

**Syllabus for courses affiliated to
the Kerala University of Health Sciences
Thrissur 680596**



Bachelor of Science in Medical Biochemistry

Course Code 020

(2024-25 Academic year onwards)

2. COURSE CONTENT

2.1. Title of course:

Bachelor of Science in Medical Biochemistry

2.2. Objectives of course:

The primary objective of this course is to give students a solid foundation in biochemical processes in human beings, to develop analytical, technical and critical thinking skills and to make them scientifically literate so as to contribute to the discipline after graduation.

Specific objectives are:

1. Acquisition of adequate theoretical and practical knowledge of foundation in the basic medical Subjects.
2. Aware of the principle underlying the organization of a clinical laboratory.
3. Ability to do routine and special investigative procedures in Medical 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. Proficiency in operating and maintaining all equipment used in Biochemistry laboratory.
8. Establish and manage a clinical or Research laboratory.

2.3. Medium of instruction:

The medium of instruction for the course shall be English.

2.4. Course outline

It is a four-year Professional Degree course with a total course duration 5760 hours including 1000 hours of training in Clinical Laboratories and a Project Work in the Final year.

The course consists of mainly:

Theory classes:

Includes scheduled teaching in lectures, tutorials, assignments & seminars to ensure active participation of the students.

Practical classes:

Laboratory based practical work is an integral part of the course which is inevitable for the careers in hospital clinical laboratories and research field.

Clinical Laboratory Posting:

Clinical laboratory is the place where materials of human origin and/or human healthcare environment are collected, stored, processed and/or analyzed and reported for the purpose of screening, diagnosis, prognosis, treatment or prevention of diseases and for clinical research. Regular clinical posting is unavoidable for developing qualified laboratory personnel who is competent for interpreting and reporting.

Project:

A laboratory based project work is included in the final year which gives the students an idea to document the work and its results in a thesis like report. The principal aim is to make the students independent as a future graduate in the research field. The supervising teacher gives guidance for carrying out project work.

2.5. Duration

☆ 4 years

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2.6. Subjects

I Year BSc Medical Biochemistry

- Paper I - Anatomy
- Paper II - Physiology
- Paper III - General Biochemistry
- Paper IV- General Methodology
- Paper V- Community Medicine, Health education and Communicative English

II Year BSc Medical Biochemistry

- Paper VI - Analytical methods & Instrumentation
- Paper VII - Enzymology
- Paper VIII - Endocrinology, Toxicology and Human Nutrition

III Year BSc Medical Biochemistry

- Paper IX- Intermediary Metabolism
- Paper X- Intermediary Metabolism- II
- Paper XI – Clinical Biochemistry
- Paper XII - Human Genetics & Molecular Biology

IV Year BSc Medical Biochemistry

- Paper XIII - Immunology & Immunochemistry
- Paper XIV – Diagnostic Biochemistry and Laboratory management
- Paper XV- Research Methodology, Biostatistics and Information technology and Artificial Intelligence in Healthcare
- Paper XVI- Project

The concept of health care counseling shall be incorporated in all relevant areas.

2.7. Total number of hours

The students have to attend a minimum of 240 working days in an academic year. Total course duration is 5760 hours including 1000 hours of hospital laboratory training.

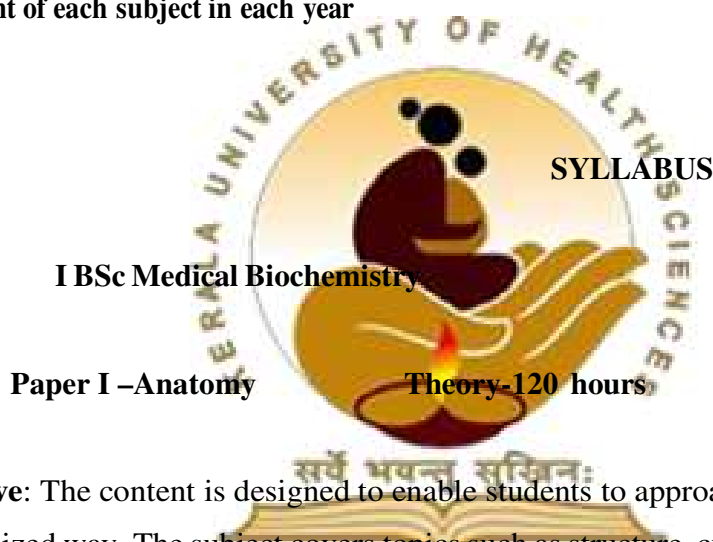
2.8. Branches if any with definition

See clause 2.10.

2.9. Teaching learning methods

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

2.10. Content of each subject in each year



Objective: The content is designed to enable students to approach the study of human body in an organized way. The subject covers topics such as structure, cytology, histology and provides essential knowledge about the human body and its systems.

- **Introduction:** to the course and the subject of anatomy. (2 hrs)
- **Orientation to:** the systems of the body; anatomical terminologies; learning methodologies in anatomy; embryology. Introduction of genetics. (6 hrs)
- **Microscopic Anatomy:** structure of cell, cell cycle and division, types of tissues – it's features. (10 hrs)
- **Respiratory system:** embryology, parts of the system, gross and microscopic structures of the lungs and trachea. Gross features of nasal cavity, pleura, diaphragm - applied aspects. (12 hrs)
- **Cardiovascular system:** gross and microscopic structure of heart, pericardium, embryology with emphasis on fetal circulation, parts and microscopic anatomy of

vessels, 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. (12 hrs)

- **Digestive system:** embryology, location, parts and functions of the system – tongue, stomach, intestine, liver, pancreas, gall bladder and spleen – gross and microscopic structure. Location of digestive glands - gross and microscopic structure. Applied aspects. (12 hrs)
- **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. (12 hrs)
b) Urinary system: developmental considerations, parts, gross and microscopic structure of kidney, ureter and urinary bladder, applied aspects. (10 hrs)
- **Musculoskeletal systems:** classification, location of the bones and muscles in the body, gross features of bones and parts, microscopic features of muscle and bone, joints, classification, bones involved, applied aspects. (12 hrs)
- **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, cerebellum, brain stem, naming of cranial nerves, functions served by each of them, brief account of degeneration and regeneration of nerves, applied aspects. (12 hrs)
- **Endocrinology:** brief outline of location and function of the endocrine glands. Gross and microscopic structure of thyroid, parathyroid, pituitary glands and adrenal gland. (10 hrs)
- **Special senses:** eye, ear, nose, tongue, skin and appendages. (10 hrs)

Practical (80 hrs)

- Demonstration of systems of the body.
- Microscopic demonstration for histology
- Osteology demonstration

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- Practical and applied anatomy demonstration depending on the topic.

Recommended books

- B.D. Chaurasia's Human Anatomy (vol 1- 3) Regional and Applied

References

- Gray's Anatomy for students Richard. L. Drake, A. Wayne Vogl, Adam W.M. Mitchell
- Text book of Human Histology with colour Atlas Inderbir Singh

Paper II- Physiology

Theory – 120 hrs

Objective: The content is designed to enable students to study regular functions in human body. The Subject covers mechanisms and processes that occur within human body.

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 anaemia (12 hrs)
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 (12 hrs).
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 (12 hrs)
4. **DIGESTIVE SYSTEM:** Digestion in mouth, stomach and intestine; digestion of carbohydrates, fats and protein; control of secretion; absorption; structure and function of liver (12 hrs).
5. **EXCRETORY SYSTEM:** Gross and minute structure of kidney; GFR; formation of urine; tubular function, renal function test, micturition (12 hrs).
6. **MUSCLE:** Structure of muscles; muscle contraction (12 hrs)

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 (12 hrs).
8. **ENDOCRINE SYSTEM:** Structure and functions of pituitary, thyroid, adrenal glands; Thymus and pancreas (12 hrs).
9. **REPRODUCTIVE SYSTEM:** Sex determination and development; puberty; structure and function of male and female reproductive system; pregnancy; parturition; lactation; foetal circulation (12 hrs).
10. **SKIN AND TEMPERATURE REGULATION (12 hrs):** Functions of skin; normal body temperature, factors effecting body temperature, temperature regulating mechanisms.

Practical (80 hrs)

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- RBC count
 - WBC count
 - Differential count
 - Haemoglobin estimation
 - ESR determination
 - Blood grouping
 - Bleeding time
 - Clotting time
 - Osmotic fragility test
 - PCV, Red cell indices
 - Measurement of blood pressure in man

Recommended books

1. Essentials of Medical Physiology K. Sembulingam, Prema sembulingam.
2. Concise Medical Physiology Sujith K chaudari

Reference Books

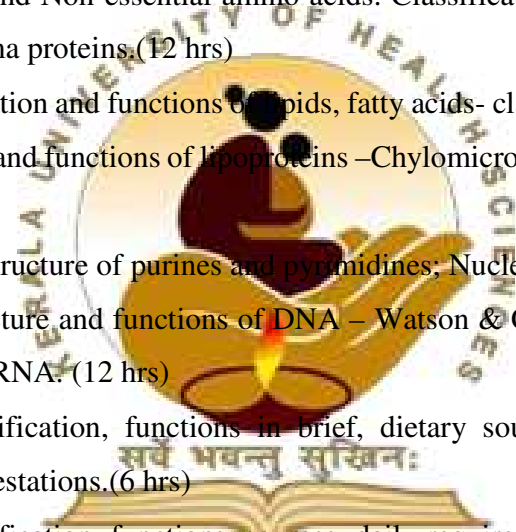
1. Ganong's Review of Medical Physiology (Reference)
 - Textbook of Medical Physiology Arthur C Guyton, John E Hall

Paper III- General Biochemistry

Theory – 120 hrs

Objective: The content is designed to enable students to focus on contributions of biochemistry toward an understanding of structure and functions of human body. The Subject includes chemistry and functions of constituents of cells and tissues, the basis for the structure of nucleic acids, proteins and carbohydrates and basic enzymology.

