SHREE GURU GOBIND SINGH TRICENTENARY UNIVERSITY

FACULTY OF MEDICINE & HEALTH SCIENCES
Gurgaon-Farukhnagar Road, Village: Budhera, Distt. Gurgaon
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Curriculum & time bound programme for Teaching and Training in MD Course in

[BIOCHEMISTRY]

CURRICULUM FOR M.D.(BIOCHEMISTRY)

PROGRAMME OBJECTIVES:

A resident on completion of his/her course in MD Biochemistry should

1. Have a thorough understanding of the concepts and principles of Biochemistry and Cell Biology.
2. Be able to apply the same to explain and interpret the Molecular and Metabolic aspects of health and disease thereby integrating his/her understanding with the concept of Molecular medicine.
3. Be equipped with laboratory skills that enable him/her to perform and interpret basic and advanced techniques and identify and solve the problems that arise during their operation.
4. Have skills of self directed learning to keep himself / herself updated with the knowledge, research and technological advancements.
5. Be thorough in Experimental Design and Research Methodology. He / She should be able to prepare research protocols, conduct experimental studies, analyze and solve experimental problems.
6. Be able to plan, organize and conduct class room lectures, seminars, practical demonstrations, tutorial classes and small group discussions on clinical problems for undergraduate students and post graduates of medical and allied disciplines.
7. Have skills to supervise modern laboratory techniques and procedures in Clinical Biochemistry in the hospital and exercise effective degree of quality control.
8. Be able to suggest, evaluate and interpret Biochemical investigations in a give clinical situation and apply knowledge to clinical problems and active patient care.
9. Have knowledge and skills to plan, conduct and lead an educational and modern research programme at the basic and applied level, guide a thesis at the post graduate level and with some relevant experience, at the Doctoral level.
10. Have the background to pursue her/his interest to academic and pursue further specializations e.g. Post doctoral / DM qualifications in different specialties and super specialty areas of life / health sciences.
11. Have knowledge in the basics of Educational Technology so that he / she improve his own performance as a facilitator of learning and can play a lead role in the

designing curriculum and education innovations for effective teaching and learning of Biochemistry at least at the departmental and institutional level.

POSTGRADUATE TRAINING

METHODOLOGY

Active learning should be the mainstay of the program. The following methods will be used to facilitate learning and training of MD students.

1) **Post graduate lectures, tutorials, seminars:** To update on various aspects of basic and clinical biochemistry, immunology & impact of molecular biology on advances in medicines.

2) **Journal club:**
   To develop a) Skills of analysis, evaluation and presentation of research papers
   b) Familiarity with approaches and methodologies of research and
   c) to update on new development / emerging trends in biochemistry.

   Practical exercises: To equip them with knowledge and skills to learn techniques at the bench level.

3) **Thesis:** Each PG student will carry out research work under the supervision of faculty member of the Department of Biochemistry.

4) **Teaching:** Participation in UG laboratory practical teaching and problem based learning tutorials as a team with faculty and senior residents of the department to develop skills of self directed learning, effective communication, leadership, organizing group discussions, working in group, facilitate students learning as a teacher and to gain in depth learning and problem solving skills.

5) **Specialized training in clinical Biochemistry:** Posting in the clinical biochemistry laboratory and other specialized laboratories of the institution to learn sample collection quality control methods, setting up of a clinical biochemistry laboratory, specialized assays, statistical analysis of data.

6) **Horizontal and vertical integration of the subject with the other preclinical, paraclinical and clinical departments:** It should be encouraged by participation in integrated joint teaching sessions, joint seminars, participation in clinical rounds for discussing cases of interest etc. This may also be achieved by framing appropriate problem based modules for small group discussion in collaboration with different departments.

CURRICULUM

The curriculum will be spread over three years and includes the following components:

1. Organized teaching sessions (Theory and Practical) as per the syllabus (attached). These include following sessions.
    i. Lectures -5 hours per week
    ii. Practicals -25 hours per week
    iii. CPC and clinical meeting -4 hours per week
2. Posting of residents for training in different laboratories of biochemistry and clinical laboratories/specialties.

3. Thesis: Each student has to write up a thesis under the guidance of one or more faculty members as per the institute's rules. The work is carried out over and above routine duties.
4. Course in Basics of Biostatistics and Clinical Research Methodology.

