

Study & Evaluation Scheme

of

Doctor of Medicine MD (Biochemistry) 2011-12



TEERTHANKER MAHAVEER MEDICAL COLLEGE & RESEARCH CENTRE
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P.G. Curriculum MD Biochemistry

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PG Curriculum MD Biochemistry

The composition of the department in terms of units, no. of beds, faculty strength, other staff, no. of PG residents will be as per MCI regulations.

1. Goals

The goal of MD course in Biochemistry is to produce a competent medical biochemist who

- ❖ Is able to demonstrate comprehensive understanding of biochemistry as well as applied disciplines.
- ❖ Has acquired the competence pertaining to basic instrumentation and procedures pertaining to biochemistry that are required to be practiced in community and at all levels of health care system.
- ❖ Has acquired skills effectively in interpreting all laboratory reports.
- ❖ Has the competence to perform relevant investigations which will help to diagnose important medical conditions.
- ❖ Has acquired skills effectively in communicating the results to clinicians.
- ❖ Should be able to demonstrate empathy and have a human approach towards patients & respect their sensibilities.
- ❖ Is oriented to principles of research methodology.
- ❖ Has acquired skills in educating medical & paramedical professionals.
- ❖ Is able to organize and equip Biochemistry Lab.

2. Objectives

At the end of MD course the student should be able to:

- ❖ Develop skills as a self-directed learner, recognize continuing educational needs; use appropriate learning resources and critically analyze relevant published literature in order to practice evidence-based biochemistry.
- ❖ Demonstrate competence in basic concepts of research methodology and epidemiology.
- ❖ Practice the specialty of biochemistry in keeping with the principles of professional ethics.
- ❖ Organize and supervise the desired managerial and leadership skills.
- ❖ Function as a productive member of a team engaged in health care, research and education.
- ❖ Perform recent investigations and procedures for patients.
- ❖ Demonstrate skills in documentation of reports.
- ❖ Facilitate learning of medical/nursing students, practicing physicians & paramedics as Teacher-Trainee.
- ❖ Play the assigned role in implementation of national health programs, effectively & responsibly.
- ❖ Demonstrate communication skills of a high order in explaining management and

prognosis, providing counselling and giving health education message to patients, families & communities.

- ❖ Design, fabricate & use indigenous methods/gadgets for experimental purpose.

3. Syllabus

3.1. Theory

Introduction

Introduction to medical biochemistry, role of biochemistry in health care, ethics & responsibilities.

- ❖ **Foundation of Biochemistry**

Cellular, chemical, physical, genetic & evolutionary foundations.

- ❖ **Physical chemistry**

Water interactions in aqueous system, ionization of water, concept of pH, weak acids & weak bases, Henderson Hasselbach equation, buffers, solutions, diffusion, osmosis, Donnan's membrane equilibrium.

- ❖ **Protein Chemistry: Amino acids**

Classification, structure & properties of amino acids, Zwitter ion & isoelectric pH, titration curve.

- ❖ **Peptides & proteins**

Structure & bonds maintaining protein structure, X-ray crystallography, NMR spectroscopy, Protein folding, Chaperones, perturbations of protein conformation, peptides of biomedical importance. Structure of collagen, elastin, myoglobin, haemoglobin, fibronectin, laminin, O₂ dissociation curves for myoglobin & haemoglobin, factors affecting release of O₂, mutant haemoglobins

- ❖ **Plasma proteins**

Albumin, globulin, haptoglobin, transferrin, ceruloplasmin etc., functions of plasma proteins.

- ❖ **Carbohydrate Chemistry**

Introduction-Definition, functions, classification, Types- monosaccharides, disaccharides, oligosaccharides & polysaccharides, Isomers (Stereo & optical isomerism, epimers, anomers, mutarotation, enantiomers), Reducing properties (oxidation & reduction), dehydration, osazone formation, ester formation, Glycosides.

- ❖ **Proteoglycans & Glycosaminoglycans**

Biosynthesis, structure, distribution & functions, Mucopolysaccharidoses.

- ❖ **Glycoproteins**

Classification, biosynthesis, functions of glycoproteins, abnormalities in synthesis of glycoproteins.

