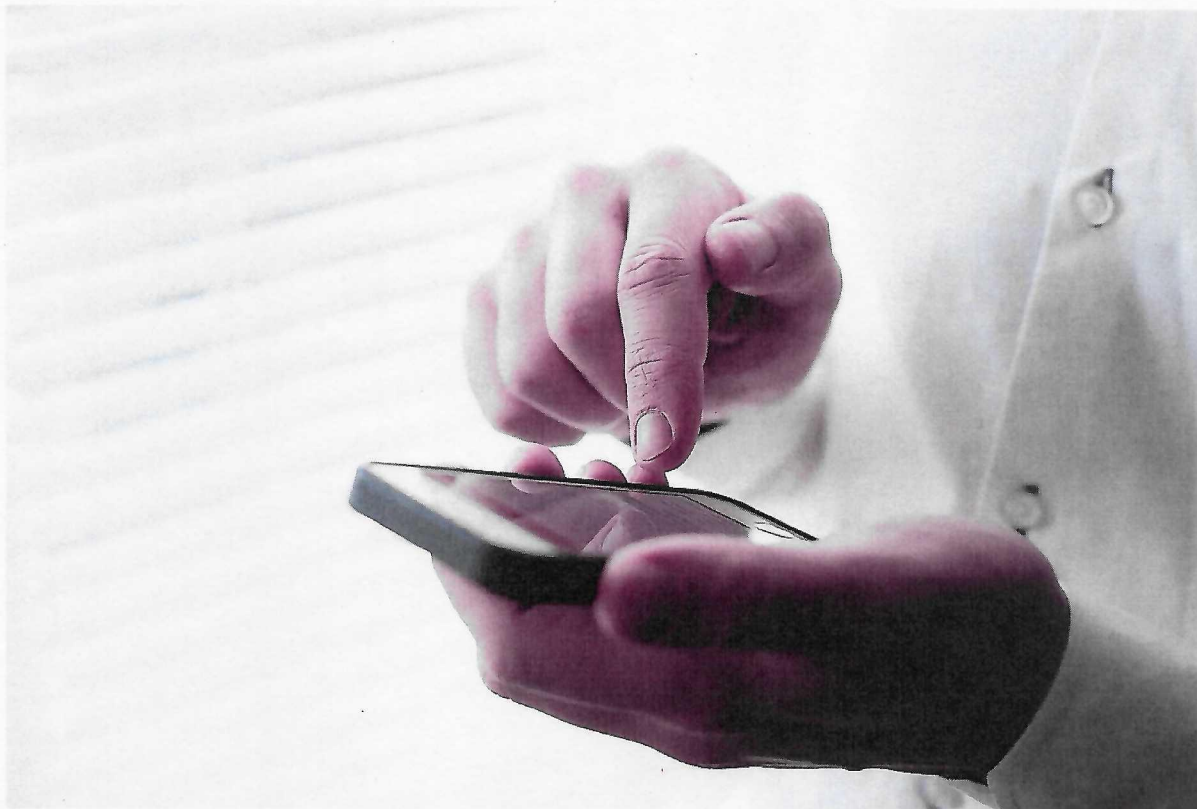


Syllabus for MD (Biochemistry) Programme



Guru Gobind Singh Indraprastha University

A State University established by the Govt. of NCT of Delhi

University School of Medicine and Allied Health Sciences

M.D. (BIOCHEMISTRY)

Course Description

- A. **Eligibility:** M.B.B.S
- B. **Selection** shall be through a competitive written examination of the objective type by an entrance examination.
- C. **Duration** of the course shall be 3 years comprising of six terms (each term shall be of six month duration)

General Objectives

A candidate, upon successfully qualifying in the MD (Biochemistry) Examination should be able to:

- I) pursue a career in laboratory technology, teaching and research.
- II) work as a teacher in medical faculty both at undergraduate & postgraduate level.
- III) supervise modern laboratory techniques & procedures in clinical Biochemistry in the hospital.
- IV) carry out & conduct various research problems both at basic & applied level.
- V) guide thesis at both Post Graduate & doctoral level.
- VI) suggest, evaluate, interpret biochemical investigations in a given clinical situation & apply knowledge in clinical problems.

Specific Learning Objectives

The student will submit the thesis protocol within 03 months of course registration for approval. The completed thesis will be submitted by the student before the end of fourth term.