ASSESSMENT

1. Sessional examination: Formal written tests and viva are organized at the end of each session.
2. Periodical examination: Students will be given class tests after a series of lectures.
3. Final M.D. examination:- This is conducted as per the pattern in the institute on the following lines.

Examiners: Two internal and two external examiners

Postgraduate Examination

The postgraduate examination shall be in 3 parts.

1. **Thesis:** Each student will prepare a thesis under the direct supervision of a faculty member of the biochemistry department and submit at least 6 months before the date of commencement of the theory examination.

2. **Theory examination** comprising of four paper (100 marks each) of three hours duration each and covering the course content as detailed below.

3. **Practical and Viva – voce examination** spread over two days

Theory examination

There should be 4 theory papers with the broad subdivision of topics as mentioned below.

PAPER I - Biomolecules, introductory biochemistry Cell biology, Physical chemistry, Biostatistics / Research methodology and Biochemical techniques, Quality control in labs.

PAPER II - Enzymes, Biological oxidation, Intermediary metabolism and regulation, inborn errors of metabolism, Nutrition (Vitamins & Minerals), Endocrinology.

PAPER III - Molecular Biology, Immunology

PAPER IV - Clinical Biochemistry& Recent advances.

DETAILED COURSE CONTENTS

PAPER – I

Biomolecules

Molecular hierarchy in the living system (primordial – macromolecular – supra-molecular structures), chemical bonds and molecular interactions. Properties of water. Concept of an acid, a base, pH, pK, buffer and buffering capacity. Classification, structure and functions of amino acids, Structural organization of proteins, relationship with their functions. Conjugated proteins and metalloproteins. Structure and functions of hemoglobin and myoglobin. Structure of collagen. Biologically active amines and neurotransmitters. Classification, chemistry and functions of carbohydrates and lipids.

Cell Biology

Structure of the cell and different subcellular organelles, structure and functions of cell membrane. Movement of substances across cell membranes, Interaction between cells and environment, Glycoproteins and proteoglycans, Extracellular matrix, Cell-cell interactions, tight junctions, gap junctions, Intracellular traffic and sorting of proteins-endoplasmic reticulum, Golgi complex, vesicle transport, endocytic pathway, protein targeting to cell surface, nucleus, lysosomes, mitochondria, peroxisomes, cytoskeleton and cell motility, cell cycle, muscle contraction, Hemoglobin and myoglobin.

Biostatistics and research methodology

Types of study design, calculation of adequate sample size and its significance, basic concepts of biostatistics as applied to health science – mean., mode, median, S.D. , analysis of variance and correlations – Students ‘t’ test, Paired ‘t’ test, Chi square test, Fisher’s exact test, Non-parametric tests of significance, One-way and two-way analysis of variance, Multivariate analysis, Survival analysis-log rank test, Relative risk calculation – Odd’s ratio, familiarity with commonly used statistical software,.

Biochemical Techniques

Centrifugation-ultracentrifugation, Optical techniques spectrophotometry, reflectance photometry, flame photometry, atomic absorption spectrophotometry, Fluorimetry, phosphorescence, chemiluminescence, turbidimetry and nephelometry.

Electrochemistry – Chemical sensors and biosensors, electrophoresis, chromatography, Immunochemical techniques – immunoassays, Spectroscopic techniques – circular dichroism, electron spin resonance, nuclear magnetic resonance, Mass spectrometry and tandem mass spectrometry, Nanotechnology and microfabrication, Techniques to study in vivo metabolism-NMR,SPECT,PET scans, Radiosotope techniques.

PAPER II

Enzymes
Introduction, classification, Coenzymes, cofactors, isoenzymes general and kinetic properties, principles of enzyme assay, Mechanism of enzyme action, regulation of enzyme activity, allosteric enzymes.

Clinical correlations:
1. Drugs as enzyme inhibitors in antibacterial, anti–viral and antitumor therapy.
2. Diagnostic and therapeutic significance of enzymes and isoenzymes in disease states including cancers

Biological oxidation and thermodynamics
Basic concepts of thermodynamics and its laws as applied to living systems, exergonic endergonic, energy transfer and coupled reactions, ATP, high and low energy compounds, redox potential, classification and Role of oxidoreductases, cytochromes, cytochrome P450 system, Free radicals formation and scavenging. Anti-oxidants – role in diseases.