- ❖ **Lipid Chemistry**

Introduction- Definition, functions, classification & properties of lipids (Phospholipids, Glucolipids, FFA, Triglycerides, Steroids (Structure of Cholesterol etc.), Lipids peroxidation (source of free radicals), eicosanoids.

- **Nucleic Acids**

Concept of nucleosides, common derivatives of purines & pyrimidines, synthetic nucleotide analogues used in chemotherapy, synthetic derivatives of nucleotide triphosphate analogues as research tools, Structure of RNA & DNA.

- **Enzymes**

General properties, Kinetics, mechanism of action and regulation of activities Definition, classification, properties of enzymes, coenzymes, cofactors, prosthetic groups, Factors affecting enzymes, activity in vitro, Units of Enzymes activity, Application of enzymes (Therapeutic, Analytical, Diagnostic enzymes), enzyme inhibition, enzyme regulation, Isoenzymes (Definition and Types), Enzymes pattern in diseases (MI, liver diseases, Muscle diseases, Cancer etc.)

- **Micronutrients**

- **Vitamins**

Structure, sources, synthesis, biochemical roles of various fat & water soluble vitamin. Recommended dietary allowances. Diseases caused by deficiency & excess. Role of vitamins as anti-oxidants.

- **Minerals**

Biochemical role of minerals (sodium, potassium, magnesium, fluorine, calcium, phosphorus, iron, iodine, chloride, sulphur, Zinc Molybdenum Manganese, copper & selenium etc.), sources, Recommended dietary allowances, Clinical disorders associated with metabolism of these minerals.

- **Bioenergetics & Biological Oxidation**

Free energy, exergonic & endergonic processes, Redox potential High energy compounds, enzymes involved, electron transport chain (process & inhibitors), oxidative phosphorylation, Chemiosmotic theory, shuttles, Uncouplers.

- **Nutrition, digestion & absorption**

Digestion & absorption of carbohydrates, lipids, proteins, vitamins & minerals. Energy balance, over & under nutrition.

- ❖ **Metabolism:-**

- **Carbohydrates**

Regulation & process of Glycolysis, PDH complex, TCA, Gluconeogenesis, Glycogen metabolism (Glycogenesis, Glycogenolysis) Glycogen storage diseases, Hormonal regulation, Details of HMP (Bioenergetics, Biomedical importance and metabolic disorder and regulation), Glucose Tolerance Test, Galactose and Fructose metabolism & their disorders, Uronic acid pathway with its biomedical importance. Regulation of blood sugar & biochemical basis of complication of diabetes, Metabolism of carbohydrates in fed & fasting state.

- **Lipids**

Details of fatty acid oxidation along with inborn errors, Details of fatty acids synthesis and oxidation, ketogenesis, Metabolism of unsaturated fatty acids and eicosanoids, Metabolism and disorders of acylglycerols and sphingolipids, Lipid transport and storage disorders of lipids (hyperlipidemia, atherosclerosis, obesity).

- **Details of cholesterol**

Synthesis, Catabolism, Regulation, treatment. Details and disorders of lipoproteins, fatty liver.

- **Proteins and Amino acids**

Biosynthesis of the nutritionally nonessential amino acids, catabolism of proteins and amino nitrogen, catabolism of carbon skeletons of amino acid, conversion of amino acids to specialized products Oxidative and nonoxidative deamination, Transamination and decarboxylation, Transamidation, Transport and toxicity of ammonia, Urea cycle with inborn errors of metabolism, Specialized products and inborn errors of glycine, Phenylalanine, Tyrosine, Tryptophan, Methionine, Cysteine, Histidine, Branch chain amino acid metabolism, Creatine metabolism. Polyamines.

- **Intermediary metabolism of Carbohydrates, Lipids and Proteins.**

- Nucleosides and Nucleotides

Functions, metabolism of purine and pyrimidine nucleotides. Hyperuricemia & other in born errors.

- ❖ **Molecular Biology**

Metabolism of nucleotides, function of nucleic acids (DNA & RNA), DNA Organization into Chromosomes, Replication & Repair, RNA Synthesis, Processing and Modification, Flow of genetic information, Genetic Code, Mutation, Protein Synthesis, Posttranslational Processing, Biochemical basis of action of anticancer drugs, Antibiotics etc. Regulation of gene expression, Genetic & Biochemical basis of diseases and neuropsychiatric disorders.