- **Introduction:** Cell- eukaryotic and prokaryotic cell structure, cell organelles and biological membranes- its structure and functions .(6 hrs)
- **Carbohydrates:** Classification, Functions, structure and Properties of mono-, di- and polysaccharides.(12 hrs)
- **Proteins:** Structure and classification of amino acids, Chemical reaction of amino acids. Essential and Non-essential amino acids. Classification , functions & structure of proteins, plasma proteins.(12 hrs)
- **Lipids:** classification and functions of lipids, fatty acids- classification and properties; Structure, Types and functions of lipoproteins –Chylomicrons, VLDL, LDL and HDL. (12 hrs)
- **Nucleic acids:** Structure of purines and pyrimidines; Nucleosides, nucleotides, cyclic nucleotides, structure and functions of DNA – Watson & Crick Model, Properties of major classes of RNA. (12 hrs)
- **Vitamins:** Classification, functions in brief, dietary sources, daily requirements, deficiency manifestations.(6 hrs)
- **Minerals:** classification, functions ,sources, daily requirements, disorders related.(6 hrs)
- **Enzymes-** Classification and properties(6 hrs)
- **Physical chemistry:** Colloids, Donnan membrane equilibrium, diffusion, dialysis, osmosis, reverse osmosis, surface tension, viscosity , adsorption .(12hrs)
- **Acids and bases:** definition, ionization of acids, ionic product of water, H⁺ concentration, strong acids and bases, weak acids and bases, strength of acids, Properties of commonly used acids and bases-sulphuric acid, nitric acid, phosphoric acid, HCl, acetic acid, KOH, NaOH, sodium carbonate, ammonia.(12 hrs)
- **PH** - definition, PH scale, calculation of PH, Henderson- Hassel balch equation.(6 hrs)
- **Buffers-**definition, components, mechanism of action, buffer capacity, pK of buffers, preparation of buffers, buffers in biological system, commonly used buffers in



laboratory-phosphate buffer, tris buffer. (6 hrs)

- **Properties of commonly used salts**- ammonium chloride, ammonium sulphate, sodium carbonate, sodium chloride. (6 hrs)
- **Properties of commonly used solvents**- methanol, ethanol, acetone (6 hrs)

Practical (80 hrs)

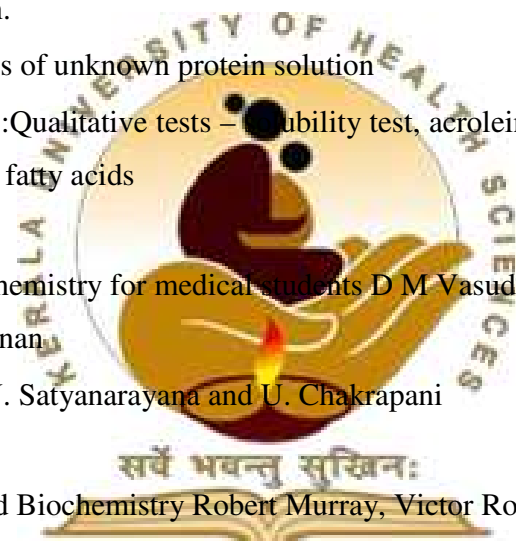
- Reactions of carbohydrates: Monosaccharides- glucose, fructose, galactose Disaccharides- maltose, lactose, sucrose, Polysaccharides- starch, dextrin
- Qualitative analysis of unknown carbohydrate solution
- Reactions of proteins: Colour reactions and precipitation reactions of albumin, Peptone, gelatin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

Recommended books:

- Text book of Biochemistry for medical students D M Vasudevan, S Sreekumari & Vaidyanathan Kannan
- Biochemistry by U. Satyanarayana and U. Chakrapani

Reference Books

- Harper's Illustrated Biochemistry Robert Murray, Victor Rodwell,
- David Bender, Kathleen M Botham, P. Anthony Weil, Peter J Kennelly



Paper IV: General Methodology

Theory 120 hrs

Objective: The content is designed to enable students to acquire foundational laboratory skills necessary for accurate and reliable laboratory work. The Subject covers calibration, dilution and proper use of common laboratory equipment.

1. General introduction to clinical laboratory – Role of Laboratory in Health care delivery, Levels of laboratories, Departments, or sections. Structure – collection, examination and reporting area, Procedures- Labelling and registering of specimens, Personnel required by laboratories. (6 hrs)
2. Laboratory hazards-physical, chemical, biological, first aid in laboratory hazards

(6hrs).

- ☆ 3. Safety in Laboratory: General safety measures, Fire safety, Electrical Safety, Biosafety precautions, Biological Safety Cabinets, PPEs, Levels of Biosafety Laboratories. (6 hrs)
4. Laboratory equipment and wares: General laboratory equipment – Analytical balance, Centrifuge, Autoclave, Incubator, Water bath, Hot air oven, Refrigerator. Laboratory glass wares and plastic ware-Types, uses, cleaning and care, Calibration of pipettes. (12hrs)
5. Chemicals and Reagents: grades of purity, storage and handling of chemicals and reagents. Primary and secondary standard chemicals, Indicators. (6hrs)
6. Preparations of standard solutions –normal, molar, molal and percentage solutions. Dilutions of solutions- inter conversion of concentrations, preparation of normal saline. (8 hrs)
7. Preparation and storage of distilled, double distilled and deionised water. (8 hrs)
8. Collection of blood: Methods of blood collection-Capillary and venous and arterial, preparation of blood smear. (6 hrs)
9. Anti-coagulants & preservatives: anti-coagulants for blood collection -types, action and uses. Colour codes of anticoagulants. Urine preservatives. (8hrs)
10. Basics of microbiology: Evolution and history of microbiology, Safety precautions in microbiology laboratory. Classification of microorganisms, morphology of bacteria. Bacterial growth and nutrition. (12 hrs)
11. Microscopy: parts, use and care of microscopes- optical microscope, phase contrast microscope, dark field microscope, interference microscope, polarisation microscope and electron microscope, Staining methods-simple staining, differential staining and special staining. (12 hrs)
12. Sterilisation and disinfection-methods of sterilisation, disinfectants- different types, methods, applications. (10 hrs)
13. Culture media- introduction, classification, preparation. Methods of cultivation of bacteria, anaerobic culture methods. (8 hrs)
14. Care and management of laboratory animals- the basic knowledge of the feeding, housing, breeding, care and immunisation of following animals- mouse, guinea pig, rat. collection of blood samples, killing of animals and post-mortem examination, different route of animal inoculation, Disposal of carcasses (12 hrs)

Practical (80 hrs)

- Measurement of liquids, Weighing solids
- Calibration of pipettes and other volumetric glass wares
- Titration of acids and bases
- Preparation of cleaning solution
- Preparation of normal, molar and percentage solutions
- Preparation of normal saline
- Preparation of saturated and half saturated solution
- Preparation of buffer solution, pH measurement
- Preparation of distilled and deionized water.
- Preparation of anticoagulants and preservatives for specimen collection.
- Blood collection
- Blood smear preparation
- Use and care of simple autoclave, incubators, hot air oven, water bath and centrifuge.
- Staining methods- simple and differential
- Cleaning and preparation of glassware for media preparation and sterilization
- Preparation of culture media, demonstration of culture methods
- Handling of laboratory animals



Recommended books:

- Ananthanarayanan and Paniker's Text book of Microbiology
R. Ananthanarayan and C. K. Jayaram Paniker
- Mackie and McCartney Practical Medical Microbiology
J. Gerald Collee, Andrew G. Fraser, Barrie P Marmion, Anthony Simmons
- Medical Laboratory Technology (Vol 1-3) Kanai L. Mukherjee

Reference Books


- Prescott / Harley Klein's Microbiology
Joanne Willey, Linda Sherwood, Chris Woolverton

- Essentials of Medical Microbiology
Apurba S Sastry, Sandhya Bhat
- Text book of Medical Laboratory Technology by Praful B Godkar, Darshan P Godkar
- Practical Clinical Biochemistry - Harold Varley (Author)

Paper V: Community Medicine, Health Education and Communicative English

Theory-120 hours (Internal Assessment only)

Community Medicine

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- 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.
 - Public health administration-an overall view of the health administration setup-central and state level.
 - The national health programme. Highlighting the role of social, economic and cultural factors in the implementation of the national programme.
 - Health problems of vulnerable groups-pregnant and lactating women, infants and school going children, occupational groups, geriatrics.
 - Occupational health- definition, scope, occupational diseases, prevention of occupational diseases and hazards.
 - Social security and other measures for the protection of occupational hazards accidents and diseases. Details of compensation acts.
 - Family planning- objectives of national family planning methods – a general idea of advantages and disadvantages of the method.
 - Mental health- community aspects, role of physiotherapists, therapists in mental health problems such as mental retardation.
 - Communicable diseases-an overall view, classification, principal mode of classification, role of insects and other vectors
 - International health agencies.

Health Education

- Review of benefits, values, norms, habits and taboos among practices. More in human groups and their importance; learning and change process.
- Review of concepts on perception, attitudes, socialisation process, learning and theories of learning, social change and change process, motivation, needs and drives.
- Principles and process of communication
- Health education philosophy- main principles and objectives. Health education vs .propagandas
- Methods and tools of health education- individual and group method. A critical evaluation of theories, tool and health education
- 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
- Elements of planning a health education programme.

Communicative 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.

Writing skills

Composition- Writing effective paragraphs, ability to describe objects, people, process and ideas and narrating incidents- note taking / making summaries. Writing 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 equipment , letters to the editor.

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; degrees of comparison, expression of necessity-must, have to, need to; expression of generalization and emphasis

Vocabulary

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

Spoken English

A course in speech in conversation with focus not on phonetics and grammar but on developing their ability to talk about object 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 expression, typical of familiar situations in medical practice. Technique of discussion at medical meeting, making presentation.



SECOND YEAR

Paper VI- Analytical Methods and Instrumentation

Theory-120 hours

Objective: The content is designed to equip students with the analytical and interpretative skills critical for working in the laboratory. The Subject provides an overview of maintenance, operation and troubleshooting of laboratory instruments.

Spectroscopic techniques: (25 hours)

Properties of light, Electro magnetic spectrum, mono and poly chromatic light , absorption and transmission of light ,Colorimetry- principle (Beer Lamberts law) technique, Flame spectrophotometry- instrumentation for atomic absorption spectrophotometry and emission flame photometry, Fluorimetry, Nephelometry and Turbidimetry ,CLIA,ECLIA.

Chromatography: (20 hours)

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

Electrophoresis: (20 hours)

General principles and factors affecting electrophoresis; Principle, technique and applications of paper electrophoresis; Gel electrophoresis- types of gels, solubilizers, electrophoretic procedure and

applications; Immuno electro phoresis; Isoelectric focusing, Capillary electrophoresis.

