



**Amrita School of Medicine
Amrita Institute of Medical Sciences (AIMS)
Kochi-682041**

PROGRAMME MD BIOCHEMISTRY

(Revised with effect from 2015-2016 onwards)

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1. ELIGIBILITY FOR ADMISSION

A Candidate who has passed the MBBS Examination after pursuing the studies in a Medical College recognized by the Medical Council of India, from a recognized Medical College affiliated to any other university recognized as equivalent there to, and has completed one year Compulsory Rotating Internship in a teaching Institution or other Institution recognized by the Medical Council of India and has obtained permanent registration of any State Medical council shall be eligible for admission.

A candidate who has failed more than three times in any University examination during the UG course cannot apply.

2. OBTAINING ELIGIBILITY CERTIFICATE BY THE UNIVERSITY BEFORE MAKING ADMISSION

No candidate shall be admitted for any Post Graduate Degree/ Diploma course unless the candidate has obtained and produced the Eligibility Certificate issued by the Amrita university. The candidate has to make an application to the Amrita university with the following documents along with the prescribed fee.

1. MBBS pass/ degree certificate issued by the concerned University
2. Mark sheets of all the University Examinations for the whole MBBS course.
3. Attempt certificate issued by the Principal of the college where the candidate had studied.
4. Certificate regarding Recognition of the Medical college by the Medical Council of India.
5. Completion of Internship certificate. If a candidate has completed internship from a non – teaching institution, a certificate from MCI recognizing such center, should be attached.
6. Registration by any State Medical Council
Not more than three attempts in the whole course .

3. INTAKE OF STUDENTS

1. Intake of students will be in accordance with AVVP notification based on written examination and interview conducted by Amrita School of Medicine.

2. There will be a Common entrance test for all students seeking admission for PG courses. The university will publish list of successful candidates. Those candidates should appear for an interview.

4. DURATION OF STUDY

The course of study shall be for a period for three completed years including Examination. Each semester shall be of 6 months duration, comprising of 20 weeks of instruction, 6 working days per week, and 36 working hours in each week.

5. ATTENDANCE, PROGRESS AND CONDUCT

1. The selected candidate should exclusively work in the School of Medicine, AIMS and allied institutions. They are not allowed to work part time in any private/ Government institutions. Private practice is forbidden during this period.
2. Each year shall be taken as a unit for calculating attendance.
3. Every student shall attend all the academic activities as prescribed by the department and not absent himself/ herself from work without valid reasons.
4. Every candidate is required to attend a minimum of 80% of the training during each academic year of postgraduate course.
5. Any student who fails to complete the course in the manner stated above shall not be permitted to appear for the University Examination.

6. MONITORING PROGRESS OF STUDIES

1. WORK DIARY/ LOG BOOK

Every candidate shall maintain a work diary and record his / her Participation in the training programmes conducted by the department.

All the presentations and procedures carried out by the candidate should be detailed in this and certified by the concerned teacher. The Log Book shall be scrutinized and certified by the Head of the Department and the head of Institution and presented in the University practical Examination.

7. DISSERTATION

1. Every candidate pursuing P.G degree course is required to carry out work on A selected research project under the guidance of recognized post Graduate teacher. The results of such work should be submitted in the form of a dissertation.
2. Dissertation is aimed to train the post graduate student in methods and Technique of research methodology. It includes identification of a problem formulation of hypothesis, search and review of literature, acquaintance with recent advances, designing of a research study collection of data, critical analysis, comparison of results in drawing conclusion.
3. Every candidate shall submit to The Principal in the prescribed proforma, a synopsis containing particulars of proposed dissertation work with in three months from the date of commencement of the course. The synopsis should be sent through proper channel.
4. Such synopsis will be reviewed and cleared by the Ethics Committee and registered by the University. No change in the dissertation topic or guide can be made without prior approval of the university.
5. The dissertation should be written under the following headings
 1. Introduction
 2. Aims or objectives of the study
 3. Review of literature
 4. Materials and Methods
 5. Results, Tables and observations
 6. Discussion
 7. Conclusion
 8. References
 9. Annexures
6. Dissertation shall be
 1. Typed in double line spacing in single side of A4 size paper (8.27inches (width) x 11.69 inches (length))
 2. Shall not be less than 50 pages and should not exceed 150 pages excluding References , tables and Annexure.
 3. Spiral binding should not be done.

7. Four copies of the dissertation along with a soft copy on a CD shall be submitted to the Principal for evaluation six months before Final Examination through proper channel.
8. The Examiners appointed by the University shall value the dissertation. Approval of dissertation work is essential pre- condition for a candidate to pass the University Examination.
9. Within one month the report of the thesis should be given to the student. In another month candidate should resubmit of the thesis after necessary modification.
10. **GUIDE:** The academic qualification and teaching experience required for recognition by this University as a Guide for dissertation work is as per Medical Council of India Minimum Qualification for Teachers in Medical Institutions Regulations 1998. Teachers in a Medical college having a total of eight years teaching experience of which 5 years after obtaining P.G. degree shall be recognized as post graduate Teachers. A Co- Guide may be included provided the work requires substantial contribution from a sister department. The co-guide shall also be a recognized postgraduate teacher.
11. **CHANGE OF GUIDE:** In the event of a registered guide leaving the Institution for any reason, the Guide may be changed with prior permission from the university.