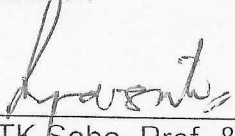
At the end of the training, the student should be able to:

- I) explain the structure-function relationships between different biomolecules.
- II) explain the biochemical principles involved in health and disease.
- III) perform procedures designed for laboratory diagnosis of diseases.
- IV) select, plan and carry out specific research projects.
- V) work as a member of the team along with clinicians to help select appropriate diagnostic tests and interpret results.
- VI) effectively organise and supervise diagnostic laboratory and ensure quality control.
- VII) develop communication skills so as to be an effective teacher.

Cognitive domain

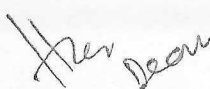
Various biomolecules present in human body should be studied with respect to:

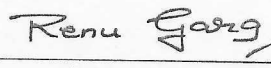
- I) historical aspects
- II) chemistry
- III) metabolism
- IV) regulation



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- V) applied aspects
- VI) recent advances.

Psychomotor domain

Student should be able to:

- I) collect biological samples with proper precaution.
- II) perform diagnostic procedures for detection and estimation of biomolecules.
- III) exercise quality supervision over laboratory equipment and processes.

Affective domain

The student should:

- I) develop communication skills to interact with students, colleagues, superiors and other staff members.
- II) be able to work as a member of a team to carry out diagnostic as well as research activities.
- III) acquire empathy towards patients

COURSE CURRICULUM

1st Term and 2nd Term

The student will:

- I) undergo basic sciences course as per MCI norms.
- II) refresh the knowledge of undergraduate practical and demonstrations in Biochemistry
- III) participate in Medical Education Technology Workshops.
- IV) attend Journal club/seminars/ symposiums/ group discussions
- V) carry out literature search for selection of thesis topic.
- VI) study methods involved in the analysis of biomolecules.
- VII) make regular ward rounds of various clinical departments and learn cases of interest for discussion with the Biochemistry faculty.

3rd to 6th Term

The students will:

- I) carry out practical demonstrations to undergraduate students and conduct small group teaching session.
- II) undergo microteaching sessions.
- III) be attached by rotation and work independently as full-time residents in sample collection centre, hospital biochemical laboratory, emergency laboratory, molecular biology laboratory, immunology laboratory, department of paediatrics and department of medicine.
- IV) participate in continued medical education programmes, Journal clubs, seminars and discussions.
- V) complete thesis works.

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Dr. Debn

COURSE SYLLABUS: THEORY

(Recent advances to be covered with each topic.)

PAPER1- CHEMISTRY OF BIOMOLECULES, ANALYTICAL TECHNIQUES, BIOSTATISTICS AND LABORATORY MANAGEMENT

1. Chemistry of carbohydrates

- I) Classification and Methods of detection
- II) Structure (only the description of accepted structures), physical & chemical properties of the following are required.
Ribose, xylose, mannose, galactose, fructose, deoxy sugars, amino sugars, uronic acids, lactose, maltose, sucrose, starch, inulin, glycogen, cellulose, glycosaminoglycans.

2. Chemistry of Lipids

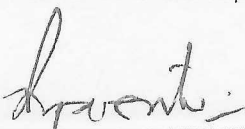
- I) Classification
- II) Structure (only the description of accepted structures), physical & chemical properties of the following are required.
Saturated & unsaturated fatty acids, their derivatives, triacylglycerol, phospholipids, glycolipids, sterols, lipoproteins

3. Chemistry of amino acids and proteins


- I) Structure (only the description of accepted structures), physical & chemical properties of the following are required.
Amino acids, peptides, polypeptides, haemoglobin, immunoglobulins, collagen & proteoglycans
- II) Levels of organisation of proteins with reference to insulin & haemoglobin
- III) Proteins structure and conformation.
- IV) Methods to determine the structure of proteins,
- V) Structure-function relationship of proteins,
- VI) Conjugated proteins including nucleoproteins, lipoproteins, immunoglobulins, glycoproteins, haemoglobin, myoglobin and collagen.
- VII) Abnormal hemoglobins and haemoglobin derivatives.

