

BIOCHEMISTRY — M D

GOAL

The main goal of the post graduate education in Biochemistry is to enable a student understand, envisage and explain life processes as molecular events and apply his knowledge and skills in clinical problem solving and scientific research.

OBJECTIVES

At the end of the 3 years training in Biochemistry, the PG student is expected to

KNOWLEDGE

Demonstrate his understanding of the

1. Concepts and principles of general biochemistry.

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

2. Fundamentals of biostatistics

SKILLS

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

METHODOLOGY

Following methods are 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 & impact of molecular biology on advances in medicines.
2. **Journal club:** To develop (a) skills of analysis, evaluation and presentation of research papers (b) familiarity with approaches and methodologies of research and (c) to update on new development/emerging trends in biochemistry.
3. **Practical exercises:** At least once in a week, under the supervision of a faculty.
4. **Thesis:** Each PG student will carry out research work under the supervision of a faculty member of the Deptt. Of Biochemistry. The thesis will be submitted to AIIMS and will be evaluated by two suitable experts in that area/field. The acceptance of the thesis will be a prerequisite for the candidate to be allowed to appear in the final exam.
5. Participation in UG laboratory practical teaching and problem based tutorials as a team with faculty incharge & senior residents of the department to gain in depth learning, teaching and tutoring experience.
6. **Specialized training in Clinical Biochemistry:** 2 months posting in the clinical biochemistry laboratory to learn sample collection, quality control methods, setting up of a clinical biochemistry laboratory, specialized assays, statistical analysis of data.

THEORY EXAMINATION

Paper I: General and Clinical Biochemistry and Enzymology

Duration 3 hrs, Marks 100

(Section 1)

Paper II: Metabolism, Bioenergetics, Nutrition, Vitamins and Hormones

Duration 3 hrs. Marks 100

(Section 2)

Paper III: Molecular biology, immunology, cancer

Duration 3 hrs, Marks 100

(Section 3)

Paper IV: Techniques in Experimental Biochemistry, Recent Advances in Biochemistry and Molecular Biology.

Durations 3 hrs, Marks 100

(Section 4)

SECTION - 1

PAPER I: General and Clinical Biochemistry Enzymology and biostatics.

General Biochemistry: Cell structure, its biochemical make up and functions, membrane structure and functions, cytoskeleton, structure and functions of proteins, muscle and plasma proteins, hemoglobin, biochemistry of blood clotting, body fluids and their importance in clinical biochemistry .

Enzymes: Principles and mechanisms of enzymatic catalysis, enzyme kinetics and regulation of enzyme activity.

Clinical biochemistry: Serum enzymes and isoenzymes – their diagnostic value. Analysis and significance of clinically important analytes in blood, urine and CSF. Quality Control in clinical biochemistry, instrumentation in clinical laboratory.

Liver, kidney and gastric function tests. pH, buffers and acid base balance, metabolic acidosis and alkalosis, respiratory acidosis and alkalosis.

Biostatistics and research methodology, their application in research and clinical chemistry, types of study designs, data analysis, correlation & agreement analysis methods, risk analysis methods, calculation of adequate sample size for various study designs, students 't' test, paired 't' test, chi-square test and Fisher's exact test, Non-parametric tests of significance, Statistical aspects of diagnostic tests, Multivariate analysis methods, One way and two way analysis of variance and multiple range tests, Commonly used statistical software for the analysis of bio-medical data.

Quality Control

Journal club and seminars.

SECTION - 2

PAPER II: Metabolism , Bioenergetics, Nutrition, Vitamins and Hormones.

Bioenergetics and intermediary metabolism: Metabolism of carbohydrates, lipids, proteins, amino acids, porphyrins, purines, pyrimidines, their regulation dysregulation and inter-relationships. Inborn errors of metabolism, genetic disorders. Principles of bioenergetics, electron transport chain and oxidative phosphorylation.

Nutrition, mineral metabolism and trace elements, water and electrolyte balance.

Vitamins: Fat and water soluble vitamins their chemistry action functions and deficiency. Role in free radical homeostasis. Biochemistry of free radicals.

Hormones: chemistry, mechanism of action and their role in regulation of metabolism and physiological functions consequence of hormonal dysfunction.

SECTION - 3

PAPER III: Molecular Biology, Immunology, Cancer.

Biochemistry and molecular biology of cancer – growth factors and oncogenes.

Nucleic acids – replication, transcription, protein biosynthesis and gene regulation: Genetic code, mutations and mutants, DNA repair. Purines and pyrimidines – biosynthesis and degradation, cell – cell interaction, adhesion molecule, signal transduction, receptor-structure and regulation, cloning, construction of genomic libraries, strategies for screening DNA libraries.