8. SCHEDULE OF EXAMINATION

The examination for PG course shall be held at the end of third academic years. The university shall conduct two examinations in a year at an interval of four to six months between the two examinations. Not more than two examinations shall be conducted in an academic year.

9. SCHEME OF EXAMINATION

MS/MD Degree examination shall consist of Dissertation, Written paper (theory), Practical and viva voce.

Criteria for appearing for practical exam – only after successfully passing the theory of exam.

1. Dissertation- Every candidate shall carryout work and submit a dissertation as indicated in SL No: 8

2. Written examination: A written examination shall consists of four question papers, each of three hours duration. Each paper shall carry 100 marks. Out of the four papers, 1st paper in clinical subjects will be on applied aspects of basic medical sciences.

Only those candidates successfully passing the written exam would be eligible to appear for practical and viva-voce.

Theory evaluation will be done by two internal and two external examiners appointed by the university.

A candidate successfully passing the theory examination would be eligible to appear for practical examination for a maximum of three chances.

Total marks in the theory examination shall be 400.

3. Practical examination: In case of practical examination, it should be aimed at assessing competence and skills of techniques and procedures as well as testing student's ability to make relevant and valid observations, interpretations and inference of laboratory or experimental work relating to his/her subject.

In case of clinical examination, it should aim at examining clinical skills and competence of candidates for undertaking independent work as a specialist.

The total marks for practical/ clinical examination shall be 200.

4. Viva Voce: Viva Voce Examination shall aim at assessing depth

of knowledge, logical reasoning, confidence and oral communication skills. The total marks shall be 100. Separate minimum of 50% in theory, practical examination and viva is necessary for passing the examination.

5. Examiners: There shall be at least four examiners in each subject. Out of them, two shall be external examiners and two shall be internal examiners. The qualification and teaching experience for appointment as an examiner shall be laid down by Medical Council of India. In exceptional circumstances with the permission of the university. Examination can be conducted by 1 external and 3 internal examiners or 1 external and 2 internal examiners.

6. Criteria for declaring as pass in University Examination: A candidate shall secure not less than 50% marks in each head of passing which shall include (1) Theory (2) Practical and (3) viva voce examination. A candidate securing less than 50% marks as described above shall be declared to have failed in examination. Failed candidates may appear in any subsequent examination upon payment of fresh fees to the principal.

7. Declaration of Distinction: A successful candidate passing the university examination in first attempt will be declared to have passed the examination with distinction, if the aggregate mark is 75% and above. Distinction will not be awarded for those candidates passing the examination in more than one attempt.

10. NUMBER OF CANDIDATES PER DAY FOR EXAM

The number of candidates for practical and viva-voce examination shall be a maximum of six per day.

MD BIOCHEMISTRY THEORY SYLLABUS

The course content will be distributed as:

Paper I, Biomedical techniques, statistics, biomolecules

Paper II, Intermediary metabolism, inborn errors of metabolism Endocrinology, Biochemistry of muscle contraction

Paper III, Molecular biology, applied chemistry, Immunology

Paper IV, Clinical biochemistry, organ function tests, Nutrition including vitamins

In the second year, students will have hospital postings in clinical laboratories.

Dissertation work will be conducted in the 2nd year

The University examination is conducted at the end of the 6th semester.

Program Outcomes of MD biochemistry

PO: 1 At the end of the course the student is able to demonstrate comprehensive understanding of biochemistry as well as applied disciplines.

PO: 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.

PO: 3 Has acquired skills effectively in communicating the diagnosis to the patients and families.

PO: 4 Should be able to demonstrate empathy and have a human approach towards patients & respect their sensibilities.

PO: 5 Practice the specialty of biochemistry in keeping with the principles of professional ethics.

PO: 6 Demonstrate communication skills of a high order in explaining management and prognosis, providing counselling and giving health education message to patients, families & communities.

PO: 7 Play the assigned role in implementation of national health programs, effectively & responsibly.

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

PO: 9 Design, fabricate & use indigenous methods/gadgets for experimental purpose

PO: 10 Pursue her / his interest to undergo further specialization

Program Specific Outcomes of MD biochemistry

PSO: 1 Has the competence to perform relevant investigations which will help to diagnose important medical conditions.

PSO: 2 Has acquired skills effectively in interpreting all laboratory reports.

PSO: 3 Perform recent investigations and procedures for patients.

PSO: 4 Demonstrate skills in documentation of reports.

PSO: 5 Is able to organize and equip Biochemistry Lab

PSO: 6 Demonstrate competence in basic concepts of research methodology and epidemiology.

PSO: 7 Develop competency in applying statistical tools in research

PSO: 8 Function as a productive member of a team engaged in health care, research and education.

PSO: 9 Conduct experimental studies analyze and solve clinical and experimental problems

PSO: 10 Develop competency to perform advanced techniques in genetic research

PSO: 11 Develop competency in understanding immunology in health and disease

PSO: 12 Develop competency in explaining the biochemical basis of cancer

PSO: 13 Plan & conduct lecture, practical demonstrations, tutorial classes and small group discussions on clinical problems for undergraduates students of medical and allied disciplines

PSO: 14 Critically review & comment on research papers and give oral presentation.

