

CHETTINAD ACADEMY OF RESEARCH & EDUCATION
(Deemed to be University under section 3 of the U.G.C. Act 1956)



REGULATIONS & SYLLABUS

M.D. BIOCHEMISTRY

CHETTINAD ACADEMY OF RESEARCH AND EDUCATION

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CHETTINAD ACADEMY OF RESEARCH AND EDUCATION

Regulations for M.D. Pre and Para Clinical Courses

1. INTRODUCTION:

M.D. Pre and Para Clinical course is a three year post graduate program under the Faculty of Medicine for students with an Under Graduate Degree in Medicine. This program is a taught course that covers relevant topics and a research project in the area of specialization. This program shall be competence based and learning shall be essentially autonomous and self directed and supplemented with practical and laboratory work. The curriculum shall have modular approach to learning. The research component is through original exploration and experiments culminating in the research project. This program shall impart advanced theoretical and practical aspects of subjects previously studied in a more generalized manner at the undergraduate level.

These courses are aimed at imparting higher level of training to qualified under graduate medical students in various branches of M.D. Pre and Para Clinical subjects and to utilize this learning to the needs of community.

In exercise of the powers conferred under sub rule (a) and (g) of Rule 8 (b) of Memorandum of Association and Clause 2.1, Chapter III of Bye-laws of Chettinad Academy of Research and Education, the Academic Council hereby makes the following regulations:-

2. SHORT TITLE AND COMMENCEMENT:

These Regulations shall be called the "Regulations for M.D. Pre and Para Clinical Courses of Chettinad Academy of Research and Education. These regulations are subject to modifications as may be approved by the Academic Council from time to time.

3. GOAL:

The goal of postgraduate medical education shall be to produce competent specialists and/or medical teachers:

- i) who shall recognize the health needs of the community and carry out professional obligations ethically and in keeping with the objectives of the national health policy
- ii) who shall have mastered most of the competencies, pertaining to the specialty, that are required to be practiced at the secondary and the tertiary levels of the health care delivery system.
- iii) who shall be aware of the contemporary advance and developments in the discipline concerned.
- iv) who shall have acquired a spirit of scientific inquiry and is oriented to the principals of research methodology and epidemiology and
- v) who shall have acquired the basic skills in teaching of the medical and paramedical professionals.

4. AIMS AND OBJECTIVES:

At the end of the Post Graduate training in the discipline concerned the student shall be able to:

- i) Recognize the importance of the concerned speciality in the context of the health needs of the community and the national priorities in the health sector.
- ii) Practice the speciality concerned ethically and in step to the principles of primary health care.
- iii) Demonstrate sufficient understanding of the basic sciences relevant to the concerned speciality.
- iv) Identify social, economic, environmental, biological and emotional determinants of health in a given case, and take them into account while planning therapeutic, rehabilitating, preventive and primitive measures/ strategies.
- v) Diagnose and manage majority of the conditions in the speciality concerned on the basis of clinical assessment, and appropriately selected and conducted investigations.
- vi) Plan and advise measures for the prevention and rehabilitation of patients suffering from disease and disability related to the speciality.
- vii) Demonstrate skills in documentation of individual case details as well as morbidity and mortality rate relevant to the assigned situation.
- viii) Demonstrate empathy and human approach towards patients and their families and exhibit interpersonal behavior in accordance with the societal norms and expectations.
- ix) Play the assigned role in the implementation of National Health Programme effectively and responsibly.
- x) Organize and supervise the chosen/assigned health care services demonstrating adequate managerial skills in the clinic/hospital or the field situation.
- xi) Develop skills as a self-directed learner, recognize continuing education needs: select and use appropriate learning resources.
- xii) Demonstrate competence in basic concepts of Research Methodology and epidemiology, and be able to critically analyze relevant published research literature.
- xiii) Develop skills in using educational methods and techniques as applicable to the teaching of Medical/ Nursing students, General Physicians and Paramedical Health Workers.
- xiv) Function as an effective leader of a health team engaged in health care, research or training.

5. COMPONENTS OF THE POSTGRADUATE CURRICULUM:

The major components of the Postgraduate curriculum shall be:

- Theoretical knowledge
- Practical and clinical skills
- Writing Thesis/Research articles
- Attitudes including communication skills
- Training in research methodology, Medical Ethics and Medico legal aspects.

6. NOMENCLATURE OF POSTGRADUATE COURSES:

The nomenclature of Post Graduate Degree should be as laid down in the Post Graduate Medical Education Regulations prescribed by the Medical Council of India.

7. ELIGIBILITY FOR ADMISSION:

Every student, selected for admission to a post graduate medical course in Chettinad University on acquiring M.B.B.S degree or an equivalent qualification thereto shall have obtained permanent registration with the Medical Council of India, or any of the State Medical Council(s) or shall obtain the same within a period of one month from the date of his/her admission, failing which his/her admission shall stand cancelled.

Provided that in the case of a foreign national, the Medical Council of India may, on payment of the prescribed fee for registration, grant temporary registration, for the duration of the post graduate course limited to the medical college/institution to which the candidate is admitted for the time being exclusively for pursuing post graduate studies.

Provided further the temporary registration to such foreign national shall be subject to the condition that such person is duly registered with appropriate registering authority in his own country wherefrom he has obtained his basic medical qualification and is duly recognized by the corresponding Medical Council or concerned authority.

8. RECOGNITION FEE AND ELIGIBILITY CERTIFICATE:

Candidates who have passed the M.B.B.S Degree Examination other than that conducted by Chettinad Academy of Research and Education shall obtain Eligibility Certificate from this University at the time of admission and also remit recognition fee as prescribed.

9. REGISTRATION:

A candidate admitted to the Post Graduate Course shall register with the University by submitting the prescribed application form for registration, duly filled in along with the prescribed fee, through the Head of the Institution.

10. PERIOD OF TRAINING /DURATION OF THE COURSE:

The duration of certified study and training for the M.D. Pre and Para Clinical Courses shall be three completed years including the period of examination.

Provided that in the case of students possessing a recognised two year postgraduate diploma course in the same subject, the period of training, including the period of examination, shall be two years.

11. COMMENCEMENT OF THE COURSE:

The course shall ordinarily commence from 2nd May of the Academic year.

12. CUT OFF DATES FOR ADMISSION:

Candidates admitted up to 31st May of the Academic year shall be registered for the same Academic Year and shall be eligible to take up the final examination along with others students admitted prior to their admission. There shall be no admission of students in respect of any academic session beyond 31st May for postgraduate courses under any circumstances. The University shall not register any student admitted beyond the said date.

13. SYLLABUS:

The Syllabus for the course shall be as specified in the annexure to these Regulations.

14. MEDIUM OF INSTRUCTION:

English shall be the medium of instruction for all the subjects of study and for examination.

15. WORKING DAYS / ATTENDANCE *

All the candidates joining the Post Graduate training programme shall work as "Full Time Residents" during the period of training and shall attend not less than 85% (Eighty Five percent) of the imparted training during each academic year including assignments, assessed full time responsibilities and participation in all facets of the educational process as per MCI norms. 85% attendance is compulsory for all the Post Graduate students for every academic year. The Attendance details may be submitted to the Controller of Examinations at the end of every academic year. The student should also be intimated quarterly regarding the lack of attendance.

16. CONDONATION FOR LACK OF ATTENDANCE *

The discretionary power of condonation of shortage of attendance to appear for University Examination rests with the Vice Chancellor.

Lack of attendance can be condoned up to a maximum of 5% of the minimum attendance Required in the following exceptional circumstances:

- (i) Any illness/ accident (for which Medical certificate from a registered medical practitioner must be produced)
- (ii) Any unforeseen tragedy in the family (should produce the letter from the parent/guardian)
- (iii) Participation in NCC/NSS and other co curricular activities representing the Institution / University. (Certificate from competent authority is required)

For any of the above reasons, request shall be made by the candidate with prescribed fees to the Controller of Examination through proper channel, ten days prior to the commencement of the theory examination. Based on the recommendation of the Head of the Institution, the Controller of Examination shall obtain the approval of the Vice Chancellor for admission of the candidate to the University Examination.

***Sl.No.15 & 16 Amended vide XVIII meeting of Academic Council dated 15.04.2014**

and to be replaced as detailed below; -

In the existing regulations for M.D. Pre – Para and clinical courses, it has been stipulated that 85% attendance is compulsory for all the Post graduate students for every academic year. This has been modified to 80% attendance in keeping with Statutory Body norms. There shall be no condonation for attendance. The attendance criteria will hence read as follow as in MCI regulations.

"All the candidates joining the Post Graduate training programme shall work as 'Full Time Residents' during the period of training and shall attend not less than 80% (Eighty percent) of the imparted training during each academic year including assignments, assessed full time responsibilities and participation in all facets of the educational process."

The Attendance details shall be submitted to the Controller of Examinations at the end of each academic year. The student should also be intimated quarterly regarding the lack of attendance.

16 (a) STIPEND AND GRANT OF LEAVE

The Post Graduate students undergoing Post Graduate Degree / Diploma/Super-Specialty course shall be paid stipend on par with the stipend being paid to the Post Graduate students of State Government Medical Institutions / Central Government Medical Institutions, in the State / Union Territory where the institution is located. Similarly, the matter of grant of leave to Post Graduate students shall be regulated as per the respective State Government rules.

17. MIGRATION / TRANSFER OF CANDIDATES:

Under no circumstances, Migration/transfer of student undergoing any Post Graduate degree course shall be permitted by the University/Authority

18. TRAINING PROGRAMME:

The training given with due care to the Post Graduate students in the recognised institutions for the award of various Post Graduate medical degrees shall determine the expertise of the specialist and / or medical teachers produced as a result of the educational program during the period of stay in the institution.

Every institution undertaking Post Graduate training program shall set up an Academic cell or a curriculum committee, under the chairmanship of a senior faculty member, which shall work out the details of the training program in each speciality in consultation with

other department faculty staff and also coordinate and or the implementation of these training Programs.

The training programmes shall be updated as and when required. The structured training programme shall be written up and strictly followed, to enable the examiners to determine the training undergone by the candidates and the Medical Council of India inspectors to assess the same at the time of inspection.

During the training for Post Graduates to be awarded, there shall be proper training in basic medical sciences related to the disciplines concerned; during the training for the degree to be awarded in basic medical sciences, there shall be training in applied aspects of the subject; and there shall be training in allied subjects related to the disciplines concerned. In all Post Graduate training programmes, both clinical and basic medical sciences, emphasis is to be laid on preventive and social aspects and emergency care facilities for autopsies, biopsies, cytopsies, endoscopic and imaging etc. also be made available for training purposes. The Post Graduate students shall be required to participate in the teaching and training programme of undergraduate students and interns.

Training in Medical Audit, Management, Health Economics, Health Information System, basics of statistics, exposure to human behaviour studies, knowledge of pharmaco – economics and introduction to non- liner mathematics shall be imparted to the Post Graduate students.

Implementation of the training programmes for the award of various Post Graduate Degree shall include the following:-

Basic Medical Sciences

- (i) Lectures, Seminars, Journal Clubs, Group Discussions, Participation in laboratory and experimental work, and involvement in research studies in the concerned speciality and exposure to the applied aspects of the subject relevant to clinical specialities.

(ii) Clinical disciplines

In service training, with the students being given graded responsibilities in the management and treatment of patients entrusted to their care: participation in seminars, journal clubs, group discussions, clinical Meetings, Grand rounds, and Clinico - Pathological Conferences; practical training in Diagnosis and medical and Surgical treatment; training in the Basic Medical Sciences, as well as in allied clinical specialities.

The training programme shall be on the same pattern as for M.D. / M.S. in clinical disciplines; practical training including advanced Diagnostic, Therapeutic and Laboratory techniques, relevant to the subject of specialization.

19. MAINTENANCE OF LOG BOOK

- a) Every Post Graduate student shall maintain a record (Log) book containing skills, the candidate as acquired during the training period certified by the various heads of department where the candidate as undergone training including outside the institution.

- b) The students shall maintain a Record Book (Log Book) of the work carried out by them & training program undergone during the period of training including details of procedures carried out independently or assisted by the candidate. The log book will be checked by the faculty members imparting the training.
- c) At the end of the course, the candidate should summarise the contents and get the record (Log) book certified by the Head of the Department.
- d) The record (Log) book should be submitted at the time of practical examination for the scrutiny of the Board of Examiners.