Centrifugation: (25hours)

Principle, RCF, rpm , types of centrifuges, different types of rotors ;

Density gradient centrifugation-rate zonal and isopycnic; Differential centrifugation; Ultra centrifugation, Analytical centrifugation , applications of centrifugation; Safety aspects in the use of centrifuges.

ELISA: Principle, substrates and enzymes used , Types-direct, indirect, sandwich and competitive .

Applications of ELISA, ELISPOT test, ELFA. (5 hrs)


Radio activity and Radio isotopic techniques (25 hrs hours)

Radioisotopes, different types of radiations, measurement of radioactivity- scintillation and GM counters. 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. RIA –principle, different methods, labeled probes. Applications of RIA

pH meter : (5 hours)

Principle, technique and applications.

Practicals (200 hrs)

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- Colorimetry
 - Verifications of Beer- Lamberts law
 - Determination of λ_{max} and selection of wavelength
 - Estimation of concentration of unknown solution
 - Spectrophotometry
 - Chromatography- paper, TLC
 - Protein Electrophoresis
 - PH meter
 - Buffer preparation
 - ELISA

Recommended Books

1. Biophysical chemistry Principles and Techniques - Avinash Upadhyaye and Nirmalendhe Nath, Himalaya Publishers.

2. Cooper TG-The tools of Biochemistry(Latest edition).
3. Work TS and Work E-Laboratory techniques in Biochemistry and molecular Biology(Latest edition).
4. A Biologist Guide to Principles and Techniques of Biochemistry, Keith Wilson and Kenneth Goulding, Edward Arnold publishers.


Reference Books

1. Principles and techniques of practical Biochemistry, Keith Wilson and John Walker,1995. Cambridge University Press.
2. An Introduction to Spectroscopy for Biochemist, Brown. SB Academic Press.

Paper VII- Enzymology

Theory 120 hours

Objective: The content is designed to enable students to understand the theories of enzyme kinetics, mechanisms of enzyme catalysis, and the mechanisms of enzyme regulation in the cell. It also covers the clinical aspects of enzymology with emphasis on diagnostic enzymes.

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- Enzyme classification and nomenclature as per IUB enzyme classification system (5hrs)
 - Factors influencing enzyme catalyzed reactions. Specificity of enzymes, Active site and catalytic groups (10 hrs)
 - Prosthetic group, Co enzymes, cofactors metallo-enzymes and metal activated enzymes, Iso-enzymes, multi enzyme complex, ribozymes, immobilised enzymes (15 hrs)
 - Mechanism of enzyme action – Theories-induced fit and lock and key model mechanism of action of Chymotrypsin and lysozyme.(10 hrs)
 - Enzyme kinetics-Exothermic, endothermic reaction, Michaeli's Menten's equation derivation, km value, LB plot,Enzyme units and turn over number . (18 hrs)
 - Enzyme inhibition-various types with examples, application in clinical medicine(10 hrs)
 - Regulation of enzyme action (10 hrs)
 - Isolation and purification of enzymes.(10 hrs)
 - Clinical enzymology (30 hrs)-
Clinical utility of various enzymes as markers. Functional and nonfunctional enzymes, Clinical importance of AST, ALT, ALP, CK, LDH, PSA,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 muscle diseases.

- Therapeutic use of enzymes(2 hrs)

Practicals (200 hours)

- Determination of Km value
- Effect of substrate, p H, temperature and enzyme concentration on enzyme activity.
- Estimation of clinically important enzymes:
AST, ALT, ALP, GGT, ACP, Amylase, LDH, CPK

Recommended Books

1. Dixon M and Webb EC- Enzymes, Academic Press.
2. Boyer PD, The enzymes, Academic press
3. Biochemistry- Jeremy M Berg, John L. Tymoczko, Lubert Stryer

Reference Books

1. Enzymes – Author: Zubay
2. Enzymes- Trevor Parmer- Philip Bonner
3. Clinical Chemistry: Principles, Techniques and Correlations
Hardcover – Michael L. Bishop



Paper VIII : Endocrinology ,Toxicology and Human Nutrition

Theory 120 hrs

Objective: The subject is designed to enable students to understand the endocrine biochemistry, physiology and various endocrine disorders. It also enables to identify and understand the different types of toxic chemicals and their toxic effects, concept of nutrition & health and understand the physiological and biochemical significance of micronutrients and macronutrients.

Endocrinology:(40 hrs)

- Endocrine organs
- Hormones-classification , hormone receptors- G proteins, insulin receptor
- Secondary and tertiary messengers.

- Mechanism of action of hormones.
- Chemistry, functions and disorders of Hypothalamic, Pituitary, Thyroid, parathyroid
- Pancreatic, Adrenal, Gonadal and GIT hormones.

Toxicology (40 hrs)

- Xenobiotics- Detoxification-phases, cytochrome P450 enzyme system
- Therapeutic drug monitoring- phenobarbital, phenytoin, digoxin, lidocaine
- Alcohol metabolism, Chronic alcoholism, alcohol toxicity, Metabolism of methanol, methanol toxicity.
- Heavy metal poisoning- Arsenic, Cadmium, Lead, Mercury, Aluminium
- Carbon Monoxide and Cyanide poisoning

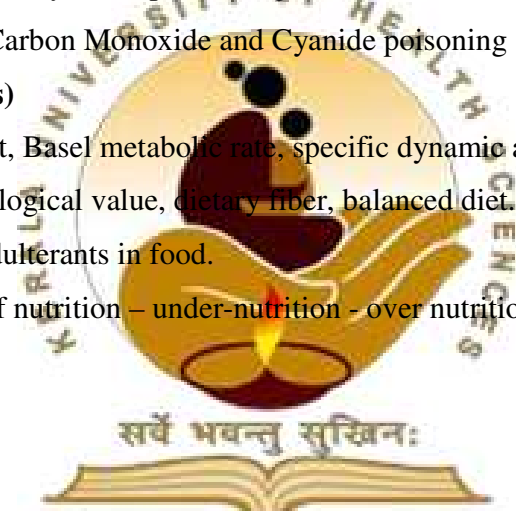
Human Nutrition : (40 hrs)

Respiratory quotient, Basal metabolic rate, specific dynamic action, nitrogen balance, protein quality, biological value, dietary fiber, balanced diet. Preservatives and adulterants in food.

Common disorders of nutrition – under-nutrition - over nutrition - protein malnutrition,

Obesity Diet for DM

Glycemic index



Practicals (200 hours)

- Hormone assays-T3, T4, TSH
- Estimation of 17 – keto steroids
- Estimation of VMA
- Screening test for drugs
- Biochemical analysis of heavy metals
- Blood alcohol estimation

Recommended Books

- Biochemistry –Author: Deba JyothiDas
- Textbook of medical biochemistry- Author: M N Chatterjee
- Textbook of biochemistry-Author: Vasudevan and Sreekumari.S

Reference Books

- Talwar CP, Text book of Biochemistry and Human Biology (latest Edition).
- Wilson JD, Foster DW (eds.). Williams Text book of Endocrinology, Wb Saunders Co.
- Tietz's Fundamentals of Clinical Chemistry (latest Edition) – Norbert Tietz
- Essentials of Environmental Toxicology - W. William Hughes

THIRD YEAR

Paper IX- Intermediary Metabolism-I

Theory- 100 hours

Objective: The subject is designed to enable students to understand the role of catabolic and anabolic pathways in cellular metabolism. It covers metabolic pathways and regulation of carbohydrates, amino acids, and heme, the biochemical basis of inherited disorders and how energy is released during cellular metabolism.


1. Carbohydrates (30 hours)

- Digestion and absorption
- Metabolic steps, energetics, functions and regulation of following pathways:
 - Glycolysis, Fate of pyruvate (aerobic and anaerobic)
 - Cori's cycle, Pasteur Effect, 2,3-BPG shunt
 - Gluconeogenesis.
 - Glycogen metabolism
 - HMP shunt pathway
 - Uronic acid pathway,
 - Metabolism of fructose and galactose
 - TCA cycle- Reactions, significance, regulations, inhibitors. Energetics, anaplerotic and amphibolic role of TCA cycle.
- Inborn errors of metabolism of carbohydrates, glycogen storage diseases, essential fructosuria, pentosuria, lactose intolerance, galactosuria, G6PD deficiency.

2. Metabolism of amino acids (30 hours)

- Digestion and absorption of proteins
- General reactions of amino acids-transamination, oxidative deamination,
- transdeamination
- Fate of ammonia- Urea cycle , hyperammonemias
- One carbon metabolism
- Glucogenic and ketogenic aminoacids.
- Over all metabolism of different amino acids- Detailed metabolism of glycine, phenyl alanine, tyrosine,tryptophan and histidine,Sulphur containing amino acids, Glucose alanine cycle.
- Specialized products-Creatinine, glutathione, catecholamines, polyamines and other biogenic amines, nitric oxide .
- Inborn errors of amino acid metabolism- Cystinuria, Homocystinuria, Tyrosinemia ,Phenyl ketonuria, Alkaptonuria, Albinism, Maple Syrup Urine diseases,Hartnups's diseases.

3. Bioenergetics: (20 hours)

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- Gibbs free energy, enthalpy, entropy, redox potential ,coupled reactions, reducing equivalents.
 - High energy compounds
 - Electron transport chain- shuttle system, outline of electron transport chain,Generation of ATP-substrate level phosphorylation, oxidative phosphorylation, chemi osmotic theory, ATP synthase, Inhibitors and uncouplers.
 - Reactive oxygen Species

4. Heme metabolism- (20 hours)

- Haemoglobin: Structure and functions.
- Biosynthesis of heme and its regulation.
- Heme catabolism: formation of bilirubin and biliverdin from heme, transport, conjugation,Excretion.
- Hyper bilirubinemias

- Urobilinogen and other bile pigments
- Porphyrins

Practicals (120 hours)

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

- Glucose
- Total protein, Albumin, A/G ratio
- Ammonia, Urea, BUN
- Creatine, Creatinine,
- Bilirubin
- Glycated Hemoglobin
- Hemoglobin Electrophoresis-demonstration
- Test for aminoacidurias

Recommended Books

1. Text book of Biochemistry for Medical students (latest Edition) – Dr. DM Vasudevan, Dr. Sreekumari S, Dr. Kannan Vaidyanathan.
2. Biochemistry (latest edition) – U. Satya Narayana, U Chakrapani

Reference Books

1. Lehninger Principles of Biochemistry (latest Edition)-David L Nelson.
2. Lippincott Illustrated Reviews – Biochemistry (latest edition) –Richards.
3. Text book of Biochemistry with Clinical co-relation (latest edition)-Thomas M Devlin

Paper X: Intermediary Metabolism-II

Theory (100 hours)

Objective: The subject is designed to learn the metabolic pathways of Lipids, Nucleotides , vitamins and minerals with their regulatory mechanisms. It also covers the biochemical basis of inherited disorders with their associated sequelae.