PSO: 15 Be familiar with literature survey/computer skills.

Course Outcomes of the Elective Course

MDBC5 Soft Skills

CO1: Proficiency in research methodology.

CO2: Ability to handle classes.

CO3: Competency in departmental administration

CO4: Ability to present topic in a proper manner in venues such as seminars and CMEs.

CO5: Competency to manage a lab independently

CO6: Organaisational skills - such as for CME programmes.

PAPER I – GENERAL BIOCHEMISTRY AND TECHNIQUES (Course Code: MDBC1)

Introductory Biochemistry and Molecular Biochemistry- cell, transport mechanisms, central dogma, gene expression, mutation, molecular techniques

CO1: Describe the structure and functions of cell at molecular level

CO2: Describe central dogma

CO3: Describe regulation of gene expression, mutation and molecular techniques

1. Methods of qualitative analysis of biomolecules :

Principle , experimental procedure and applications of chromatography: Paper, thin layer, ion exchange, affinity, gel filtration, gas- liquid and HPLC. Principle, procedures and application of Electro phoresis: Paper, polyacrylamide gel, agarose gel, and cellulose acetate Ultracentrifugation, Ultrafiltration.

2. Quantitative methods:

Principle and applications of Photometry, spectrophotometry, Fluorometry, ion selective procedures and flame photometry.

3. Principles of Biophysical methods used for analysis of biopolymer structure X-ray diffraction, fluorescence, UV, ORD/CD, visible, NMR and ESR spectroscopy, Hydrodynamic methods, Atomic absorption and plasma emission spectroscopy.

4. Principles and application of light, phase contrast, fluorescence, scanning and transmission electron microscopy, cytophotometry and flow cytometry, fixation and staining.

5. Isotopes :

Detection and measurement of radioactive isotopes. Principles and application of tracer techniques in biology; Radiation desitometry. Application of isotopes in research and clinical biochemistry. Effect of radiation on biological system; Autoradiography, Cerenkov radiation, Liquid Scintillation spectrometry.

6. Concept of pH and buffers. Henderson – Hasselbalch equation and its clinical application. Principle and procedures of determination of pH. Physiological buffers.

7. Diffusion, Osmosis, Osmotic Pressure, Surface tension, Adsorption, Hydrotropy, viscosity, Colloids. Surface tension and surfactants

8. Amino acids and proteins. Structure and properties of Amino acids, Protein structure and conformation, determination of amino acid Sequence of proteins, chemistry of conjugated proteins, nucleoproteins, lipoproteins, Immunoglobulins, glycoproteins. Structure, functional relationship of proteins: hemoglobin, myoglobin and collagen. Protein - protein interaction. Prions, beta amyloid.

9. Chemistry of carbohydrate:

Monosaccharides, Disaccharides, Homopolysaccharides,

Heteropolysaccharides, Enantiomer, Diastereomer, Mutarotation, Anomer, Epimers.

10. Chemistry of lipids: Classification, Fatty acids, PUFA, Compound lipids, Cholesterol. Triglycerides, Phospholipids, Gangliosides

11. Nucleic acid: Chemistry and structure of bases, Nucleosides, Nucleotides, RNA and DNA .DNA sequence determination. Properties of Nucleic acid. Nucleic acid metabolism and its clinical correlation

12. Bioenergetics and biological oxidation: concept of free energy change, High energy compounds, ATP generation, redox potential, electron transport chain, oxidative phosphorylation, inhibitors, uncouplers, ionophores.

13. Cell fractionation, biochemical activities of different fractions marker enzymes.

14. Enzymes: Classification, nomenclature, enzyme specificity, enzyme kinetics, coenzymes, cofactors, factors regulating enzyme activity, isozymes, proenzymes, multienzyme complexes,

tandem enzymes, covalent modification, Active site of enzymes, methods of locating the amino acids residues in the active site of enzymes. Mechanism of enzyme action.

Enzyme inhibition: competitive, non-competitive, Allosteric and suicidal inhibition.

15. Purification of enzymes from cells, characterization and criterion of purity. Purification of proteins.

16. Membranes: Chemical composition, structure, biological properties, functions, membrane transport systems, ion-channels, endocytosis, exocytosis, defects.

PAPER II INTERMEDIARY METABOLISM (Course Code: MDBC2)

MDBC2 Biochemistry of body metabolism--metabolism of carbohydrates, aminoacids, lipids, Hb, nucleic acids and their related inborn errors

CO1: Describe the metabolism of carbohydrates and lipids

CO2: Describe the metabolism of protein and Hb

CO3: Describe the metabolism of nucleic acids

CO4: Describe the various inborn errors of metabolism

1. Methods of investigation of metabolic pathways, primary, secondary and tertiary metabolisms.

2. Carbohydrate metabolism: Carbohydrate digestion and absorption. Details of metabolic pathways involving carbohydrates in mammals. Embden-Meyerhof pathway, hexosemonophosphate shunt, gluconeogenesis other minor pathways, fructose and Galactose metabolisms. Inborn errors of metabolism. Blood glucose homeostasis, Hormones influencing carbobyhydrate utilization -insulin, glucagons, glucocorticoids, epinephrine, and glucose tolerance test, Diabetes Mellitus. Carbohydrate metabolism and brain

3. Amino acid metabolisms: Protein digestion and absorption of amino acid metabolism of individual amino acids, one carbon units, polyamines, nitric oxide, plasma proteins, transport proteins. Inborn errors of metabolism. Types of aminoaciduria and its clinical manifestations.