Respiratory chain and oxidative phosphorylation, its components & complexes, flow of electrons in respiratory chain, ATP synthesis and control, site specific inhibitors, uncouplers, ionophores, biological uncouplers.

Clinical correlations:
1. Cyanide poisoning
2. Hypoxic injury

Metabolism
Overview, including methods of studying metabolism

Metabolism of carbohydrates: Digestion and absorption, glycolysis, TCA cycle – regulation, Glycogen metabolism and its regulation, Cori cycle, gluconeogenesis and control of blood glucose, metabolism of fructose, galactose, metabolism of ethanol. Significance of pentose phosphate pathway and uronic acid pathway.

Clinical correlations:
1. Glycogen storage diseases
2. Essential fructosuria; galactosemia
3. Lactic acidosis
4. G6PD deficiency
5. Alcoholism – Methanol poisoning
6. Diabetes mellitus – detailed biochemical aspects of etiopathology, symptomatology, diagnosis, principles of treatment, complications, monitoring of diabetic control of immediate and long term targets.

Metabolism of lipids: Digestion & absorption, role of bile salts. Storage and mobilization of fats, biosynthesis and oxidation of fatty acids, ketone bodies – formation, utilization. Regulation of ketosis. Metabolism of unsaturated fatty acids and eicosanoids –

prostaglandins, thromboxanes, leukotrienes, Role of aspirin and other NSAIDs. Lipid transport – structure, metabolism and functions of different classes of lipoproteins. Role of liver. Separation of lipoprotein classes. Cholesterol synthesis, transport and excretion. Bile acid formation. Role of cholesterol in the development of atherosclerosis – relationship of hypercholesterolemia and dietary fat intake….

Clinical correlations:
1. Obesity
2. Ketoacidosis
3. Fatty liver
4. Hyperlipidemias
5. Atherosclerosis – molecular and clinical aspects including risk evaluation and principles of therapeutic nutritional and life style changes interventions.

Metabolism of amino acids & proteins: Digestion and absorption, pathways of amino acid degradation – transamination, oxidative deamination. Transport and metabolism of ammonia – urea cycle. Essential, non essential and glucogenic and ketogenic amino acids, Catabolism of C-skeletons, Synthesis of biologically important compounds from amino acids. Clinical correlations: Disorders of ammonia metabolism including biochemical basis of common underlying clinical conditions and interventions; Inborn errors of metabolism associated with various amino acids – biochemical aspects of their diagnosis and interventions.

Metabolism of special tissus – Liver, Adipose tissue, Brain, RBCs, Kidneys, eye lens, heart, muscles, sperms. Bone metabolism – Bone formation, resorption, Biochemical markers.

Integration and hormonal regulation of mammalian metabolism
Interconversion of major foodstuffs, tissue specific metabolism – liver, muscle, erythrocytes, heart, adipose tissue, brain etc.

Clinical correlations:
1. Starvation
2. Uncontrolled diabetes mellitus
3. Metabolic response to stress, injury
4. Hemolysis, erythrocyte membrane stability

Heme Metabolism: formation and catabolism of heme, bile pigments, and salts and correlation with liver function

Clinical correlations:
1. Porphyrias
2. Jaundice
3. Hemolytic disease of the new born
4. Metabolism of Xenobiotics and Cytochrome P450 system

Endocrine biochemistry: Classification and general mechanism of action of hormones.

Biogenesis, secretion, control, transport and mode of action of following – hypothalamic peptides, adenohypophyseal and neurohypophyseal hormones, thyroid parathyroid hormones, calcitonin pancreatic hormones, adenocortical and medullary hormones, gonadal hormones, gastrointestinal hormones, opioid peptides, endorphins.
Biochemical aspects of diagnosis and treatment of endocrinal disorders; Biochemistry of conception, reproduction and contraception.
Endocrine interrelationship and their involvement in metabolic regulation Neuromodulators and their mechanism of action, physiological significance.

Human nutrition: General aspects:
Principal food components, general nutritional requirements, energy requirements, biological value of proteins, specific dynamic action, balanced diet, diet formulation in health and disease, mixed diet, nutritional supplements, food toxins and additives, parenteral nutrition, disorders of nutrition, obesity, protein and protein energy, malnutrition dietary fibers, undernutrition, laboratory diagnosis of nutritional disorders, National Nutritional programme

Vitamins- Biochemical role, sources, deficiency, daily requirement of vitamins Biochemical basis of vitamin deficiency states, their consequences, diagnosis and treatment.