- ❖ **Recombinant DNA Technology**

Restriction enzymes, DNA Library, Blotting Techniques, Cloning Polymerase Chain Reaction, Gene Mapping, Restriction Fragment length Polymorphism, Gene Knockout, Gene Therapy, Human Genome Project, DNA finger printing, Recombinant proteins.

- ❖ **Cancer, Cancer genes & Growth Factors**

Etiology of cancer, Biochemical changes in cancer cells, Role of oncogenes, proto-oncogenes & tumor suppressor genes, Action of Growth Factors on cell cycle and mitosis, Cancer Chemotherapy, Biochemical basis of metastasis, Evaluation of Tumor Markers in cancer management.

- ❖ **Extracellular Matrix**

Membrane Structure, & Function, Transport processes, Mutation affecting membrane proteins.

- ❖ **Endocrinology**

Hormone Receptors, Pathways of signal transduction, Hormone Metabolism & its regulation, Mechanism of action, Pathophysiology, Function test (Pituitary & Hypothalamic, Thyroid, Adrenal Cortical and Medullary Hormones, pancreatic, Gastrointestinal & Gonadal hormones).

- ❖ **Homeostasis of Thrombosis**

Intrinsic & Extrinsic pathway, Haemophilia, RBC & White cells, ABO Blood group system, Haemolytic Anemias.

- ❖ **Muscle and Cytoskeleton**
Concept of Actin & myosin, Contraction of muscle, Role of calcium in contraction of muscles, myopathies. Role of cytoskeleton in cellular function.
- ❖ **Radioisotopes**
Introduction, Properties, Detection of radiation. Hazards, Role in metabolic processes, Diagnostic and Therapeutic application.
- ❖ **Porphyryns**
Porphyryns and bile pigments, Definition, Classification and their disorders.
- ❖ **Organ Function test**
 - Gastric function tests
 - Liver function tests
 - Kidney function tests
 - Thyroid function tests
 - Pancreatic function tests
- ❖ **Detoxification of Xenobiotics**
Role of Cytochrome P450, Various mechanism of Detoxification.
- ❖ **Separative Procedures**
Chromatography-Basis concepts, separation, mechanism, resolution, planar & column chromatography, qualitative & quantitative analysis.
- ❖ **Electrophoresis**
Basic concepts & definitions, theory, description of techniques, types & technical considerations.
- ❖ **Immunochemistry**
Concepts of immunity, Antigen, Antibodies, Ag-Ab reaction , Complement system, Structure & functions of immune system. Immune response of the body, immune deficiency diseases, hypersensitivity, autoimmunity, immunology of transplantation & malignancy.
- ❖ **Statistics**
Sampling, Mean, SD, CV, Normal distribution, Probability etc.
- ❖ **Quality control of Clinical investigations**
External & internal quality control
- ❖ **Automation in Clinical Biochemistry**
- ❖ **Environmental Biochemistry**
- ❖ **Bioinformatics**
 - Basic Concepts.

3.2. Practical

Introduction to Clinical Chemistry

Concepts, definition, characterization of diagnostic accuracy of tests.

❖ **Introduction to principles of Laboratory analysis**

Concepts of solute & solvents, units of measurements, basic techniques & procedures, Weighing (use of mechanical & electronic balance), preparation of reagents.

❖ **Specimen collection & other pre-analytical variables**

Specimen collection, handling of specimens, other pre-analytical variables, preservative & anticoagulants, normal biological variability.

❖ **Safety measures & First Aid**

Corrosive chemicals, Toxic chemicals, Carcinogens, Explosive & inflammable chemicals, Electrical apparatus (Centrifuges machines, Water baths, Hotplates, Spectrophotometers, Flame photometers) etc. Distillation plant maintenance, Glass apparatus, Dispensers, Radiation hazards, Low pressure systems (vacuum desiccators), Chemical injuries, Mechanical and thermal injuries, Electrical injuries. Obtaining help for Emergency drug supply, First aid boxes. Special procedures common to several emergency conditions and taking care of treatment of shock, unconscious patients, Artificial respiration, Cardiac massage.