20. THESIS / DISSERTATION AND EVALUATION

- a) All Candidates admitted to undergo M.D. Pre and Para Clinical Courses shall be assigned a topic for dissertation / thesis by the Head of the concerned unit and the title of the topic assigned to the candidates be intimated to the Controller of Examination of the University by the Head of the Department through the Head of the Institution before end of the First year.
- b) The dissertation / thesis shall be a bound volume of minimum 50 pages and not exceeding 75 pages of typed matter (double line spacing and on one side only) excluding certification, acknowledgements, annexure and bibliography.
- c) Four copies of dissertation shall be submitted six months prior to the commencement of the examination on the prescribed date to the controller of examination of the University.
- d) Two copies are to be submitted as an electronic version of the entire dissertation in a standard C.D. format mentioning the details and technicalities used in the C.D. format.
- e) The concerned Professors / Readers are to supervise and to see that the dissertation is done properly utilising the clinical materials of their own department / institution. The students must learn the design and interpretation of research studies, responsible use of informed consent and research methodology and interpretation of data and statistical analysis. They should seek the help of qualified staff members in the conduct of research. They must learn to use library and the computer-based research. This training will help them to develop skills in planning, designing and conduct of research studies.
- f) All candidates on admission will be allotted one of the department faculties who have fulfilled the requirement to be guides for purposes of guiding Dissertation/thesis. The topic for dissertation shall be finalized and discussed in the departmental faculty meeting and allotted to the individual candidates before the completion of 3 months after admission. The purpose of dissertation is to develop in the candidate the ability to perform an independent study keeping the principles and research methodology in mind. The candidate will therefore work on the prospective problem either within the department or in collaboration with other departments. There will be continuous monitoring of the dissertation work by the guides and co-guide and by the other department staff throughout the course. The candidate will present the progress of the dissertation to the faculty on the completion of 1 ½ years for monitoring and

feedback. The completed dissertation should be submitted not later than 6 months before final examination.

- g) 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.
- h) 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. A candidate shall be allowed to appear for Theory and Practical/Clinical examination only after the acceptance of thesis by the examiners. The thesis shall be evaluated under the following heading:
 - 1) Approved
 - 2) Not approved

In all cases the approval shall be given before 3 months of the date of appearing for the examination and this will be essential before the candidate is allowed to appear for the written examination.

21. SCHEDULE OF EXAMINATIONS:

The examination for M.D. Pre and Para Clinical courses shall be held at the end of 3rd academic year. An academic term shall mean six month's training period."

22. SCHEME OF EXAMINATIONS *

Post Graduate Examinations shall consist of Dissertation/Thesis, Written Paper (Theory), Practical and Viva voce.

The examinations shall be organised on the basis of "Marking system" to evaluate and to certify candidate's level of knowledge, skill and competence at the end of the training.

- a. **Dissertation/Thesis:** Every candidate shall carry out and submit a Dissertation/Thesis as explained and approval of Dissertation/Thesis shall be a precondition for a candidate to appear for the final examination.
- b. A postgraduate student of a postgraduate degree course would be required to present one poster presentation, to read one paper at a national/state conference and to present one research paper which should be published/accepted for publication/sent for publication during the period of his postgraduate studies so as to make him eligible to appear at the postgraduate degree examination.
- c. **Theory:** A Written Examination shall consist of four theory papers each of three hours duration. Each paper carries 100 marks (Total 400 marks). Out of these one shall be of Basic Medical Sciences and one shall be of Recent advances. The theory examinations shall be held well before the Practical examination, so that the answer books can be assessed and evaluated well before the commencement of the Practical and Oral examination.

d. Practical Examination:

Practical Examination 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 ability to perform such studies as are relevant to the subject.

e. **Oral Examination:** The Oral examination shall be thorough and shall aim at assessing the candidate's knowledge and competence about the subject, investigative procedures, therapeutic technique and other aspects of the speciality, which form a part of the examination.

f. **Pedagogy:** Pedagogy to evaluate the communication and teaching skills, and subject knowledge of the student. The topic for Pedagogy will be given at the end of 1st day of the Practical Examination.

THEORY	
No. of Theory Papers	4
Marks for each Theory Paper	*100
Total marks for Theory Papers	400
Passing Minimum for Theory	200/400
Total marks for PRACTICAL	300
Passing Minimum for Practical	150/300
Viva voce	50
Pedagogy	50
Passing minimum for Practical including Viva voce / Pedagogy	200/400

i) If any candidate fails even under one head, he/she has to re-appear for whole examination.

ii) Theory papers consist of 2 essay questions of 25 marks each (2 X 25 = 50) & 5 short notes of 10 marks each (5 X 10 = 50). Total =100 marks each.

***Sl.No.22 (ii) Amended vide XVIII meeting of Academic Council Dated**

15.04.2014 and to be replaced as detailed below:

Resolved to approve 2 Essay Questions (2 x 20 marks) and 10 short notes (10 x 6 marks) for all post graduate medical / broad and higher speciality courses which will take effect for the students appearing for first time examination from March 2015 .

Resolved to approve 2 essays (2 x 20 marks) and 6 short notes (6 x 10 marks) for theory paper in all M. D/ M.S. courses by the Academic Council in its XX meeting held on 25.03.2015.

***Resolved to approve that an examinee should obtain minimum 40% marks in each theory paper and not less than 50% marks cumulatively in all the four papers in P.G. degree examination to be cleared as passed which will be implemented prospectively. (Academic Council in its XX meeting held on 25.03.2015).**

23. EXAMINERS:

All the Post Graduate Examiners shall be recognized Post Graduate Teachers holding recognized post graduate qualification in the subject concerned. 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 recognized universities from outside the state / outside university. The remaining two will be internal examiners.

The qualification and teaching experience for appointment of examiner shall be as detailed below and by the guidelines of Medical Council of India issued from time to time.

No person shall be appointed as an internal examiner in any subject unless he/she has three years experience as recognized PG teacher in the concerned subject. For external examiners, he/she should have minimum six years of experience as recognized PG teacher in the concerned subject'. "An examiner shall ordinarily be appointed for not more than two consecutive terms"

Under exceptional circumstances, examinations may be held with 3 (three) examiners provided two of them are external and Medical Council of India is intimated for 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.

24. MAXIMUM NUMBER OF CANDIDATES:

The maximum number of candidates to be examined in clinical/practical and oral on any day shall not exceed eight for M.D. Pre and Para Clinical Courses.

25. *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. The examination shall be conducted in September and March.

***SI. No.25 Amended in XXI meeting of Academic Council dated 22.07.2015**

Resolved to approve the commencement of M.D. /M.S. University examination in April (for Regular Batch) and October (for Supplementary Batch).

26. REVALUATION OF ANSWER PAPERS:

There shall be no revaluation of answer papers. However, re-totaling is allowed in the failed subjects with the payment of required fee fixed by the University within 15 days from the date of receipt of statement of marks.

Modified M.D. Biochemistry syllabus from the Academic Year 2015-16 as approved by the Academic Council in its XX Meeting held on 25.03.2015

SYLLABUS for MD BIOCHEMISTRY From 2015-16

1. GOAL

The goal of post graduate education in Biochemistry is to enable a student acquire an in depth knowledge and understanding of life processes at the molecular level. He must acquire the knowledge of the applications of biochemistry, molecular biology, and genetics in the practice

of medicine to solve clinical problems, impart knowledge to other learners and conduct research independently.

2. OBJECTIVES

Knowledge

At the end of three years training in Biochemistry the Postgraduate student shall be able to demonstrate comprehensive understanding of biochemistry as well as applied disciplines.

This will include the following broad headings.

- Molecular motif of a living cell, the constituent bio molecules, their structure function relationship.
- Biochemistry of human nutrition, metabolism, intermediary metabolism and disorders of metabolism.
- Cell and molecular biology.
- Defence against pathogens and metabolism of xenobiotics.
- Principles of basic instrumentation and laboratory procedure and rational use of laboratory testing.
- Fundamentals of biostatistics.

Skills

The student should :

Have acquired the competence in basic instrumentation and procedures in biochemistry as applied to hospital laboratories.

Have the competency to plan and establish a clinical laboratory and the proficiency in laboratory management.

Apply his knowledge in performing relevant investigations and interpreting laboratory reports to solve clinical problems.

Acquire communication skills to work with other medical , paramedical professionals and common people who come to the hospital.

Be oriented to principles of research methodology and be able to prepare protocols, conduct experimental studies to solve experimental and clinical problems.

Acquired skills in educating medical and paramedical professionals.

Be able to critically review and comment on research papers.

Be able to do literature survey and must possess basic computer skills.

Pattern of examination:

The post graduate degree examinations for MD Biochemistry course consist of theory papers, clinical/practical, oral examinations, thesis and pedagogy.

The students should take four theory papers at the end of the final year. One paper out of this will consist of questions on recent advances.

Practical examination for the students will be conducted to test the Knowledge and competency in experiments relevant to the subjects

Practical oral examination will be conducted to assess the candidate knowledge and competency on experiments.

Theory viva will be conducted to assess the Knowledge and competence relevant to the subject.

Pedagogy will be conducted to evaluate candidate's knowledge about the subject, communication ability and teaching skill of the student.

Student will take four theory papers. Each paper carries 100 marks

A candidate should secure not less than 50% of marks in

Theory

Practical including viva voce examination

Marks distribution

Theory – 400 (each paper carries 100 marks)

Practical – 300

Viva – 50

Pedagogy – 50

TOTAL = 800 marks

Marks required to pass

Theory – 200/400

Viva – 50 marks (No separate minimum to pass)

Pedagogy – 50 marks (No separate minimum to pass)

Practical + viva + Pedagogy – 200/400

TOTAL = 400/800 marks

2.THESIS

Every candidate must carry out work on assigned research project under the guidance of a recognized post graduate teacher.

Completed thesis must be submitted 6 months before the theory and practical examinations which will be examined by minimum of 3 examiners(One internal and two external examiners who shall not be the examiner for theory examination & practical exam). The candidate shall be accepted to appear for exam only after the acceptance of thesis by the examiners.

3.LOG BOOK:

Post graduate students must maintain a log book of the work carried out by them and training program undergone by them during their course period. The record/log book must be checked and assessed periodically by the faculty members imparting the training.

4. ATTENDANCE:

The PG students must work as full time resident during the period of training and should have 80% attendance.

5. POSTER PRESENTATION:

A Post Graduate student is required to present one poster, oral presentation either at national/state conference and to publish one research paper which should be either published/accepted for publication/sent for publication during the PG period to make student eligible to appear for PG examinations as per MCI guidelines

6. FOUNDATION COURSE:

The foundation course is a part of curriculum and the foundation course will be of 2 months duration after admission to prepare a student to study medicine effectively. This period aims to orient student to national health scenarios, medical ethics, health economics, learning skills and communication, life support, computer learning, sociology and demographics, biohazard safety, environmental issues and community orientation. The foundation course will be followed by clinical postings or postings in relevant departments as per the requirement of the course for the next 2 – 3 months

PAPER I

GENERAL BIOCHEMISTRY, BIostatISTICS AND BIOCHEMICAL TECHNIQUES.

Physical Chemistry

Water – as a universal biological solvent, its physical and chemical properties

pH, Buffers, types of solutions.

Colloidal state, Gibbs - Donnan equilibrium,

Surface tension, viscosity, osmosis , diffusion,

Law of mass action.

Vander walls forces, hydrogen bonding, hydrophobic interactions, Ionic bridges.

Chemistry of carbohydrates

Structure, physical, chemical properties and biological role of :

Glucose, fructose, galactose, mannose, Ribose, xylose, xylulose. Lactose, maltose, sucrose.

Deoxy and amino sugars. Dextrin, starch, glycogen, cellulose, inulin.

Glycosaminoglycans, glycoproteins.

Chemistry of Proteins

Structure, physical and chemical properties and biological functions of amino acids present in proteins. Amino acids not found in proteins.

pK_a, amino acids as buffers, amino acid titration, zwitter ions, isoelectric point.

Cross links, hydrogen bonds, disulphide bonds, non covalent and ionic bonds in peptides and proteins. Ramachandran plot, X- ray diffraction studies.

Covalent structure of proteins, Mass spectrometry, Mass analyzers, Tandem mass spectrometers.

Primary, secondary, tertiary and quaternary structure of proteins.

Protein structure and function – relationship with reference to the three dimensional structure of Myoglobin, Hemoglobin, Collagen, Elastin. Structure of enzymes and peptide hormones.

Structure of Immunoglobulins. Peptide sequencing and peptide synthesis.

Chemistry of Lipids

Definition, classification, Structure, physical and chemical properties of

Saturated, unsaturated fatty acids, Polyunsaturated fatty acids,

Eicosanoids, Triacyl glycerol, Cholesterol, Phospholipids, glycolipids, sphingolipids, lipoproteins, fluid mosaic model of cell membrane, artificial membrane-liposomes.

Chemistry of purines and pyrimidines

Nucleotides, polynucleotides. Synthetic nucleotides.

Nucleotide analogues in therapy.

Principles of Laboratory analyses and safety

Units of measurement, International system of units in laboratory medicine.

Conversion from conventional units to SI units.
IFCC, IUPAC system recommendations.
Reference materials.
Reagent grade water production and testing for water purity.
Sample collection Anticoagulants, preservatives for blood.
Timed urine collection, urine preservatives.
Lab safety, Hazards in the laboratory
Biological, chemical wastes. Waste management.

Instrumentation

Centrifugation, Ultracentrifuge
Radioactivity,
properties of radionuclides, measurement of radioactivity.
Autoradiography
Geiger counter, Scintillation counting.
RIA, Radio receptor assay, Immuno Radiometric Assay, Stable isotopes, Mass spectrometry.
Photometry and other instrumentation
Spectrophotometry, Reflectance photometry.
Flame emission photometry,
Atomic absorption spectrophotometry, Fluorometry, Infrared spectroscopy
Electrochemistry: Chemical sensors, Potentiometry, ion selective electrodes.
Coulometry, Optical chemical sensors, Enzyme electrodes,
Enzyme immobilization. Osmometry
Electrophoresis: Paper, Agar gel, PAGE, SDS PAGE, Iso electric focusing.
Chromatography: Column, Paper, TLC, GLC, HPLC, Gel filtration, Ion exchange, and their applications.

