MD Biochemistry
Curriculum and Syllabus 2015
Branch Code: 13

SRM Medical College Hospital & Research Centre
SRM University
SRM Nagar, Kattankulathur
Kancheepuram (Dt). 603 203
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MD (BIOCHEMISTRY)

1.A.GOALS

The goal of MD course in Biochemistry is to produce a competent medical biochemist who
1. Is able to demonstrate comprehensive understanding of biochemistry as well as applied disciplines.
2. 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.
3. Has acquired skills effectively in interpreting all laboratory reports.
4. Has the competence to perform relevant investigations which will help to diagnose important medical conditions.
5. Has acquired skills effectively in communicating the diagnosis to the patients and families.
6. Should be able to demonstrate empathy and have a human approach towards patients & respect their sensibilities.
7. Is oriented to principles of research methodology.
8. Has acquired skills in educating medical & paramedical professionals.
9. Is able to organize and equip Biochemistry lab.

B.Objectives
At the end of MD course, the student should be able to:

1. 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.
2. Demonstrate competence in basic concepts of research methodology and epidemiology.

3. Practice the specialty of biochemistry in keeping with the principles of professional ethics.

4. Planning of investigation and knowledge of biochemical basis of diseases

5. Ability to appraise published literature and to apply his knowledge in biochemistry

6. Ability to teach postgraduate, undergraduate students in biochemistry

7. Organize clinical biochemistry section of a laboratory to deliver optimum investigative support for patient care services.

8. Organize and supervise the desired managerial and leadership skills.

9. Function as a productive member of a team engaged in health care, research and education.

10. Perform recent investigations and procedures for patients.

11. Demonstrate skills in documentation of reports.

12. Facilitate learning of medical/nursing students, practicing physicians & paramedics as Teacher-trainee.

13. Play the assigned role in implementation of national health programs, effectively & responsibly.

14. Demonstrate communication skills of a high order in explaining management and prognosis, providing counseling and giving health education message to patients, families & communities.

2. COURSE OVERVIEW

Duration of the Course

The period of certified study and training for the Post-Graduate MD BIOCHEMISTRY shall be Three Academic years (six academic terms). The academic terms shall mean six months training period.

Commencement of Academic Session

The academic session for the Post-Graduate shall commence from May/June of the Academic Year.

Date of Examination

The students admitted up to May/ June of the academic year shall be registered for that academic year and shall take up their Final Third Year regular examination in April/October of the academic year after completion of 3 years/36 months.

Number of Examinations

The University shall conduct not more than two examinations in a year, for any subject, with an interval of not less than 4 and not more than 6 months between the two examinations.

Attendance

All students joining the postgraduate training programme shall work as full time residents during the period of training, attending not less than 80% (eighty percent) of the training during each calendar year, and will be given full time responsibility, assignments and participation in all facets of the educational process.

The period of training for obtaining the degrees shall be three completed years including the period of examination.
3. COURSE CONTENT

Themes & Topics

First year

1. Introduction to Biochemistry and its applications
2. Clinical laboratory posting
3. Log book maintenance
4. Biostatistics and computer skills
5. Selection of Thesis topic and ethical committee approval
6. Standardization of laboratory methods
7. Periodic evaluation

Second year

1. Clinical department postings at II year (Time 10.00 a.m. – 1.00 p.m.) – General Medicine, Pediatrics, Cardiology, Nephrology, Genetics, Rheumatology, Gastroenterology, Intensive care unit, Blood bank, Microbiology, Clinical Pathology.
2. Thesis work
3. Teaching duties
4. Clinical laboratory posting (On rotation)
5. Journal Club and seminars
6. Attend continuing Medical Education Programs, Workshops and at least one National Conference
7. Other lab visits
8. Log book maintenance
9. Periodic evaluation
Third year

1. Teaching duties
2. Clinical laboratory posting (On rotation)
3. Journal club and Seminars
4. Attend Continuing Medical Education programs, workshops and atleast one National Conference.
5. Training in Higher laboratory techniques (HPLC, PAGE Electrophoresis, PCR, Inborn error screening etc.,)
6. Completion of Thesis and submission within stipulated time
7. Log book maintenance
8. Periodic evaluation.

4. SYLLABUS

a) Theory

I. Physical and organic aspects of biochemistry, Biostatistics and General Principles of biochemical techniques.

II. Cell and Molecular biology, Endocrinology and Immunology.

III. Enzymology, Macro and Micronutrients, Intermediary metabolism, Inborn errors of metabolism, Human nutrition.

IV. Clinical biochemistry and Recent advances in Biochemistry.
I. Physical and Organic aspects of Biochemistry, Instrumentation, Biochemical Techniques, Biostatistics

1) Physical Chemistry:
Water as universal biological solvent.
pH.
Buffers.
Colloidal state and Gibbs – Donnan equilibrium. Van der waals forces.
Surface tension.
Osmosis, diffusion and viscosity.
Law of mass action.

