phosphorylation, activators and inhibitors.
2. Metabolism of lipids
  - Digestion and absorption of Lipids

- Oxidation of Fatty acids- Beta, Alpha, Omega and peroxisomal Oxidation of unsaturated Fatty acids, Odd chain Fatty acids
  - De novo synthesis of Fatty acids, chain elongation, synthesis of unsaturated Fatty acids, PUFA and their importance, Eicosanoids classification and biological functions.
  - Metabolism of adipose tissue, synthesis and break down of TAG, Fatty liver and lipotropic factors, lipid storage diseases
  - Synthesis of cholesterol, regulation, functions of cholesterol, bile acids-synthesis
  - Ketone bodies- synthesis and utilization, ketosis
3. Metabolism of aminoacids
- Digestion and absorption of proteins
  - General reactions of amino acids-transamination, oxidative deamination, transdeamination
  - Removal of ammonia- sources and utilization of ammonia, urea cycle hyperammonemias
  - Glucogenic and ketogenic aminoacids, overall metabolism of different aminoacids
  - Detailed metabolism of glycine, phenyl alanine, tyrosine, tryptophan and histidine, sulphur metabolism
  - Creatinine, glutathione, catecholamines, polyamines, nitric oxide metabolism
  - One carbon metabolism
  - Inborn errors of amino acid metabolism

### PRACTICALS:

1. Estimation of following parameters in blood / plasma/ serum/ urine/CSF by different methods:
 

+ Glucose	+ Cholesterol – total and HDL
+ Triglycerides	+ Total protein
+ Albumin, A/G ratio	+ Urea, creatine, creatinine, uric acid

## **PAPER VII- ANALYTICAL METHODS AND INSTRUMENTATION**

### **1. Colorimetry:**

- Properties of light, Electro magnetic spectrum, mono and poly chromatic light , absorption and transmission of light , principle of colorimetry, Beer Lamberts law, selection of filters, Flame photometer, Atomic absorption spectrophotometer, Fluorimeter, Nephelometry and Turbidimetry

### **2. Chromatography:**

- General principles, partition and adsorption principles
- Paper chromatography, column chromatography, TLC, ion exchange chromatography, molecular exclusion chromatography, affinity chromatography, HPLC and GLC

### **3. Electrophoresis:**

- Theory and factors affecting electrophoresis. Principle, technique and applications of paper electrophoresis.
- Gel electrophoresis- types of gels, solubilizers, tracking dyes
- PAGE
- Applications of gel electrophoresis.
- immuno electrophoresis and iso electric focusing

### **4. Centrifugation**

- Principle, RCF, rpm
- Types of centrifuges, different types of rotors
- Ultra centrifugation, density gradient centrifugation
- Determination of molecular weight using centrifugation
- Cell fractionation by differential centrifugation
- Isopycnic centrifugation or equilibrium isodensity centrifugation
- Density gradient materials
- Applications of centrifugation

### **5. ELISA**

- Different methods, substrates and enzymes used
- Applications of ELISA

### **6. Radio activity**

- Isotopes, different types of radiations, measurement of radioactivity- scintillation and GM counter.
- Use of radioactive isotopes in biochemistry and medicine

- Biological effects of radiation
  - General laboratory rules for handling RA isotopes
  - Radiation protection and disposal of radioactive wastes
7. **RIA** : different methods, labeled probes. Applications of RIA

## PRACTICALS

1. Colorimetry
  - Verifications of Beer- Lamberts law
  - Determination of  $\lambda_{\max}$  and selection of wavelength
  - Estimation of concentration of unknown solution
2. Spectrophotometry
3. Flame photometry
4. Chromatography- paper, TLC
5. Electrophoresis
6. P<sup>H</sup> meter
7. Buffer preparation
8. ELISA

## PAPER VIII- ENZYMOLOGY

1. Properties, classification, nomenclature of enzymes
  - Oxidoreductases
  - Specificity of enzymes, factors influencing enzyme action,
  - Active site and catalytic groups, prosthetic group, co-enzyme, co-factors, metallo- enzymes and metal activated enzymes.
  - Iso-enzymes, multi enzyme complex, ribozymes, immobilised enzymes
  - Enzyme units and turn over number
  - Reaction rate and equilibria of enzyme catalyzed reactions
2. Mechanism of enzyme action
  - Action of chymotrypsin and lysozyme
3. Enzyme kinetics, Michaeli's Menten's law, Lineweaver Burke plot.
4. Enzyme inhibition-various types with examples, application in clinical medicine
5. Regulation of enzyme action.
6. Isolation and purification of enzymes
7. Clinical enzymology
  - Functional and non functional serum enzymes