Immunochemistry:

Phosphorescence, Chemiluminescence, Bioluminescence.
Nephelometry, Turbidimetry,
Immuno-electrophoresis, western blot, EIA.
Automation in clinical chemistry.

Quality assurance
Use of reference values, quality assurance in clinical labs

Basic principles of bio statistics as applied to health sciences

Mean, Standard deviation, Coefficient of variation, Correlation coefficient, selecting an analytical method, evaluating an analytical method

Reference values.

Computer application in clinical chemistry.

Setting up a clinical chemistry laboratory and a 24 – hours emergency lab service, Laboratory management.

Biostatistics :

Basic principles of biostatistics as applied to health sciences. Concepts of probability, mean, standard deviation. Correlation co-efficient. Co-efficient of variation. Test of significance. Selecting an analytical methods. Evaluation of analytical methods . Evaluation of diagnostic tests.

PAPER II

CELL, MOLECULAR BIOLOGY, AND IMMUNOLOGY.

Cell

An overview of cells and cell research

Prokaryotic cells, eukaryotic cells – Difference between Prokaryotic cells & eukaryotic cells

Structure, metabolic activities, clinical significance of eukaryotic cell - Eukaryotic sub cellular organelles- Nucleus, Nucleolus, Mitochondria, Ribosomes, Golgi apparatus, Peroxisomes lysosomes – Functions of lysosomes, Lysosomal storage disorders, Non membrane organelles – Cytoskeleton, microfilaments, microtubules, microvilli. Marker enzymes of various organells.

Plasma membrane – Properties of biological membranes –Motility, permeability, semipermeable membrane concept, electrochemical gradient. Fluid mosaic model of cell membrane -membrane functions, Artificial membrane and liposomes and its uses.

Membrane transport - active, passive diffusions, facilitated.

Transport mechanisms – ion channels, pumps, carrier proteins, glucose transporter (GLUT), active transporters, symporters and antiporters

Evolution of organic molecules, endosymbiosis hypothesis,

Separation of sub cellular organells: Sub cellular fractionation- Density gradient centrifugation, differential centrifugation,
Cell interactions and adhesion – type of junction – tight junction, Gap junctions
Cell Surface molecules – ABO blood groups, Major histo compatibility complex,
Adhesion molecules – Cadherins, selectins, integrins – Beta1 and Beta2 integrins.
Cell cycle – The concept of cell cycle, regulation of cell cycle, regulators – Cyclins, extracellular regulators of cell cycle. Cell division – mitosis and meiosis. Programmed cell death

Molecular biology

Structure of DNA, RNA, Nucleosomes, Chromosomes, histones, chromatins.
Different types of DNA, Different types of RNA – Messenger, Ribosomal, Transfer, hnRNA, snRnp.MicroRNA
DNA replication – Prokaryotic and eukaryotic, DNA damage and repair mechanism
Transcription – Prokaryotic and eukaryotic, Post transcriptional modification
Inhibitors of transcription. Transcriptional regulation.
Genetic code, Mitochondrial and plasmid DNA
Translation – Eukaryotic and prokaryotic, post translational modification,
Signal peptide, protein targeting and chaperones, Disorders of post translational modification
Factors effecting protein synthesis, Control of protein synthesis
Prokaryotic and eukaryotic gene expression (Operon-Lac, Tryptophan),
Helix turn helix motif, zinc finger motif and Leucine zipper motif

Molecular techniques

Isolation of nucleic acids
DNA digestion with restriction enzymes, Restriction maps, Southern analysis: Hybridization and Southern blotting.
PCR - procedure, visualizing the products of PCR
Reverse transcriptase PCR (RT-PCR)
DNA electrophoresis. DNA sequence analysis, Automated DNA sequencing.
Cloning and vectors – Definition, characteristics of different vectors, basic cloning technique.
Gene libraries, c DNA libraries
The human genome project, Genetic maps.
Restriction fragment length polymorphisms (RFLP) – their application.

Methods of identifying human disease genes – Mutation analysis.

Gene therapy – pros and cons, Transgenic animals, Repeat DNA and mobile DNA elements, Reporter gene.

Molecular basics of carcinogenesis:

Carcinogenic agents – radiation, chemicals and viruses.

Oncogenes and tumor suppressor genes.

Genetic related cancer – ataxia telangiectasia, familial breast cancer, familial adenomatous polyposis coli and retinoblastoma.

Inherited conditions that predispose to development of cancer (e.g., ataxia telangiectasia, xeroderma pigmentosum, Fanconi syndrome).

Mechanisms of action of cytotoxic drugs.

Population genetics, overview of cytogenetics and epigenetics.

Risk assessment and genetic counseling. Medical ethics in counseling.

Immunology

Definition, Cells involved in immune system, Antigen, haptens, adjuvants, antigenicity, antigenic determinants and epitopes. Types of immunity- acquired, innate immunity.

Immunoglobulins: classification, functions, generation of antibody diversity (immunogenesis), complement system, major histocompatibility complex (MHC) multiple myeloma and other associated disorders. Immunological techniques - RIA, ELISA. Monoclonal and polyclonal antibodies and their applications.

Bioinformatics:

Basic of bioinformatics – proteomics, drug designing (pharmacogenomics), protein data bases and micro arrays

PAPER III

Enzymes, Bioenergetics, Nutrition, Intermediary metabolism

Enzymes

General properties, definition, classification, properties of enzymes, coenzymes, cofactors, prosthetic groups.

Factors affecting enzymes activity invitro, kinetics, mechanisms of action of serine proteases, lysozyme and regulation of activities.

Units of Enzymes activity,

Application of enzymes (Therapeutic, Analytical, Diagnostic enzymes), isolation and purification of enzymes from natural sources.

Enzyme inhibition, naturally occurring enzyme inhibitors, enzyme regulation, Isoenzymes (Definition and Types), isoforms

Enzymes pattern in diseases (Myocardia infarction, liver diseases, Muscle diseases, Cancer, bone disease, brain disorders and others).

Clinical Enzymology:

Enzyme in the diagnosis of pancreatic, cardiac and skeletal muscle and liver disorders.

Bioenergetics and Biological Oxidation

Free energy, exergonic and endergonic processes.

Redox potential.

High energy compounds, enzymes associated with electron transport and the electron transport chain, inhibitors of ETC, oxidative phosphorylation, Chemiosmotic theory, Shuttles, Uncouplers and inhibitors.

Nutrition

Digestion and absorption:

Digestion and absorption of carbohydrates, lipids, proteins, vitamins and minerals.

Energy balance, over and under nutrition.

General principles of nutrition. RDA, Energy requirements. Macronutrients and their role. Biological value of proteins, specific dynamic action, balanced diet, dietary fibre.

Dietary supplements, fortification of foods, food additives, food fads, vegetarianism.

Total parenteral nutrition. National nutrition programs. Biomarkers to analyse nutritional status. obesity, metabolic syndrome.

Vitamins

Chemistry, sources, RDA, synthesis, biochemical roles, deficiency manifestations, reference range, methodology to estimate and hypervitaminosis of fat-soluble vitamins.

Chemistry, sources, RDA, synthesis, biochemical roles, deficiency manifestations, methodology to estimate, reference range of water-soluble vitamins.

Megavitamin therapy. Antivitamins and vitamin analogues and use of vitamins in therapy.

Role of vitamins as anti-oxidants.

Minerals

Biochemical role of minerals - sodium, potassium, magnesium, calcium, phosphorus, iron, iodine, chloride, sulphur, zinc, molybdenum, manganese, copper, chromium, selenium and cobalt - their sources, recommended dietary allowances.

Clinical disorders associated with metabolism of these minerals.

METABOLISM

Carbohydrates

An overview of metabolism, methods used to study intermediary metabolism.

Carbohydrates of physiological significance.

Pathways – glycolysis in various tissues, TCA cycle, Glycogen metabolism, Gluconeogenesis, and HMP-shunt and regulation of these cycles

Metabolism of fructose and galactose and the disorders in their metabolism.

Regulation of blood glucose

Lipids

Oxidation of fatty acids, beta, alpha and Omega oxidation. Oxidation of unsaturated fatty acids. Ketones generation and utilisation. Ketosis,

Fatty acid synthesis – chain elongation and unsaturated fatty acids synthesis.

Synthesis and catabolism of cholesterol and its regulation.

Metabolism of Triacyl glycerol.

Chemistry and metabolism of eicosenoids, phospholipids

Metabolism in adipose tissue – brown adipose tissue. Lysosomal storage disorders. spingolipidosis and mucopolysaccharadosis.

Lipoproteins -Apoproteins- exogenous and endogenous lipid transport and hyperlipoproteinemia..

Proteins

Catabolism of amino acids, fate of the amino nitrogen and carbon skeleton.

Ammonia metabolism, Urea cycle and associated disorders. Hyperammonemias.

Metabolism of individual amino acids, biosynthesis of non essential amino acids.

Specialised products formed from amino acids, inborn errors of amino acid metabolism.

Integration of metabolism

Metabolic adaptations in starvation and fed state.

Metabolism in specialized tissues

Liver, Central nervous system, adipose tissue, muscle, kidney, erythrocyte and lens.

Nucleic acids

Synthesis and breakdown of purines and the disorders associated with abnormal purine metabolism.

Metabolism of pyrimidines. Disorders of abnormal pyrimidine metabolism.

Heme

Heme containing compounds and their functions.

Heme biosynthesis, porphyria, Abnormal hemoglobins and hemoglobinopathies.

Breakdown of heme. Metabolism of bilirubin. Jaundice: definition, types, cause, and lab diagnosis.

Metabolism of xenobiotics and detoxification. Free radicals and antioxidants.

PAPER IV

CLINICAL BIOCHEMISTRY, ENDOCRINOLOGY AND RECENT ADVANCES

Clinical Biochemistry

Carbohydrates

Diabetes Mellitus lab diagnosis and monitoring. Complications of diabetes mellitus, gestational diabetes. Glycated and glycosylated proteins. Urine albumin in diabetes mellitus.

Hypoglycemia. Glucose estimation.

Inborn errors of carbohydrate metabolism – galactose, fructose and pentose. Lactose intolerance.

Glycogen storage disorders.

Lipids

Reference range and interpretation of lipid profiles, Estimation of total cholesterol, TGL, HDL, Friedewald's formula for estimation of VLDL, LDL, (NCEP ATP III guidelines), dyslipidemias and atherosclerosis. Metabolic syndrome.

Proteins and amino acids

Abnormalities in plasma proteins. Plasma proteins separation, interpretation, Urine protein estimation by different methods, cerebrospinal fluid proteins. Proteins in other fluids. Protein losing enteropathy.

Inborn errors occurring in the metabolism of amino acids.

Organ Function Tests

Gastric function tests

Liver function tests

Kidney function tests

Pancreatic function tests

Biomarkers and their applications: Cardiac, tumor markers, bone markers

Fluid, electrolyte and pH maintenance and their imbalance:

Hyponatremia, hypernatremia, hypokalaemia, hyperkalemia, pH, how body pH is maintained, buffer, ABG analysis and interpretation

Endocrinology

Hormones: classification, mechanism of action of steroidal and non-steroidal hormones, second messenger

Intracellular receptor mediated responses

Types of membrane receptor signaling systems

Signal transduction pathways

Tyrosine kinase receptor pathways

G protein – coupled receptors and associated signal transduction pathways. Signal transduction pathways using cGMP as second messenger.

Programmed cell death.

Pituitary and hypothalamus

Growth hormone – Actions

Testing

Acromegaly

Growth hormone deficiency

Prolactin -

Prolactinoma

Hyperprolactinemia

Clinical and lab evaluation of hyperprolactinemia

Management of prolactinoma

Idiopathic Galactorrhea

Hypopituitarism

Panhypopituitarism – etiology and treatment

Posterior pituitary

Oxytocin

Vasopressin

Adrenal function

Cortex

Steroidogenesis

Congenital adrenal hyperplasia

Diagnosis of primary aldosteronism

Adrenal insufficiency

Hypercortisolism

Cushings syndrome

	CRH stimulation
	Androgen excess – diagnosis and treatment
Adrenal Medulla	<p>Biosynthesis and storage of catecholamines</p> <p>Urine and plasma catecholamine measurements</p> <p>Causes of sympathetic hyperactivity</p> <p>Diagnosis of Pheochromocytoma</p> <p>Treatment of pheochromocytoma – outcome, prognosis</p> <p>Incidentaloma</p>
Gonadal function	<p>Ovary</p> <p>Hormone production by the ovaries</p> <p>The menstrual cycle</p> <p>Hormonal control of ovulation</p> <p>Hypogonadotrophic hypogonadism</p> <p>Hirsutism</p> <p>Estrogen replacement therapy</p> <p>The Testes</p> <p>Diagnosis of hypogonadism</p> <p>Testosterone replacement therapy</p> <p>Monitoring testosterone replacement therapy</p> <p>Placental hormones.</p> <p>Biochemistry of conception, reproduction, and contraception.</p>
The Thyroid gland	<p>Thyroid hormone synthesis</p> <p>Protein binding of thyroid hormone</p> <p>Control of thyroid function</p> <p>Actions of thyroid hormone</p> <p>Tests for thyroid evaluation</p> <p>Hypothyroidism</p> <p>Thyrotoxicosis</p> <p>Grave's disease</p> <p>Toxic adenomas and multinodular goiter</p> <p>Non thyroidal illness</p>

Parathyroid function and calcium homeostasis

- Hormones controlling calcium metabolism
- Calcium metabolism in bone, GIT and kidney
- Hypercalcemia
- Hypocalcemia
- Drugs that affect calcium metabolism
- Metabolic bone disease
- Osteoporosis

GIT hormones.