4. **Enzymes:** Classification, nomenclature, specificity, kinetics, mechanism of action and study of active sites. Coenzymes, cofactors and their mode of action. Mechanisms of regulation of enzyme activity. Isoenzymes, pro-enzymes, multienzyme complexes, Enzyme inhibitions- competitive, non- competitive and allosteric. Metal ions in catalysis.

5. **Membrane:** Chemical composition, structure, biological properties, functions, and defects. membrane transport systems, ion channels, endocytosis, exocytosis.



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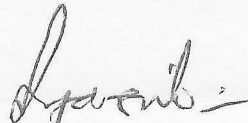


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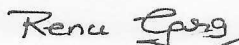
6. Concept of pH and buffer. Principles and procedures of determination of pH.
7. Osmosis, diffusion, colloidal solutions, adsorption, surface tension, viscosity: Basic concepts and applications.
8. **Isotopes**: detection & measurement of radioactive isotopes, application of isotopes in research & clinical biochemistry
9. **Analytical methods**: Principles and applications of spectrophotometry, fluorimetry, flame photometry, ion selective procedures. Qualitative analysis of biomolecules. Principles, experimental procedure and applications of chromatography, electrophoresis and ultracentrifugation. Basics of Mass spectrometry, nuclear magnetic resonance, nephelometry, X-ray crystallography & chemiluminescence
10. **Purification and separation** of proteins and other biomolecules.
11. **Laboratory management**- Establishment of biochemical laboratory; architectural, electrical specifications for a functional laboratory. Calibration, standardisation and periodical maintenance of equipment.
12. **Quality control**: Monitoring of Laboratory performance, precision, accuracy, specificity, sensitivity and method evaluation. Laboratory safety, precautions in handling hazardous material and disposal of laboratory waste including radioactive waste. Emergency laboratory services. Automation in clinical biochemistry. Collection and preservation of samples. Procurement policies and economic audit.
13. **Biostatistics**:
 - i) Basic principles and concepts of biostatistics as applied to health sciences, like concepts of probability, mean, standard deviation, law of chance, binomial expression, analysis of variance, coefficient of correlation, evaluation of new diagnostic procedure etc.
 - ii) Statistical methods in research, mean, SD, SE, P distribution, regression and correlations.
 - iii) Computer based applications

PAPER II – NUTRITION AND METABOLISM

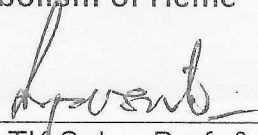
1. **Vitamins**: Chemistry, absorption, metabolism, biochemical roles, requirement, deficiency manifestations and methods for their estimation.
2. **Mineral metabolism**: Sodium, potassium, chloride, magnesium, calcium, phosphorus, trace elements, iron, copper, manganese, zinc, cobalt, molybdenum, selenium, iodine, fluorine, chromium.
3. **Nutritional requirements**: Energy requirements, balanced diet, nutritional disorders, obesity, starvation. Role of PUFA and dietary fibre.

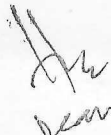

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4. Proteins requirement, nitrogen balance, nutritive value, biological value, caloric score, protein energy malnutrition.
5. **Digestion and absorption.**
6. Methods of investigation of metabolic pathways.
7. **Carbohydrate metabolism:** Embden-Meyerhof pathway, hexose monophosphate shunt, other minor pathways, fructose and galactose metabolism. Inborn errors of metabolism. Regulation of carbohydrate metabolism. Blood glucose homeostasis, hormones influencing carbohydrate utilization. Glyoxylate pathway.
8. **Amino acid & protein metabolism:** Amino acid derived products, one carbon unit metabolism, polyamines. Plasma proteins
9. **Lipid metabolism:** Transport and storage of lipids, fatty acid synthesis, fatty acid oxidation pathways in liver and muscles. Biosynthesis of phospholipids, glycolipids. Cholesterol metabolism. Plasma lipoprotein metabolism, Role of adipose tissue and liver in lipid metabolism. Regulation of lipid metabolism. Prostaglandin synthesis, functions and metabolism.
10. **Purine and pyrimidine metabolism:** Salvage pathway, de novo synthesis, regulation and degradation. Gout, Lesch – Nyhan syndrome.
11. **Intermediary metabolism:** Integration of metabolism, TCA cycle as common terminal pathway & its regulation. Anaplerotic reaction- Cori's cycle, Glucose – Alanine cycle, adaptation during starvation. Hormonal regulations of metabolic pathways.
12. **Alcohol metabolism.**
13. **Endocrine System:** Mechanism of action of hormones, hormone receptors, signal transduction, G-proteins, second messengers, cyclic AMP, cyclic GMP, calcium, Inositol triphosphate, diacyl glycerol, calmodulin. Hypothalamic and pituitary hormones, local hormones, hormones regulating fuel metabolism. Hormones affecting water and electrolyte homeostasis, growth, differentiation and reproduction.
14. **Bioenergetics and biological oxidation:** Concept of free energy change, high energy compounds, ATP generation, Redox potential, electron transport chain, oxidative phosphorylation, inhibitors, uncouplers, ionophores.
15. Reactive oxygen species and antioxidants. Nitric oxide
16. **Biotransformation:** Phase I and Phase II reactions.
17. **Metabolic adaptation** in brain, muscle, bone and erythrocytes.
18. **Metabolism of Heme**