4. Lipid metabolism: Digestion and absorption, transport and storage, fatty acid synthesis, fatty acid oxidation pathways. Biosynthesis of phospholipids glycolipids. Cholesterol metabolism plasma lipoprotein metabolism. Role of adipose tissue and liver in lipid metabolism. Hormonal regulation of lipid metabolism. Prostaglandins, prostacyclins, leukotriens, thromboxanes and very long chain fatty acids. Inborn errors.

5. Regulation of metabolism: TCA Cycle, integration of metabolisms, common terminal pathway, regulation, amphibolic role. Hormonal regulations of metabolic pathways, Cori's cycle, Alanine cycle, adaptation during starvation. Electron transport chain(ETC) and its clinical and pathological correlation.

6. Purine and Pyrimidine metabolisms: Synthesis and degradation of bases and nucleotides, regulation, gout, Lesch- Nyhan syndrome.

7. Antibiotics and other chemotherapeutic agents-Inhibition of cell-wall synthesis, nucleic acid and protein synthesis, specific enzyme system, Damage to cytoplasmic membrane. Antifungal antibiotics, Anitviral chemotherapeutic agents, Mechanism of action of anticancer drugs. Drug resistance, Assay of antibiotics. Susceptibility to chemotherapeutic agents.

8. Host-microbeinteraction: The process of infection, toxins, Diphtheria toxin, Botulinum toxin, tetanus toxin, Cholera toxin, SLO and SLS, virulence factors.

9. Pituitary and Hypothalamic hormones, Thyroid hormones. Hormones that regulate calcium metabolism, Hormones of adrenal cortex, adrenal medulla, gonads, pancreas and GI.

10. Toxicity studies, Drug assays.

11. Structure & function, Neurochemical basis, Synthesis, storage, release & metabolism of neurotransmitters, Adrenergic and cholinergic systems, pharmacological manipulation of the ANS.

Neurotransmitter: Types, location, function & role in disorders of the CNS, receptors & Nomenclature, Major diseases of the CNS-Epilepsy, Parkinsonism, Alzheimer's Disease, stroke

and their pharmacotherapy, GABA-sedative & hypnotics, Biological basis of anaesthesia, Pain & analgesia- role of opioids, Biological basis of Psychiatric disorders, CNS depressants-alcohol. CNS stimulants including drug dependence.

12. Biochemistry of muscle contraction.

PAPER III MOLECULAR BIOLOGY AND IMMUNOLOGY (Course Code: MDBC3)

MDBC3 Biochemistry of tissues- biochemistry of vitamins, enzymes, minerals, hormones, nutrition, TCA cycle, ETC

CO1: Describe the biochemistry of vitamins and minerals

CO2: Describe the biochemistry of enzymes and hormones

CO3: Describe the biochemical basis of nutritional deficiency disorders

CO4: Describe energy metabolism- steps and regulatory mechanisms of TCA cycle and ETC

1. DNA: Replication, DNA damage and repair processes, mutations, amplification of genes, somatic recombination, Telomeres, inhibitors of replication.

2. Fine structure of gene, Eukaryotic genomic organization (structure of chromatin, coding and non coding sequences, satellite DNA)

3. 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.

4. Translation: Genetic code, tRNA, ribosomes, protein biosynthesis, post translational modifications, inhibitors of translation, signal sequences, chaperones and heat shock proteins, anticancer drugs.

5. Lysogeny and lytic cycle of bacteriophages, Bacterial transformation, Host cell restriction, Transduction, complementation. Molecular recombination, DNA ligases, Topoisomerases, Gyrases, Methylases, Nucleases, Restriction endonucleases, plasmids and bacteriophages based vectors for cDNA and genomic libraries.

6. Principles and methods of genetic engineering and gene targeting, Application in health.

7. **Recombinant DNA technique.** Cloning procedures, vectors, plasmids, phages, Cosmids, Restriction map, PCR technique. Southern, Northern, Western blotting procedures. Restriction fragment polymorphism. In-situ hybridization. Genomic library and cDNA library, Mutations, mutagens, carcinogens, in-vitro mutagenesis. Transgenic animals and micro injection technique. Genetherapy. Protein degradation. Cathepsins, proteosomes, Caspases, Apoptosis.

8. **Biochemistry and molecular biology of cancer,** oncogenes, Chemical carcinogenesis, Genetic and metabolic disorders, Hormonal imbalances, Drug metabolism and detoxification. Genetic load and genetic counseling.