Pancreas- insulinsynthesis, function, deficiency,
Neuromodulators and mechanism of their activity.

Prenatal diagnosis. Fetal monitoring, fetal lung maturity.

Neonatal screening.

Pediatric biochemistry.

Biochemistry in the elderly.

Homeostasis

Intrinsic and Extrinsic pathways of coagulation, Haemophilia, 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 functions.

Principles of hemo and peritoneal dialysis.

CLINICAL POSTINGS – M.D. Biochemistry

In the first year of training, the postgraduate student must be posted in clinical Departments. A period of three months is recommended.

The student must be trained in the following during their clinical postings.

1. General Medicine

Duration - 1 month

At the end of the posting in the Department of Medicine, the student must be able to carry out

Systematic examination of a patient and suggest relevant Biochemical investigations to confirm a diagnosis. He/She should be competent in carrying out a complete Laboratory evaluation of Diabetes mellitus, Nephrotic syndrome, acute and chronic renal failure, Cirrhosis of the liver, Jaundice, Metabolic bone diseases and bleeding disorders.

In the area of critical care, he/she should be conversant with Acid – base disorders, Electrolyte imbalances and their management. He /She should be able to suggest investigations to be carried out in an acutely ill patient.

He/She should be conversant with techniques for proper collection and handling of samples.

The student must be able to assess by means of laboratory tests, a patient's lipid status and be able to give dietary advice in a case of dyslipidemia. He/ She should be competent in the laboratory evaluation of myocardial infarction.

Must be conversant with the pathogenesis and metabolic consequences of Myocardial infarction, biochemistry of ischaemia – reperfusion injury.

The student should learn evaluation of obesity and metabolic syndrome.

2. Pediatrics

Duration - 15 days

During this posting the student must learn the evaluation of nutritional status of a child and plan a dietary program

Plan and evolve a program for investigation of in born errors of metabolism.

Learn to calculate fluid deficit and replacement fluid therapy.

Learn to identify and diagnose acid base disorders in children.

3. Nephrology

Duration – 15 days

This posting should equip the student with competence in the laboratory evaluation of patient before and after Dialysis and a prospective kidney donor. He/She should be conversant with principles of fluid maintenance in a patient with renal disease.

He/She should also be competent to advice on diets for patients with acute and chronic renal failure.

4. Gastroenterology

Duration – 15 days

At the end of this posting the student should become competent in the laboratory evaluation of malnutrition, jaundice and cirrhosis.

During this posting the student should gain competency in the evaluation of the functions of liver, pancreas, intestine

5. Endocrinology

Duration – 15 days

The student should acquire competence in the laboratory evaluation of

Diabetes Mellitus, Metabolic bone disease, diseases of the thyroid gland and other hormonal abnormalities.

Special Training

In the first three months of the course the postgraduate will be trained in the following with all the other postgraduates of the institution.

Ethics

Research methodology

Educational technology

Thesis

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.

The student will

- i. identify a relevant question
- ii. perform a critical review of literature
- iii. formulate a hypothesis
- iv. plan a study design

- v. prepare the objectives of the study
- vi. prepare protocol for his study design
- vii. undertake a study according to the protocol
- viii. analyze and interpret research data and draw conclusions
- ix. write the research paper.

Assessment

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

General Principles

The assessment will aim to be valid, objective and reliable.

Cognitive, psychomotor and affective domains will be assessed.

Formative, continuing and assessment will be conducted in theory as well as practicals/clinical. Thesis will be regularly discussed and evaluated.

Formative Assessment

The formative assessment will be continuous and there will be an evaluation at the end of term. There will be a feedback from the concerned faculty based on the student's entries in the Log book and periodic assessment. End of the term assessment will be held at the end of each semester for 2 years and 6 months. Formative assessment will not count towards pass/fail at the end of the program, but will provide constructive feedback to the candidate and provide a regular work schedule through the course.

There will be a practical examination at the end of every year.

Internal Assessment

The performance of the Postgraduate student during the training period should be monitored throughout the course and duly recorded in the log books as evidence of the ability and daily work of the student. The log book will be submitted for the practical examinations and scrutinised by the examiners.

Other assessments throughout the course will include:

Personal attributes

Behavior and Emotional Stability

Motivation and Initiative towards accepting responsibilities.

Regularity.

Honesty and Integrity.

Interpersonal Skills and Leadership Quality.

Practical Work including academic abilities and performance.

Academic Activities like skills exhibited during departmental activities like seminar, clinical discussions and journal club.

Summative Assessment

The pass percentage will be 50%.

Candidate will have to pass theory and practical examinations separately.

Theory Examination (Total = 400)

Paper Title Marks

Paper 1 **100**

General Biochemistry, Biostatistics and Biochemical techniques.

Paper 2 **100**

Cell, Molecular Biology, Human Genetics and Immunology.

Paper 3 **100**

Enzymes, Bioenergetics, Nutrition, Intermediary metabolism

Paper 4 **100**

Clinical Biochemistry, Endocrinology and Recent advances

Theory Question Paper Format

Time : 3 hrs **100marks**

1) Essay **25**

2) Essay **25**

3) Short notes **5x10=50**

Practicals & Viva voce Examination (Total = 400)

The Practical Examination will be held for 2 days

Distribution of Marks

Clinical examination, discussion and differential diagnosis of a given case **100**

Presentation of the case after relevant investigations. **25**

Interpretation of a given data **25**

Enzyme assay and interpretation	50
Electrophoresis	50
Standard Curve and Paper Chromatography/TLC	50
Grand Viva	50
Pedagogy	50

Criteria for pass

50 % in theory examination – minimum 200 out of 400

50% in Practical/Viva & Pedagogy examination – minimum 200 out of 400

50% overall marks – minimum 400 out of 800.

SUGGESTED BOOKS FOR M.D BIOCHEMISTRY

Biochemistry

- 1) Biochemistry Ed Lubert Stryer. W.H. Freeman and Company, Newyork.
- 2) Priciples of Biochemistry. Ed Lehninger, Nelson & Cox. CBS publishers and Distributors
- 3) Harper’s Biochemistry. Ed. R.K Murray, D.K.Granner, P A Mayes and V.W.Rodwell. Appleton and Lange, Stamford, Connecticut.
- 4) Biochemistry. Ed Donald Voet and Judith G.Voet. John Wiley & sons, Inc.
- 5) West & Todd, Text Book of Biochemistry – Oxford and IBH Publications Com Pvt Ltd. – 4th Editions.
- 6) Text book of Biochemistry with clinical correlation. Ed. Thomas M. Devlin. Wiley – Liss Publishers

Clinical Biochemistry

- 7) Tietz Textbook of clinical chemistry. Ed Burtis and Ashwood. W.B.Saunders Company.
- 8) Principles and techniques of Practical Biochemistry. Ed Kieth Wilson & John walker. Cambridge university press
- 9) Varley et al Heinemann, Practical clinical Biochemistry – Medical Books, London – 6th edition.

- 10) Clinical chemistry Theory, Analysis and correlation – Lawrence A Kaplan et al. , - Mosby
- 11) McGilvery: **Biochemistry - A Functional Approach** - W. B. Saunders Company.
- 12) Montgomery, Biochemistry- a case oriented approach – the CV, Mosby Company – 5th Edition

Genetics

- 13) Genes VI Ed - Benjamin Lewin. Oxford university Press
- 14) **Molecular Cell Biology**, Harvey Lodish, Arnold Berk, Paul Matsudaira, James Darnell, D. Baltimore.
- 15) APPS, Biochemistry – W.B. Brothers and Company / Newyork – 3rd edition.
- 16) Molecular cloning – A laboratory manual. J.Sambrook, E.F.Fritsch and T.Maniatis. Cold spring Harbor Laboratory Press

Endocrinology

- 1) Williams Textbook of endocrinology
- 2) Principles and practice of endocrinology and metabolism, Kenneth L Becker

Nutrition

- 1) Nutritional biochemistry of the vitamins, David A Benden
- 2) Food and Nutrition in Diet and therapy, L Mahan. Escott-Stum

Suggested Journals and other periodicals for M.D biochemistry

1. Clinical Chemistry
2. Annals of Biochemistry
3. Indian Journal of Nutrition and Dietetics
4. Indian Journal of clinical chemistry
5. New England Journal of Medicine
6. Lancet
7. JAMA
8. Medical Teacher
9. BMJ
10. Clinics of North America

11. American Journal of Clinical Nutrition.

FIRST YEAR PROGRAM

FIRST MONTH:

Orientation to the department

NEXT 5 MONTHS:

THEORY:

General biochemistry, enzymes, nutrition syllabus will be covered along with M.B.B.S theory classes

PRACTICALS:

All M.B.B.S practical syllabuses as Qualitative analysis of carbohydrates, proteins and identifying the abnormal constituents of urine analysis along with relevant case studies

LAB POSTINGS:

One month of first 6 months they will be posted in clinical labs where they will be taught about sample collection, data entry and centrifugation of samples.

Training IN Biostatistics twice in a week for 3 months

LAST 6 MONTHS:

POSTINGS:

As a part of PG Curriculum they will be posted in various clinical departments for a period of 6 months from 9.00 AM to 2.00 PM every day.

The departments are as follows

General Medicine – 2 months

Pediatrics – 15 days

Reproductive medicine department – 15 days

Nephrology – 15 days

Gastroenterology – 15 days

Endocrinology – 15 days

Cardiology – 15 days

AFTERNOON: They will be doing self-study and attending UG practicals.

SECOND YEAR PROGRAM

FIRST 6 MONTHS:

THEORY:

General Biochemistry (Chemistry & Metabolism of Carbohydrates, proteins & lipid) is dealt along with M.B.B.S in M.B.B.S classes.

Instrumentation & Lab safety Procedures will be covered as seminars and faculty teaching programs

ASSIGNMENT: They will be provided assignment on theory topics once a month

Test will be conducted once in month

PRACTICALS:

Practical sessions on

Standardization & Estimation of analytes

Electrophoresis of proteins and hemoglobin

LAB POSTINGS:

1 month clinical lab posting in which pipetting, semi auto analyzer and to estimate analytes in semi auto analyzer is dealt

NEXT 6 MONTHS:

THEORY:

Human Genetics and biotechnology syllabus will be covered in the last 6 months of second year

PRACTICALS:

Chromatography of carbohydrates & amino acids – Thin layer chromatography and paper

LAB POSTINGS:

2 months of the last 6 months, they will be posted in clinical lab where they will be taught about semi auto analyzer and to estimate analytes on semi auto analyzer & about to work on Blood gas analyzer and interpretation of results.

PROJECT:

Thesis should be completed at the end of second year.

THIRD YEAR PROGRAM**FIRST 6 MONTHS:****THEORY:**

Recent trends, clinical biochemistry & endocrinology syllabus will be covered

Once a month assignment will be provided

Test will be conducted once a month

PRACTICALS:

Molecular Biology such as DNA and RNA separation techniques

LAB POSTINGS:

PGs will be posted in lab for 2 months again where they will be taught about interpretation of results, quality control and case studies.

LAST 6 MONTHS:

Complete revision of theory and practicals

Test will be conducted for assessment.

Practical exams with viva discussion

Publishing the thesis & presentation in conferences.