2) Chemistry of Carbohydrates:
Structure, physical and chemical properties and biological role of: Glucose, fructose, galactose, mannose, ribose, xylose, xylulose, Lactose, maltose, sucrose.
Deoxy and amino sugars. Uronic acids and sugar alcohols.
Dextrin, starch, glycogen, cellulose, inulin.
Glycosaminoglycans and glycoproteins.

3) Chemistry of Proteins:
Structure, physical and chemical properties and biological functions of:
Amino acids present in proteins, including selenocysteine
Amino acids not found in proteins. Modified amino acids.
Dissociation constant (pKa).
Amino acids as buffers, amino acid titration, zwitterions and isoelectric point.
Primary, secondary, tertiary and quaternary structure of proteins and elucidation
4) **Protein structure and function:**
Relationship of function to the three dimensional structure of myoglobin, haemoglobin, collagen and elastin.
Enzymes and peptide hormones. Immunoglobulins.
Peptide sequencing and peptide synthesis.

5) **Chemistry of lipids:**
Structure, physical and chemical properties of:
Saturated and unsaturated fatty acids.
Polyunsaturated fatty acids.
Eicosanoids.
Triacylglycerol.
Sterols.
Phospholipids.
Glycolipids.
Sphingolipids.
Lipoproteins.
Membranes and fluid mosaic model.

6) **Chemistry of purines and pyrimidines:**
Nucleotides and their derivatives. Polynucleotides.
Synthetic nucleotides.

7) **Principles of laboratory analyses and safety:**
Units of measurement.
International system of units in laboratory medicine.
Conversion from conventional units to SI units.
IFCC and IUPAC system recommendations.
Reference materials.
Reagent grade water production.
Testing for water purity.
8) Instrumentation and techniques:
Centrifugation.
Ultracentrifugation.
Radioactivity, properties of radionuclides and measurement of radioactivity. Autoradiography.
Immunoradiometric assay (IRMA).
Stable isotopes and mass spectrometry. Spectrophotometric Techniques-Spectrophotometry
Reflectance photometry.
Flame emission photometry.
Atomic absorption spectrophotometry.
Fluorometry-Phosphorescence, chemiluminescence and bioluminescence.
Nephelometry.
Turbidimetry.
Direct vision spectroscope.
Electrochemistry
Biosensors
Osmometry.
Electrophoresis (zone) – paper, agar gel, PAGE, SDS PAGE, iso-electric focusing, Chromatography – column, paper, TLC, GLC, HPLC, gel filtration, ion exchange and their applications.
Principles of immunochemistry.
Immuno-electrophoresis.
Blotting techniques.
ELISA.
Automation in clinical chemistry.
Point of care testing.
9) Laboratory Management:
Common hazards in the laboratory.
Management of biological, chemistry and radioactive wastes. Computer applications in clinical chemistry.
Setting up a clinical chemistry laboratory and a 24 hours emergency laboratory service.
Selecting an analytical method
Evaluation of an analytical method
Evaluation of a diagnostic test

10) Sample collection:
Anticoagulants and preservatives for blood.
Timed urine collections and urine preservatives.

11) Quality assurance:
Use of reference values.
Quality assurance in clinical laboratories.

12) Basic principles of biostatistics as applied to health sciences:
Concepts of probability. Mean.
Standard deviation.
Coefficient of variation.
Correlation coefficient.
Tests of significance.

II. Cell Physiology, Molecular biology, Endocrinology and human genetics

1) Cell Physiology:
An overview of cellular structure and function.
Prokaryotic and eukaryotic cells.
Structure of eukaryotic cells – sub cellular organelles, cytosol, endoplasmic reticulum, nucleus, nucleolus, mitochondria, lysosomes, ribosomes, Golgi apparatus, peroxisomes, plasma membranes and their functions.
Receptor-mediated endocytosis.
Properties of biological membranes – motility, permeability, concept of semi-permeable membranes, electrochemical gradient and pumps, artificial membranes and liposomes.

Transport across membranes – active, facilitated and passive.

Transport mechanisms – ion channels including gated channels, carrier proteins, glucose transporters (GLUT), active transporters, symporters and antiporters. Non-membrane organelles – cytoskeleton, microfilaments, microtubules and microvilli.

Sub-cellular fractionation – density gradient centrifugation, differential centrifugation, markers for each organelle and fraction.

Cell interactions and adhesion – types of junctions: tight junctions and gap junctions.

Surface glycoproteins and cell surface labeling – ABO blood groups, major histo-compatibility complex (MHC).