1. Metabolism of lipids (40hrs)

- Digestion and absorption ,disorders- Steatorrhea

- Oxidation of Fatty acids- Beta,Alpha, Omega and peroxisomal Oxidation, Oxidation of odd chain Fatty acids.
- Ketone body metabolism, ketosis in Starvation and Diabetes Mellitus
- 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.
- Metabolism of cholesterol- Biosynthesis , regulation and fate of cholesterol.
- Compounds formed from cholesterol-bile acids and Bile salts.
- Apo lipoproteins functions and Lipoprotein metabolism-chylomicron, VLDL,LDL and HDL metabolism.
- Inborn errors- Hypolipoproteinemias, Hyperlipoproteinemias and Sphingolipidoses

2. Metabolism of Nucleotides (20 hrs)

- Sources of carbon and nitrogen atoms of purine and pyrimidine ring.
- Purine and Pyrimidine metabolism: De-novo synthesis of nucleotides and degradation, regulation and inhibitors.
- Salvage pathways.
- Nucleotide analogues and their use in medicine
- Disorders- gout , Lesch-Nyhan syndrome, Hyperuricemia ,Hypouricemia

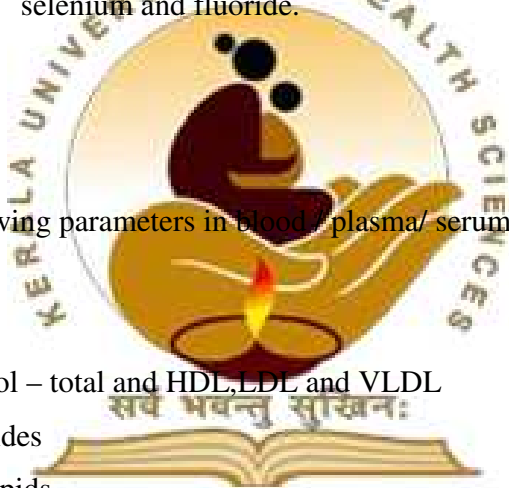
3. Metabolism of Vitamins and Minerals (40 hrs)

- Vitamin A: dietary sources, RDA, biochemical functions of vitamin A,Wald's visual cycle, Deficiency manifestations, Hypervitaminosis.
- Vitamin D: Chemical nature, dietary sources &RDA. Active form of vitamin D: its formation and actions ,Deficiency manifestations .
- Vitamin E: Chemical forms, biochemical functions,& deficiency manifestations.
- Vitamin K: Chemical forms, dietary sources, biochemical functions, RDA & Deficiency Manifestations.

- Thiamine, Niacin ,Pyridoxine , Pantothenic acid, Riboflavin, Biotin, Folic acid, Vitamin B 12, Vitamin C: Chemical nature, dietary sources, RDA, coenzyme form, biochemical functions & deficiency manifestations.
- Sodium, potassium, chloride, Phosphorus, Sulphur : Biochemical functions, sources, disorders related.
- Calcium: Biochemical functions, RDA, Sources, homeostasis of calcium, Hypercalcemia and Hypocalcaemia.
- Functions of Iron and iron containing proteins. Absorption Transport and Storage of Iron. Iron deficiency anaemia and Hereditary hemochromatosis.
- Functions and disorders of zinc, Copper, Magnesium, Iodine, selenium and fluoride.

Practical (120 hrs)

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

- 
- Cholesterol – total and HDL, LDL and VLDL
 - Triglycerides
 - Phospholipids
 - Estimation of ketone bodies
 - Uric acid
 - Sodium, Potassium, Calcium, Phosphorus, Chloride
 - Iron, Zinc, Copper
 - Estimation of Vitamins

Recommended Books

1. Text book of Biochemistry for Medical students (latest Edition) – Dr. DM Vasudevan, Dr. Sreekumari. S, Dr. Kannan Vaidyanathan.
2. Biochemistry – Author: Deba Jyothi Das
3. Biochemistry (latest edition) -U. Satya Narayana.

Reference Books

1. Lehninger Principles of Biochemistry (latest Edition)-David L Nelson.
2. Lippincott Illustrated Reviews – Biochemistry (latest edition) –Richards
3. Bhagavan NV-Medical Biochemistry

Paper-XI : Clinical Biochemistry

Theory 100 hours

Objective: Designed to enable students to understand the pathophysiology and molecular basis of most prevalent diseases .It also covers the use of biochemical tests to support the diagnosis, treatment, prevention and monitoring of disease.

1. Carbohydrates: (15 hrs)

Blood glucose regulation, role of hormones in it Hyperglycemia, Hypoglycemia
Diabetes Mellitus including gestational diabetes mellitus
Laboratory diagnosis of diabetes mellitus- GTT, GCT
Diabetic ketoacidosis, Biochemical basis of complications of Diabetes mellitus
Monitoring of treatment of diabetes mellitus
Glycated Hemoglobin
Urinary albumin excretion
Glycogen storage disorders

2. Proteins (15 hrs)

- Plasma proteins-separation, classification, functions and clinical significance- Multiple myeloma, Liver cirrhosis, nephrotic syndrome
- Acute phase proteins

3. Lipids (20 hrs)

- Lipo proteinemias, atherosclerosis and coronary artery disease
- Obesity, Fatty liver and lipotropic factors
- Lipid storage diseases

4. Acid base balance (15 hrs)-

- Blood buffers, mechanism of action, acidosis and alkalosis, Compensatory mechanisms, assessment of acid base status, Anion gap. Blood gas analysis: Principle and use of Blood gas analyzer.

5. Water and electrolyte balance and imbalance (15 hrs)-

- Distribution of water and electrolytes in ICF and ECF, Regulation of fluid and electrolyte in various body compartments, Derangements in fluid electrolyte balance: Dehydration & over hydration.

6. Haemoglobin (10 hrs)

- Hb derivatives, haemoglobin variants, Glycated hemoglobin, Hemoglobinopathies, Anemias Jaundice

7. CSF and other body fluids (10 hrs)

- Composition, chemical analysis and diagnostic importance of CSF, pleural fluid, synovial fluid, amniotic fluid, and sweat.

Practicals (120 hrs)

- GTT
- GCT
- Glycated haemoglobin
- Fructosamine
- Microalbumin
- Ketone bodies in blood and Urine
- Acute phase proteins
- Plasma proteins
- Estimation of plasma alkali reserve
- Estimation of titrable acidity and urinary ammonia
- Urine analysis
- CSF-Estimation sugar, protein and Chloride



Recommended Books

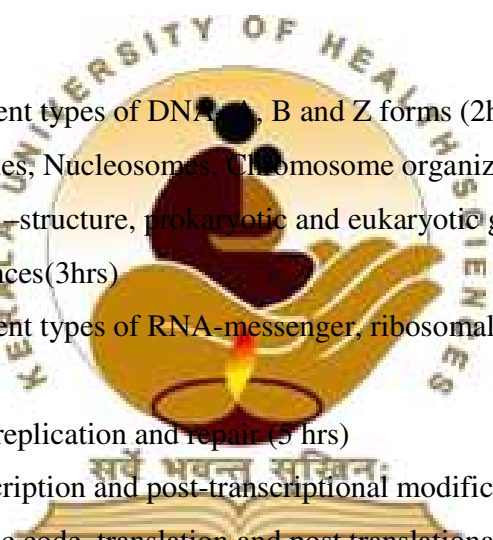
1. .Text book of Biochemistry for Medical students (latest Edition) –Dr. DM Vasudevan, Dr. Sreekumari. S, Dr. Kannan Vaidyanathan.
2. Text book of Medical Biochemistry (latest edition)-Dr. Dinesh Puri.
3. Bhagavan NV-Medical Biochemistry

Reference Books

1. Clinical Biochemistry -Principles and Practice: Praful B. Godkar.
2. Text book of Biochemistry with Clinical co-relation (latest edition)-Thomas M Devlin
3. Clinical Chemistry:Principles, Techniques and Correlations Hardcover –Michael L.Bishop
4. Marshall WJ Bangert CK-Clinical Biochemistry-Metabolic and clinical aspects.

Paper XII : Human Genetics and Molecular Biology (100 hours)

Objective: The content explains the fundamental aspects of human genetics. It gives an in-depth insight into the molecular aspects of life - the central dogma. It also explains various molecular biology techniques.