THEORY SCHEDULE**TOPICS TO BE COVERED IN FIRST HALF OF II YEAR**

S.No.	Topics	Mode of Teaching
1	Unit of Measurement	Lecture
2	Centrifugation	Seminar
3	Photometry & Other Instrumentation	Lecture
4	Spectrophotometry	Seminar
5	Reflectance Photometry	Seminar
6	Flame Emission Photometry	Seminar
7	Atomic Absorption Photometry	Seminar
8	Flurometry	Seminar
9	Nephelometry	Seminar
10	Turbidometry	Seminar
11	Electrochemistry	Lecture
12	Electrophoresis - Principle, Types of Electrophoresis	Lecture
13	Agar Gel Electrophoresis	Seminar
14	PAGE	Seminar
15	Isoelectric Focus	Seminar

16	Chromatography - Basic Principle, Procedure, Application	Lecture
17	HPLC	Seminar
18	TLC	Seminar
19	Immunochemistry	Lecture
20	Automation in Clinical Chemistry	Lecture

TOPICS TO BE COVERED IN SECOND HALF OF II YEAR

S.No.	Topics	Mode of Teaching
1	Hormones - Definition , Classification & Function	Seminar
2	Signal Trasduction	Lecture
3	Hypothalamus	Problem Based Teaching
4	Anterior Pituitary	Problem Based Teaching
5	Posterior Pituitary	Problem Based Teaching
6	Adrenal Medulla	Problem Based Teaching
7	Gonads	Problem Based Teaching
8	Thyroid	Problem Based Teaching
9	Para Thyroid	Problem Based Teaching
10	Placental Hormones	Problem Based Teaching
11	GIT Hormones	Lecture
12	Neurotranmitters	Lecture
13	Neonatal Screening	Lecture
14	Peadiatric Biochemistry	Lecture
15	Biochemistry in the elderly	Lecture

TOPICS TO BE COVERED ON FIRST HALF OF THIRD YEAR

S.No.	Topics	Mode of Teaching
1	Nucleic Acid Chemistry	Seminar
2	DNA Organisation	Assignment
3	DNA Replication	Lecture
4	Mutation	Lecture
5	Transcription	Lecture
6	Translation	Lecture
7	Protein Targetting	Seminar
8	HIV	Seminar
9	Recombinant DNA	Seminar
10	PCR	Lecture
11	DNA Electrophoresis	Lecture
12	DNA Sequence Analysis	Lecture
13	Cloning	Lecture
14	RFLP	Lecture
15	Human Genome Project	Lecture
16	Transgenic Animals	Seminar
17	Gene Therapy	Seminar
18	Molecular aspects of Cancer	Lecture
19	Basics of Immunology	Lecture
20	Major Histocompatibility Complex	Lecture & Assignment
21	Monoclonal & Polyclonal Antibodies	Lecture
22	Multiple Myeloma	Problem Based Teaching
23	Schradosis	Problem Based Teaching
24	Amyloidosis	Problem Based Teaching
25	Rejection and Immune Supression	Seminar
26	Biochemical Assessment of Nutritional Status	Seminar & Problem Based Teaching
27	Nutrition & Dietetics	Seminar

TOPICS TO BE COVERED IN SECOND HALF OF III YEAR

S.No.	Topics
1	Theory Revision
2	Practical Revision
3	Submission of Thesis

List of Practicals for MD Biochemistry

SI No.	Experiment
1	Basics of Weights and measurements
2	Reactions of Carbohydrates, Proteins and Amino acids
	Basic Instrumentation and applications
3	Colorimeter – Basic Principles and Instrumentation
4	Spectrophotometer – Basic Principles and Instrumentation
5	Standardization graph
6	Identification Absorption Spectrum of a given compound
7	Identification of Molar Extinction Coefficient of Amino acids
8	pH and pH meter- Basic Principles and Instrumentation
9	Determination of pH of a buffer by Hendersen-Hasselbach Equation
10	Preparation of Solutions – Molarity, Normality, Molality
11	Preparation of Buffers
12	Preparation and demonstration of a buffer and its buffering capacity
	Quantitative Estimation in Serum
13	Estimation of Glucose
14	Estimation of Urea
15	Estimation of Creatinine
16	Estimation of Uric acid
17	Estimation of Total protein
18	Estimation of Albumin
19	Estimation of Cholesterol
20	Estimation of Bilirubin
21	Estimation of Calcium
22	Estimation of Phosphorus
23	Estimation of Plasma Ammonia
24	Estimation of serum triglycerides
25	Estimation of AST, ALT ALP acid Phosphatase, GGT, Cholinesterase, Amylase, Lipase, LDH and Creatine Kinase
26	Estimation of Ceruloplasmin
27	Estimation of Iron, Iron Binding Capacity, Copper, Lithium and Magnesium
	Urine analysis
28	Urine analysis – Normal and Abnormal Constituents
29	Detection of Bence – Jones proteins in Urine
30	Estimation of urine creatinine
31	Estimation of Urine proteins
32	Estimation of Urinary VMA
	Enzyme Kinetics
33	Effect of Enzyme concentration on rate of the reaction
34	Effect of Substrate concentration on rate of the reaction
35	Effect of pH on rate of the reaction

36	Effect of temperature on rate of the reaction
	Separation techniques - Chromatography
37	Chromatography – Basic Principles
38	Paper Chromatography- Ascending – Sugars, Amino acids and Lipids
39	Paper Chromatography- Descending - Sugars, Amino acids and Lipids
40	Circular Paper Chromatography- Sugars and Amino acids
41	Thin Layer Chromatography - Sugars, Amino acids and Lipids
42	Gel Filtration Chromatography
43	Affinity Chromatography – HbA1c estimation
44	HPLC - Demonstration
	Separation techniques - Electrophoresis
45	Electrophoresis – Basic Principles and Instrumentation
46	Cellulose Acetate electrophoresis – Plasma Proteins
47	Agarose Gel Electrophoresis – Plasma Proteins and Lipoproteins
48	Hemoglobin Electrophoresis
49	Separation of Isoenzymes by Electrophoresis – LDH, CK, ALP
50	SDS PAGE – Determination of molecular weight of protein
51	Submarine Electrophoresis for Nucleic Acids
	Separation techniques - Centrifugation
52	Centrifugation – Basic Principles and Instrumentation
53	Isolation of Subcellular organelles (Nucleus and Mitochondria) by Cell Fractionation
54	Molecular Biology Experiments
55	DNA extraction and Quantification from Blood, Saliva, Tissue and Hair
56	RNA extraction
57	Blotting Techniques – Northern, Southern and Western Blotting
58	Restriction Digestion of DNA
59	Primer Designing
60	Amplification of DNA by PCR
	Milk Analysis-
61	Qualitative analysis
62	Determination of Lactose in milk
	Stone Analysis
63	Urinary stone Analysis
64	Gall Bladder Stone analysis
65	Urine Screening tests for Inborn errors of metabolism
	Fluid analysis
66	CSF analysis for chloride and protein
	Auto Analyzer
67	Use of Random access Analyzer and Batch Analyzer for various analytes
68	Chemiluminescent assay of Various analytes
69	Plotting of L J Charts – Internal Quality Control and Analysis using Westgard Rules
70	Blood Gas Analysis using – Blood gas Analyzer

LAB POSTINGS

Lab Posting for M.D. Biochemistry	
LAB POSTING I	
S.No.	Topics
1	Orientation of Laboratory activities
2	Training in Phlebotomy
3	Maintaining the Nominal Register
4	Training in Centrifugation
LAB POSTING II	
S.No.	Topics
1	Training in Pipetting
2	Training in Semi Auto Analyser (Processing and Maintenance)
LAB POSTING III	
S.No.	Topics
1	Training in Electrolyte Analyser (Processing and Maintenance)
2	ABG Analyser (Processing and Maintenance)
3	Interpretation of Results
4	Case Discussion
LAB POSTING IV	
S.No.	Topics
1	Interpretation of Results
2	Case Discussion
3	User Training in Automated Systems (Siemens - Dimension)
LAB POSTING V	
S.No.	Topics
1	ELISA Technique (Biorad Reader and Washer)
2	User training on Immunoanalyser
LAB POSTING VI	
S.No.	Topics
1	Quality Control

Assessment Summary

1 Internal Assessment – Theory and Practicals

2. Viva Voce – Theory
3. Viva Voce – Practical
4. Viva Voce – Seminar
5. Pedagogy (Seminar) - Content and Presentation
6. Assignment

Revised M.D. (Biochemistry) syllabus from 2017-20 batch onwards as approved by the Academic Council in its XXV Meeting held on 09.11.2016

Revised SYLLABUS for MD BIOCHEMISTRY (2017-20) batch

1. GOAL

The goal of post graduate education in Biochemistry is to enable a student acquire an in depth knowledge and understanding of life processes at the molecular level. He must acquire the knowledge of the applications of biochemistry, molecular biology, and genetics in the practice

of medicine to solve clinical problems, impart knowledge to other learners and conduct research independently.

2. OBJECTIVES

Knowledge

At the end of three years training in Biochemistry the Postgraduate student shall be able to demonstrate comprehensive understanding of biochemistry as well as applied disciplines.

This will include the following broad headings.

- Molecular motif of a living cell, the constituent bio molecules, their structure function relationship.
- Biochemistry of human nutrition, metabolism, intermediary metabolism and disorders of metabolism.
- Cell and molecular biology.
- Defence against pathogens and metabolism of xenobiotics.
- Principles of basic instrumentation and laboratory procedure and rational use of laboratory testing.
- Fundamentals of biostatistics.

Skills

The students should :

Have acquired the competence in basic instrumentation and procedures in biochemistry as applied to hospital laboratories.

Have the competency to plan and establish a clinical laboratory and the proficiency in laboratory management.

Apply his knowledge in performing relevant investigations and interpreting laboratory reports to solve clinical problems.

Acquire communication skills to work with other medical, paramedical professionals and common people who come to the hospital.

Be oriented to principles of research methodology and be able to prepare protocols, conduct experimental studies to solve experimental and clinical problems.

Acquired skills in educating medical and paramedical professionals.

Be able to critically review and comment on research papers.

Be able to do literature survey and must possess basic computer skills.

Pattern of examination:

The post graduate degree examinations for MD Biochemistry course consist of theory papers, clinical/practical, oral examinations, thesis and pedagogy.

The students should take four theory papers at the end of the final year. One paper out of this will consist of questions on recent advances.

Practical examination for the students will be conducted to test the Knowledge and competency in experiments relevant to the subjects

Practical oral examination will be conducted to assess the candidate knowledge and competency on experiments.

Theory viva will be conducted to assess the Knowledge and competence relevant to the subject.

Pedagogy will be conducted to evaluate candidate's knowledge about the subject, communication ability and teaching skill of the student.

Student will take four theory papers. Each paper carries 100 marks

A candidate should secure not less than 50% of marks in theory and practical including viva voce examination.

Marks distribution

Theory – 400 (each paper carries 100 marks)

Practical – 300

Viva – 50

Pedagogy – 50

TOTAL = 800 marks

Marks required to pass

Theory – 200/400

Viva – 50 marks (No separate minimum to pass)

Pedagogy – 50 marks (No separate minimum to pass)

Practical + viva + Pedagogy – 200/400

TOTAL = 400/800 marks

2.THESIS

Every candidate must carry out work on assigned research project under the guidance of a recognized post graduate teacher.

Completed thesis must be submitted 6 months before the theory and practical examinations which will be examined by minimum of 3 examiners(One internal and two external examiners who shall not be the examiner for theory examination & practical exam). The candidate shall be accepted to appear for exam only after the acceptance of thesis by the examiners.

3.LOG BOOK:

Post graduate students must maintain a log book of the work carried out by them and training program undergone by them during their course period. The record/log book must be checked and assessed periodically by the faculty members imparting the training.

4. ATTENDANCE:

The PG students must work as full time resident during the period of training and should have 80% attendance.

5. POSTER PRESENTATION:

A Post Graduate student is required to present one poster, oral presentation either at national/state conference and to publish one research paper which should be either published/accepted for publication/sent for publication during the PG period to make student eligible to appear for PG examinations as per MCI guidelines

6. FOUNDATION COURSE:

The foundation course is a part of curriculum and the foundation course will be of 2 months duration after admission to prepare a student to study medicine effectively. This period aims to orient student to national health scenarios, medical ethics, health economics, learning skills and communication, life support, computer learning, sociology and demographics, biohazard safety, environmental issues and community orientation. The foundation course will be followed by clinical postings or postings in relevant departments as per the requirement of the course for the next 2 – 3 months.

PAPER I

GENERAL BIOCHEMISTRY, BIostatISTICS AND BIOCHEMICAL TECHNIQUES.

Physical Chemistry

- I. Water – as a universal biological solvent, its physical and chemical properties. Colloidal state, Gibbs - Donnan equilibrium, Surface tension, viscosity, osmosis , diffusion, Law of mass action. Vander walls forces, hydrogen bonding, hydrophobic interactions, Ionic bridges.
- II. pH, Buffers, types of solutions. Henderson –Hasselbalch equation. Principles and procedures of determination of p^H , PO_2 , PCO_2 (blood gas analysis)

Chemistry of carbohydrates

- i. Carbohydrates : Structure, physical, chemical properties and biological role of Glucose, fructose, galactose, mannose, ribose, xylose, xylulose, lactose,

maltose, sucrose. Deoxy and amino sugars. Dextrin, starch, glycogen, cellulose, inulin.

- ii. Glycosaminoglycans, glycoproteins.

Chemistry of Proteins

- i. Proteins : Structure, physical and chemical properties and biological functions of amino acids present in proteins. Amino acids not found in proteins.
- ii. pK_a , amino acids as buffers, amino acid titration, zwitter ions, isoelectric point. Cross links, hydrogen bonds, disulphide bonds, non covalent and ionic bonds in peptides and proteins.
- iii. Methods of study of structure of protein, Ramachandran plot, X-ray diffraction studies. Covalent structure of proteins, Mass spectrometry, Mass analyzers, Tandem mass spectrometers. Amino acid sequence determination, Peptide sequencing and peptide synthesis.
- iv. Primary, secondary, tertiary and quaternary structure of proteins.
- v. Protein structure and function – relationship with reference to the three dimensional structure of Myoglobin, Hemoglobin, Collagen, Elastin. Structure of enzymes and peptide hormones.