Cell division – mitosis and meiosis.

Cells as experimental models – E.coli, yeast, Drosophila melanogaster, viruses. Programmed cell death.

2) Human genetics:

Structure of DNA and RNA.

Histones, chromatins, nucleosomes and chromosomes. Different types of DNA.

Agents that cause DNA damage – ionizing radiation, ultraviolet light, mutagens, (chemical and viral).

Different types of RNA – messenger, ribosomal, transfer, heterogenous nuclear RNA, Snurps.

DNA replication – prokaryotic and eukaryotic.

Transcription – prokaryotic and eukaryotic.

Post-transcriptional modifications. Antibiotics and transcription.

Regulation of transcription. Genetic code.
Mitochondrial and plasmid DNA.
Translation – eukaryotic and prokaryotic.
Post-translational modifications.
Factors affecting protein synthesis.
Regulation of protein synthesis and gene expression, helix turn helix motif, zinc finger motif and leucine zipper motif.
Signal peptides, protein targeting and chaperones.
Disorders of post-translational modifications.
Constitutive, inducible and repressible enzymes.
Viral genetics – DNA and RNA viruses.
HIV and drugs in the treatment of HIV.

3) Molecular genetics:
Isolation of nucleic acids.
DNA digestion with restriction enzymes. DNA electrophoresis.
Restriction maps.
Southern analysis: hybridization and blotting.
Polymerase chain reaction (PCR): principle, procedure, and visualization of products.
Reverse transcriptase PCR (RT-PCR). DNA sequence analysis.
Automated DNA sequencing.
Cloning and vectors – definition, characteristics of different vectors and basic cloning techniques.
Gene libraries.
cDNA libraries.
The human genome project – sequencing of the genome and physical mapping.
Genetic maps.
Restriction fragment length polymorphisms and their applications.
DNA diagnostics – methods of identifying genes in human disease.
Fluorescent in-situ hybridization (FISH).
Gene therapy.
Repeat DNA and mobile DNA elements.
DNA repair and associated disorders.
Reporter genes.
Transgenic animals.
The human proteome.

4) Molecular basis of carcinogenesis:
Basics of cytogenetics

5) Population genetics:
Risk assessment and genetic counseling. Medical ethics in counseling.

6) Bioinformatics:
Basics of bioinformatics – proteomics, drug designing (pharmacogenomics), protein data bases and micro arrays.

7) Endocrinology:
8) Immunology:
Concepts, mechanisms and role of Innate and acquired immunity, humoral and cell mediated immunity, antigen and antibodies, MHC.
Recognition of antigens: Primary interaction, antigen processing and presentation Immune response: Lymphocyte maturation, activation of T and B lymphocytes, cytokines, regulation of immune response, immunologic tolerance, hypersensitivity, autoimmunity and autoimmune disease, immunodeficiency, tumor immunity, transplantation, immunosuppression and immunopotentiation including vaccination.

III. Intermediary Metabolism, macro and micro nutrients and inborn errors of metabolism
1) Enzymes:
Biomedical importance.
Nomenclature.
Classification.
General properties.
Coenzymes and cofactors.
Inhibitors of enzymes, naturally occurring enzyme inhibitors. Regulation of enzyme activity.
Enzymes in clinical medicine.
Isoenzymes and isoforms of enzymes.
Metalloenzymes and metal activated enzymes.
Isolation and purification of enzymes from natural sources.
The use of enzymes as laboratory tools (for diagnostic and research applications).

2) Vitamins:
Structure, sources, recommended dietary allowances (RDA), biochemical role, metabolism in the body and deficiency manifestations of water soluble and fat-soluble vitamins.
Megavitamin therapy.
Hypervitaminosis.
Antivitamins and vitamin analogues.
Use of vitamins in therapy.

3) **Bioenergetics and biological oxidation:**
The role of ATP and other high-energy phosphates.
Biologic oxidation.
The respiratory chain.

4) **Carbohydrates:**
An overview of metabolism.
Methods of studying intermediary metabolism.
Carbohydrates of physiological significance.
Digestion and absorption of carbohydrates.
Various pathways of metabolism of glucose.
Generation of ATP by substrate – level phosphorylation.
Pathways of metabolism of fructose and galactose. Regulation of the major metabolic pathways of carbohydrates.
Inborn errors that occur in the metabolic pathways of carbohydrate metabolism.
Regulation of blood glucose levels.
Metabolism of glycosaminoglycans and glycoproteins; associated disorders. Metabolism of alcohol.

