



YENEPOYA UNIVERSITY

Deralakatte, Mangaluru -575018

REGULATIONS AND CURRICULUM GOVERNING POSTGRADUATE PROGRAM M.Sc. IN MEDICAL BIOCHEMISTRY

(CURRICULUM - EFFECTIVE FROM 2010-11)

ATTESTED

Dr.Gangadhara Somayaji K.S.
Registrar
Yenepoya(Deemed to be University)
University Road, Deralakatte
Mangalore-575 018, Karnataka



Office of the Registrar
University Road
P.O. Nithyananda Nagar
Deralakatte
Mangalore - 575018
Ph:0824-2204667/68/69/71
Fax: 0824-2203943

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31.10.2009

NOTIFICATION

Sub: Starting of M.Sc. in pre & para clinical departments

Ref: Resolution of the Academic Council at its 3rd meeting held on 31.10.2009
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The Academic Council at its 3rd meeting and subsequently the Board of Management at its 9th meeting held on 31.10.2009 have resolved to approve the proposal to start following M.Sc. in pre & para clinical departments:-

1. M.Sc Medical Anatomy
2. M.Sc Medical Physiology
3. M.Sc Medical Biochemistry
4. M.Sc Medical Pharmacology
5. M.Sc Medical Microbiology

This notification is issued for implementation with effect from the academic year 2010-2011.

To:
The Principal - YMC

Copy to:

1. Controller of Examinations
2. File copy


I/c **REGISTRAR**
Registrar
YENEPOYA
(Deemed to be University)

Regulations and Curriculum for MSc Medical Biochemistry

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Preamble

The prime concern of the Institute is to develop patterns of teaching in postgraduate medical education so as to demonstrate a high standard of medical education to all medical colleges and other allied institutions globally. This educational experience is imparted in an atmosphere of research.

Regulations

1. Eligibility for a Recognized Post Graduate Teacher:
 - (a) Qualification:
MD Biochemistry
Or
MSc Medical Biochemistry with Medical PhD
 - (b) Teaching Experience: 5 years of UG (MBBS) teaching after acquiring PG degree
 2. Eligibility of Student:
M.B.B.S.; or B.Sc. with Chemistry /Biology/ Zoology / Botany / Biotechnology from a recognized institution.
 3. Number of Admissions / Student-Teacher Ratio:
The number of students to be admitted for MSc Medical Biochemistry together with MD Biochemistry shall be 1 P.G. per each eligible PG teacher.
 4. Duration of the Course:
 - 3 years
 - First Year (one Academic year from July to June) is the Preliminary Course (Orientation Course) – teaching of Biochemistry, Physiology and Anatomy at the I M.B.B.S. level with the syllabus of latest M.C.I. regulations, except that there will be University Examination only in Theory and not in Practicals at the end of the one year course.
Students shall attend all Lectures , tutorials, and practicals along with 1st M.B.B.S students during the preliminary Course (Orientation Course)s
 - Second and Third Year of the Course is the Post Graduate Course proper.
 5. Nature of the Course:
Candidates joining M.Sc. Medical Biochemistry course shall work as full time P.G. student and he/she will not be paid any stipend during the training period and he/she will be given full time responsibility, assignments and participation in all facets of the educational process.
 6. Log Book:
P.G. student shall maintain a record (log) book of the work carried out by them and will be checked & assessed by his/her P.G. teacher & H.O.D.
 7. Work in Central Clinical Laboratory:
P.G. students shall work in Central Clinical Laboratory & would carry out routine, emergency & special investigations during training period.
 8. Academic Activities::
They shall participate in all P.G. academic activities;
viz, Seminars, Group discussion, Journal club, etc.
 9. Teaching-training program:
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They will be required to participate in the teaching and training programs of U.G. students.

10. Attendance:

They will be granted a term provided they will put 80% attendance during the academic term.

11. Tuition Fees:

Rs 1 lakh / annum

Curriculum

Goal

The broad goal of teaching and training of postgraduate students in Medical Biochemistry is to enable a student acquire sound knowledge in the subject and develop practical skills to contribute effectively in the fields of **academics, health care and research**.

At the end of his/her training, the student shall be able to take up a career in **Teaching Institution, Diagnostic Laboratory or Research**.

Objectives

At the end of the training in Biochemistry, the PG student is expected to demonstrate sound **Knowledge and Skills** in the field of **Medical Biochemistry**.