Chemistry of Lipids

- i. Definition, classification, Structure, physical and chemical properties of Saturated, unsaturated fatty acids, Polyunsaturated fatty acids, Eicosanoids, Triacylglycerol, Cholesterol, Phospholipids, glycolipids, sphingolipids, lipoproteins,
- ii. Fluid mosaic model of cell membrane, artificial membrane-liposomes.

Chemistry of purines and pyrimidines

- i. Nucleotides, polynucleotides. Synthetic nucleotides.
- ii. Nucleotide analogues in therapy.

Instrumentation

- i. Centrifuge : Principles and applications of Centrifugation, Ultracentrifuge
- ii. Radioactivity, properties of radionuclides, measurement of radioactivity. Autoradiography, Geiger counter, Scintillation counting.
- iii. RIA, Radio receptor assay, Immuno Radiometric Assay, Stable isotopes,
- iv. Mass spectrometry.

- v. Photometry and other instrumentation: principles and applications of Spectrophotometry, Reflectance photometry, Flame emission photometry, Atomic absorption spectrophotometry, Fluorometry, Infrared spectroscopy
- vi. Electrochemistry : Chemical sensors, Potentiometry, ion selective electrodes.
- vii. Coulometry, Optical chemical sensors, Enzyme electrodes, Osmometry
- viii. Electrophoresis: principles and applications of Paper, Agar gel, PAGE, SDS PAGE, Iso electric focusing.
- ix. Chromatography : principles and applications of Column, Paper, TLC, GLC, HPLC, Gel filtration, Ion exchange and affinity chromatography, .
- x. Immunochemistry: principles and applications of Phosphorescence, Chemiluminescence, Bioluminescence. Nephelometry, Turbidimetry,
- xi. Cytogenetics – Karyotyping, FISH, centromeric probes, chromosome painting probes etc.
- xii. Immunoelectrophoresis, western blot, EIA, ELISA.
- xiii. Automation in clinical chemistry.

Biostatistics :

- i. Basic principles of biostatistics as applied to health sciences. Concepts of probability, mean, standard deviation. Correlation coefficient. Co-efficient of variation.
- ii. Test of significance. Selecting an analytical methods. Evaluation of analytical methods . Evaluation of diagnostic tests.

PAPER II

CELL BIOLOGY , MOLECULAR BIOLOGY, HEMOSTASIS AND METABOLISM IN SPECIALIZED TISSUES.

cellbiology

- i. Structure, metabolic activities, clinical significance of eukaryotic cell - Eukaryotic sub cellular organelles- Nucleus, Nucleolus, Mitochondria, Ribosomes, Golgi apparatus , Peroxisomes lysosomes – Functions of lysosomes, Lysosomal storage disorders, Non membrane organelles – Cytoskeleton, microfilaments, microtubules, microvilli. Marker enzymes of various organelles. Prokaryotic cells, eukaryotic cells – Difference between Prokaryotic cells & eukaryotic cells
- ii. Membrane transport - active, passive diffusions, facilitated. Transport mechanisms – ion channels, pumps, carrier proteins, glucose transporter

- (GLUT), active transporters, symporters and antiporters Cell interactions and adhesion – type of junction – tight junction, Gap junctions.
- iii. Cell Surface molecules – ABO blood groups, Major histocompatibility complex, Adhesion molecules – Cadherins, selectins, integrins – Beta1 and Beta2 integrins.
 - iv. Cell cycle – The concept of cell cycle, regulation of cell cycle, regulators – Cyclins, extracellular regulators of cell cycle. Cell division – mitosis and meiosis. Programmed cell death. Biochemistry of aging. Stem cells and their differentiation . Cytogenetics
 - v. Plasma membrane – Properties of biological membranes – Motility, permeability, semipermeable membrane concept, electrochemical gradient. Fluid mosaic model of cell membrane-. membrane functions, Artificial membrane and liposomes and its uses.
 - vi. Evolution of organic molecules, endosymbiosis hypothesis,
 - vii. Separation of sub cellular organelles: Sub cellular fractionation- Density gradient centrifugation, differential centrifugation,

Molecular biology

- i. Structure of DNA, RNA, Nucleosomes, Chromosomes, histones, chromatins. Different types of DNA, Different types of RNA – Messenger, Ribosomal, Transfer, hnRNA, snRnp. MicroRNA
- ii. DNA replication – Prokaryotic and eukaryotic, DNA damage and repair mechanism
- iii. Transcription – Prokaryotic and eukaryotic, Post transcriptional modification Inhibitors of transcription. Transcriptional regulation. Genetic code, Mitochondrial and plasmid DNA
- iv. Translation – Eukaryotic and prokaryotic, post translational modification, Signal peptide, protein targeting, Intracellular traffic and sorting of proteins and chaperones , Disorders of post translational modification.
- v. Factors effecting protein synthesis, Control of protein synthesis
- vi. Prokaryotic and eukaryotic gene expression (Operon-Lac , Tryptophan), Helix turn helix motif, zinc finger motif and Leucine zipper motif of DNA binding proteins.

Molecular techniques

- i. Isolation of nucleic acids. DNA digestion with restriction enzymes, Restriction maps, Southern analysis: Hybridization and Southern blotting.

- ii. PCR - procedure, visualizing the products of PCR. Reverse transcriptase PCR (RT-PCR)
- iii. DNA electrophoresis. DNA sequence analysis, Automated DNA sequencing.
- iv. Cloning and vectors – Definition, characteristics of different vectors, basic cloning technique. Gene libraries, cDNA libraries. The human genome project, Genetic maps.
- v. Restriction fragment length polymorphisms (RFLP) – their application.
- vi. Methods of identifying human disease genes – Mutation analysis.
- vii. Gene therapy – pros and cons, Transgenic animals, Repeat DNA and mobile DNA elements, Reporter gene.

Molecular basics of carcinogenesis :

- i. Carcinogenic agents – radiation, chemicals and viruses. Oncogenes and tumor suppressor genes. Genetic related cancer – ataxia telangiectasia, familial breast cancer, familial adenomatous polyposis coli and retinoblastoma. Inherited conditions that predispose to development of cancer (e.g., ataxia telangiectasia, xeroderma pigmentosum, Fanconi syndrome).
- ii. Mechanisms of action of cytotoxic drugs.
- iii. Population genetics, overview of cytogenetics and epigenetics.
- iv. Risk assessment and genetic counselling. Medical ethics in counselling.

Hemostasis and thrombosis

- i. The vessel wall, prostacyclin, Nitric oxide, Clotting factors, blood clotting.
- ii. Platelets, coagulation, Fibrinolysis, lab tests
- iii. Coagulation disorders, Bleeding disorders, Platelet disorders, anticoagulants

Metabolism in Specialized tissues:

- i. Muscle tissue- composition, mechanism of muscle contraction, Muscle energy metabolism, Muscular dystrophy
- ii. Nerve tissue- composition, transmission of nerve impulse, neurotransmitters.
- iii. Erythrocytes- composition and metabolism, enzymology of RBC, Blood group antigens, other blood cells, Phagocytosis, Anemia, Abnormal hemoglobins, Hemoglobinopathies, Thalassemias,
- iv. Extracellular matrix: Connective tissue- composition, chemistry of collagen, elastin, proteoglycans and other fibrous proteins, connective tissue disorders
- v. Adipose tissue including brown adipose tissue metabolism.
- vi. Bone and teeth – Composition, Markers of bone turnover, osteoporosis,

osteoarthritis, rickets, Pagets disease

vii. Composition of lens- biochemical changes during cataractogenesis.

Bioinformatics & Bionanotechnology

- i. Bioinformatics – Basics, application in medicine, proteomics, drug designing (pharmacogenomics), protein data bases and micro arrays.
- ii. Bionanotechnology – basics, application in medicine and research.

PAPER III

INTERMEDIARY METABOLISM, ENZYMES AND NUTRITION

Intermediary metabolism

- i. Introduction to intermediary metabolism, various methods of study of intermediary metabolism with examples. Their advantages and disadvantages.
- ii. **Enzymes**
 - i. Definition, classification, properties of enzymes, coenzymes, cofactors, prosthetic groups.
 - ii. Factors affecting enzymes activity, Michaelis-Menten constant, Lineweaver- Burk plot, Edey-Hofstee plot. mechanisms of action of serine proteases, lysozyme and regulation of activities. Units of Enzymes activity,
 - iii. Application of enzymes (Therapeutic, Analytical, Diagnostic enzymes), isolation and purification of enzymes from natural sources.
 - iv. Immobilized enzymes –applications.
 - v. Enzyme inhibition- competitive, non-competitive, uncompetitive and allosteric,
 - vi. mechanism and application. Enzyme poisons.
Enzyme regulation, Isoenzymes (Definition and Types), isoforms
- vii. Enzymes pattern in diseases (Myocardia infarction, liver diseases, Muscle diseases, Cancer, bone disease, brain disorders and others).
- viii. Clinical Enzymology:
- ix. Enzyme in the diagnosis of pancreatic, cardiac and skeletal muscle and liver disorders.

Nutrition

Digestion and absorption:

- i. Digestion and absorption of carbohydrates, lipids, proteins, vitamins and minerals. Energy balance, over and under nutrition. Nitrogen balance, Net protein utilization
- ii. General principles of nutrition. RDA, Energy requirements. Macronutrients and their role. Biological value of proteins, specific dynamic action, balanced diet, dietary fibre.
- iii. Dietary supplements, fortification of foods, food additives, food fads, vegetarianism. Total parenteral nutrition. National nutrition programs. Biomarkers to analyse nutritional status.
- iv. Obesity- risk factors, metabolic derangements, genetics, hormonal regulation of adipose tissue metabolism, hormonal regulation of eating behaviour, adipokines. metabolic syndrome.
- v. Mal absorption syndrome
- vi. Modification and supplementation of dietary requirements in health and disease.

Vitamins

- i. Chemistry, sources, RDA, synthesis, biochemical roles, deficiency manifestations, reference range, methodology to estimate and hyper vitaminosis of fat soluble vitamins.
- ii. Chemistry, sources, RDA, synthesis, biochemical roles, deficiency manifestations, methodology to estimate, reference range of water soluble vitamins.
- iii. Megavitamin therapy, Anti vitamins and vitamin analogues and use of vitamins in therapy.
- iv. Role of vitamins as anti-oxidants.

Minerals

- i. Biochemical role of minerals - sodium, potassium, magnesium, calcium, phosphorus, iron, iodine, chloride, sulphur, zinc, molybdenum, manganese, copper, chromium, selenium and cobalt - their sources, recommended dietary allowances.
- ii. Clinical disorders associated with metabolism of these minerals.

METABOLISM

Carbohydrates

- i. An overview of metabolism, methods used to study intermediary metabolism.
- ii. Carbohydrates of physiological significance.
- iii. Pathways – glycolysis in various tissues, TCA cycle, Glycogen metabolism, Gluconeogenesis, and HMP-shunt, and regulation of these cycles
- iv. Metabolism of fructose and galactose and the disorders in their metabolism.
- v. Regulation of blood glucose

Lipids

- i. Oxidation of fatty acids, beta, alpha and Omega oxidation. Oxidation of unsaturated fatty acids. Ketones generation and utilisation. Ketosis,
- ii. Fatty acid synthesis – chain elongation and unsaturated fatty acids synthesis. Synthesis and catabolism of cholesterol and its regulation..
- iii. Metabolism of Triacyl glycerol..
- iv. Chemistry and metabolism of eicosenoids, phospholipids
- v. Metabolism in adipose tissue – brown adipose tissue. Lysosomal storage disorders.- spingolipidosis and mucopolysaccharadosis.
- vi. Lipoproteins-Apoproteins- exogenous and endogenous lipid transport and hyperlipoproteinemia..

Proteins

- i. Catabolism of amino acids , fate of the amino nitrogen and carbon skeleton.
- ii. Ammonia metabolism, Urea cycle and associated disorders. Hyperammonemias.
- iii. Metabolism of individual amino acids, biosynthesis of non essential amino acids.
- iv. Specialised products formed from amino acids, inborn errors of amino acid metabolism.

Bioenergetics and Biological Oxidation

- i. Free energy, exergonic and endergonic processes. Redox potential.
- ii. High energy compounds, enzymes associated with electron transport and the electron transport chain, inhibitors of ETC, oxidative phosphorylation, Chemiosmotic theory, Shuttles, Uncouplers and inhibitors

Integration of metabolism: .Metabolic adaptations in starvation and fed state.

Nucleic acids

- i. Synthesis and breakdown of purines and the disorders associated with abnormal purine metabolism.
- ii. Metabolism of pyrimidines. Disorders of abnormal pyrimidine metabolism.

Heme

- i. Heme containing compounds and their functions.
- ii. Heme biosynthesis, porphyria, Abnormal hemoglobins and hemoglobinopathies.
- iii. Breakdown of heme. Metabolism of bilirubin. Jaundice: definition, types, cause, and lab diagnosis. Metabolism of xenobiotics and detoxification. Free radicals and antioxidants.