5) **Lipids:**
Lipids of physiological significance.
Digestion and absorption of lipids.
Importance of bile.
Assembly of chylomicrons and their metabolism.
Oxidation of fatty acids.
Biosynthesis of fatty acids.
Metabolism of triacylglycerol.
Metabolism in adipose tissue (including brown adipose tissue). Metabolism of ketone bodies and associated disorders.
Metabolism of cholesterol and associated disorders.
Compounds derived from cholesterol.
Metabolism of apoproteins and lipoproteins and associated disorders.
Functions and metabolism of eicosanoids.
Metabolism of phospholipids.
Lipid storage disorders and prenatal and neonatal screening Obesity.
Metabolic adaptations in starvation and obesity.
 Associated disorders of lipid metabolism

6) Proteins:
Digestion and absorption of proteins.
General reactions of catabolism of amino acids.
Inborn errors of amino acid metabolism and prenatal and neonatal Screening

7) Integration of metabolism:
The provision of metabolic fuels in various conditions like starvation, feeding, diabetes, pregnancy.

8) Metabolism in specialized tissues:
Erythrocytes.
Liver.
Muscle.
Central nervous system.
Adipose tissue.
Lens.
Kidney.
9) Nucleic acids:
Metabolism of purines.
Disorders associated with abnormalities in the metabolism of purines.
Metabolism of pyrimidines.
Disorders associated with abnormalities in the metabolism of pyrimidines. Nucleotide analogues in chemotherapy.

10) Heme:
Functions.
Biosynthesis.
Disorders associated with defects in biosynthesis. Degradation of heme.
Metabolism of bilirubin.
Disorders associated with abnormalities in the metabolism of bilirubin. Laboratory diagnosis in these disorders.

11) Biochemical and molecular aspects of processes in the body:
Muscle contraction.
Nerve conduction.
Coagulation of blood.

12) Metabolism of minerals:
Sodium.
Potassium.
Calcium.
Phosphorus.
Magnesium.
Copper.
Zinc.
Iron.
Chromium.
Selenium.
Cobalt.
Manganese.
Other trace minerals.
Inborn errors of mineral metabolism.
13) Human Nutrition:


14) Metabolism of xenobiotics and detoxification.
15) Free radicals and anti-oxidants.

IV. Clinical biochemistry and recent advances in biochemistry
The following topics are to be covered with special emphasis on the laboratory investigations relevant to the conditions:
1) Carbohydrates:
Inborn errors of carbohydrate metabolism – disorders of galactose, fructose lactose and pentose metabolism.
Glycogen storage disorders.

2) Lipids :
Disorders of lipoprotein metabolism.
Laboratory diagnosis of these disorders.
Association with atherosclerosis and the consequences.
Biochemical derangements in metabolic syndrome.

3) Proteins :
Plasma proteins in health and disease.
Proteins in other body fluids (urine, cerebrospinal fluid, amniotic fluid, saliva and faeces).

4) Amino acids:
Aminoacidurias and their laboratory diagnosis.
Disorders of amino acid metabolism and their laboratory diagnosis.

5) Clinical enzymology:
Enzymes of liver, cardiac and skeletal muscle.
Laboratory diagnosis of myocardial infarction.
Pancreatic enzymes.

6) Tumour markers.

7) Fluid and electrolyte homeostasis :
Maintenance of fluid and electrolyte balance
Associated disorders and laboratory diagnosis.

8) Hydrogen ion homeostasis:
Maintenance of pH
Associated disorders and laboratory diagnosis.

9) Renal function:
Disorders of renal function, including acute and chronic renal failure. Laboratory assessment of renal function.

10) Laboratory assessment of gastrointestinal function:
Gastric function tests.
Pancreatic function tests.
Intestinal function tests.
Investigation of hepatobiliary function.

11) Mineral and bone metabolism:
Laboratory assessment of rickets, osteomalacia, osteoporosis.
Markers for osteoblasts and osteoclasts.
Hyper and hypocalcemia.
Disorders of magnesium.

12) Disorders of heme metabolism:
Laboratory assessment of porphyrias.
Laboratory assessment of jaundice.

13) Cerebrospinal and other body fluids:
Analysis in health and disease.

14) Principles of hemo and peritoneal dialysis.

15) Other topics:
Paediatric biochemistry – Fetal monitoring including fetal lung maturity
Biochemistry in the elderly.