9. Basic concepts of immunology: Chemistry of immunoglobulins, primary and secondary immune responses, auto immune responses, auto immune phenomenon, Anaphylaxis, clonal selection, B cells, T cells, helper T cells, NK cells, macrophages, Interleukins, cytokines, HLA antigens, monoclonal antibodies, Hybridoma technology, Immunodiffusion, Immuno electrophoresis, radio immuno assay (RIA), enzyme linked immunosorbent assay (ELISA), Fluorescent in situ hybridization (FISH) techniques.

10. Humoral and cell mediated immunity, MHC Mechanism of immune response and generation of immunological diversity, Genetic Control immune response. Effector mechanism.

11. Hypersensitivity reactions, Delayed type hypersensitivity: T-cell mediated immunity
Autoimmunity, Transfusion immunology, Transplantation immunology.

12. Allergy & inflammation: Histamine, 5HT, Prostaglandins, PAF, Bradykinin, Adenosine- role
in allergy & inflammation, pharmacological manipulation, Non-steroidal anti-inflammatory
drugs, Pathogenesis of asthma & principles of therapy.

**PAPER IV–CLINICAL BIOCHEMISTRY AND NUTRITION(Course Code:
MDBC4)**

**MDBC4 Practical and recent advances in Biochemistry-routine blood chemistry,
LFT,RFT, PFT, analysis of body fluids, special tests-ELISA, Chemiluminence techniques,
immunoflurimetry, biosensors, biochemistry and immunolgy of cancer, AIDS, organ
transplantation, Gene therapy Biostatistics and biomedical intrumentation, cytogenetics,**

CO1: Perform routine biochemical investigations like LFT, RFT, TFT

CO2: Perform specialised biochemical investigations like ELISA,Chemiluminence
techniques,immunoflurimetry,biosensors

CO3: Describe the biochemistry and immunology of cancer,AIDS and organ
transplantation

CO4: Describe Gene therapy and cytogenetics

CO5: Apply biostatistical tools in medical research

1. Vitamins: Fat soluble and water soluble vitamins, chemistry, absorption, metabolism,
biochemical roles, requirement, deficiency manifestations.

2. Mineral metabolism: Macrominerals, sodium, potassium chloride, magnesium, calcium,
phosphorus.

Trace elements: iron, copper, manganese, zinc, cobalt, molybdenum, selenium, iodine and
fluoride.

3. Nutritional requirements: Energy requirements, balanced diet, nutritional disorders, obesity, starvation, PUFA, dietary fibres, Cholesterol.
4. Protein requirements: Nitrogen balance, nutritive value, biological value, chemical score, protein energy malnutrition, Kwashiorkor and Marasmus.
5. Endocrinology: Mechanism of action of hormones, hormone receptors, signal transduction, G-proteins, second messengers, cyclic AMP, cyclic GMP, calcium, inositol triphosphate, diacyl glycerol, nitric oxide, Biosynthesis of adrenal and thyroid hormones, metabolic regulation by hormones, hormonal regulation of gene expression , hormonal disorders, biochemical investigation of endocrine disorders, thyroid and adrenal function tests.
6. Erythrocytes: Chemical make up, metabolic pathways, haemoglobin, hemoglobinopathies, porphyrias, heme synthesis and degradation, bilirubin - metabolism, jaundice, laboratory findings in jaundices. Composition of blood plasma in health and diseases, normal values.
7. Acid base balance , water balance and electrolyte balance, related disorders.
- 8. Clinical Pharmacokinetics, Clinical Trials, Adverse drug reactions including interactions, pharmacoepidemiology, pharmacogenetics.**
9. Pathogenesis of hypertension, angina pectoris, myocardial infarction, congestive cardiac failure, cardiac arrhythmias, shock and hyperlipidaemias, Principles of their pharmacotherapy, Diuretics.
10. Principles of use of anticoagulants, antiplatelet drugs, fibrinolytic agents and drugs for treatment of anaemia.
11. Biochemical investigation of liver, kidney and gastric functions, Malabsorption disorders, inherited metabolic disorders.
12. Cell biology: Cell cycle, check points, regulation, Oncogenes, tumour suppressor genes, tumour markers.

13. Reactive oxygen species and defence mechanisms, antioxidants, and enzyme systems.
14. Diagnostic enzymology: LDH, CPK, AST, ALT, ALP, ACP, GGT, Amylase, 5' nucleotidase, etc.
15. Acute phase proteins: Alpha-1, anti-trypsin, Alpha-2, macroglobulin, Haptoglobin, Ceruloplasmin etc.
16. Tumor markers
17. AIDS; HIV, genes and gene products, diagnosis, precautions. Alzheimer's disease, Prions, beta amyloid.
18. Laboratory management: Precision, accuracy, specificity, sensitivity, percentage error, quality control, precautions in handling hazardous materials pre-analytical variations.

SOFT SKILLS (Course Code:)

- 1: Proficiency in research methodology.
- 2: Ability to handle classes.
- 3: Competency in departmental administration
- 4: Ability to present topic in a proper manner in venues such as seminars and CMEs.
- 5: Competency to manage a lab independently
- 6: Organisational skills - such as for CME programmes.