- Clinical importance and methods for the estimations of AST, ALT, ALP, CK, LDH, ACP, 5' nucleotidase, amylase, lipase, GGT, ceruloplasmin, G6PDH, aldolase, leucine amino peptidase, iso citrate dehydrogenase, enolase, choline esterase.
- Plasma enzyme pattern in various disease conditions like MI, Liver diseases, bone disorders, pancreatic disease and malignancies
- Therapeutic enzymes

### PRACTICALS

1. Determination of  $K_m$  value
2. Estimation of clinically important enzymes
  - AST, ALT, ALP, GGT, ACP, Amylase, LDH, CPK

## III YEAR

### PAPER IX- METABOLISM II- NUTRITION , HEAM, VITAMINS, MINERALS AND HORMONES

1. **Vitamins** – classification, sources, daily requirement, structure, functions and deficiency diseases of
  - Fat soluble - A, D, E & K.
  - water soluble vitamins
  - Vitamin C-
  - B complex vitamins-
  - Anti-vitamins
2. **Minerals** : classification, sources, daily requirements, functions and disorders of various minerals
3. **Nutrition and dietetics**: respiratory quotient, Basal metabolic rate, specific dynamic action, nitrogen balance, protein quality, biological value, dietary fiber, balanced diet.
  - Preservatives and adulterants in food.
  - Obesity
  - Protein – energy malnutrition
  - Starvation
  - Diet therapy for DM, arteriosclerosis and hyper tension.

Glycemic index

4. **Heam metabolism**- chemistry and properties of heamoglobin and myoglobin, transport of gases, oxygen dissociation curve, isohydric transport of carbondioxide, biosynthesis of Hb, catabolism of heam.
  - Porphyrines- porphyrines and disorders of [porphyrine metabolism. Chemistry of porphyrins, porphyrias- primary and secondary porphyrias and its analytical procedures.
  - Bile pigments- bilirubin and related chromoproteins
  - Hb derivatives, heamoglobin variants, jaundice
5. **Hormones:** - Endocrine organs – hormones, classification of hormones, hormone receptors- insulin receptor, secondary and tertiary messengers.
  - Mechanism of action of hormones.
  - Hypothalamic hormones- chemistry, functions and disorders.
  - Pituitary hormones- chemistry, functions and disorders.
  - Thyroid and parathyroid hormones-chemistry, synthesis, functions and disorders
  - Pancreatic hormones- insulin and glucagon –chemistry, formation, functions and disorders.
  - Adrenal hormones- classification, chemistry, synthesis, functions and disorders
  - Gonadal hormones- classification, chemistry, functions, disorders.
  - GIT hormones- their functions.
  - Other hormones.

## **PRACTICALS**

1. Estimation of calcium, phosphorous
2. Estimation of serum electrolytes- sodium, potassium, chloride, bicarbonate
3. Estimation of iron and TIBC
4. Estimation of vitamin A, C, E and metabolites of vitamins in urine (B-complex)
5. Hormone assays
  - T<sub>3</sub>, T<sub>4</sub>, TSH
  - Estimation of 17 – keto steroids
  - Estimation of VMA

## **PAPER X- CLINICAL BIOCHEMISTRY**

1. Clinical conditions related to carbohydrate metabolism- blood glucose regulation
  - Hyperglycemia- Diabetes mellitus
  - Hypoglycemia
  - Methods of estimation of blood glucose
2. Clinical conditions related to lipid metabolism
  - Diagnosis and treatment of lipid disorders
  - Lipo proteinemia disorders
  - Atherosclerosis and CHD
  - Lipid profile- methods of estimation of cholesterol and TG
3. Clinical conditions related to protein metabolism
  - Plasma proteins- separation, classification, functions and clinical significance, Acute phase proteins
4. Methods of estimation of urea, creatinine and uric acid
5. Xenobiotics- biological effects of pollutants- pesticides and toxins. Adultrants in food, food preservatives, Detoxification- phase I and phase II reactions, metabolism of ethanol, toxic effects of ethanol
6. Water and electrolyte balance and imbalance- water intake and loss, regulatory mechanisms, blood osmolarity and osmolality, extra cellular and intracellular cations and anions, electrolyte balance
  