16) Recent advances related to human Biochemistry

List of Practicals

1) Reactions of carbohydrates, lipids, proteins and amino acids.
2) Chromatographic separation of sugars, amino acids and lipids.
3) Haemoglobin and its derivatives.
4) Determination of enzyme activity and kinetic properties of acid / alkaline phosphatase.
5) Agarose gel electrophoresis.
6) Polyacrylamide gel electrophoresis (PAGE).
7) Glucose estimation in plasma / serum.
8) Glucose tolerance test, Glucose challenge test
9) Estimation of cholesterol, triglyceride and lipoproteins in plasma.
10) Estimation of calcium, electrolytes, pH and blood gas.
11) Estimation of urea, uric acid, creatinine, ammonia in blood and urine.
12) Clearance studies.
13) Estimation of bilirubin, ALT, AST, GGT, cholinesterase, prothrombin time.
14) Estimation of copper, ceruloplasmin, lithium, iron, iron binding capacity, magnesium in serum.
15) T3 and T4 assays and TSH, TPO antibodies. Anti thyroglobulin, Anti microsomal antibodies, Urinary Iodine measurement, FSH, LH, Prolactin, β-hCG assays.
16) Urinalysis for normal and abnormal constituents.
17) Estimation of 17-ketosteroids and vanillyl mandelic acid (VMA) in urine.
18) Analysis of gastric juice.
19) Analysis of renal and biliary calculi.
20) Estimation of LDH, phosphatases, amylase and creatine kinase in serum.
21) Separation of serum LDH isoenzymes by polyacrylamide gel electrophoresis.
22) Separation of serum alkaline phosphatase isoenzymes.
23) CSF analysis for biochemical parameters.
24) Analysis of ascitic, pleural and other fluids.
26) Electrophoresis of serum proteins and lipoproteins.
27) Estimation of glycated haemoglobin.
28) Estimation of urine proteins.
29) Detection of Bence-Jones protein in urine.
30) DNA separation and electrophoresis.
31) Polymerase chain reaction
32) Hemoglobin electrophoresis
33) Urine testing for porphyrias
### Time Table - M.D. Biochemistry

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<tr>
<th>Time</th>
<th>8.00 – 10.30 a.m.</th>
<th>10.30 – 11.00 a.m.</th>
<th>11.00 – 1.00 p.m.</th>
<th>1.00 – 2.00 p.m.</th>
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<td><strong>Days</strong></td>
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<td>Practical</td>
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<td><strong>Mon</strong></td>
<td>Clinical Lab</td>
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<td>Lecture</td>
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<td><strong>Tues</strong></td>
<td>Clinical Lab</td>
<td>Break</td>
<td>Seminar</td>
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<td><strong>Wed</strong></td>
<td>Clinical Lab</td>
<td>Break</td>
<td>Journal Club</td>
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<td>Clinical Lab</td>
<td>Break</td>
<td>Lecture</td>
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<tr>
<td><strong>Fri</strong></td>
<td>Clinical Lab</td>
<td>Break</td>
<td>Academic Society Meeting</td>
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## Integrated Teaching Programme

### 1. Horizontal Teaching

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<tr>
<th>Sl. No.</th>
<th>Topic</th>
<th>Departments</th>
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<tbody>
<tr>
<td>1.</td>
<td>Hemoglobin</td>
<td>Anatomy, Physiology, Pathology</td>
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<td>2.</td>
<td>Thyroid</td>
<td>Anatomy, Physiology, Pathology</td>
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<td>3.</td>
<td>Liver Function Tests</td>
<td>Anatomy, Physiology, Pathology</td>
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<td>4.</td>
<td>Renal Function Tests</td>
<td>Anatomy, Physiology, Pathology</td>
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<td>5.</td>
<td>Immunoglobulins</td>
<td>Physiology, Pathology, Microbiology, Pharmacology</td>
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### 2. Vertical Teaching

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<thead>
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<th>Sl. No.</th>
<th>Topic</th>
<th>Departments</th>
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<tbody>
<tr>
<td>1.</td>
<td>Diabetes</td>
<td>General Medicine, Obstetrics &amp; Gynecology</td>
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<tr>
<td>2.</td>
<td>Acid Base Balance</td>
<td>General Medicine</td>
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<td>3.</td>
<td>Liver Function Test</td>
<td>General Surgery, General Medicine</td>
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<td>4.</td>
<td>Screening for Inborn Errors of Metabolism</td>
<td>Pediatrics</td>
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<td>Cardiac Markers</td>
<td>Cardiology</td>
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<td>6.</td>
<td>Gout</td>
<td>Rheumatology</td>
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<td>7.</td>
<td>Renal Function Test</td>
<td>Nephrology</td>
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<td>8.</td>
<td>Thyroid Function Test</td>
<td>Endocrinology</td>
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5. MAINTENANCE OF LOG BOOK

a. Every Post Graduate student shall maintain a record of skills He/She has acquired during the three years training period certified by the various Head of departments where He/She has under gone training including outside the institution.

b. The student should also participate in the teaching and training programs of Under Graduate students of medical, Dental and Other paramedical courses, both in Theory and Practicals from the first year onwards of the Post Graduate Degree course.

c. In addition the Head of the department should involve their post graduate students in Seminars, Journal clubs, group discussions and participation in workshops, CME program’s national and international conferences organized by the Department, Institution and outside the institution in the state and outside the state.

d. Every Post Graduate student should be encouraged to present short title papers in conferences and improve on it and submit them for publication in indexed journals. Motivation by the Head of the Department is essential in this area to sharpen the skills of the Post Graduate students.

e. The Head of the Department should scrutinize the logbook every three months and certify the work done.

f. At the end of the course the student should summarise the contents and get the log book certified by the Head of the Department and submit the log book at the time of the University Practical Examination for the scrutiny of the board of examiners.