Practical syllabus

MD BIOCHEMISTRY)

PAPER I – Biomedical Techniques, Biomolecules and Statistics

GENERAL

Preparation of reagents

Standardization of methods

Preparation of buffers

General care and maintenance of equipment and glassware

Precautions and handling laboratory hazards

Familiarity with equipment: microbalance, pH meter, spectrophotometer, fluorimeter, centrifuges, incubators, freezers, fraction collectors, electrophoresis, homogenizer etc.

Paper chromatography of amino acids.

Thin layer chromatography of amino acids.

Thin layer chromatography of carbohydrates.

Ion exchange chromatography

Gel filtration chromatography (Sephadex) of proteins, molecular weight determination.

Affinity chromatography, Blue Sepharose and albumin.

Demonstration of HPLC

Paper electrophoresis, Agarose gel

Electrophoresis of serum proteins

Polyacrylamide gel electrophoresis, molecular weight determination.

Amylase, effect of substrate, pH and chloride.

Trypsin or chymotrypsin, caseinolytic method, effect of pH, effect of temperature, and K_m value.

Study of proteinase inhibitor.

Enzyme purification: Amylase or Urease.

Assay of enzyme, K_m value

Cell fractionation

Estimation of amino acid, Ninhydrin (colorimetric) method.

Protein estimation by Lowry's method.

Estimation of proteins by Folin's method

Estimation of protein by dye binding method.

Estimation of nitrogen content of protein by Kjeldahl method.

Titration of amino acid, formol titration and pK values.

Absorption spectra of Phenylalanine, Tyrosine and Tryptophan.

Absorption spectra of Purines and pyrimidines.

Estimation of total sugars, by Phenol- sulfuric acid method.

Estimation of reducing sugars – Arsenomolybdate method.

Estimation of ketohexoses (fructose) – Resorcinol method.

Estimation of Aldohexoses (glucose) – Iodometric method.

Periodate oxidation of sugars.

Estimation of amino sugars.

Graphical representation of data, correlation and regression analysis, students “t” test, “chi-square’ test, analysis of variance.

PAPER II - INTERMEDIARY METABOLISM

Estimation of glucose by Glucose oxidase method.

Estimation of glucose by ortho toluidine method.

Estimation of glucose by Nelson-Somogyi method.

Glucose tolerance test

Blood urea estimation

Blood creatinine estimation

Serum creatinine.

Cholesterol and HDL cholesterol, Abell’s and Ferric chloride methods.

Flame photometry, Sodium and Potassium.

Lipid profile

Plasma chloride, bicarbonate, pH and pCO₂.

CSF analysis, protein, sugar and chloride.

TC, DC, ESR, Hb, BT, CT, Prothrombin time

Inborn errors of metabolism, urine screening

PAPER III – Molecular Biology, Applied Genetics, and Immunology

Isolation of DNA from animal tissue, check its purity by 260/280 nm absorption.

Isolation of plasmid / bacteriophage DNA.
Restriction digestion and agarose gel electrophoresis.
Southern blotting.
Isolation of mitochondria from animal tissue.
Isolation of RNA
Estimation of succinate dehydrogenate activity.
Study of mitosis, karyotyping
Ame's test
Immunodiffusion
Radial immunodiffusion.
Hemagglutination
Latex agglutination
Widal test
Complement fixation test
Immunoelectrophoresis.
ELISA: Tumor markers, T3, T4, TSH.
Radio immuno assay
Lymphocyte culture
Purification of IgG from human sere.
Raise anti IgG and purify it.
Conjugation with ALP or HRP.
FITC conjugation of antibody
Western blotting.
Blood grouping and cross matching
C reactive protein, haptoglobins, ceruloplasmin
Diagnosis of HIV

PAPER IV - CLNICAL BIOCHEMISTRY AND NUTRITION

Specimen collection, handling and storage.

Estimation of Albumin, total proteins and Albumin globulin ratio in serum. Biuret and dye binding method.

Serum calcium estimation.

Serum bilirubin estimation.

Serum Alkaline phosphatase.

Serum Acid phosphatase.

SGOT (AST).

SGPT (ALT).

Total LDL and iso-enzymes.

Serum amylase, Somogyi method.

Serum iron and iron binding capacity.

Electrophoresis, Lipoproteins and serum proteins

Electrophoresis, normal and abnormal hemoglobins.

Glycated hemoglobin, by affinity chromatography.

Serum triglycerides, enzymatic.

Creatinine clearance.

Urea clearance.

Protein estimation in urine and microproteinuria.

Serum GGT.

Serum lipase.

Serum inorganic phosphorus.

Estimation of Vitamin C, titration, and colorimetric method.

Estimation of iron, transferring

Estimation of T3, T4, TSH, thyroglobulin

Estimation of cortisol, VMA

Physical and chemical analysis of urine, pH, specific gravity, reducing substances, protein, ketone bodies, blood, bile salts, bile pigments

Urinary aminogram

Urine urea, creatine, creatinine, uric acid, calcium, phosphorus

Autoanalyser (demonstration).

Quality control, internal and external, analysis of variance

Accuracy, precision, sensitivity and specificity.