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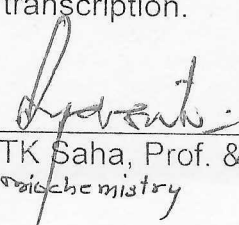
PAPER III – CLINICAL BIOCHEMISTRY

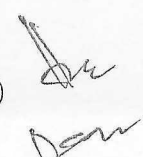
1. **Disorders of metabolism:** Diabetes mellitus, Glucose tolerance test, Glycogen storage diseases, fatty liver, atherosclerosis, inborn errors of lipid and amino acid metabolism.
2. **Biochemistry of biological fluids:** Blood, ascitic fluid, pleural fluid, CSF.
3. **Role of Kidneys** in urine formation and excretion. Urine analysis.
4. Chemistry of respiration.
5. **Water metabolism**, blood buffers, acid base and electrolyte balance and their aberrations.
6. **Biochemical evaluations** of liver, kidney, pancreas and gastric function.
7. **Biochemical evaluation** of endocrine disorders of : Thyroid, hypothalamus, pituitary, reproductive organs, parathyroid and GIT.
8. **Biochemical adaptations** in neonates, premature infants, pregnancy and lactation.
9. Enzyme and isoenzymes in clinical diagnosis.
10. **Acute phase proteins:** α -1 anti-trypsin, α -2 macroglobin, haptoglobin, ceruloplasmin.
11. **Biochemical aspect of geriatrics:** Aging, Alzheimer's disease, multiple sclerosis, osteoporosis.
12. **Environmental biochemistry:** Pollution, heat-stroke, cold-shock, adaptations, occupational hazards.
13. **Therapeutic drug monitoring.**

PAPER IV – IMMUNOLOGY, ONCOLOGY AND MOLECULAR BIOLOGY

1. Molecular Biology:

- I) **Nucleic acids:** Chemistry and structure.
- II) **DNA replication**, damage and repair processes. Mutations, amplification of genes, somatic recombination. Inhibitors of replication, anticancer drugs.
- III) **Transcription:** Details of Transcription, Transcriptional control of gene expression. Operon concept, promoters, enhancers, silencers, hormone responsive elements, transcription factors, post-transcriptional modifications of RNA exons, introns, splicing, ribozymes, inhibitors of transcription.


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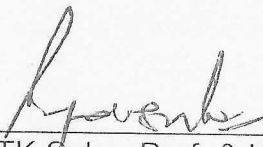
- IV) **Translation:** Genetic code, tRNA, ribosomes, protein biosynthesis, post-translational modifications, inhibitors of translation, signal sequences, chaperones and heat shock proteins, targeting, anticancer drugs.
- V) **Recombinant DNA techniques**, cloning procedure, vectors, plasmids, phages, cosmids and restriction mapping. blotting procedures, PCR, RFLP, in-situ hybridization, Genomic library, cDNA library, Gene therapy.
- VI) **Knock-out and transgenic animals.** Microinjection technique

2. Oncology:

- I) Cell cycle, check points, regulation, apoptosis.
- II) Mutagens, carcinogens, *in vitro* mutagenesis. Carcinogenesis. Tumour suppressor genes. Tumour markers.
- III) Medical genetics. Chromosomal aberration, Turner's syndrome, Down's syndrome, Klinefelter's syndrome, Genetic counselling.