❖ **Waste Disposal**

Infectious material (Biological material) with special consideration for AIDS and Hepatitis B&C, Disposal of specimens and contaminated materials. Laboratory waste etc.

❖ **Analytical Techniques and Instrumentation**
Optical Techniques

• Photometry and Spectrophotometry, Instrumentation, Flame Emission Spectrophotometry, Nephelometry and Turbidimetry.

• **Maintenances of Laboratory Records**
Electrochemistry and Chemical Sensors

Potentiometry, Biosensors.

• **Electrophoresis**

Basic Concepts and Definitions, Theory of Electrophoresis, Description of Technique, Type of Electrophoresis, Technical, Considerations.

• **Chromatography**

Basic Concepts, Separation Mechanisms, Resolution, Planar Chromatography, Column Chromatography, Qualitative and Quantitative Analyses.

• **Principles of Clinical Enzymology**

Basic principles, Enzyme Kinetics (Effect of temperature on enzyme activity, Effect of pH on enzyme activity, Effect of Inhibitors on enzyme activity, K_M , Specific activity), Analytical Enzymology.

• **Principles of Immunochemicals Techniques**

Basic Concepts and Definition, Antigen-Antibody Binding, Qualitative Methods, Quantitative Methods, Other Immunochemicals Techniques.

• **Automation in the Clinical Laboratory**

Basic Concepts, Automation of the Analytical Processes, Integrated Automation for the Clinical Laboratory, Practical Considerations, other Area of Automation.

- **Point-of-Care Testing**

Analytical and Technological Consideration, Implementation and Management Consideration.

- ❖ **Laboratory Operations**

- Routine Biochemistry Investigations

Blood Glucose Estimation, RFT, LFT, Lipid Profile, Cardiac Markers, Bone Markers, pancreatic Markers, Anemia Profile, Trace Elements, Urine CSF, Fluid Biochemistry.

- Special Investigation

Hormones, Tumor Markers, Troponins, Vitamins, Antioxidants, Special proteins like CRP, Haptoglobin, Ceruloplasmin etc.

- ❖ **Selection and Analytical Evaluation of Methods- With Statistical Techniques**

Method Selection, Basic statistics, Basic concepts in Relation to analytical Methods, Analytical Goals, Method Comparison, Monitoring Serial Result, Trace ability and Measurement Uncertainly, Guidelines, Regulatory Demands and Accreditation, Software Packages.

- ❖ **Establishment and use of Reference Values**

Establishment and use of Reference Values, Use of Reference Value.

- ❖ **Quality Management**

Fundamental of Total Quality Management, Implementing TQM, The total testing process, Control of Preanalytical Variables. Control of Analytical Variables, External Quality Assessment and Proficiency Testing Programs, New Quality Initiatives.

4. Teaching Programme

4.1 General Principles

Acquisition of practical competencies being the keystone of postgraduate medical education, postgraduate training is skills oriented.

Learning in postgraduate programme is essentially self-directed and primarily emanating from clinical and academic work. The formal sessions are merely meant to supplement this core effort.

4.2 Teaching Sessions

In addition to daily routine reporting with consultants in every section, there are one hourly formal teaching sessions of PG per week. This is in addition to UG teaching classes, which they are required to attend to gain basic knowledge of Biochemistry.

- ❖ Clinical case discussion
- ❖ Seminars / Journal Club
- ❖ Statistical meetings- month / weekly
- ❖ Inter departmental meetings
- ❖ Guest Lectures / Vertical Seminars or central stat meetings

4.3 Teaching Schedule

The suggestive departmental teaching schedule is as follows:-

1. Journal Club	Once a week
2. Case discussion	Once a week
3. Stat meeting / Thesis work	Once a week
4. Inter departmental meeting or Mock examination	Once a week
5. Practical	Once a week
6. Central session on CPC, guest lecturers	Once a week,

Student seminar, biostatistics, teaching on research methods, medical ethics etc.

5. Postings

(1) Teaching (2) Clinical Lab Posting

5.1 Teaching

- i) Attend all UG classes theory & teach as & when assigned & Practical classes.
- ii) Self study on all aspects of biochemistry mentioned in syllabus.
- iii) Learning all basic biochemistry techniques like photometry, flame photometry etc.
- iv) Standard calibration curves for all routine analytes.
- v) Undertake classes for nursing & paramedical staff.
- vi) Posted in allied departments like Transfusion medicines, Microbiology, Pathology, and Endocrinology.