Knowledge

1. Concepts and principles of general biochemistry.

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

2. Fundamentals of biostatistics

Skills

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

Methodology

Following methods are used to facilitate learning and training of PG students during II and III year (Post Graduate Course proper).

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1. **Post graduate lectures, tutorials, seminars:** To update on various aspects of basic and clinical biochemistry & impact of molecular biology on advances in medicines.
 2. **Journal club:** To develop (a) skills of analysis, evaluation and presentation of research papers (b) familiarity with approaches and methodologies of research and (c) to update on new development/emerging trends in biochemistry.
 3. **Practical exercises:** under the supervision of a faculty.
 4. Participation in UG laboratory practical teaching and problem based tutorials as a team with faculty of the department to gain in depth learning, teaching and tutoring experience.
 6. **Specialized training in Clinical Biochemistry:** 1 month posting in the clinical biochemistry laboratory to learn sample collection, quality control methods, setting up of a clinical biochemistry laboratory, specialized assays, statistical analysis of data.

Syllabus

I year (Preliminary Course)

Theory

1. Chemistry of Biomolecules
2. Enzymes
3. Cell Structure
4. Digestion and Absorption
5. Metabolism
 - Carbohydrate Metabolism
 - Lipid Metabolism
 - Amino Acid Metabolism
 - Biological Oxidation, Oxidative Phosphorylation
 - Heme Metabolism
 - Purine and Pyrimidine Metabolism
 - Acid Base Balance and Disorders
 - Detoxification
 - Vitamins
 - Minerals
 - Genetics
 - DNA Replication, Transcription, Translation, Mutation, Regulation of Gene Expression, Recombinant DNA Technology
6. Hemoglobin
7. Plasma Proteins
8. Liver Function Test, Kidney Function Test
9. Nutrition
10. Biochemical Techniques

Practical Syllabus

A. Qualitative Experiments

1. Reactions of carbohydrates
 2. Reactions of Proteins
 3. Reactions of non-protein nitrogenous (NPN) substances
 4. Identification of substance of physiological importance
 5. Qualitative analysis of normal urine
 6. Analysis of urine for abnormal constituents
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B. Quantitative experiments

1. Colorimetry
2. Estimation of blood sugar
3. Estimation of blood urea
4. Estimation of serum inorganic phosphate
5. Estimation of total serum protein and albumin
6. Estimation of urine creatinine.

C. Demonstration experiments

1. Glucose tolerance test
2. Paper Chromatography
3. Electrophoresis
4. Estimation of urine albumin

II and III Year

Theory

Paper I - Chemistry and Techniques

Methods of qualitative analysis of biomolecules : Principles, experimental procedure and applications of : Chromatography, paper, thin layer, ion exchange, affinity, gel filtration, gas-liquid, HPLC. Principles, procedures and application of : Electrophoresis, paper, polyacrylamide gel, agarose gel, and cellulose acetate. Ultracentrifugation, ultrafiltration.

Quantitative methods: Principles and applications of : Photometry, Spectrophotometry, fluorometry, ion selective procedures, flame photometry.

Isotopes : Detection and measurement of radioactive isotopes. Application of isotopes in research and clinical biochemistry.

Concept of pH and buffers. Henderson - Hasselbalch equation. Principles and procedures of determination of pH.

Chemistry of amino acids and proteins : Structure and properties of amino acids. Protein structure and conformation. Methods to determine the amino acid sequence of proteins. Chemistry of conjugated proteins, nucleoproteins, lipoproteins, immunoglobulins, glycoproteins. Structure- function relationship of proteins: hemoglobin, myoglobin and collagen. Protein - protein interactions.

Chemistry of carbohydrates : Monosaccharides, disaccharides, homopolysaccharides and heteropolysaccharides.

Chemistry of lipids: Classification, fatty acids, PUFA, compound lipids, cholesterol.

Nucleic acids : Chemistry and structure of bases, nucleosides, nucleotides, RNA and DNA. DNA sequence determination. Properties of nucleic acids. Recombinant DNA technique, cloning procedures, vectors, plasmids, phages, cosmids, and restriction map and PCR technique. Southern, Northern, Western blotting procedures. Restriction fragment polymorphism. In-situ hybridization. Genomic library and cDNA library mutations, mutagens, carcinogens, in vitro mutagenesis. Transgenic animals and microinjection technique. Gene therapy.