Minerals – Ca, P, Mg, Na, K, Cl., Trace elements – Fe, Cu, Se, etc.

Clinical correlations:
Protein-energy malnutrition
Malabsorption syndromes
Iron deficiency anemia, Wilson's disease
Tetany
PUFA and risk factors for IHD
Cholera gastroenterit

PAPER III

Molecular Biology
Purines and Pyrimidines, their functions, Structure and metabolism of nucleotides and nucleic acids, including chromatin remodeling, Structure and organization of chromosomes. DNA replication and transcription, translation, Gene expression in prokaryotes and eukaryotes, Recombinant DNA and other molecular biology techniques, Human genome project, functional genomics, proteomics, Bioinformatics.

Principles of human genetics
Transmission of genetic disease – mutations and their functional consequences, alleles, genotypes and phenotypes, genetic linkage, identification of disease causing gene, chromosomal disorders, monogenic Mendelian disorders, mitochondrial disorders, nucleotide repeat expansion disorders, polygenic disease and complex genetic traits, imprinting disorders, methods of mutation detection, gene therapy.

Stem cells in clinical medicine
Basic concepts regarding nature, harvesting, storage and applications of stem cells; future prospects etc.

Cancer and cancer genetics:
Clonal origin and multistep nature, oncogenes, tumor suppressor genes, familial cancer syndromes, chromosomal instability in solid tumors, viruses in human cancer, epigenetic regulation in cancer, gene expression profiling in cancer, cancer cell biology, cell cycle abnormalities, telomerase, apoptosis, metastasis – molecular basis and therapeutic strategies, tumor angiogenesis – molecular events and antiangiogenic therapy, biological basis of cancer chemotherapy, multidrug resistance, molecularly targeted cancer therapy, cancer immunotherapy.

Immunology:
Overview-innate and acquired immunity, cells and organs of the immune system – T and B cells, macrophages, dendritic cells, NK cells, granulocytes, antigens, epitopes and haptens, immunoglobulins classes, isotypes, allotypes, idiotypes, monoclonal antibodies, organization and expression of immunoglobulin genes, immunoglobulin gene rearrangement, class switching, antigen-antibody interaction-immunochemical techniques, MHC, antigen processing and presentation, T cell and B cell receptor, toll like receptors, T cell maturation / activation / differentiation, B cell generation / activation / differentiation, cytokines, complement system, cell mediated immunity, T regulatory cells, hypersensitivity, immune response to infections, vaccines-newer approaches, immuno-deficiencies, autoimmunity, transplantation immunology, cancer and immune system, immunodiagnostics and immunotherapy.

Environmental Biochemistry:
Xenobiotic metabolism, pollutants, adulterants and their effect on health.

PAPER IV

1. Fluid and electrolyte balance and Acid-Base balance: regulation and disturbances

2. Haematopoietic disorders Iron deficiency and other hypoproliferative anaemias – iron metabolism, laboratory tests of iron status, iron therapy, anaemia of chronic disease, anaemia of renal disease.

Hemoglobinopathies-sickle cell anaemia, methaemoglobinemias, thalassemia syndromes Megaloblastic anaemias RBC membrane and metabolism.

Hemolytic anaemias-inherited defects in RBC memberane and enzymes-G6PD deficiency, immunologic causes of hemolysis. ABO blood group system-Plasma cell disorders multiple myeloma.

3. **Hemostasis and thrombosis**
Biochemical mechanisms, related laboratory tests, antiplatelet / anticoagulant /fibrinolytic therapy.

4. **Cardiovascular system**
Atherosclerosis – pathogenesis, risk factors, its prevention and treatment. Heart failure, acute coronary syndrome, cardiac biomarkers, cardiomyopathy-etiology.
Hypertension – essential and secondary, genetics, laboratory evaluation, approach to therapy.

5. **Respiratory system:**
Gaseous exchange in lungs – physiological features and disturbances, arterial blood gases. Pathogenesis of asthma, cystic fibrosis, emphysema, α1- antitrypsin inhibitor deficiency.