- 
- Different types of DNA - A, B and Z forms (2hrs)
 - Histones, Nucleosomes, Chromosome organization (5hrs)
 - Genes –structure, prokaryotic and eukaryotic genes, repetitive sequences(3hrs)
 - Different types of RNA-messenger, ribosomal, transfer, hn RNA, SNurps. (5 hrs)
 - DNA replication and repair (5 hrs)
 - Transcription and post-transcriptional modifications, inhibitors (5 hrs)
 - Genetic code, translation and post translational modifications, inhibitors (5 hrs)
 - Regulation of gene expression- Regulation of gene expression in prokaryotes: Induction, repression & de-repression: lac operon model. Regulation of gene expression in eukaryotes: Hormone Responsive elements, Enhancers, transcription factors, Gene amplification, gene switching, Gene rearrangement, RNA Processing, RNA editing (10 hrs)
 - Protein targeting (5 hrs)
 - Molecular basis of cancer-cell cycle and its regulation, oncogens, tumor suppressor genes (5 hrs)
 - Mutation-types of mutation- Frame shift mutation, Silent mutation, Missence mutation, Mutagens, Ames test (10 hrs)
 - Ageing-molecular basis of aging-telomere erosion, oxidative stress, oncogene activation, Ageing related diseases Alzheimer' s disease,

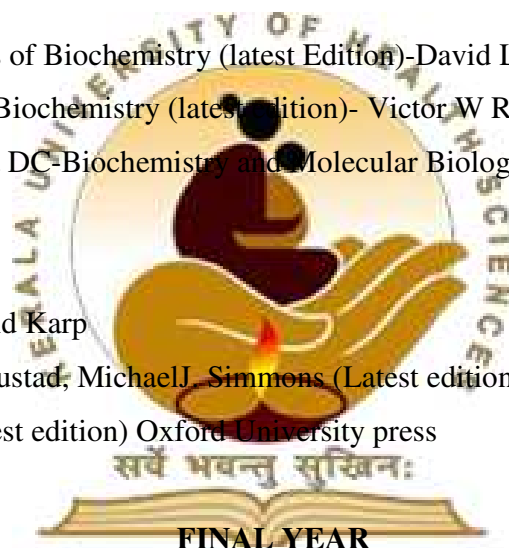
- Parkinson's disease (5 hrs)
- Blotting techniques-Principle and applications of southern, northern and western blotting (5 hrs)
- PCR-principle, steps and applications, RT-PCR (4 hrs)
- DNA sequencing (2 hrs)
- Human Genome Project (3 hrs)
- Gene library (2 hrs)
- Recombinant DNA technique- applications,vectors, techniques and restriction endonucleases (10 hrs)
- RFLP and applications , FISH (5 hrs)
- Gene therapy, DNA profiling, Transgenic animals (5 hrs)

Recommended Books

1. Lehninger Principles of Biochemistry (latest Edition)-David L Nelson.
2. Harper's Illustrated Biochemistry (latest Edition)- Victor W Rodwell
3. Elliot WH and Elliot DC-Biochemistry and Molecular Biology (Latest edition) Oxford University press.

Reference Books

1. Cell Biology – Gerald Karp
2. Genetics-D.Peter Snustad, MichaelJ. Simmons (Latest edition)
3. Lewin D Genes(Latest edition) Oxford University press



Paper XIII- Immunology and Immunochemistry

Theory 100 hours

Objective: The content is designed to enable students to explore the body's immune system and its responses to various pathogens, infections and diseases. The Subject includes basic immunology, clinical immunology , various antigen-antibody reactions involved in diseases, vaccines and advanced topics like cancer immunology and transplant immunology. The application of immunology in medicines is also dealt with.

- **Infection (5hrs) :** source, methods of transmission and routes of infection.
- **Immunity (10hrs):**innate immunity mechanism of innate immunity, acquired immunity-active and passive immunity, natural and artificial immunity.

- **Structure and functions of immune system (10hrs):** lymphoid organs- primary and secondary lymphoid organs, cells involved in immune system-lymphocytes, APC-functions, surface receptors
- **Antigens (5hrs) :** characteristics, determinants of antigenicity, antigenic specificity-epitope- characteristics- haptens, adjuvants.
- **Antibodies (10hrs):** Classification, structure and function of immunoglobulins, theories of antibody formation, monoclonal antibodies-their synthesis and significance.
- **Immune response (10hrs):** Humoral and cell mediated-mechanism
- **Antigen-antibody reaction (10 hrs):** General features, precipitation reactions, immunodiffusion, agglutination, CFTs,neutralisation,RIA,ELISA, immuno fluorescence, immunoelectrophoresis
- **Complement system (10 hrs) :**General properties, components, complement activation, classical, alternate pathway, biological effects of complements, quantification of complements and its importance. Deficiency diseases.
- **Immunohematology (10 hrs) :** ABO blood group system, Rh blood group system, medical application of blood groups, haemolytic disease of new born, identification of Rh in compatibility, Rh immunization
- **Immunodeficiency diseases (10 hrs):** humoral and cellular immune deficiency, AIDS, disorders of specific immunity, disorders of complement, disorders of Phagocytosis
- **Hypersensitivity (3hrs) :** Classification, basic mechanism.
- **Autoimmunity-(5 hrs) :** mechanism of auto immunization, auto immune disorders-SLE, Rheumatic fever
- **Immunology of transplantation (5hrs):** allograft rejection, histocompatibility, MHC classification, location, its importance.
- **Cancer:(2hrs) :** Immuno therapy of cancer.
- **Vaccines (5 hrs) :** Different types of vaccines and their mechanism of action-live attenuated vaccines, in activated vaccines, subunit, recombinant ,mRNA, polysaccharide, toxoid, conjugate vaccines.

Practical (240 hours)

- Ouchterlony double diffusion vaccines technique
- Radial Immunodiffusion

- Agglutination reactions-ASO,CRP, RPR, RF, Coombs test, Widal test, Blood grouping.
- Coagulation test-APTT
- ELISA-HIV, HBSAg, HCV

Recommended Text Books

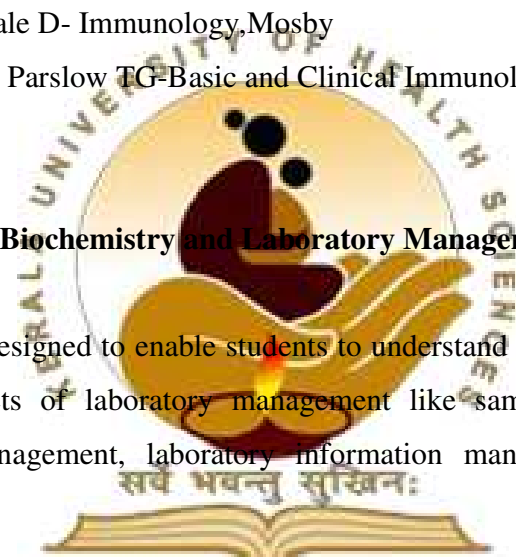
1. Kuby's text book of immunology-Thoma sJ Kindt, Richard Goldsby, Barbara A Osborne
2. Essential immunology – Ivan Roitt,Jonathan Brostaff,David Male
3. Ananthanarayan and Panicker's Text Book of Microbiology (Latest edition)

Reference Books

1. Roitt I Brostoff J, Male D- Immunology, Mosby
2. Stites DP, Terrai and Parslow TG-Basic and Clinical Immunology

Paper XIV- Diagnostic Biochemistry and Laboratory Management Theory 100 hours

Objective: The content is designed to enable students to understand various organ function tests. It also covers various aspects of laboratory management like sample management, occurrence management, Quality Management, laboratory information management as well as clinical Laboratory organization.



Organ Function Tests.

- Liver function tests
- Renal function tests
- Cardiac function tests
- Thyroid function tests
- Pancreatic function tests

Tumor markers:

- Definition , classification, clinical significance – Bence- Jone's proteins, AFP, serotonin, PSA,Thyroglobulin, Calcitonin, CA 125,CA15-3,CA 19-9, CEA, beta HCG, VMA.

Organization of a Clinical Laboratory

- Planning
- Registration
- Staff
- Infrastructure
- Equipment, Regents and consumables

Laboratory Quality Management System:

- Importance of laboratory quality
- Overview of the quality management system model
- Laboratory standards and organizations- ISO 9001:2000, ISO 15189:2007, ISO/IEC 17025:2005, CLSI
- Sample management- collection requirements, labeling, processing, storage, retention and disposal, sample transport.
- Quality control – Accuracy, Precision, Sensitivity and Specificity, IQC- control materials, establishing the value range for control material, graphical representation of control ranges, Levey–Jennings chart, interpreting QC data, detecting error-random and systematic error, corrective actions.
- External Quality Assessment.
- Certification and accreditation- introduction to NABL
- Occurrence management-Laboratory errors-pre-examination, Examination and post examination errors.
- Documents and Records-SOP, Laboratory records-use and examples
- Information Management-Manual paper based systems, Computerized laboratory information systems-LIS
- Biomedical Waste Management.



Laboratory automation

- Advantages of automation
- Types of auto analysers – continuous flow analyzers, Discrete analyzers - Semi-automatic analyser, Fully automatic analyser, Dry chemistry analyzers
- Recent trends in automation of clinical chemistry

Reference Values

- Establishment and use of reference values, analytical and statistical procedures used in establishing reference values.

Practical (240hrs)

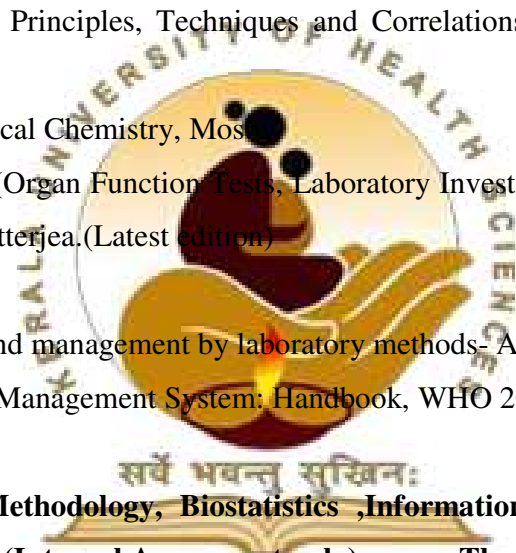
- LFT-Test based on synthetic, metabolic, detoxification, excretory and storage functions of liver
- RFT- Screening tests, Tests based on glomerular function, and tubular function.
- TFT-T3,T4,TSH,Thyroid autoantibodies
- CFT-cardiac risk assessment markers, Markers of MI
- PFT-serum lipase and amylase
- Preparation of QC chart.

Recommended Books

1. Text book of Biochemistry for Medical students (latest Edition) – Dr. DM Vasudevan, Dr. Sreekumari. S, Dr. Kannan Vaidyanathan.
2. Clinical Chemistry: Principles, Techniques and Correlations Hardcover (latest Edition) – Michael L. Bishop
3. Kaplan A et al-Clinical Chemistry, Mosby
4. Clinical Chemistry (Organ Function Tests, Laboratory Investigations And Inborn Metabolic Diseases) –MN Chatterjea, (Latest edition)

Reference Books

1. Clinical diagnosis and management by laboratory methods- Author: John Bernard Henry.
2. Laboratory Quality Management System: Handbook, WHO 2011



Paper XV : Research Methodology, Biostatistics, Information Technology and Artificial Intelligence in Healthcare (Internal Assessment only) Theory 120 hrs

Research methodology

- Introduction to research methods,
- Identifying research problem, formulating a hypothesis,
- Ethical issues in research,
- Research design
- Research methodologies: Study population; Variables; Sampling; Sample size, determination; sampling techniques, data collection methods, data analysis procedures, ethical considerations.