Basic concepts of immunology: Chemistry of immunoglobulins, primary and secondary immune responses, auto immune phenomenon, anaphylaxis, Clonal selection, B cells, T

cells, helper T cells, NK cells, macrophages, interleukins, cytokines, HLA antigens, monoclonal antibodies, Hybridoma technology, immunodiffusion, immuno- electrophoresis, radio immune assay (RIA), enzyme linked immunosorbent assay (ELISA), fluorescent in situ hybridization (FISH) techniques. (NK cells – Natural Killer Cells).

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

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

Enzymes: Classification, nomenclature, enzyme specificity, kinetics of enzyme activity, coenzymes and cofactors, regulation of enzyme activity, isoenzymes, pro-enzymes, multienzyme complexes, tandem enzymes, covalent modification, active site of enzymes, methods of locating the amino acid residues in the active sites, mechanism of enzyme action.

Enzyme inhibitions: competitive, non-competitive, Allosteric, suicide.

Purification of enzymes from cells, characterization and criteria of purity. Purification of proteins.

Paper II(Intermediary Metabolism)

Methods of investigation of metabolic pathways. Primary secondary and tertiary metabolisms.

Carbohydrate metabolism: Details of metabolic pathways involving carbohydrates in mammals. Embden-Meyerhof pathway, hexose monophosphate shunt pathway, other minor pathways, fructose and Galactose metabolisms. Digestion and absorption. Blood glucose homeostasis, hormones influencing carbohydrate utilisation, insulin, glucagon, glucocorticoids, epinephrine and glucose tolerance test, Diabetes mellitus.

Amino acid metabolisms : Protein digestion an absorption of amino acids, metabolism of individual amino acids, one carbon units, polyamines, nitric oxide, plasma proteins, transport proteins.

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

Regulation of metabolisms: TCA cycle, integration of metabolisms, common terminal pathway, regulation, amphibolic role. Hormonal regulations of metabolic pathways, Cori's cycle, Alanine cycle, adaptation during starvation.

Purine and pyrimidine metabolisms: synthesis and degradation of bases and nucleotides, regulation, gout, Lesch-Nyhan syndrome.

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

Transcription: Details of transcription, transcriptional control of gene expression, Operon concept, promoters, enhancers, silencers, hormone responsive elements, transcription factors, post-transcriptional modifications of RNA, exons, introns, splicing, Ribozymes, inhibitors of transcription.

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

Protein degradation: Cathepsins, Proteosomes, Caspases. Muscle contraction.

Paper – III

Clinical Biochemistry and Nutrition

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

Mineral metabolism: Macrominerals, sodium, potassium, chloride, magnesium, calcium, phosphorus. Trace elements: iron, copper, manganese, zinc, cobalt, molybdenum, selenium, iodine and fluoride.

Nutritional requirements: Energy requirements, balanced diet, nutritional disorders, obesity, starvation, PUFA, dietary fibres, cholesterol.

Protein requirements: Nitrogen balance, nutritive value, biological value, chemical score, protein energy malnutrition, Kwashiorkor and Marasmus.

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

Endocrinology: Mechanism of action of hormones, hormone receptors, signal transduction, G-proteins, second messengers, cyclic AMP, cyclic GMP, calcium, Inositol triphosphate, diacyl glycerol, nitric oxide, Biosynthesis of adrenal and thyroid hormones, metabolic regulation by hormones, hormonal regulation of gene expression, hormonal disorders, biochemical investigation of endocrine disorders, thyroid and adrenal function tests.

Erythrocytes: chemical make up, metabolic pathways, haemoglobin, hemoglobinopathies, porphyrias, heme synthesis and degradation, bilirubin metabolism, jaundices, laboratory findings in jaundices.

Composition of blood plasma in health and diseases, normal values.

Acid base balance and electrolyte balance, related disorders.

Biochemical investigations of liver, kidney and gastric functions, malabsorption disorders, inherited metabolic disorders.

Cell biology: cell cycle, check points, regulation, Oncogenes, tumour suppressor genes, Apoptosis, tumour markers.

Reactive oxygen species and defence mechanisms, antioxidants and enzyme systems.

Diagnostic enzymology: LDH, CPK, AST, ALT, ALP, ACP, GGT, Amylase, 5' nucleotidase, etc.