6. **Kidney:**
Kidney function tests, pathophysiology, biochemistry, laboratory findings and management in acute renal failure, chronic renal disease and failure / uremia, Estimation of GFR, glomerular diseases – pathogenesis and mechanisms of glomerular injury, Nephrotic syndrome, Diabetic nephropathy, Tubular disorders, Renal tubular acidosis proteinurea, nephrolithiasis, renal replacement, therapy,
kidney transplant. Biochemistry of renal stones.

7. **Gastrointestinal system:**
Alimentary tract – gastric physiology patho-physiology of peptic ulcer disease, role of *H. pylori,* gastric function tests, Zollinger Ellison syndrome, nutirient digestion and absorption, evaluation of malabsorption, celiac sprue, inflammatory bowel disease, steatorrhea, lactose intolerance, protein losing enteropathy, investigation of mal-digestion / malabsorption, GIT regularoy peptides, Neuroendocrine tumours.

8. **Liver –** liver function tests, hyperbilirubinemias, viral hepatitis, serologic / virologic markers, alcoholic liver disease, fatty liver, chronic liver disease, cirrhosis and its

complications, pathogenesis of ascites, hepatic encephalopathy, metabolic diseases affecting liver, Reye's syndrome, diseases of gall bladder / bile ducts – pathogenesis of gall stones. Pancreas-acute and chronic pancreatitis, cystic fibrosis, pancreatic function tests.

8. Disorders of Immune system, connective tissue and joints

Immune tolerance, mechanisms of immune mediated damage to host tissues, primary immune deficiency diseases – laboratory evaluation, allergies anaphylaxis: pathophysiology – lipid mediators, autoimmunity – immunopathogenetic mechanisms, SLE-etiology / pathogenesis / laboratory tests for autoantibodies, Rheumatiod arthritis genetics, pathogenesis, lab findings, vasculitic syndromes – pathophysiology, lab findings, sarcoidosis amylodosis, osteoarthritis – pathophysiology, gout, pseudogout, Rheumatic fever – immunological aspects, Scleroderma, synovial fluid analysis..

9. **Bone and mineral metabolism**

Bone structure and metabolism, calcium, phosphate and magnesium, regulation and abnormalities, vitamin D, calcitonin, PTH, PTHrP, osteoporosis- pathophysiology, markers of bone turnover.

10. **Nervous system and neurologic disorders**

Neurotransmitters and their receptors, ion channels and channelopathies, memory and learning – signaling pathways, neurotrophic factors, excitotoxicity and apoptosis, protein aggregation and neurodegeneration, genetic disorders of CNS, pathophysiology of ischaemic stroke, Alzheimer's disease, Parkinson' disease, Huntington' disease, Inherited ataxias, Amyotrophic lateral sclerosis and other motor neuron diseases, Multiple sclerosis. Prions and prion diseases, Guillain – Barre syndrome – immunopathogenesis, Myasthenia gravis – pathophysiology, Hereditary myopathies – Duchenne muscular dystrophy, Inherited disorders of muscle energy metabolism, mitochondrial myopathies. Biochemistry of olfaction, taste, vision and touch. Psychiatric disorders – anxiety, depression, schizophrenia –pathophysiology.

11. **Neuropsychiatric drugs**

Biochemical basis of mode of action, biochemial basis of drug addiction and abuse, CSF analysis

12. **Clinical Biochemistry**

Investigative aspects – principles of laboratory analysis and safety, specimen collection and processing, automation, point of care testing, evidence based laboratory medicine, selection and analytical evaluation of methods, clinical evaluation of methods – sensitivity and specificity, ROC curves, establishment and use of reference values, preanalytical variables, clinical laboratory informatics, quality management Clinical relevance of different analytes – amino acids / peptides / proteins, plasma proteins, enzymes, clinical enzymology, tumour markers carbohydrates, lipids / lipoproteins / apolipoproteins, cardiovascular risk factors, electrolytes and bilirubin, porphyrins and their disorders, Therapeutic drug monitoring.

Pituitary, adrenal and thyroid function, tests Reproduction related disorders – infertility, Pregnancy – maternal and fetal health Inborn errors of metabolism, Clinical toxicology.

PATTERN & SCHEDULE OF INTERNAL ASSESSMENT & FINAL EXAMINATION:-

General Principles

A. The assessment should be valid, objective, and reliable.
B. It must cover cognitive, psychomotor and affective domains.
C. Formative, continuing and summative (final) assessment should be conducted in theory as well as practicals/clinicals. In addition, thesis should be assessed separately.