Biostatistics

- Introduction

- Measures of central tendency
- Statistical surveys and representation of data.
- Measures of dispersion and variability
- Significance tests 't' test, 'z' test and χ^2 values
- Probability, Sampling distribution and statistical inference; Estimation, Hypothesis testing & application;
- Correlation & regression analysis.
- Application of statistical principles in biology

Information Technology (IT) in Healthcare

- Basics of IT- software, Computer networking
- Benefits of IT
- Need for IT in healthcare
- IT tools in healthcare

Artificial Intelligence(AI) in Healthcare

- Benefits of using AI in healthcare
- Types of AI in healthcare - Machine learning, Deep learning, Natural Language processing
- Robotics –AI powered robotics
- Applications of AI in healthcare

Paper XVI: Project :

Every candidate admitted to BSc. Medical Biochemistry course should undergo 1000 hours of compulsory hospital posting as detailed in the curriculum. A mini project may also be done during the fourth year hospital posting. 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 teacher, carry out the work on the topic selected and prepare a project report. The project report shall be duly certified by the supervising teacher, Head of the Department of Medical Biochemistry and Principal one month prior to the fourth year university practical examination.

2.11 No. of hours per subject.

| Paper | Subject | Hours of Instruction | | | | |
|--------------------|--|----------------------|-----------|----------|-------|------------------|
| | | Theory | Practical | Tutorial | Total | Clinical posting |
| FIRST YEAR | | | | | | |
| I | Anatomy | 120 | 80 | 120 | 320 | ---- |
| II | Physiology | 120 | 80 | 120 | 320 | |
| III | General Biochemistry | 120 | 80 | 120 | 320 | |
| IV | General Methodology | 120 | 80 | 120 | 320 | |
| V | Community medicine, Health Education & Communicative English | 120 | ---- | 40 | 160 | |
| SECOND YEAR | | | | | | |
| VI | Analytical Methods & Instrumentation | 120 | 200 | 80 | 400 | 240 |
| VII | Enzymology | 120 | 200 | 80 | 400 | |
| VIII | Endocrinology, Toxicology & Human nutrition | 120 | 200 | 80 | 400 | |
| THIRD YEAR | | | | | | |
| IX | Intermediary Metabolism-I | 100 | 120 | 80 | 300 | 360 |
| X | Intermediary Metabolism-II | 100 | 120 | 80 | 300 | |
| XI | Clinical Biochemistry | 100 | 120 | 80 | 300 | |
| XII | Human Genetics & Molecular Biology | 100 | ---- | 80 | 180 | |
| FOURTH YEAR | | | | | | |
| XIII | Immunology & Immunochemistry | 100 | 240 | 80 | 420 | 400 |
| XIV | Diagnostic Biochemistry & Laboratory Management | 100 | 240 | 80 | 420 | |
| XV | Research methodology, Biostatistics, Information technology & Artificial Intelligence in Health care | 120 | ---- | 80 | 200 | |
| XVI | Project | | | | | 400 |
| Grand Total | | 1680 | 1760 | 1320 | 4760 | 1000 |

2.12 Practical training

As given in curriculum and clause 2.11

2.13 Records

Records should be maintained for each experiment done in the practical laboratory for every subject and duly signed by the supervising teacher and should be submitted at the time of University practical examination.

2.14 Dissertation:

Not Applicable

2.15 Specialty training if any

Not Applicable

2.16 Project work to be done if any

As stipulated by HOD from time to time

2.17 Any other requirements [CME, Paper Publishing etc.]

To present at least one paper in state/national conference [desirable]

2.18 Prescribed/ recommended textbooks for each subject

As given under clause “Content of each subject in each year “

2.19 Reference books

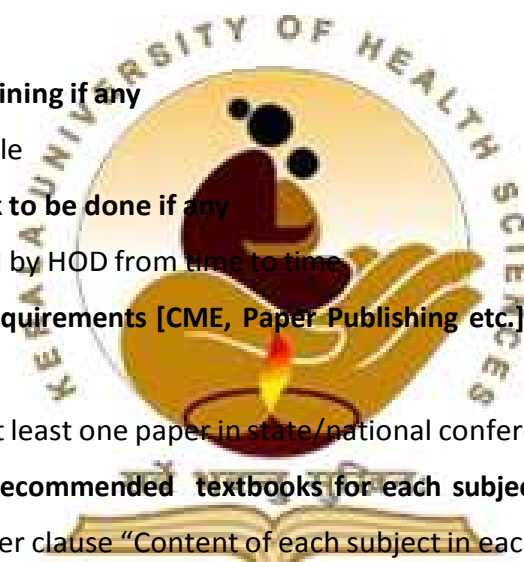
As given under clause “Content of each subject in each year “

2.20 Journals

As decided by the concerned faculties/HOD

2.21 Logbook

To be maintained for all academic work which shall be counter signed by concerned HOD



3.EXAMINATIONS

3.1. Eligibility to appear for exams Attendance

No candidates shall be admitted to any year of B. Sc. Medical Biochemistry examinations unless he /she has a minimum of 80% attendance.

Regarding condonation of shortage of attendance clause 1.9 shall apply.

Internal Assessment

The minimum requirement of internal assessment mark for appearing university examination shall be 50% for theory and practical separately. The internal assessment marks in theory / Practical shall be on the basis of the assessment made by the teachers from the candidate's performance in the:

- Three (3) sessional examinations evenly placed and conducted by the department,
- Seminars, assignments, attendance, laboratory work and record work during the course of study.

The third sessional examination should be conducted as model examination as that of university and is mandatory to appear for familiarization of the University Examination model. The average of best two Sessional examinations together with other internal assessment components like seminars, assignments, attendance, laboratory work and record work shall be considered for calculating the final internal assessment mark.

The marks secured by the candidates in each paper/subject shall be forwarded to the university at the end of the course for university examinations. The class average of the sessional marks should not exceed 75%. The candidates who failed in the university examination will be allowed a separate internal assessment for both theory and practical.

If a candidate not securing minimum internal assessment marks, he / she should appear for next university examination (supplementary or regular) after securing the minimum internal assessment.

A regular record of theory and practical sessional marks shall be maintained for each student in the institution. A separate internal assessment examination shall be conducted for theory and practical for the failed candidates to make them eligible to appear for the next university examination (supplementary or regular).

3.2. Schedule of Regular/Supplementary exams

Regular university examinations will be conducted at the end of each academic year and supplementary



examinations will be conducted within six months after the publication of the result of regular examination.

3.3. Scheme of examination showing maximum marks and minimum marks

First Year B. Sc. Medical Biochemistry Examination

| Paper | Theory | | | | | | Practical | | | | | | Grand Total | | |
|--|------------|-----|----------|------|-------|------|------------|-----|----------|------|------|-------|-------------|------------|------------|
| | University | | Internal | | Total | | University | | Internal | | Viva | Total | | Max | Min |
| | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Max | Min | | |
| I – Anatomy | 50 | 25 | 25 | 12.5 | 75 | 37.5 | 50 | 25 | 25 | 12.5 | 50 | 125 | 62.5 | 200 | 100 |
| II – Physiology | 50 | 25 | 25 | 12.5 | 75 | 37.5 | 50 | 25 | 25 | 12.5 | 50 | 125 | 62.5 | 200 | 100 |
| III – General Biochemistry | 50 | 25 | 25 | 12.5 | 75 | 37.5 | 50 | 25 | 25 | 12.5 | 50 | 125 | 62.5 | 200 | 100 |
| IV – General Methodology | 50 | 25 | 25 | 12.5 | 75 | 37.5 | 50 | 25 | 25 | 12.5 | 50 | 125 | 62.5 | 200 | 100 |
| V – Community Medicine, Health Education and Communicative English | - | - | 50 | 25 | 50 | 25 | - | - | - | - | - | - | - | 50 | 25 |
| Total Marks | | | | | | | | | | | | | | 850 | 425 |

Second Year BSc. Medical Biochemistry Examination

| Paper | Theory | | | | | | Practical | | | | | | Grand Total | | |
|--|------------|-----|----------|------|-------|------|------------|-----|----------|------|------|-------|-------------|------------|------------|
| | University | | Internal | | Total | | University | | Internal | | Viva | Total | | Max | Min |
| | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Max | Min | | |
| VI – Analytical Methods and Instrumentation | 100 | 50 | 25 | 12.5 | 125 | 62.5 | 100 | 50 | 25 | 12.5 | 50 | 175 | 87.5 | 300 | 150 |
| VII – Enzymology | 100 | 50 | 25 | 12.5 | 125 | 62.5 | 100 | 50 | 25 | 12.5 | 50 | 175 | 87.5 | 300 | 150 |
| VIII – Endocrinology, Toxicology & Human nutrition | 100 | 50 | 25 | 12.5 | 125 | 62.5 | 100 | 50 | 25 | 12.5 | 50 | 175 | 87.5 | 300 | 150 |
| Total Marks | | | | | | | | | | | | | | 900 | 450 |



Third Year BSc. Medical Biochemistry Examination

| Paper | Theory | | | | | | Practical | | | | | | Grand Total | | |
|--|------------|-----|----------|------|-------|------|------------|-----|----------|------|------|-------|-------------|-------------|--------------|
| | University | | Internal | | Total | | University | | Internal | | Viva | Total | | Max | Min |
| | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | | | |
| IX – Intermediary Metabolism-I | 100 | 50 | 25 | 12.5 | 125 | 62.5 | 100 | 50 | 25 | 12.5 | 50 | 175 | 87.5 | 300 | 150 |
| X– Intermediary Metabolism-II | 100 | 50 | 25 | 12.5 | 125 | 62.5 | 100 | 50 | 25 | 12.5 | 50 | 175 | 87.5 | 300 | 150 |
| XI-Clinical Biochemistry | 100 | 50 | 25 | 12.5 | 125 | 62.5 | 100 | 50 | 25 | 12.5 | 50 | 175 | 87.5 | 300 | 150 |
| XII – Human Genetics and Molecular Biology | 100 | 50 | 25 | 12.5 | 125 | 62.5 | - | - | - | - | - | - | - | 125 | 62.5 |
| Total Marks | | | | | | | | | | | | | | 1025 | 512.5 |