5.1 It is preferable that a post graduate student during the course to present one poster presentation and/or to read one paper at a national/state conference.
and /or to present one research paper which can be published/accepted for publication/sent for publication during the period of his/her postgraduate studies.

6. THESIS

Every student registered as post graduate shall carry out work on an assigned research project under the guidance of a recognized post graduate teacher, the result of which shall be written up and submitted in the form of a thesis.

Work for writing the Thesis is aimed at contributing to the development of a spirit of enquiry, besides exposing the student to the techniques of research, critical analysis, acquaintance with the latest advances in medical science and the manner of identifying and consulting available literature. Thesis shall be submitted at least six months before the theoretical and clinical / practical examination.

The thesis shall be a bound volume of a minimum of 50 pages and not exceeding 75 pages of typed matter (Double line spacing and on one side only) excluding certification, acknowledgements, annexure and bibliography.

Thesis should consist of
(a) Introduction
(b) Review of literature
(c) Aims and objectives
(d) Material and methods
(e) Result
(f) Discussion
(g) Summary and conclusion
(h) Tables
(i) Annexure
(j) Bibliography

Four copies of thesis shall be submitted six months prior to the commencement of the theory examinations on the date prescribed by the Controller of Examinations of this University. The thesis should be approved by
the Professor of that branch and the same has to be forwarded to the Controller of Examinations, by the head of the department through the Dean of the college.

Two copies in addition are to be submitted as an electronic version of the entire thesis in a standard C.D. format by mentioning the details and technicalities used in the C.D. format.

The thesis shall be examined by a minimum of three examiners; one internal and two external examiners, who shall not be the examiners for Theory and clinical; and on the acceptance of the thesis by two examiners, the student shall be allowed to appear for the final examination.

EVALUATION OF THESIS :

ACCEPTED / NOT ACCEPTED

No marks will be given

7. SCHEME OF EXAMINATION

University Examination Pattern

a) Mark Distribution

<table>
<thead>
<tr>
<th>Four Papers</th>
<th>100 Marks each</th>
<th>3 Hours duration each</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory Title</td>
<td>Duration</td>
<td>Marks</td>
</tr>
<tr>
<td>Paper – I</td>
<td>Physical and Organic as aspects of Biochemistry, Biostatistics and General Principles of Biochemical Techniques, Instrumentation</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>Paper – II</td>
<td>Cell and Molecular biology, Endocrinology and Immunology</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>Paper – III</td>
<td>Enzymology, Macro and Micronutrients, Intermediary Metabolism, Inborn errors of Metabolism, Human nutrition</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>
Paper – IV  Clinical Biochemistry Recent Advances related to human Biochemistry 3 hrs. 100

Distribution of Marks: **

<table>
<thead>
<tr>
<th>Marks Distribution</th>
<th>Calculation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Essays</td>
<td>2 x 20 = 40</td>
<td>40</td>
</tr>
<tr>
<td>10 Short Notes</td>
<td>10 x 6 = 60</td>
<td>60</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

**Practical Examinations:**

These examinations will be held over 2 days. They should consist of 2 parts Part I & II.

**Part – I will consist of:**

1) General Biochemistry.
   - Qualitative identification of an unknown amino acids or sugar and confirmation by chromatography … 30 marks
2) Preparation of a standard graph for a given analyte … 20 marks
3) Interpretation of clinical data (4 cases) from cases on endocrine diseases, electrolyte and acid base disorders, mineral metabolism, analysis of body fluids, lipid profile, etc., to be given … 20 marks
Part – II will consist of:

1) Clinical examination of a patient, making of a provisional diagnosis and giving differential diagnosis, giving a list of relevant investigations … 30 marks

2) Two to Three clinical biochemistry exercises, including separation of proteins by electrophoresis … 100 marks

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Total … 200 marks

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3) Pedagogy … 50 marks

4) Oral examination … 50 marks

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Total … 100 marks

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Practical Including clinical and Viva voce examination marks – 300

Note: No. of students to be examined - 4 per day for Practical/Viva

MARKS QUALIFYING FOR A PASS

<table>
<thead>
<tr>
<th>MARKS QUALIFYING FOR A PASS</th>
<th>MAXIMUM MARKS</th>
<th>QUALIFYING FOR A PASS 50% MARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory Examination</td>
<td>400</td>
<td>200</td>
</tr>
<tr>
<td>Practical Including pedagogy and Viva voce examination</td>
<td>300</td>
<td>150</td>
</tr>
</tbody>
</table>