Formative assessment

The formative assessment should be continuous as well as end-of-term. The former should be based on the feedback from the senior residents and the unit faculty concerned. End-of-term assessment should be held at the end of each semester (upto the 5th semester). Formative assessment will not count towards pass/fail at the end of the program, but will provide feedback to the candidate. Scheme of internal assessment examination It is held by means of a written test and practical (and or clinical) with viva examination by all consultants of the department as per distribution of marks as follows. In such five six monthly tests a candidate shall be evaluated for

Theory (Four papers)	4x100=400
Practical and viva	300+100=400
Total	800

MD Examination:

Pattern of question for theory Papers- There shall be four theory papers. One paper out of these shall be on ‘Basic Medical Sciences’ and one paper on ‘Recent Advances’ in the discipline. There shall be 100 marks for each paper to be answered in 3 hours’ time. There shall be ‘1 structured essay type question’ for 20 marks besides 8‘short essay type questions’ for 10 marks each in each paper. Days of practical examination- Practical Examination should be conducted for a batch of upto 8 candidates over a minimum period of two to three days subject to the subject curriculum with due approval of the board of examiners. For a batch of more than 8 the examination may extend accordingly. The theory papers shall be evaluated at the examination center itself

before commencement of the practical/clinical and oral examination in the subject during these practical examination days. Components of examination-It consist of a written examination, a practical examination to assess the clinical/practical competencies and skills, and a viva voce examination.

The examinations shall consist of

A) Theory

B) Practical including clinical

C) oral

A. Theory:

The 4 papers in theory shall be conducted well in advance before the oral clinical/practical examination.

B. Practical:

Clinical/Practical examination is the most important part of the evaluation and is aimed at assessing the clinical/practical skills of the candidate and diagnostic reasoning. Entirely objective evaluation of these skills is neither feasible nor desirable. However, in order to test the various skills, the examiners may evaluate the candidates on a structured format.

C. Micro- teaching

The candidate shall be allotted a topic from the discipline at a short notice of few hours, (preferably on the first day of the examination) to prepare and present before the board of examiners within a time span of 15 minutes (preferably on the second day of the examinations). The teaching skill will be evaluated under various points(as illustrated below) and marks given accordingly.

(i) Choice of article/topic (unless specifically allotted)
(ii) Completeness of presentation
(iii) Clarity of presentation
(iv) Understanding of the subject and ability to convey the same
(v) Whether relevant references have been consulted
(vi) Ability to convey points in favor and against the subject under discussion
(vii) Use of audio-visual aids

(viii) Ability to answer questions
(ix) Time scheduling
(x) Overall performance

D. Viva-Voce1

A.Viva-voce is expected to be conducted at every stage of the practical examination.

The resident will be required to answer oral questions on any aspect of the specialty. Oral. Examination is designed to test the general scientific background of the candidate and his/her own particular contribution embodied by the thesis. A formal "grand viva-voce" may be held at the end of the practical examination. Questions on the thesis/dissertation may be asked at this time as well. The board of examiners will conduct the examination. They will read out the comments & questions and will seek the answers from the candidate. The viva voce should be assessed under the following headings:

1. **Thesis viva voce**
2. **Grand viva voce**

All examiners shall be jointly responsible for all parts of the examination. In presence of the external examiners, the Chairman of the conducting board shall make the necessary arrangements for conducting the oral and practical including clinical examination at the department in the college centre .

The candidate shall bring the logbook and a copy of his/her thesis mandatorily while appearing for the oral, practical and clinical examination. Marks for examinations: The examinations shall be organized on the basis of marking system to evaluate and certify candidate's level of knowledge, skill and competence as per distributions mentioned below. In total the overall assessment for a postgraduate shall be for 800 marks.

PASS/FAIL- In order to pass the examination in each subject a candidate must secure not less than 50% marks in each head of passing which shall include (1) Theory (2) Practical including clinical and viva voce examination (3) internal assessment examination.

SYLLABUS FOR PRACTICALS:

1. All undergraduate practicals and routine emergency and special investigations carried out in central clinical laboratory of the hospital,which are useful for diagnosis and prognosis of the disease.

2. Total Quality Management of Laboratory
   a) Specimen collection, handling & storage of sample.
   b) Methods of standardization & calibration.
   c) Methods of quality control & assessment.