3. Immunology:

- I) Chemistry of immunoglobulins, primary and secondary immune responses, autoimmune phenomenon, anaphylaxis, clonal selection, B-cells, T-cells, helper T cells, NK cells, macrophages, interleukins, cytokines, HLA antigens.
- II) Monoclonal antibodies, Hybridoma technology,
- III) Immunodiffusion, immuno- electrophoresis, radio immuno assay (RIA), enzyme linked immunosorbent assay (ELISA). Fluorescent in situ hybridization (FISH) techniques. Immune disorders and AIDS.



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Distribution of marks

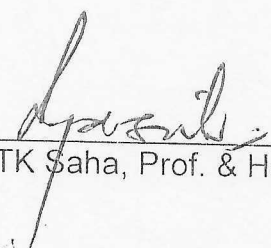
THEORY EXAMINATION (Four papers)

Paper-I	Chemistry of biomolecules, Analytical Techniques, Biostatistics and Laboratory Management
Paper-II	Nutrition and Metabolism
Paper-III	Clinical Biochemistry
Paper-IV	Immunology, Oncology and Molecular biology.

Total marks for Theory Examination (each paper carries 80 marks):	320 marks
Internal Assessment (Theory)	80 marks

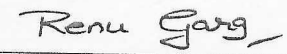
PRACTICAL EXAMINATION: (3 days duration)

Day 1 : Long Case (Four investigations)	120 marks
Day 2 : A) Short Case Profiles - 2	
i) Enzyme Kinetics	40 marks
ii) Chromatography/ Electrophoresis	40 marks
B) Standardisation	40 marks
Day 3 : A) Microteaching	40 marks
B) Grand Viva (covering all topics including dissertation)	40 marks
Total	320 marks
Internal assessment (Practical)	80 marks
Grand Total	800 marks



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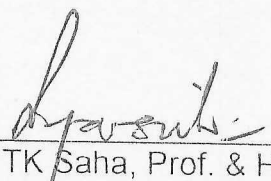
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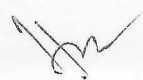



COURSE SYLLABUS: PRACTICALS

1. Specimen collection, handling and storage of samples.
2. Method standardization, evaluation and calibration.
3. Methods for quality control and assessment.
4. Preparation and storage of reagents.
5. Fractionation & identification of amino acids, sugars, proteins and lipoproteins by
 - a) Thin Layer chromatography.
 - b) Paper chromatography.
 - c) Gel electrophoresis – agarose, starch, polyacrylamide.
 - d) Paper electrophoresis.
6. Urine analysis.
7. Enzyme kinetics; isoenzyme separation by polyacrylamide gel electrophoresis.
Study of AST, ALT, Alkaline phosphatase, Acid phosphatase, Amylase, Creatine kinase.
8. Isolation and characterization of biochemical substances from tissues.
 - a) Glycogen from liver.
 - b) Cholesterol from brain.
 - c) Casein from milk.
 - d) DNA isolation.
 - e) Haemoglobin from blood.
 - f) RNA isolation.
9. Estimation of serum-
 - a) Total cholesterol.
 - b) HDL cholesterol.
 - c) VLDL cholesterol.
 - d) Triglycerides.
10. Urine stone analysis.
11. Estimation of iron and TIBC
12. Estimation of glycosylated Hb.
13. Orientation to auto analysers and basic techniques of PCR, ELISA, RIA, HPLC and blotting.


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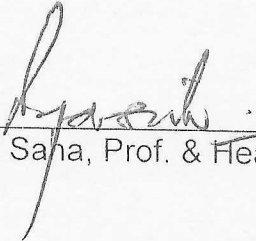



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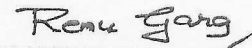
RECOMMENDED BOOKS

- Biochemistry – Voet & Voet
- Lippincott's Illustrated reviews of Biochemistry – Lippincott
- Essential of Immunology – Ivan Roitt
- Harper's Biochemistry
- Principles of Biochemistry – Lehninger
- Bioenergetics – Lehninger
- Human Nutrition & Dietetics – Davidson
- Biochemistry – Stryer
- Text book of Biochemistry with Clinical Correlation – Devlin
- Practical Clinical Biochemistry (Volume – I & II) – Varley
- Harrison's Textbook of Medicine
- Fundamentals of Clinical Chemistry – Tietz
- Case oriented approach – Montgomery
- Molecular Biology of the cell – Bruce Alberts/ Lodish



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