A student shall secure not less than 50% marks in each head of passing which shall include 1. Theory 2. Practical including clinical and viva voce examination.
**The postgraduate medical students are required to pass theory and practical examinations separately. An examinee should obtain minimum 40% marks in each theory paper and not less than 50% marks cumulatively in all the four papers for Degree examination to be cleared as “Passed” at the said Degree examination**

*As per Medical Council of India notification date 03.09.2014 and the same approved in the 28th Academic council meet of SRM University held on 23/03/2015.*

8. EXAMINATION AND EVALUATION

(1) EXAMINERS

(a) All the Post Graduate Examiners shall be recognised Post Graduate Teachers holding recognised Post Graduate qualifications in the subject concerned.

(b) For all Post Graduate Examinations, the minimum number of Examiners shall be four, out of which at least two (50%) shall be External Examiners, who shall be invited from other recognised universities from outside the State and other two will be internal examiners for M.D.

(c) Under exceptional circumstances, examinations may be held with 3 (three) examiners provided two of them are external and Medical Council of India is intimated the justification of such action prior to publication of result for approval. Under no circumstances, result shall be published in such cases without the approval of Medical Council of India.

(d) The guidelines regarding appointment of examiners are as follows:-

1. No person shall be appointed as an examiner in any subject unless he /she fulfils the minimum requirements for recognition as a Post Graduate teacher as laid down by the Medical Council of India and has teaching experience of 8 (Eight) years as a Lecturer / Assistant Professor out of which he has not less than 5 (Five) years teaching experience after obtaining Post Graduate degree. For external examiners, he should have minimum three years experience of examinership for Post Graduate diploma in the concerned subject. Out of internal examiners, one examiner shall be a Professor and Head of Department or Professor.
2. There shall be at least four examiners in each subject at an examination out of which at least 50% (Fifty percent) shall be external examiners. The external examiner who fulfils the condition laid down in clause – 1 above shall ordinarily be invited from another recognised university, from outside the State: provided that in exceptional circumstances examinations may be held with 3 (three) examiners if two of them are external and Medical council of India is intimated with the justification of such examination and the result shall be published in such a case with the approval of Medical council of India.

3. An external examiner may be ordinarily been appointed for not more than three years consecutively. Thereafter he may be reappointed after an interval of two years.

4. The internal examiner in a subject shall not accept external examinership for a college from which external examiner is appointed in his subject.

5. The same set of examiners shall ordinarily be responsible for the written, practical or part of examination.

6. There shall be a Chairman of the Board of paper – setters who shall be an external examiner and shall moderate the question papers.

7. The Head of the Department of the institution concerned shall ordinarily be one of the internal examiners and second internal examiner shall rotate after every two year.

(2) Number of candidates

The maximum number of candidates to be examined in Clinical / practical and Oral on any day shall not exceed six for M.D. degree examination.

3) Number of examinations

The university shall conduct not more than two examinations in a year, for any subject, with an interval of not less than 4 and not more than 6 months between the two examinations.
(4) Doctor of Medicine (M.D.)/Master of Surgery (M.S.)

M.D. examination, shall consist of Thesis, Theory Papers, and clinical/Practical and Oral examinations.

(a) Thesis

Every candidate shall carry out work on an assigned research project under the guidance of a recognised Post Graduate Teacher, the result of which shall be written up and submitted in the form of a Thesis.

Work for writing the Thesis is aimed at contributing to the development of a spirit of enquiry, besides exposing the candidate to the techniques of research, critical analysis, acquaintance with the latest advances in medical science and the manner of identifying and consulting available literature. Thesis shall be submitted at least six months before the theoretical and clinical / practical examination.

The thesis shall be examined by a minimum of three examiners; one internal and two external examiners, who shall not be the examiners for Theory and Clinical; and on the acceptance of the thesis by two examiners, the candidate shall appear for the final examination.

(b) Theory

(i) There shall be four theory papers.

(ii) Out of these one shall be of Basic Medical Sciences and one shall be of recent advances.

(iii) The theory examinations shall be held sufficiently earlier than the Clinical and Practical examination, so that the answer books can be assessed and evaluated before the start of the Clinical/Practical and Oral examination.

(c) Practical and Oral

(i) Practical examination for the subjects in Basic Medical Sciences shall be conducted to test the knowledge and competence of the candidates for making valid and relevant observations based on the
experimental/Laboratory studies and his ability to perform such studies as are relevant to his subject.