3. Fractionation & Identification of,
   a) Amino acids
   b) Sugar
   c) Proteins
   d) Lipoproteins by
   i. Thin Layer Chromatography
   ii. Paper chromatography (circular, Unidimensional& two dimentional iii) Gel electrophoresis- agarose, starch, & Polyacrylamide Gel Electrophoresis iv) paper electrophoresis & cellulose acetate paper electrophoresis.

4. a) Estimation of total activity of following enzymes .
   i. LDH & seperation of its isoenzymes by Polyacryamide gel electrophoresis, Cellulose acetate electrophoresis & quantitation by densitometry.
   ii. AST(GOT)
   iii. ALT(GPT)
   iv. Alkaline phosphatase
   v. Acid phosphatase
   vi. Amylase
   vii. Creatine kinase its Isoenzymes
   b) Enzyme kinetics and Determination of Km value and effect of pH substrate concentration & temperature on Enzyme activity.
   d) Endocrinology: Estimation of Hormones.

5. Isolation of DNA and PCR technique.

6. Estimation of serum lipid profile .
   i) Serum total cholesterol
   ii) Serum HDL cholesterol
   iii) Serum VLDL & LDL
   iv) Serum Triglycerides

7. Estimation of Fe & Total Iron Binding capacity,& ferritin

8. Estimation of Glycosylated Hb.

9. Body fluid analysis
    - Urine
    - CSF
    - Ascitic fluid
    - Pleural fluid

10. Estimation of Na, K & Lithium by ION SELECTIVE METHODS

11. Electrophoresis (AGAROSE & PAGE)

12. ELISA

13. SDS-PAGE

Dissertation:

The dissertation is compulsory for candidates registered for P.G. degree & should include candidates own work under a supervisor, qualified for the purpose & recognized as a P.G. teacher by the University. The subject of dissertation along with synopsis (about 200 words) signed by P.G. teacher, H.O.D.& Head of the Institution will be submitted to the University within the 6 months of the admission. Ethics Committee of the Institution must approve the topic of dissertation.

Completed dissertation will be submitted to the University preferably in the 4th term not later than 6 months before the date of final examination.

MODEL QUESTION PAPER
MD BIOCHEMISTRY (PAPER- 1)
(Introductory Biochemistry, Biochemical Techniques & Biostatistics)

Time: 3hours **Max. Marks: 100**

NOTE: Attempt all the questions

1.	Describe the principle, operation and biochemical applications of Mass Spectrometry.	**10**
2.	Describe the principle, operative procedure and biochemical applications of chemiluminescence.	**10**
3.	How is Levy Jennings control chart plotted? What is its utility in a clinical biochemistry laboratory?	**10**
4.	Describe randomized control trial.	**10**
5.	Describe collagen disorders.	**10**
6.	Describe protein folding and the disorders associated with protein misfolding.	**10**
7.	Explain Electron transport Chain and its inhibitors.	**10**
8.	Describe lysosomes in health and disease.	**10**
9.	What are the various levels of organization of proteins?	**10**
10.	Describe the principle and applications of HPLC.	**10**

MODEL QUESTION PAPER
PAPER – 2
(Biochemistry of Body Metabolism including Vitamins and Minerals))

Time: 3hours **Max. Marks: 100**

NOTE: Attempt all the questions

1.	Describe the structure and biological role of glutathione.	**10**
2.	Discuss the steps of heme synthesis. Tabulate the different types of porphyrias along with deficient enzyme.	**10**
3.	Describe the synergistic role of Vitamin E and Selenium.	**10**
4.	Describe glycogenolysis and mention Glycogen storage disease.	**10**
5.	Write the functions of lipoproteins and give a brief account of clinical disorders associated with lipoprotein metabolism.	**10**
6.	Describe the vitamins implicated in capturing energy from oxidizable substances.	**10**
7.	Write regulatory mechanisms of circulatory LDL and HDL.	**10**
8.	Describe fructose metabolism and mention its inherited Disorders.	**10**
9.	Inborn metabolic errors pertaining to tyrosine.	**10**
10.	Describe Calcium and Phosphorus metabolism.	**10**

MODEL QUESTION PAPER
(PAPER 3)
(Molecular Biology and Immunology)