7. Acid base balance- blood buffers, mechanism of action acidosis and alkalosis, compensatory mechanisms, assessment of acid base status.
8. Therapeutic drug monitoring
9. Ageing

## **PRACTICALS**

1. Urine analysis – normal and abnormal constituents
2. GTT, glycated hemoglobin, fructosamine, micro albumin
3. Lipid profile
4. Acute phase proteins
5. Plasma proteins
6. Estimation of plasma alkali reserve
7. Estimation of titrable acidity and urinary ammonia

## **PAPER XI- METABOLISM – III (Nucleic acid metabolism and recombinant DNA Technology)**

1. Nucleotide metabolism- structure of purines and pyrimidines. De-novo synthesis of nucleotides and degradation. Salvage pathway for the synthesis of nucleotides. Disorders- gout and inborn errors.
2. Chromosomes- structure, genes- chemical nature
  - Organization of chromatin in nucleus
3. DNA replication and repair
4. Transcription and post-transcriptional modifications, inhibitors
5. Genetic code, translation and post translational modifications, inhibitors
6. Protein targeting
7. Regulation of gene expression-prokaryotes and eukaryotes
8. Mutation
9. Recombinant DNA technology
  - Tools- restriction endonuclease, vectors
  - Steps
  - Techniques- blot techniques
    - RFLP
    - PCR
    - DNA finger printing
  - Applications: gene therapy, trans genics

## IV YEAR

### PAPER XII- IMMUNOLOGY AND IMMUNOCHEMISTRY

1. **Infection:** source, methods of transmission and routes of infection.
2. **Immunity:** innate immunity- mechanism of innate immunity, acquired immunity- active and passive immunity, natural and artificial immunity, vaccination
3. **Structure and functions of immune system:** lymphoid organs- primary and secondary lymphoid organs, cells involved in immune system- lymphocytes, APC- functions, surface receptors
4. **Antigens:** characteristics, determinants of antigenicity, antigenic specificity- epitope-characteristics- hapten, adjuvants.
5. **Antibodies:** classification, structure and function of immunoglobulins, theories of antibody formation, monoclonal antibodies- their synthesis and significance.
6. **Immune response:** humoral and cell mediated, mechanism
7. **Antigen-antibody reaction:** general features, precipitation reactions, immuno diffusion, agglutination, CFTs, neutralisation, RIA, ELISA, immuno flurescence, immuno electrophoresis
8. **Complement system:** general properties, components, complement activation, classical, alternate pathway, biological effects of complements, quantification of complements and its importance. Deficiency diseases.
9. **Immuno hematology:** ABO blood group system, Rh blood group system, medical application of blood groups, heamolytic disease of newborn, identification of Rh incompatibility, Rh immunization
10. **Immuno deficiency diseses:** humoral and cellular immuno deficiency, AIDS, disorders of specific immunity, disorders of complement, disorders of Phagocytosis
11. **Hypersensitivity** :- classification, basic mechanism,
12. **Autoimmunity-** mechanism of autoimmunization
13. **Immunology of transplantation:** allograft rejection, histocompatibility, MHC classification, location, its importance.

14. **Biochemistry of cancer:** cell cycle, mutagens, oncogenes, tumor markers, immuno therapy of cancer.

### 15. Vaccines

### PRACTICAL:

1. Immuno electrophoresis (Demonstration)
2. Serological reactions
3. Precipitation reaction
4. Agglutination reaction
5. Coombs test
6. ELISA

## PAPER XII- DIAGNOSTIC BIOCHEMISTRY AND LABORATORY

### MANAGEMENT

1. **Organization of a clinical laboratory-** basic requirements in heamatology, pathology, microbiology, serology and biochemistry departments in a lab
2. **Automation in clinical biochemistry lab-** definition, principle, different parts and functions, merits and demerits of different auto analysers.
  10. Continuous flow analysers
  11. Discrete analysers
    - I] Batch analysers-
      - a) semi auto analysers
      - b) fully automated analysers
    - II] Stat analyser-
      - a) Centrifugal analyser
      - b) Dry chemistry analyser
- Recent trends in automation of clinical chemistry
3. **Biochemical specimens-** specimen collection, transport, preservation and storage
  - Scientific practice of handling specimens
  - Laboratory management and planning, receiving and recording of specimens, indexing, maintaining records.