Immunology: Structure functions, classifications and synthesis of immunoglobulins, antigen-antibody reaction, mechanisms and regulation of immune responses. Complement system, hypersensitivity, immune-tolerance, immunity to infection, autoimmunity & auto immune diseases, tumor immunity, genetics of immune response, transplantation, experimental system used in immunology, vaccination and immunization strategies, hybridoma technology. Apoptosis, telomeres and telomerase, cytokine network, immunodiagnostics.

SECTION - 4

PAPER IV: Techniques in Experimental Biochemistry, and Recent Advances in Biochemistry and Molecular Biology.

General Laboratory Techniques and procedures, pH meter, balances.

Centrifugation, sub-cellular fractionation

Purification of an enzyme and study of its kinetics

Chromatography

Electrophoresis techniques immune-diffusion and Isoelectric focusing, HPLC

Immunoassay techniques, Immuno-electrophoresis, immunoblotting and ELISA.

Spectroscopy techniques, including NMR.

Radioactive Isotopes their application in biomedical research and clinical diagnosis and measurements of radioactivity, tracer techniques, autoradiography and microassays like RIA, ELISA, estimation of hormones etc.

Molecular diagnostics, recombinant DNA technology and its applications.

Microscopy – light microscopy electron microscopy and confocal microscopy

Cell Culture

Environmental biochemistry and detoxification

Genomics, proteomics and array technology

Clinical biochemistry

Practical examination: Duration 2 days, Marks 200

Practicals: Fractionation of proteins, purification and kinetic analysis of enzymes (LDH/Alkaline, phosphatase) from a suitable source, separation and molecular weight determination of proteins by SDS-PAGE, cell culture, lymphocyte separation, Invitro carcinogenesis (cytotoxicity and survival assay), estimation of progesterone/hormone levels in human blood by RIA/ELISA, separation of lipoproteins by electrophoresis, Estimation of LDL and HDL cholesterol in serum, clinical biochemistry, immunodiffusion techniques, Western blotting, Southern blotting, preparation of competent E.Coli cells, transformation and plasmid DNA by agarose gel electrophoresis), PCR, RT-PCR, DNA fingerprinting by RARD analysis. Affinity purification of IgG by protein A sepharose column chromatography, DNA-protein binding, determination of binding constant, scatchard plot and co-opertivity test, purification of synthetic polypeptide by column chromatography. Diffential, densitygradient, ultracentrifegation, radioactivity measurements. Students will attend the weekly biochemistry practicals for the undergraduates.

Oral examination

1. Thesis work presentation and discussion.
2. General viva voce and practical bench viva.

Books recommended

1. Biochemistry Ed Lubert Stryer. W.H. Freeman and Company, New York.
2. Principles of Biochemistry. Ed Lehninger, Nelson and Cox. CBS publishers and distributors.
3. Harper's Biochemistry. Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell. Appleton

and Lange, Stamford, Connecticut.

4. Textbook of Biochemistry with Clinical Correlations. Ed. Thomas M. Devlin. Wiley-Liss Publishers.
5. Genes VI. Ed Benjamin Lewin. Oxford University Press.
6. Tietz Textbook of Clinical Chemistry. Ed Burtis and Ashwood. W.B. Saunders Company.
7. Principles and techniques of practical biochemistry. Ed Keith Wilson and John Walker. Cambridge University Press.
8. Biochemistry. Ed Donald Voet and Judith G. Voet. John Wiley & sons, Inc.
9. Molecular Cloning - A Laboratory Manual. J. Sambrook, E.F. Fritsch and T. Maniatis. Cold Spring Harbor Laboratory Press.
10. Molecular Cell Biology, H. Lodish, A. Berk, S.L. Zipursky, P. Matsudaira, D. Baltimore, J. Darnell.

BIOPHYSICS — M D

PREAMBLE

The MD (Biophysics) course serves to interface the various disciplines – biology, medicine, physical sciences and computer applications. The students undergo training in an environment of advanced research in various aspects biophysics. They receive a sound theoretical knowledge coupled with a demanding practical application. By the end of the course, the student is confident to discuss and dissect any aspect biophysical problem related to clinical sciences.

OBJECTIVES

The course aims to impart to the students

1. a sound theoretical perspective of biophysics
2. practical skill to use biophysical techniques
3. capability to evaluate any published work
4. capability to carry out independent research

SALIENT FEATURES

1. regular lectures by the faculty on the basics and current aspects of biophysics
2. group discussions to critically evaluate the work
3. seminars to review and update the developments in biophysics
4. thesis embodying advanced research
5. computer training and applications
6. use of bioinformatic tools

EXAMINATION

1. Theory examination

Paper – I

Paper – II

Paper – III