Time: 3hours **Max. Marks: 100**

NOTE: Attempt all the questions

1.	Give an account of various stages of translation of mRNA into protein and add a note on inhibitors of this process.	**10**
2.	Describe the therapeutic applications of RNA interference.	**10**
3.	What is PCR? Discuss its applications.	**10**
4.	Discuss the hormones released from adipose tissue.	**10**
5.	Describe biochemical basis of antibody diversity.	**10**
6.	Explain MHC – II Complex.	**10**
7.	Describe DNA repair mechanisms.	**10**
8.	Molecular Cloning Technique.	**10**
9.	cDNA library.	**10**
10.	Telomerase in aging and cancer.	**10**

MODEL QUESTION PAPER
(PAPER 4)
(Recent advances and Clinical Biochemistry)

Time: 3hours **Max. Marks: 100**

NOTE: Attempt all the questions

1.	What is proteomics? Discuss in brief the principle of various techniques used in proteomics. Explain the importance of proteomic in medicine.	**10**
2.	Discuss the emerging role of nanotechnology in medicine and clinical biochemistry.	**10**
3.	Discuss etiology and patho physiology of chronic liver disease.	**10**
4.	Novel anticancer drugs directed against tyrosine kinases.	**10**
5.	Troponins in acute coronary syndromes.	**10**
6.	Procalcitonin as a biomarker.	**10**
7.	Immunoelectrophoresis.	**10**
8.	Acute phase proteins.	**10**
9.	Recent advances in metabolic syndrome.	**10**
10.	Adipokines in health and disease.	**10**

Books Recommended:

1. Biochemistry Ed Lubert Stryer. W.H. Freeman & company,New york.

2. Principles of Biochemistry . Ed. Lehninger , Nelson & Cox . CBS publishers & distributers .

3. Harpers Biochemistry Ed. R.K. Murray, D.K. Granner, P. A. Mayes & V.W.Rodwell. Appleton & Lange ,Stanford, Conneticut.

4. Textbook of Biochemistry with clinical correlations. Ed. Thomas M. Devlin. Wiley Liss Publishers.

5. Genes VI Ed. Benjamin Lewin .Oxford University press.

6. Tietz Textbook of Clinical chemistry, Ed. Burtis & Ashwood W.B. Saunders Company.

7. Principles & techniques of practical Biochemistry Ed. Keith Wilson & John Walker Cambridge University press.

8. Biochemistry Ed. Donald Voet & Judith G. Voet John Wiley & Sons ,

9. Molecular cell Biology, H.Lodish,A. Berk, S.L. Zipursky, P. Matsudaira, D.Baltimore , J.Darnell.

10. Lippincott's Illustrated Reviews: Biochemistry. Denise R. Ferrier. Lippincott William Wilkin publications.

11. Kuby Immunology. Thomas J. Kindt, Barbara A. Osborne, Richard A. Goldsby. W. H. Freeman & Company.

12. Practical Clinical Biochemistry. Harold Varley. CBS Publishers & Distributors

13. Text book of medical biochemistry by Dinesh Puri

14. Immunology by S.K.Gupta

15. Lippincott – Molecular Biology

16. Harrisons Internal Medicine 2 volumes

APPENDIX (LOG BOOK)

(LOG BOOK DETAILS)

S.NO:	DATE	TIME	TOPIC	TEACHER	REMARKS & SIGN. OF PG TEACHER

Topic – topic of lecture/demonstration attended

Topic of /demonstration taught

Activity- microteaching/seminars/journal club

Practical- UG & PG

Clinical Laboratory

Thesis work

Fortnightly submission of the log book to the concerned PG teacher and signature obtained.

APPENDIX -2

Direction – please tick the statement, which most closely corresponds to your observation

Name of teacher:

Topic :

Date :

s.no	skill		Teacher action	yes	To some extent	No
1.	Set induction	a)	Aroused interest in the beginning			
		b)	Specified objectives of presentation			
2	planning	a)	Organized material in a logical sequence			
		b)	Used relevant content matter			
3	presentation	a)	Fluency in language			
		b)	Used non verbal cues, eye contact			
4	Interaction	a)	Allows questions from students			
		b)	Asked questions			
5	Use of AV aids	a)	Used proper AV aids			
		b)	Used aids effectively			
6	summarization	a)	Summarized important points at the end			
		b)	Checked that all the students understood the points			
		c)	Lesson on the whole was effective			
7	Any suggestions for the speaker to improve the teaching/learning exercise					