PAPER IV

CLINICAL BIOCHEMISTRY, ENDOCRINOLOGY, IMMUNOLOGY AND RECENT ADVANCES

Clinical Biochemistry

Principles of Laboratory analyses and safety

- i. Units of measurement, International system of units in laboratory medicine. Conversion from conventional units to SI units. IFCC, IUPAC system recommendations. Reference materials.
- ii. Reagent grade water production and testing for water purity.
- iii. Sample collection, Preanalytical variables and biological variables, Anticoagulants, preservatives for blood. Timed urine collection, urine preservatives.
- iv. Lab safety, Hazards in the laboratory.
- v. Biological, chemical wastes. Waste management.

Quality assurance

- i. Use of reference values, quality assurance in clinical labs. Reference values. Setting up of reference range.
- ii. Basic principles of bio statistics as applied to health sciences : Mean, Standard deviation, Coefficient of variation, Correlation coefficient, selecting an analytical method, evaluating an analytical method
- iii. Computer application in clinical chemistry.
- iv. Setting up a clinical chemistry laboratory and a 24 – hours emergency lab service, Laboratory management.

Carbohydrates

- i. Diabetes Mellitus lab diagnosis and monitoring. Complications of diabetes mellitus, gestational diabetes. Glycated and glycosylated proteins. Urine albumin in diabetes mellitus.
- ii. Hypoglycemia. Glucose estimation.
- iii. Inborn errors of carbohydrate metabolism – galactose, fructose and pentose. Lactose intolerance.
- iv. Glycogen storage disorders.

Lipids

- i. Reference range and interpretation of lipid profiles, Estimation of total cholesterol, TGL, HDL, Friedewald's formula for estimation of VLDL, LDL, (NCEP ATP III guidelines), dyslipidemias and atherosclerosis. Metabolic syndrome.

Proteins and amino acids

- i. Abnormalities in plasma proteins. Plasma proteins separation, interpretation, Urine protein estimation by different methods, cerebrospinal fluid proteins. Proteins in other fluids. Protein losing enteropathy.
- ii. Inborn errors occurring in the metabolism of amino acids.

Organ Function Tests : Gastric function tests, Liver function tests, Kidney function tests and

Pancreatic function tests

Biomarkers and their applications. : Cardiac, tumor markers, bone markers

Fluid, electrolyte and pH maintenance and their imbalance:

Hyponatremia, hypernatremia, hypokalaemia, hyperkalemia, pH, how body pH is maintained, buffer, ABG analysis and interpretation

Systemic biochemistry:

- i. Biochemical basis of normal physiological functions, pathophysiology, complications, laboratory evaluation, biomarkers of various systemic disorders:
Diabetes mellitus, Obesity, Metabolic syndrome
- ii. Cardiovascular system – Atherosclerosis, Acute coronary syndrome, Myocardial infarction, Dyslipidemia and cardiovascular risk assessment, shock, Hypertension, congestive heart failure
- iii. Nervous system – Parkinson's disease, Schizophrenia, Myasthenia gravis, Huntington disease, Alzheimer's disease, Stroke, Epilepsy

Renal system - Acute and chronic kidney disease, Glomerulonephritis, Nephrotic syndrome, Renal tubular acidosis, Renal stones, Renal transplantation

- iv. Hepatobiliary system – Jaundice, Hepatitis, fatty liver, cirrhosis, hepaticcoma, Gall stones and Cholestasis.
- v. Digestive system – Peptic ulcer, Malabsorption, hereditary and acquired enzyme defects, GI regulatory hormones, Investigations in diarrhea.
- vi. Pregnancy and reproductive endocrinology – Prenatal diagnosis, Screening tests, Pregnancy induced hypertension, anemia, gestational diabetes,
 - Infertility
 - Biochemical processes in pediatric and geriatric population
 - Newborn screening and Inborn errors of metabolism

Endocrinology

- i. Hormones: classification, mechanism of action of steroidal and non-steroidal hormones, second messenger. Intracellular receptor mediated responses
- ii. Types of membrane receptor signaling systems Signal transduction pathways
- iii. Tyrosine kinase receptor pathways
- iv. G protein – coupled receptors and associated signal transduction pathways. Signal transduction pathways using cGMP as second messenger.

Pituitary and hypothalamus

Growth hormone : Actions, Testing, Acromegaly and Growth hormone deficiency

Prolactin : Prolactinoma, Hyperprolactinemia, Clinical and lab evaluation of Hyperprolactinemia. Management of prolactinoma

Idiopathic Galactorrhea

Hypopituitarism: Panhypopituitarism – etiology and treatment

Posterior pituitary: Oxytocin and Vasopressin

Adrenal function

Cortex: Steroidogenesis, Congenital adrenal hyperplasia
 Diagnosis of primary aldosteronism, Adrenal insufficiency,
 Hypercortisolism, Cushing's syndrome, CRH stimulation
 Androgen excess – diagnosis and treatment

Adrenal Medulla: Biosynthesis and storage of catecholamines.
 Urine and plasma catecholamine measurements
 Causes of sympathetic hyperactivity
 Diagnosis of Pheochromocytoma

Treatment of pheochromocytoma – outcome, prognosis

Incidentaloma

Gonadal function:

Ovary

Hormone production by the ovaries

The menstrual cycle

Hormonal control of ovulation

Hypogonadotrophic hypogonadism

Hirsutism

Estrogen replacement therapy

The Testes

Diagnosis of hypogonadism

Testosterone replacement therapy

Monitoring testosterone replacement therapy

Placental hormones.

Biochemistry of conception, reproduction, and contraception.

The Thyroid gland: Thyroid hormone synthesis

Protein binding of thyroid hormone

Control of thyroid function

Actions of thyroid hormone

Tests for thyroid evaluation

Hypothyroidism

Thyrotoxicosis

Grave's disease

Toxic adenomas and multinodular goiter

Non thyroidal illness

Parathyroid function and calcium homeostasis:

Hormones controlling calcium metabolism

Calcium metabolism in bone, GIT and kidney

Hypercalcemia

Hypocalcemia

Drugs that affect calcium metabolism

Metabolic bone disease

Osteoporosis

GIT hormones: Pancreas- insulinsynthesis, function, deficiency,
Neuromodulators and mechanism of their activity.

Prenatal diagnosis. Fetal monitoring, fetal lung maturity.

Neonatal screening.

Pediatric biochemistry.

Biochemistry in the elderly.

Homeostasis

Intrinsic and Extrinsic pathways of coagulation, Haemophilia, 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 functions.

Principles of hemo and peritoneal dialysis.

Immunology

- i. Definition, Cells involved in immune system, Antigen, haptens, adjuvants, antigenicity, antigenic determinants and epitopes. Types of immunity- acquired, innate immunity.
- ii. Immunoglobulins: structure, classification, functions, generation of antibody diversity (immunogenesis), complement system, major histocompatibility complex (MHC). Multiple myeloma and other associated disorders. Immunological techniques - RIA, ELISA. Monoclonal and polyclonal antibodies and their applications

CLINICAL POSTINGS – M.D. Biochemistry

Practical training in Biochemistry: (First half of I year) 1. Introduction to research methodology and Biostatistics. One month every postgraduate student should be given an introductory course in research methodology and research techniques. He/ She must be taught as to how a research project can be planned and implemented. He/ She must also acquire a basic knowledge in the statistical methods and their applications.

In the first year of training, the postgraduate student must be posted in clinical Departments. A period of three months is recommended. The student must be trained in the following during their clinical postings.

1. General Medicine

Duration - 1 month

At the end of the posting in the Department of Medicine, the student must be able to carry out

Systematic examination of a patient and suggest relevant Biochemical investigations to confirm a diagnosis. He/She should be competent in carrying out a complete Laboratory evaluation of Diabetes mellitus, Nephrotic syndrome, acute and chronic renal failure, Cirrhosis of the liver, Jaundice, Metabolic bone diseases and bleeding disorders.

In the area of critical care, he/she should be conversant with Acid – base disorders, Electrolyte imbalances and their management. He /She should be able to suggest investigations to be carried out in an acutely ill patient.

He/She should be conversant with techniques for proper collection and handling of samples.

The student must be able to assess by means of laboratory tests, a patient's lipid status and be able to give dietary advice in a case of dyslipidemia. He/ She should be competent in the laboratory evaluation of myocardial infarction.

Must be conversant with the pathogenesis and metabolic consequences of Myocardial infarction, biochemistry of ischaemia – reperfusion injury.

The student should learn evaluation of obesity and metabolic syndrome.

2. Pediatrics

Duration - 15 days

During this posting the student must learn the evaluation of nutritional status of a child and plan a dietary program

Plan and evolve a program for investigation of in born errors of metabolism.

Learn to calculate fluid deficit and replacement fluid therapy.

Learn to identify and diagnose acid base disorders in children.

3. Nephrology

Duration – 15 days

This posting should equip the student with competence in the laboratory evaluation of patient before and after Dialysis and a prospective kidney donor. He/She should be conversant with principles of fluid maintenance in a patient with renal disease.

He/She should also be competent to advice on diets for patients with acute and chronic renal failure.

4. Gastroenterology

Duration – 15 days

At the end of this posting the student should become competent in the laboratory evaluation of malnutrition, jaundice and cirrhosis.

During this posting the student should gain competency in the evaluation of the functions of liver, pancreas, intestine

5. Endocrinology

Duration – 15 days

The student should acquire competence in the laboratory evaluation of

Diabetes Mellitus, Metabolic bone disease, diseases of the thyroid gland and other hormonal abnormalities.

Practical training in Biochemistry: (First half of I year)

Clinical Lab Postings

Microbiology - 15 days

Clinical Pathology – 15 days

Cytogenetics- 15 days

Clinical postings in the forenoon to be attended and return to the department to do the experimental work in the afternoon. Later half of I year, II year and first half of third year (2 years) study and training in the department of Biochemistry. Third year (later half) Clinical Biochemistry (Exclusively) – 6 months Every postgraduate student in Biochemistry shall be posted to clinical biochemistry laboratory of the department where clinical investigations of

the attached hospital are done. Student should be trained in collection of samples, carrying out investigations, interpretation, reporting of the results and maintenance in records of investigations. Quality assurance.

Thesis

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.

The student will

- i. identify a relevant question
- ii. perform a critical review of literature
- iii. formulate a hypothesis
- iv. plan a study design
- v. prepare the objectives of the study
- vi. prepare protocol for his study design
- vii. undertake a study according to the protocol
- viii. analyze and interpret research data and draw conclusions
- ix. write the research paper.

Assessment

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

General Principles

The assessment will aim to be valid, objective and reliable.

Cognitive, psychomotor and affective domains will be assessed.

Formative, continuing and assessment will be conducted in theory as well as practical/clinicals. Thesis will be regularly discussed and evaluated.

Formative Assessment

The formative assessment will be continuous and there will be an evaluation at the end of term. There will be a feedback from the concerned faculty based on the student's entries in the Log book and periodic assessment. End of the term assessment will be held at the end of each semester for 2 years and 6 months. Formative assessment will not count towards pass/fail at the end of the program, but will provide constructive feedback to the candidate and provide a regular work schedule through the course.

There will be a practical examination at the end of every year.

Internal Assessment

The performance of the Postgraduate student during the training period should be monitored throughout the course and duly recorded in the log books as evidence of the ability and daily work of the student. The log book will be submitted for the practical examinations and scrutinised by the examiners.

Other assessments throughout the course will include:

Personal attributes

Behavior and Emotional Stability

Motivation and Initiative towards accepting responsibilities.

Regularity.

Honesty and Integrity.

Interpersonal Skills and Leadership Quality.

Practical Work including academic abilities and performance.

Academic Activities like skills exhibited during departmental activities like seminar, clinical discussions and journal club.

Summative Assessment

The pass percentage will be 50%.

Candidate will have to pass theory and practical examinations separately.

Theory Examination (Total = 400)

Paper Title Marks

Paper 1 **100**

General Biochemistry, Biostatistics and Biochemical techniques.

Paper 2 **100**

Cellbiology, Molecular Biology, Hemostasis and metabolism in specialized tissues.

Paper 3 **100**

Intermediary metabolism, Enzymes, and Nutrition

Paper 4 **100**

Clinical Biochemistry, Endocrinology and Immunology and Recent advances

Theory Question Paper Format

Time : 3 hrs **100marks**

4) Essay **20**

5) Essay **20**

6) Short notes **6x10=60**

Practicals & Viva voce Examination (Total = 400)

The Practical Examination will be held for 2 days

Distribution of Marks

Clinical examination, discussion and differential diagnosis of a given case
100

Presentation of the case after relevant investigations.
25

Interpretation of a given data **25**

Enzyme assay and interpretation
50

Electrophoresis **50**

Standard Curve and Paper Chromatography/TLC
50

Grand Viva **50**

Pedagogy **50**

Criteria for pass

50 % in theory examination – minimum 200 out of 400

50% in Practical/Viva & Pedagogy examination – minimum 200 out of 400

50% overall marks – minimum 400 out of 800.

SUGGESTED BOOKS FOR M.D BIOCHEMISTRY

Biochemistry

17) Biochemistry Ed Lubert Stryer. W.H. Freeman and Company, Newyork.

18) Principles of Biochemistry. Ed Lehninger, Nelson & Cox. CBS publishers and Distributors

19) Harper's Biochemistry. Ed. R.K Murray, D.K.Granner, P A Mayes and V.W.Rodwell.
Appleton and Lange, Stamford, Connecticut.