5.2 Clinical Laboratory Posting

❖ Pre-Analytical Laboratory

Collection Center

❖ Analytical Lab :

- Semiautoanalyser / Autoanalyser Lab
- Immuno-chemical Lab

- Chromatography
- Electrophoresis

- Point of care testing
- Emergency Lab

Post-Analytical Lab

- Selection & analytical evaluation of method with statistical techniques (Basic statistics, Method comparison, Accreditation, Trace ability)

6. Thesis

6.1 Every candidate shall carry out work on an assigned research project under the guidance of a recognized Postgraduate Teacher; the project shall be written and submitted in the form of a Thesis.

6.2 Every candidate shall submit thesis plan to the university within six months from the date of admission.

6.3 Thesis shall be submitted to the university six months before the commencement of theory examination i.e. for examination May / June session, 30th NOV of the proceeding year of examination.

6.4 The student will identify (i) a relevant problem: (ii) conduct a critical review of literature : (iii) formulate a hypothesis: (iv) determine the most suitable study design: (v) state the objectives of the study: (vi) prepare a study protocol: (vii) undertake a study according to the protocol: (viii) analyze and interpret research data and draw conclusions: (ix) Write a Thesis

6.5 The thesis will be evaluated by two experts in the field. Approval of thesis will be a pre-requisite for appearing in examination.

7. Assessment

All the PG residents are to be assessed daily for their academic activities and also periodically.

7.1 General Principles

- ❖ The assessment is valid, objective and reliable.
- ❖ It covers cognitive, psychomotor and affective domains.
- ❖ Formulative, continuing and summative (final) assessment is also conducted in theory

as well as practicals / clinical . In addition, thesis is also assessed separately.

7.2 Formative Assessment

The formative assessment is continuous as well as end the of term. The former is based on the term feedback from the senior residents and the consultants concerned. End of the term assessment is 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.

7.3 Summative Assessment

- ❖ The pass percentage will be 50%
- ❖ Candidate will have to pass theory and practical examinations separately.

A. Theory Examination (Total = 400)

PAPER	TITLE	MARKS
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Paper 1	Applied and Clinical Biochemistry	100
Paper 2	Bio-energetics, Enzymes, Metabolism	100
Paper 3	Nutrition, Vitamins, Minerals, Hormones, Molecular Biology, immunology cancer	100
Paper 4	Recent advances in Biochemistry & Biochemical methodologies	100

B. Practicals & Viva Voce Examination (Total = 400)

Two practical exercises (and oral examination) of 200 marks each

8. Job Responsibilities

For Teaching

- ❖ Should be able to take a class using audiovisual aids right from blackboard & chalk to that with laptop & multimedia session.
- ❖ Should be able to make short lectures under senior teacher's supervision.
- ❖ Should have learnt to make Power-Point presentation.
- ❖ Should have learnt to make multiple-choice questions.
- ❖ Must attend all undergraduate theory and practical classes. They must play an active role in table teaching in all practical classes.

For Research Work

- ❖ Should have skill to look up references from journals and present seminars.
- ❖ Should have computer skills.
- ❖ Will be expected to be familiar with standards methods of preparing a bibliography and for preparing manuscripts and illustrations for publications.

For Clinical Work

- ❖ Should have skill to work in Clinical Biochemistry Lab in all areas: Pre-analytical, analytical and post analytical.
- ❖ Will be expected to perform all investigation and interpret all investigative data.
- ❖ Should be able to set up new experiments and methods for diagnosis and research.
- ❖ Should be expected to maintain quality control at all levels.
- ❖ Should be familiar with collection and processing of data.

9. Suggested Books:

9.1. Core Books:

- ❖ Text book of Biochemistry by Devlin
- ❖ Harper's Illustrated Biochemistry

- ❖ Text book of Biochemistry by Lehninger
- ❖ Biochemistry by D. Puri
- ❖ Clinical Chemistry by Tietz

9.2. Reference Books:

- ❖ Clinical Biochemistry by Varley
- ❖ Text Book of Biochemistry by N.V. Bhagwan
- ❖ Biochemistry by Styrer.