MODEL QUESTION PAPER
MD BIOCHEMISTRY
PAPER I

(Biomedical Techniques, Biomolecules and Statistics)

Time: 3 hrs

Max Marks: 100

Answer all questions

Draw neat diagrams wherever necessary

I Write in detail the chemical composition, structure & biological properties of biomembranes. Outline the different transport mechanisms across membranes. Add a note on ion channels. (8 + 8+ 4=20 marks)

II **Write precise answers**

- a) Ion exchange chromatography
- b) Serum lipoprotein electrophoresis- procedure and patterns in health and dyslipidemias
- c) Applications of radioactive isotopes in clinical Biochemistry
- d) Line weaver Burk plot & its use in Km determination and evaluation of enzyme inhibitions
- e) Standard deviation and Standard error

(6x5= 30 marks)

III Derive the Handeson - Hasselbalch equation. Outline the different methods of pH determination. Write in detail the renal regulation of acid base balance. Add a note on metabolic acidosis. (2+6+8+4= 20marks)

IV Write Short notes:

- a) Structure and functions of immunoglobulins
- b) Marker enzymes of diagnostic importance
- c) Ecosinioids
- d) Mucopolysaccharides
- e) Renin angiotensin mechanism in electrolyte balance

(6x5= 30 marks)

MD BIOCHEMISTRY

PAPER II

(Intermediary metabolism, Inborn errors, Endocrinology, Biochemistry of muscle contraction)

Time: 3 hrs

Max Marks: 100

**Answer all questions
Draw neat diagrams wherever necessary**

- I Write in detail the hormonal regulation of blood sugar –
Indicating the actions & mechanism of action of each hormone at the cellular, enzymatic and molecular level
(20 marks)
- II Write precise answers
1. One carbon transfer reactions.
 2. Synthesis of phospholipids
 3. Biochemical shuttle mechanisms
 4. Anaplerotic reactions
 5. Biochemistry of muscle contraction (6 x 5 = 30 marks)
- III Define redox potential. Represent the electron transport chain in the mitochondria indicating the redox potential of the components, sites of ATP synthesis and inhibitors of each site. What is P:O Ratio? Add a note on chemiosmotic hypothesis. (1+ 12+ 1+ 6= 20 marks)
- IV Write short notes
1. Serum calcium homeostasis
 2. Ketogenesis and ketolysis
 3. Physiologically important tripeptides
 4. Specialised compounds derived from tyrosine
 5. Biochemical and molecular defects in Alzheimer's disease (6 x 5 = 30 marks)

MD BIOCHEMISTRY

PAPER III

(Molecular Biology, Applied Genetics and Immunology)

Time: 3 hrs

Max Marks: 100

**Answer all questions
Draw neat diagrams wherever necessary**

- I. Describe the denovo synthesis of Purine nucleotides. How is it regulated? Indicate the clinical uses of inhibitors of purine nucleotide synthesis. Add a note on the inborn errors of metabolism associated with degradation of purines
(6+3+3+8= 20 marks)
- II. Explain DNA repair mechanisms, describe the different types and diseases associated with DNA repair mechanisms
(3+7+5= 15 marks)
- III. Define mutation. Explain with suitable examples the different types of mutations and the manifestations of mutations. Test to detect mutagenicity. (2+3+6+4=15)
- IV. Write the different phases of cell cycle and the checkpoints. Add a note on RB and p53 Oncosuppressor proteins (4+4+4+3= 15 marks)
- V. Write short notes on: -
1. Post- transcriptional and post- translational processing
 2. Retroviruses
 3. Hybridization and Blot Techniques
 4. Animal cloning and application of molecular cloning in medicine.
 5. Somatic recombination of DNA
 6. Monoclonal bands
 7. Fish techniques (7x5= 35 marks)

MD BIOCHEMISTRY

PAPER IV

(CLINICAL BIOCHEMISTRY AND NUTRITION)

Time: 3 hrs

Max Marks: 100

**Answer all questions
Draw neat diagrams wherever necessary**

- I. Describe the source, co-enzyme forms, dependent enzymes, generating and utilizing reactions, normal requirement, deficiency manifestations, causes for deficiency and therapeutic use of Niacin. (1+1+4 +2+3+1+2+5+1= 20)
- II. Enumerate liver function tests and discuss the biochemical alterations seen in blood and urine in different types of jaundice. (10+10=20)
- III. Describe the source, daily requirement, factors influencing and regulating absorption and transport, storage and excretion, causes for deficiency, clinical manifestations and laboratory findings of Iron deficiency, and toxicity of Iron. (1+1+2+3+2+1+1+3+1+3+2= 20)
- IV. Write short notes on: -
- 1.Dark adaptation mechanism
 - 2.Types of Rickets
 - 3.Vitamin K cycle
 - 4.Causes for folate deficiency
 - 5.Fanconi's syndrome
 - 6.Glycemic index
 - 7.Pre analytical variations
 - 8.Clearance tests (8x5= 40)

REFERENCE BOOKS:

1.	Text Book Of Biochemistry	Dr.D.M Vasudevan
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2.	Biochemistry	U.Satyanarayana
3.	Medical biochemistry	Chatterjii and Ranashindae
4.	Lehninger - Principles of Biochemistry	David.L. Nelson
5.	Harper's Biochemistry	Robert.K.Murray
6.	Clinical Biochemistry(2 volumes)	Harold Varley
7.	Tietz Text book of Clinical Chemistry	Carl A Burtis
8.	Fundamentals of clinical chemistry	Carl A Burtis
9.	Text Book of Biochemistry	Thomas M Devlin
10	Fundamentals of Biochemistry	Dr.A.C.Deb
11	Biochemistry for Nurses	Raju.Madala
12.	Practical Biochemistry Principles &Techniques	Keith Wilson &John walker
13.	Biochemistry	Lubert Stryer
14.	Biochemistry(2 vol)	White Handler Smith
15.	Leninger Principles of Biochemistry	Leninger
16.	Molecular Biology of the gene	Watson Hopkin

AMRITA VISHWA VIDYAPEETHAM

UNIVERSITY

DEPARTMENT OF BIOCHEMISTRY



Amrita School of Medicine,

AIMS, Ponekkara P.O,
Kochi - 682041, Kerala, India.

LOG BOOK

Name of the candidate:

Ph : ++91-484-400 8131 / 280 1234. Fax : ++91-484 – 280 2051 / 280 2020 Email : medicalcollege@aims.amrita.edu

AMRITA VISHWA VIDYAPEETHAM

UNIVERSITY

DEPARTMENT OF BIOCHEMISTRY



*Amrita School of Medicine,
Amrita Institute of Medical Sciences*

AIMS, Ponekkara P.O,
Kochi - 682041, Kerala, India.

LOG BOOK

Name of the candidate:

University Reg. No :



CERTIFICATE

*This is to certify that the content of log book is a bonafide work of
_____ Reg. No. _____ MD/MS
student in Department of _____, Amrita School
of Medicine, Amrita Institute of Medical Sciences & Research Centre for the
Academic year _____ to _____.*

Head of the Department



RECORD OF PG COURSE

1. Name of the candidate :
2. Registration No. :
3. Name of Institution/Hospital : Amrita School of Medicine
4. Name of University : Amrita Vishwa Vidyapeetham
5. Duration of the Course :

6. Address : Elamakkara, Kochi, Kerala-682026

7. Department : Biochemistry

Signature of Principal

Signature of HOD

Date:

Place: Kochi, Kerala



Bio-data

Name :

Permanent Address :

Education

Course	College	Period
MBBS		
Diploma		
PG Degree		

Subject :

Date of Joining :

Provisional Reg.No :

Thesis Research work

Signature



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POSTING SCHEDULE

S. No.	Speciality	From	To	Period	Signature of Incharge
1	Cardiology				
2	Endocrinology				
3	Internal Medicine				
4	Gynaecology				
5	Haematology				
6	Toxicology				
7	Serology				
8	Microbiology				
9	Pathology				
10	Nuclear Medicine				
11	Flow Cytometry				
12	Molecular Biology				

LECTURES

S. No.	Date	Topic	

SEMINARS

S. No.	Date	Topic	Chairperson	

JOURNAL CLUBS

S. No.	Date	Topic	Chairperson	

Biochemistry Clinical Laboratory Posting

S.	Date	Investigation Details	Method	Result

Post Graduate Laboratory Posting				
S.No.	Date	Estimation	Observation	Result

Metabolic Laboratory Posting				
S. No.	Date	Name of investigation	Equipment	Observation

Cytogenetics Laboratory Posting				
S. No.	Date	Name of investigation	Equipment	Observation

Posting in ABG Room				
S. No.	Date	Name of investigation	Equipment	Observation

Posting in Molecular Biology				
S. No.	Date	Name of investigation	Equipment	Observation

Posting in Toxicology				
S. No.	Date	Name of investigation	Equipment	Observation

Posting in Haematology				
S. No.	Date	Name of investigation	Equipment	Observation

CONFERENCES/WORKSHOPS			
S. No.	Date	Conference/Workshop	Remarks

PAPERS PUBLISHED			
S. No.	Date	Details	Remarks

MISCELLANEOUS

S. No.	Date	Details	Remarks

Biochemistry		
1	The Lancet	International
2	Nature	International
	British Medical Journal (BMJ)	International
3	Pediatric Gastroenterolgy and Nutrition	International
4	New England Journal of Medicine	International
5	Science	International
6	Journal of Parenteral and Enteral Nutrition	International
7	JAMA(Journal of American Medical Association)	International
8	Indian Journal of Biochemistry & Biophysics (CSIR)	Indian
9	Indian Journal of Clinical Biochemistry	Indian
10	Indian Journal of Clinical Practice	Indian
11	indian Journal of Medical research	Indian
12	Indian Journal of Pathology & Microbiology	Indian
13	Indian journal of Physiology and Parmacology	Indian
14	Indian Journal of Experimental Biology(CSIR)	Indian
15	Natural Products & Radiance (CSIR)	Indian
16	The Indian Journal of Pharmacology	Indian
17	The National Medical Journal of India	Indian
18	Journal of Association of Physicians of India (JAPI)	Indian
19	The National Medical Journal of India	Indian
20	Journal of Indian Medical Association	Indian