20) Biochemistry. Ed Donald Voet and Judith G.Voet. John Wiley & sons, Inc.

21) West & Todd, Text Book of Biochemistry – Oxford and IBH Publications Com Pvt Ltd.
– 4th Editions.

22) Text book of Biochemistry with clinical correlation. Ed. Thomas M. Devlin. Wiley – Liss
Publishers

Clinical Biochemistry

23) Tietz Textbook of clinical chemistry. Ed Burtis and Ashwood. W.B.Saunders Company.

24) Principles and techniques of Practical Biochemistry. Ed Kieth Wilson & John Walker.
Cambridge university press

25) Varley et al Heinemann, Practical clinical Biochemistry – Medical Books, London – 6th
edition.

26) Clinical chemistry Theory, Analysis and correlation – Lawrence A Kaplan et al. , -
Mosby

27) McGilvery: **Biochemistry - A Functional Approach** - W. B. Saunders Company.

28) Montgomery, Biochemistry- a case oriented approach – the CV, Mosby Company – 5th
Edition

Genetics

29) Genes VI Ed - Benjamin Lewin. Oxford university Press

30) **Molecular Cell Biology**, Harvey Lodish, Arnold Berk, Paul Matsudaira, James Darnell,
D. Baltimore.

31) APPS, Biochemistry – W.B. Brothers and Company / Newyork – 3rd edition.

32) Molecular cloning – A laboratory manual. J.Sambrook, E.F.Fritsch and T.Maniatis. Cold
spring Harbor Laboratory Press

Endocrinology

3) Williams Textbook of endocrinology

4) Principles and practice of endocrinology and metabolism, Kenneth L Becker

Nutrition

3) Nutritional biochemistry of the vitamins, David A Benden

4) Food and Nutrition in Diet and therapy, L Mahan. Escott-Stum

Suggested Journals and other periodicals for M.D biochemistry

12. Clinical Chemistry

13. Annals of Biochemistry
14. Indian Journal of Nutrition and Dietetics
15. Indian Journal of clinical chemistry
16. New England Journal of Medicine
17. Lancet
18. JAMA
19. Medical Teacher
20. BMJ
21. Clinics of North America
22. American Journal of Clinical Nutrition.

FIRST YEAR PROGRAM

FIRST MONTH:

Orientation to the department

NEXT 5 MONTHS:

THEORY:

General biochemistry, enzymes, nutrition syllabus will be covered along with M.B.B.S theory classes

PRACTICALS:

All M.B.B.S practical syllabuses as Qualitative analysis of carbohydrates, proteins and identifying the abnormal constituents of urine analysis along with relevant case studies

LAB POSTINGS:

One month of first 6 months they will be posted in clinical labs where they will be taught about sample collection, data entry and centrifugation of samples.

Training IN Biostatistics twice in a week for 3 months

LAST 6 MONTHS:

POSTINGS:

As a part of PG Curriculum they will be posted in various clinical departments for a period of 6 months from 9.00 AM to 2.00 PM every day.

The departments are as follows

General Medicine – 2 months

Pediatrics – 15 days

Reproductive medicine department – 15 days

Nephrology – 15 days

Gastroenterology – 15 days

Endocrinology – 15 days

Cardiology – 15 days

AFTERNOON: They will be doing self-study and attending UG practicals.

SECOND YEAR PROGRAM

FIRST 6 MONTHS:

THEORY:

General Biochemistry (Chemistry & Metabolism of Carbohydrates, proteins & lipid) is dealt along with M.B.B.S in M.B.B.S classes.

Instrumentation & Lab safety Procedures will be covered as seminars and faculty teaching programs

ASSIGNMENT: They will be provided assignment on theory topics once a month

Test will be conducted once in month

PRACTICALS:

Practical sessions on

Standardization & Estimation of analytes

Electrophoresis of proteins and hemoglobin

LAB POSTINGS:

1 month clinical lab posting in which pipetting, semi auto analyzer and to estimate analytes in semi auto analyzer is dealt

NEXT 6 MONTHS:

THEORY:

Human Genetics and biotechnology syllabus will be covered in the last 6 months of second year

PRACTICALS:

Chromatography of carbohydrates & amino acids – Thin layer chromatography and paper

LAB POSTINGS:

2 months of the last 6 months, they will be posted in clinical lab where they will be taught about semi auto analyzer and to estimate analytes on semi auto analyzer & about to work on Blood gas analyzer and interpretation of results.

PROJECT:

Thesis should be completed at the end of second year.

THIRD YEAR PROGRAM

FIRST 6 MONTHS:

THEORY:

Recent trends, clinical biochemistry & endocrinology syllabus will be covered

Once a month assignment will be provided

Test will be conducted once a month

PRACTICALS:

Molecular Biology such as DNA and RNA separation techniques

LAB POSTINGS:

PGs will be posted in lab for 2 months again where they will be taught about interpretation of results, quality control and case studies.

LAST 6 MONTHS:

Complete revision of theory and practicals

Test will be conducted for assessment.

Practical exams with viva discussion

Publishing the thesis & presentation in conferences.

THEORY SCHEDULE

TOPICS TO BE COVERED IN FIRST HALF OF II YEAR

S.No.	Topics	Mode of Teaching
1	Unit of Measurement	Lecture
2	Centrifugation	Seminar
3	Photometry & Other Instrumentation	Lecture
4	Spectrophotometry	Seminar
5	Reflectance Photometry	Seminar
6	Flame Emission Photometry	Seminar
7	Atomic Absorption Photometry	Seminar
8	Flurometry	Seminar
9	Nephelometry	Seminar
10	Turbidometry	Seminar
11	Electrochemistry	Lecture
12	Electrophoresis - Principle, Types of Electrophoresis	Lecture
13	Agar Gel Electrophoresis	Seminar
14	PAGE	Seminar
15	Isoelectric Focus	Seminar
16	Chromatography - Basic Principle, Procedure, Application	Lecture
17	HPLC	Seminar
18	TLC	Seminar
19	Immunochemistry	Lecture
20	Automation in Clinical Chemistry	Lecture

S.No.	Topics	Mode of Teaching
1	Hormones - Definition , Classification & Function	Seminar
2	Signal Trasduction	Lecture
3	Hypothalamus	Problem Based Teaching
4	Anterior Pituitary	Problem Based Teaching
5	Posterior Pituitary	Problem Based Teaching
6	Adrenal Medulla	Problem Based Teaching
7	Gonads	Problem Based Teaching
8	Thyroid	Problem Based Teaching
9	Para Thyroid	Problem Based Teaching
10	Placental Hormones	Problem Based Teaching
11	GIT Hormones	Lecture
12	Neurotranmitters	Lecture
13	Neonatal Screening	Lecture
14	Peadiatric Biochemistry	Lecture
15	Biochemistry in the elderly	Lecture

TOPICS TO BE COVERED IN SECOND HALF OF II YEAR

TOPICS TO BE COVERED ON FIRST HALF OF THIRD YEAR

S.No.	Topics	Mode of Teaching
1	Nucleic Acid Chemistry	Seminar
2	DNA Organisation	Assignment
3	DNA Replication	Lecture
4	Mutation	Lecture
5	Transcription	Lecture
6	Translation	Lecture
7	Protein Targetting	Seminar
8	HIV	Seminar
9	Recombinant DNA	Seminar
10	PCR	Lecture
11	DNA Electrophoresis	Lecture
12	DNA Sequence Analysis	Lecture
13	Cloning	Lecture
14	RFLP	Lecture
15	Human Genome Project	Lecture
16	Transgenic Animals	Seminar
17	Gene Therapy	Seminar
18	Molecular aspects of Cancer	Lecture
19	Basics of Immunology	Lecture
20	Major Histocompatibility Complex	Lecture & Assignment
21	Monoclonal & Polyclonal Antibodies	Lecture
22	Multiple Myeloma	Problem Based Teaching
23	Schradosis	Problem Based Teaching
24	Amyloidosis	Problem Based Teaching
25	Rejection and Immune Supression	Seminar
26	Biochemical Assessment of Nutritional Status	Seminar & Problem Based Teaching
27	Nutrition & Dietetics	Seminar

TOPICS TO BE COVERED IN SECOND HALF OF III YEAR

S.No.	Topics
1	Theory Revision

2	Practical Revision
3	Submission of Thesis

List of Practicals for MD Biochemistry

SI No.	Experiment
1	Basics of Weights and measurements
2	Reactions of Carbohydrates, Proteins and Amino acids
	Basic Instrumentation and applications
3	Colorimeter – Basic Principles and Instrumentation
4	Spectrophotometer – Basic Principles and Instrumentation
5	Standardization graph
6	Identification Absorption Spectrum of a given compound
7	Identification of Molar Extinction Coefficient of Amino acids
8	pH and pH meter- Basic Principles and Instrumentation

9	Determination of pH of a buffer by Hendersen-Hasselbach Equation
10	Preparation of Solutions – Molarity, Normality, Molality
11	Preparation of Buffers
12	Preparation and demonstration of a buffer and its buffering capacity
	Quantitative Estimation in Serum
13	Estimation of Glucose
14	Estimation of Urea
15	Estimation of Creatinine
16	Estimation of Uric acid
17	Estimation of Total protein
18	Estimation of Albumin
19	Estimation of Cholesterol
20	Estimation of Bilirubin
21	Estimation of Calcium
22	Estimation of Phosphorus
23	Estimation of Plasma Ammonia
24	Estimation of serum triglycerides
25	Estimation of AST, ALT ALP acid Phosphatase, GGT, Cholinesterase, Amylase, Lipase, LDH and Creatine Kinase
26	Estimation of Ceruloplasmin
27	Estimation of Iron, Iron Binding Capacity, Copper, Lithium and Magnesium
	Urine analysis
28	Urine analysis – Normal and Abnormal Constituents
29	Detection of Bence – Jones proteins in Urine
30	Estimation of urine creatinine
31	Estimation of Urine proteins
32	Estimation of Urinary VMA
	Enzyme Kinetics
33	Effect of Enzyme concentration on rate of the reaction
34	Effect of Substrate concentration on rate of the reaction
35	Effect of pH on rate of the reaction
36	Effect of temperature on rate of the reaction
	Separation techniques - Chromatography
37	Chromatography – Basic Principles
38	Paper Chromatography- Ascending – Sugars, Amino acids and Lipids
39	Paper Chromatography- Descending - Sugars, Amino acids and Lipids
40	Circular Paper Chromatography- Sugars and Amino acids
41	Thin Layer Chromatography - Sugars, Amino acids and Lipids
42	Gel Filtration Chromatography
43	Affinity Chromatography – HbA1c estimation
44	HPLC - Demonstration
	Separation techniques - Electrophoresis
45	Electrophoresis – Basic Principles and Instrumentation
46	Cellulose Acetate electrophoresis – Plasma Proteins
47	Agarose Gel Electrophoresis – Plasma Proteins and Lipoproteins
48	Hemoglobin Electrophoresis
49	Separation of Isoenzymes by Electrophoresis – LDH, CK, ALP
50	SDS PAGE – Determination of molecular weight of protein
51	Submarine Electrophoresis for Nucleic Acids
	Separation techniques - Centrifugation

52	Centrifugation – Basic Principles and Instrumentation
53	Isolation of Subcellular organelles (Nucleus and Mitochondria) by Cell Fractionation
54	Molecular Biology Experiments
55	DNA extraction and Quantification from Blood, Saliva, Tissue and Hair
56	RNA extraction
57	Blotting Techniques – Northern, Southern and Western Blotting
58	Restriction Digestion of DNA
59	Primer Designing
60	Amplification of DNA by PCR
	Milk Analysis-
61	Qualitative analysis
62	Determination of Lactose in milk
	Stone Analysis
63	Urinary stone Analysis
64	Gall Bladder Stone analysis
65	Urine Screening tests for Inborn errors of metabolism
	Fluid analysis
66	CSF analysis for chloride and protein
	Auto Analyzer
67	Use of Random access Analyzer and Batch Analyzer for various analytes

68	Chemiluminescent assay of Various analytes
69	Plotting of L J Charts – Internal Quality Control and Analysis using Westgard Rules
70	Blood Gas Analysis using – Blood gas Analyzer

LAB POSTINGS

Lab Posting for M.D. Biochemistry	
LAB POSTING I	
S.No.	Topics
1	Orientation of Laboratory activities
2	Training in Phlebotomy
3	Maintating the Nominal Register
4	Training in Centrifugation
LAB POSTING II	
S.No.	Topics
1	Training in Pipetting
2	Training in Semi Auto Analyser (Processing and Maintenance)
LAB POSTING III	
S.No.	Topics
1	Training in Electrolyte Analyser (Processing and Maintenance)
2	ABG Analyser (Processing and Maintenance)
3	Interpretation of Results
4	Case Discussion
LAB POSTING IV	
S.No.	Topics
1	Interpretation of Results
2	Case Discussion
3	User Training in Automated Systems (Siemens - Dimension)
LAB POSTING V	
S.No.	Topics
1	ELISA Technique (Biorad Reader and Washer)
2	User training on Immunoanalyser
LAB POSTING VI	
S.No.	Topics
1	Quality Control