Final Year BSc. Medical Biochemistry Examination

| Paper | Theory | | | | | | Practical | | | | | | Grand Total | | |
|---|------------|-----|----------|------|-------|------|------------|-----|----------|------|------|-------|-------------|-----|-----|
| | University | | Internal | | Total | | University | | Internal | | Viva | Total | | Max | Min |
| | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | | | |
| XIII – Immunology and Immunochemistry | 100 | 50 | 25 | 12.5 | 125 | 62.5 | 100 | 50 | 25 | 12.5 | 50 | 175 | 87.5 | 300 | 150 |
| XIV – Diagnostic Biochemistry and Laboratory Management | 100 | 50 | 25 | 12.5 | 125 | 62.5 | 100 | 50 | 25 | 12.5 | 50 | 175 | 87.5 | 300 | 150 |
| XV – Research Methodology, Biostatistics, Information Technology and Artificial Intelligence in | --- | --- | 50 | 25 | 50 | 25 | - | - | - | - | - | - | - | 50 | 25 |



| | | | | | | | | | | | | | | | |
|--------------------|---|---|---|---|---|---|----|----|---|---|---|---|------------|------------|----|
| Healthcare | | | | | | | | | | | | | | | |
| XVI – Project | - | - | - | - | - | - | 50 | 25 | - | - | - | - | - | 50 | 25 |
| Total Marks | | | | | | | | | | | | | 700 | 350 | |

3.4. Papers in each year

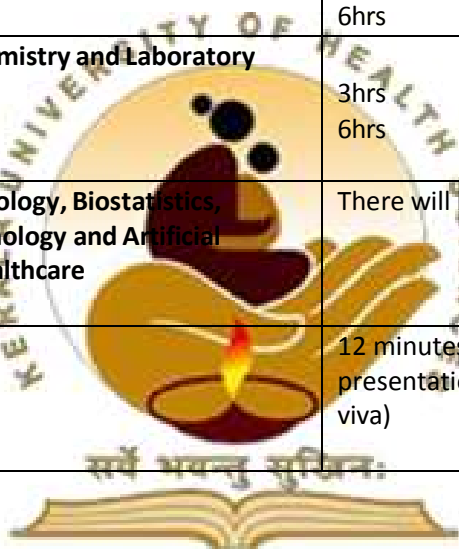
As given in clause 2.6

3.5. Duration of theory and practical exams

| Year | Paper | Subject | Duration |
|---------------|-------------|---|--|
| First | I | Anatomy Theory Practical | 2 hrs 3hrs |
| | II | Physiology Theory Practical | 2 hrs 3hrs |
| | III | General Biochemistry Theory Practical | 2 hrs 3hrs |
| | IV | General Methodology Theory Practical | 2 hrs 3hrs |
| | V | Community Medicine, Health Education and Communicative English | There will be no university examination. |
| Second | VI | Analytical Methods and Instrumentation Theory Practical | 3hrs 6hrs |
| | VII | Enzymology Theory Practical | 3hrs 6hrs |
| | VIII | Endocrinology, Toxicology and Human Nutrition Theory Practical | 3hrs 6hrs |



| | | | |
|---------------|-------------|--|---|
| Third | IX | Intermediary Metabolism-I Theory Practical | 3hrs 6hrs |
| | X | Intermediary Metabolism-II Theory Practical | 3hrs 6hrs |
| | XI | Clinical Biochemistry Theory Practical | 3hrs 6hrs |
| | XII | Human Genetics and Molecular Biology Theory Practical | 3hrs There will be no practical examination. |
| Fourth | XIII | Immunology and Immunochemistry Theory Practical | 3hrs 6hrs |
| | XIV | Diagnostic Biochemistry and Laboratory Management Theory Practical | 3hrs 6hrs |
| | XV | Research Methodology, Biostatistics, Information technology and Artificial Intelligence in Healthcare | There will be no university examination. |
| | XVI | Project Evaluation | 12 minutes per candidate (Power point presentation for maximum 10 minutes and viva) |



3.6 Details of theory exams

a). Question paper setters

Question paper setters shall be posted from among the qualified teachers as per norms of Kerala University of Health and Allied Sciences.

b). Question paper pattern

Total marks- 100

Time- 3 hrs

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

Brief essay - 2 no. s x 10 marks = 20 marks

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

Comment on- 10 nos x 2 marks = 20 marks

Total marks- 50

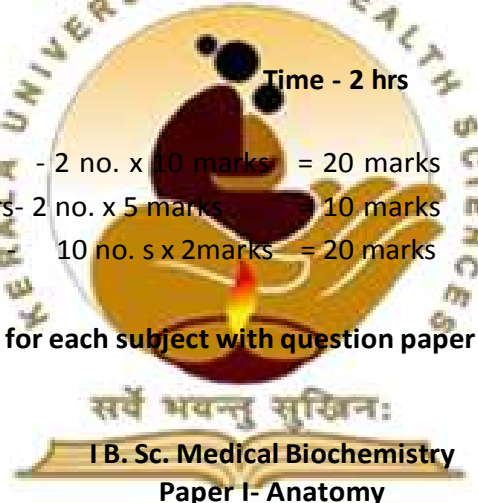
Time - 2 hrs

Essay - 2 no. x 10 marks = 20 marks

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

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

c). Model question paper for each subject with question paper pattern



Total marks- 50

Time- 2 hrs

Essay-2 no. x 10 marks= 20 marks

1. Define epithelium. Describe its functions and structure. Classify epithelium giving suitable examples.
2. Name the parts of the Urinary system and describe in detail the kidney

Short answers 2 no. x 5 marks = 10 marks

3. Name the parts of female reproductive system. Describe in detail the uterus.
4. Name the endocrine glands. Describe in detail the pituitary gland and thyroid gland.

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Comment on

10 no. s x 2marks = 20 marks

5. Sessmoid bones
6. Connective tissue cells
7. Islets of Langerhans
8. Spermatic cord
9. Parts of Respiratory system
10. Structure of heart
11. Location of Digestive glands
12. Peripheral Nervous system
13. Tongue
14. Microscopic structure of skin



Total marks- 50

Time- 2 hrs

Essay- 2 no. x 10 marks

= 20 marks

1. Define Cardiac cycle. Give the normal value of duration of one Cardiac cycle. Explain the events occurring during the cardiac cycle.
2. Define Spermatogenesis. Explain the steps of spermatogenesis. Add a note on factors influencing Spermatogenesis.

Short answers

2 no. x 5 marks

= 10 marks

3. Explain neural regulation of respiration.
4. Explain the steps of urine formation

Comment on

10no. s x 2marks

= 20 marks



5. Properties of Cardiac Muscle
6. Endocrine functions of kidney
7. Sarcomere
8. Chloride shift
9. Webers test
10. Functions of saliva
11. Erythroblastosis foetalis
12. Muscle contraction
13. Structure of neurons
14. Temperature Regulation

Paper III- General Biochemistry

Total marks- 50

Time- 2 hrs

Essay-2 no. x 10 marks

= 20 marks

1. Define Lipids. Classify lipids giving examples of each class
2. Write in detail about the sources, RDA, functions and deficiency of iron. Add a note on iron absorption.

Short answers

2 no. x 5 marks

= 10 marks

3. Essential amino acids
4. Lipoproteins

Comment on

10 no. s x 2marks

= 20 marks

5. Bicarbonate buffer
6. Structure of eukaryotic cell
7. Disaccharides
8. Hendreson- Hasselback equation
9. Zinc sulphate
10. Nyctalopia
11. Structure of t RNA



12. Sodium carbonate
13. Scurvy
14. Indicators

Paper IV- General Methodology

Total marks - 50

Time - 2 hrs

Brief Essay- 2 no. s x 10 marks

= 20 marks

1. Define culture media. Write a brief essay on different culture media.
2. General Procedures of Clinical laboratory.

Short answers-

2 no. s x 5 marks

= 50 marks

3. Autoclave
4. Laboratory animals

Comment on-

10 nos x 2 marks= 30 marks

5. Thin blood smear
6. Gram staining
7. Universal safety precautions
8. Labelling and registering of specimens
9. Anticoagulants
10. properties of buffer
11. Capillary blood collection
12. Molal solution
13. Volumetric Analysis
14. Phase contrast Microscope



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Paper VII- Analytical Methods and Instrumentation

Total Marks:100

Time: 3 hrs

Essay

1. Describe the principle, types and application of ELISA
2. What is principle of electrophoresis, discuss on factors influencing electrophoretic mobility. Enumerate on PAGE
(2×15=30)

Brief Essay

3. Describe on the principles and application of spectrophotometry
4. Give an account of different types of centrifuges (2×10=20)

Short Answers

5. RIA
6. Flame photometry
7. Ion exchange chromatography
8. Iso-electric foccusing
9. HPLC
10. Immuno electrofoecusing (6×5=30)

Comment On

11. Application of centrifugation
12. Nebulizer
13. Turbidimetry
14. Rotors
15. Types of gels
16. Solubilizers
17. Errors in paper chromate graphy
18. Column preparation
19. Beer -Lamberts law
20. Partition coefficient (10×2=20)



Paper VIII- Enzymology

Total Marks:100

Time: 3 hrs

Essay

1. Explain in detail the clinical significance of any five enzymes. Add a note on their estimation.
2. Describe in detail methods of regulations of enzyme activity (2×15=30)

Brief Essay

3. What do you mean by enzyme inhibition? Explain in detail about competitive and noncompetitive inhibition
4. Enzyme purification (2×10=20)

Short Answers

5. Classification of enzymes
6. Enzyme specificity
7. Iso-enzymes of LDH
8. LB plot
9. Ribozymes
10. Functional and non functional enzymes (6×5=30)



Comment On

11. Km value
12. Suicide inhibition
13. Active site
14. Co-enzymes
15. Lock and key model method
16. Multi enzyme complex
17. Pancreatic amylase
18. Turn over number
19. M-M equation
20. Metallo enzymes (10×2=20)

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Paper –IX Endocrinology, Toxicology and Human Nutrition

Total Marks:100

Time: 3 hrs

Essay

1. Give an account of chemistry, functions and disorders of pancreatic hormones.
2. Explain the mechanism of action of hormones. Add a note on second messengers

(2×15=30)

Brief Essay

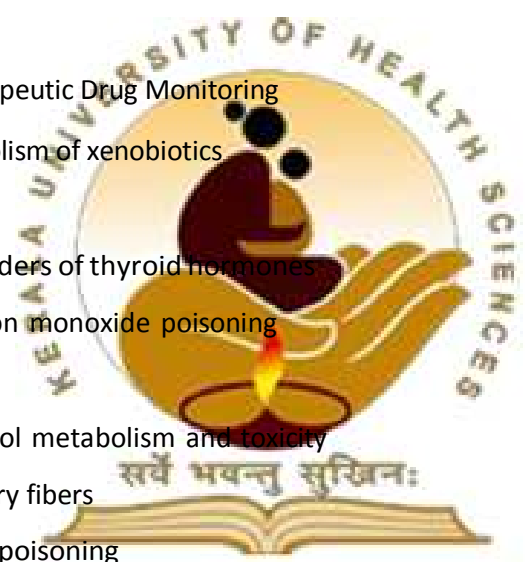
3. Therapeutic Drug Monitoring
4. Metabolism of xenobiotics

(2×10=20)

Short Answers

5. Disorders of thyroid hormones
6. Carbon monoxide poisoning
7. PEM
8. Alcohol metabolism and toxicity
9. Dietary fibers
10. Lead poisoning

(6×5=30)



Comment On

11. Hormone receptors
12. Catecholamines
13. Glycemic index
14. SDA
15. Positive nitrogen balance
16. Scurvy
17. Insulin
18. Food preservatives
19. Pellagra



20. RQ

(10x2=20)

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Biochemistry Paper IX -Intermediary

Metabolism-I

Total Marks:100

Time: 3 hrs

Essay

1. Discuss reaction, regulation, energetics and significance of TCA cycle.
2. Explain the steps involved in glycolysis. Add a note on its energetics.