- Disposal of wastes.
- 4. Diagnostic importance of CSF, pleural fluid, seminal fluid, amniotic fluid, saliva and sweat in clinical biochemistry.
- 5. **Tumor markers:** classification, their importance in differential diagnosis – Bence- Jones's proteins, AFP, serotonin, PSA, TPA, MCA, CA, CEA, beta HCG, VMA.
- 6. **Quality Control-** definition of precision , accuracy, standard deviation
  - Pre analytical variables and analytical variables
  - Quality control charts, control serum
  - Quality control programme
    - a) Internal quality control and b) external quality control
- 7. Establishment and use of reference values, analytical and statistical procedures used in establishing reference values.
- 8. Interpretation of results.
- 9. Liver function tests
- 10. Renal function tests
- 11. Gastric function tests
- 12. Cardiac function tests
- 13. Thyroid function tests
- 14. Pancreatic function tests

### **PRACTICAL:**

1. LFT
2. RFT
3. TFT
4. CFT
5. PFT
6. Preparation of QC chart.

### **Recommended books:**

1. B.D. Chaurasia's Human Anatomy (vol 1- 3) Regional and Applied
2. Gray's Anatomy for students Richard. L. Drake, A. Wayne Vogl, Adam W.M. Mitchell
3. Text book of Human Histology with colour Atlas Inderbir Singh
4. Essentials of Medical Physiology- K. Sembulingam, Prema sembulingam
5. Concise Medical Physiology - Sujith K chaudari
6. Ganong's Review of Medical Physiology - Kim E Barrett, Susan M Barman, Scott Boitano, Heddwen Brooks
7. Textbook of Medical Physiology -Authur C Guyton, John E Hall
8. Prescott / Harley klein's microbiology - Author's: joanne willey, Linda Sherwood, Chris Woolverton
9. Mackie and McCartney practical mediac microbiology
10. Microbiology: an introduction - Author: Gerard J. Tortora Berdell R. Funke, Christine L. Case
11. Microbiology : principles and exploration - Author's: Jacquelyn G. Black
12. Ananthanarayanan and Paniker's text book of microbiology
13. Medical laboratory technology (vol 1-3) - Author: Kanai L. Mukherjee
14. Text book of medical laboratory technology by Praful B Godkar, Darshan P Godkar
15. Practical clinical biochemistry - Author: Harold Varley
16. Text book of clinical biochemistry- Author: Nobert W. Teitz
17. Clinical biochemistry- Author: Kaplan
18. Biochemistry in clinical practice- Author: Williams and Marks
19. Clinical chemistry in diagnosis and treatment- Author: Philip D. Mayne
20. Biochemistry- Author: Trehan
21. Clinical chemistry- Author : Michel L Bishop
22. Clinical biochemistry metabolic and clinical aspects- Author: William J. Marshal
23. Lecture notes on clinical biochemistry- Author : L.J. Whitby
24. Biochemistry- a care oriented approach- Author: Montogomiry
25. Practical clinical biochemistry- Author: Harolod Varley
26. Practical biochemistry- Author: Wilson and Walker
27. Harper's biochemistry- Author: R K Murray and Granner
28. Clinical biochemistry principles and practice- Author: Praful B Godkar
29. Principles of biochemistry- Author: Lehninger
30. Biochemistry- Author: Lubert Stryer

31. Enzymes – Author: Zubay
32. Biochemistry with clinical correlation- Author : Devlin
33. Harrison's internal medicine
34. Clinical diagnosis and management by laboratory methods- Author: John Bernard Henry
35. Textbook of biochemistry- Author: Vasudevan and Sreekumari.S
36. Biochemistry – Author: Deba Jyothi Das
37. Textbook of medical biochemistry- Author: M N Chatterjee
38. Kuby's textbook of immunology
39. Essential immunology – Author: Roitt and Roitt
40. Basic and clinical immunology- Author: Daniel P Straits