(ii) The Oral examination shall be thorough and shall aim at assessing the candidate knowledge and competence about the subject, investigative procedures, therapeutic technique and other aspects of the speciality, which form a part of the examination.

A candidate shall secure not less than 50% marks in each head of passing which shall include (1) Theory, (2) Practical including clinical and viva voce examination.

**Evaluation of Answer Scripts**

The answer books will be valued by two examiners. One of the two examiners will be from this university and the other will be from any other university. The Average of the two marks secured by the candidate will be taken into account. If the difference between two marks exceeds 20%, the answer scripts shall be valued by the third examiner. The average of the nearest two marks shall be considered as the final mark.
9. MODEL QUESTION PAPER

M. D., Degree Examination Branch –XIII: Biochemistry - Paper – I

Physical and Organic aspects of Biochemistry, Biostatistics and General Principles of Biochemical Techniques, Instrumentation

Time: 3 hours Max. Marks: 100

(2 x 20 = 40 Marks)

1. Describe the various levels of organization of adult hemoglobin at the molecular level. Explain the molecular events taking place during oxygenation. How is HbA better suited than HbF for oxygen transport after birth?

2. Describe the various uses of radio isotopes in biochemical investigations. Explain the measurement of radioactivity in a laboratory.

Write briefly on:

(10 x 6 = 60 Marks)

1. Principles and applications of affinity chromatography
2. Blood group antigens
3. Isolation and purification of proteins
4. Regression analysis
5. Organization of proteoglycans
6. Nucleotide analogues
7. Phospholipids
8. Biosensors
9. Anticoagulants
10. Donan Membrane Equilibrium
Model Question Paper

M. D., Degree Examination Branch –XIII: Biochemistry - Paper – II

Cell and Molecular biology, Endocrinology and Immunology

Time: 3 hours  Max. Marks: 100

(2 x 20 = 40 Marks)

1. Describe the mechanisms of transport across cell membranes. Add a note on Na+ /K+ ATPase.

2. Describe the various mechanisms involved in regulation of gene expression with suitable examples. Add a note on drugs, which inhibit protein synthesis.

Write briefly on:

(10 x 6 = 60 Marks)

1. Mechanism of action of insulin
2. Class switching of Immunoglobins
3. Endorphins
4. Human Leukocyte Antigens (HLA)
5. Gut hormones
6. Fatty liver
7. Genetic code
8. Laboratory assessment of thyroid disorders
9. Polymerase chain reaction (PCR)
10. Post-translational modifications
Model Question Paper

M. D., Degree Examination Branch –XIII: Biochemistry - Paper – III

Enzymology, Macro and Micronutrients, Intermediary Metabolism, Inborn errors of Metabolism, Human nutrition

Time: 3 hours

Max. Marks: 100

(2 x 20 = 40 Marks)

1. Describe the various metabolic processes which are activated during starvation.

2. Explain the various molecular mechanisms of regulation of enzymes in the body.

Write briefly on:

(10 x 6 = 60 Marks)

1. Glycogen storage diseases – Hepatic types
2. Functional importance of copper
3. Chain breaking antioxidants
4. Use of enzyme inhibitors as drugs
5. Oxidation of Phytanic acid
6. Organization of electro transport chain and its inhibitors
7. Urea cycle disorders
8. Significance of HMP pathway
9. Protein energy malnutrition
10. Hematopoietic vitamins
Model Question Paper

M. D., Degree Examination Branch –XIII : Biochemistry - Paper – IV

Clinical Biochemistry Recent Advances related to human Biochemistry

Time: 3 hours

Max. Marks: 100

(2 x 20 = 40 Marks)

1. Describe the various biochemical tests performed in the differential diagnoses of jaundice.

2. Describe the laboratory diagnosis of Diabetes Mellitus. Explain the basis of chronic complications of Diabetes Mellitus.

Write briefly on:

(10 x 6 = 60 Marks)

1. Analysis of renal calculi
2. Prion disease
3. Biochemistry of Alzheimer’s disease
4. Tests to assess fetal maturity
5. Levy-Jenning’s curve
6. Point of case testing
7. Tumour markers
8. Biochemistry of Atherosclerosis
9. Acid Base disorders
10. Laboratory diagnosis of aminoacidurias
10. RECOMMENDED BOOKS & JOURNALS


JOURNALS

1. Annals of Clinical Biochemistry
2. Annual Review of Biochemistry
3. Biochemical Journal
4. Clinica Chemica Acta
5. Clinical Chemistry
6. Diabetes
7. Diabetologia
8. Journal of Biological Chemistry
9. Journal of Clinical Endocrinology and Metabolism
10. Journal of Lipid Research
11. Metabolism
12. Nature
13. Trends in Biochemical Sciences
14. Kidney International

Success is peace of mind knowing you did your best. - John wooden