(2×15=30)

Brief Essay

3. Describe in detail steps involved in gluconeogenesis
4. Urea cycle

(2×10=20)

Short Answer

5. Add a note on Transamination reaction
6. Digestion and absorption of carbohydrates
7. Synthesis of catecholamines
8. Glycogenolysis
9. Add a note on the synthesis of serotonin and melatonin and its functions
10. Catabolism of heme

(6×5=30)

Comment On

11. Significance of HMP pathway
12. Porphyrins
13. Cori's cycle
14. Redoxpotential
15. Pasteur effect
16. Phenyl ketonurea

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17. G6PD deficiency

18. Entropy

19. Lactose intolerance

20. Glutathione

(10×2=20)

Paper X-Intermediary Metabolism-II

Total Marks:100

Time: 3 hrs

Essay

1. Explain the steps involved in cholesterol biosynthesis. Add a note on its regulation.
2. Discuss the de novo synthesis of purine nucleotides. Add a note on its inhibitors

(2×15=30)

Brief Essay

3. Describe in detail steps involved beta oxidation
4. Digestion and absorption of lipids

(2×10=20)

Short Answer

5. Ketone body synthesis
6. Fatty liver and lipotropic factors
7. Absorption Metabolism of Iron
8. Gout
9. Functions and disorders of Calcium
10. Lipoprotein metabolism

(6×5=30)

Comment On

11. Salvage pathway
12. PUFA
13. Orotic aciduria
14. Alpha oxidation
15. Eicosanoids
16. Apolipoproteins

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17. Sodium-potassium pump

18. Lesch Nyhan syndrome

19. PRPP

20. Sphingolipidoses

(10×2=20)

Paper XI- CLINICAL BIOCHEMISTRY

Total Marks:100

Time: 3 hrs

Essay

1. Describe the laboratory diagnosis, monitoring and complications of diabetes mellitus.

2. What is the normal blood pH? How is it regulated? Add a note on acid base balance

(2×15=30)

Short Essay

3. Blood glucose regulation

4. Obesity

(2×10=20)

Short Answers

5. Functions and clinical significance of plasma proteins

6. Atherosclerosis

7. Electrolyte balance

8. Hypoglycemia

9. Acute phase proteins

10. Atherosclerosis

(6×5=30)

Comment On

11. Glycated hemoglobin

12. Anion Gap

13. Gestational diabetes mellitus

14. Fatty liver

15. Hemoglobinopathies

16. Hypokalemia

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17. Microalbuminuria
18. Insulin
19. Osmolality
20. Glycogen storage disorders

Paper –XII : Human Genetics and Molecular Biology

Total Marks:100

Time: 3 hrs

Essay

1. Explain the principle and applications of blotting techniques
2. Describe in detail steps involved in translation. Add a note on the post translational modifications and inhibitors of protein synthesis
(2×15=30)

Short Essay

3. Briefly describe the organization of DNA
4. Role of Enzymes and proteins involved in DNA replication (2×10=20)

Short Answers

5. Mutation
6. DNA profiling
7. Genetic code
8. DNA repair
9. PCR
10. Protein targetting (6×5=30)

Comment On

11. Mutagens
12. Oncogenes
13. RNA polymerase

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14. Human genome project
15. HGPRT
16. Genetic code
17. Operon
18. Vector
19. Gene therapy
20. Repetitive sequences (10x2=20)

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Paper XIII- Immunology and Immunochemistry

Total Marks:100

Time: 3 hrs

Essay

1. What are immunoglobulins? Classify and describe the structure of IgG in detail
2. List the cells and organs of immune system. Write in detail about primary lymphoid organs.

2x15=30)

Brief Essay

3. Define monoclonal antibodies. Explain the production of monoclonal antibodies and their uses.
4. Define hypersensitivity. Write in detail about immediate type of hypersensitivity reactions.

(2x10=20)

Short Answers

5. Tumor markers
6. Vaccines
7. HDN
8. CFT

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9. Autoimmunity

10. AIDS

(6×5=30)

Comment On

11. Epitopes

12. APC

13. Haptens

14. Precipitation reactions

15. Rh blood grouping systems

16. Phagocytosis

17. Oncogenes

18. Neutralisation

19. Adjuvants

20. Agglutination reactions

(10×2=20)

Paper XIV- Diagnostic Biochemistry And Laboratory Management

Total Marks:100

Time: 3 hrs

Essay

1. What are the different biological functions of liver? Describe briefly on laboratory tests to assess liver function

2. What are the different types of errors occurring in laboratory?

Discuss briefly on QC systems used in clinical chemistry labs

(2×15=30)

Brief Essay

3. Discuss automation in clinical biochemistry lab.

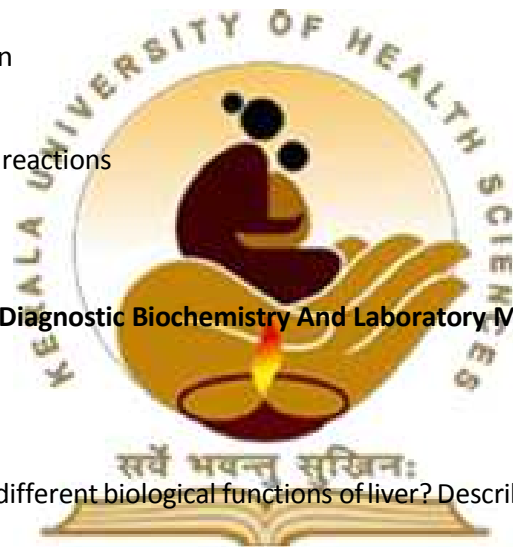
4. Describe briefly on laboratory tests to assess thyroid functions. (2×10=20)

Short Answer

5. Biochemistry of CSF

6. Preservation and storage of clinical chemistry samples

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7. Gastric stimulation tests

8. PFT

9. Disposal of wastes

10. Dry chemistry analyser

(6×5=30)

Comment On

11. Bence jones proteins

12. VMA

13. PSA

14. Seminal fluid

15. Beta HCG

16. Centrifugal analyser

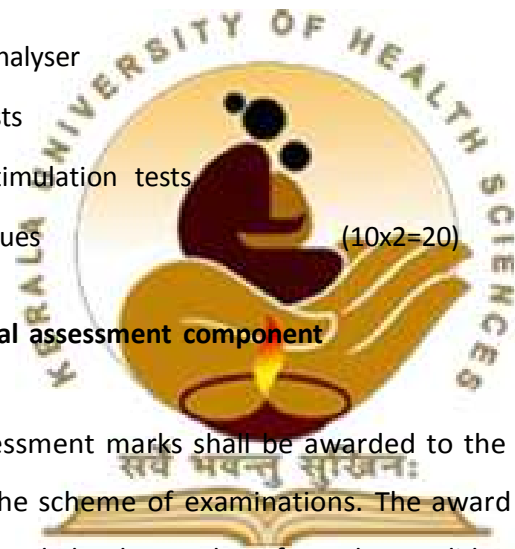
17. Clearance tests

18. Histamine stimulation tests

19. Reference values

(10×2=20)

3.7 Internal assessment component



Internal assessment marks shall be awarded to the candidates in each paper as detailed in the scheme of examinations. The award shall be on the basis of the assessment made by the teachers from the candidate's performances in the

- Three sessional examinations evenly placed and conducted by the department of which the third one is university model and is mandatory and average of two best performances shall be taken into consideration,
- Seminars, assignments, attendance, laboratory work and record work during the course of study.
- The marks secured by the candidates in each paper shall be forwarded to the University at the end of the course for the University examinations. The candidates who failed in the University Examinations will be allowed a separate

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internal assessment for both theory and practical

- The class average of internal assessment marks of the whole class should not exceed 75% of maximum marks for regular examination and 80% for supplementary examination both in theory and practical examination.

3.8 Details of Practical Examination

As detailed in Clause 3.3 and 3.5

A certified practical Record is compulsory for each subject with Practical Examination and that will be evaluated at the time of concerned University Practical Examination. A maximum of 10 marks shall be given for the record.

3.9 Number of examiners needed (Internal & External) and their qualifications

The examiner should be an Assistant Professor or above with MSc. Medical Biochemistry and minimum 3 years Post PG teaching experience in the concerned subject. The evaluator should be an Assistant Professor or above with MSc. Medical Biochemistry and minimum 3 years Post PG teaching experience.

3.10. Details of viva: division of marks

As Given in Clause 3.3 and 3.5

3.11 Project Evaluation

The project evaluation will be conducted by the internal and external examiners together in the Fourth year B Sc Medical Microbiology University practical examination. Soft Copy of the project in PDF format should be sent to the examiners at least one week before the date of University Examination

4. INTERNSHIP

Not applicable

5. ANNEXURES

5.1 Check Lists for Monitoring: Log Book, Seminar Assessment etc. to be formulated by the curriculum committee of the concerned Institution

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