Acute phase proteins: Alpha-1 anti-trypsin, Alpha-2 macroglobulin, Haptoglobin, Ceruloplasmin etc.

Alzheimer's disease, Prions, beta amyloid.

AIDS: HIV, genes and gene products, diagnosis, precautions.

Laboratory management: Precision, accuracy, specificity, sensitivity, percentage error, quality control, precautions in handling hazardous materials.

Practical Syllabus (and Work Schedule)

General Experiments

Acids Bases and Buffers : Factors determining Buffer capacity	(3 days)
Colorimetry : Beer's Law	(1 day)
Spectrophotometry	(1 day)
Molar extinction coefficient	(1 day)
pK of glycine using pH meter	(3 days)
General reactions of carbohydrates	(2 days)
7.Periodate oxidation of sugars	(3 days)
8.Chromatography of carbohydrates : (using honey and other sugars)	

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| a) Paper | (2days) |
| b) Thin layer | (2days) |
| 9. Analysis of honey | (3days) |
| 10. Isolation of starch from potato / Reactions of starch | (2 days) |
| 11. Acid hydrolysis of starch | (1 day) |
| 12. Isolation of liver glycogen / Reactions of glycogen | (2 days) |
| 13. Preparation of glucose- 1-phosphate from potato | (4 days) |
| 14. Color reactions of amino acids | (3 days) |
| 15. Estimation of amino acids by Ninhydrin method | (1 day) |
| 16. Chromatography of amino acids : a) Paper (2days) b) Thin layer (2days) | |
| c) Ion exchange | (3 days) |
| 17. Reactions of lipids saponification value, iodine number | (4days) |
| 18. Isolation of cholesterol from goat brain/ Reactions of cholesterol | (3 days) |
| 19. Isolation of phospholipids from egg yolk | (3 days) |
| 20. TLC of lipids in plasma and rat brain | (3 days) |
| 21. Analysis of Milk | (2 days) |
| Estimation of Lactose- Folin wu method | |
| Alkaline phosphatase activity | |
| 22. Isolation and estimation of DNA from spleen : effect of temperature on DNA | (3 days) |

Clinical Investigations

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| 23. Blood sugar : | Folin- Wu method | (2 days) |
| • | O – Toluidine dmethod | (1 day) |
| • | Glucose oxidase method | (1 day) |
| 24. Blood Urea - Diacetyl monoxime method | | (2 days) |
| ❖ | Urease Nesslerization method | (2 days) |
| ❖ | Enzymatic method | (2 days) |
| 25. Plasma uric acid | | (2 days) |
| 26. Plasma creatinine | | (2 days) |
| 27. Serum proteins | | |
| ❖ | Lowry's method (including preparation of Folin's reagent | (3 days) |
| ❖ | Biuret (Total and A/G) | (2 days) |
| ❖ | Albumin –Dye binding method | (1 day) |
| ❖ | Zinc sulphate turbidity | (1 day) |
| ❖ | Electrophoresis a) Agar Gel | (2 days) |
| | b) Polyacrylamide | (2 days) |
| ❖ | Gel filtration | (3 days) |
| 28. Hb by Cyanomethemoglobin method | | (1 day) |
| 29. Urine nitrogen by Kjeldahl method | | (2 days) |
| 30. C.S.F. Analysis : Proteins | | (1 day) |
| | Sugar | (1 day) |
| 31. Plasma Chlorides | | (1 day) |
| 32. Plasma bicarbonate | | (2 days) |
| 33. Plasma calcium | | (2 days) |
| 34. Plasma inorganic phosphate | | (2 days) |
| 35. Bilirubin : Total & Direct | | (2 days) |
| 36. ALT | | (3 days) |
| 37. AST | | |
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38. Acid phosphatase	
39. Alkaline phosphatase	(3 days)
40. Serum amylase	(2 days)
41. GGT	(2 days)
42.LDH	a) Spectrophometric method (2 days)
	b) Isoenzyme separation (2 days)
43. Lipid Profile :	Total lipids (3 days)
	Cholesterol -Free & Ester (4 days)
	Triglyceride (2 days)
	Phospholipids (2 days)
	LDL and HDL (2 days)
	Lipoprotein electrophoresis (2 days)
44.Plasma Vitamin A	(1 day)
45.Plasma Vitamin C	(3 days)
46.Plasma Vitamin E	(2 days)

Cell Fractions and Enzymes

48. Subcellular fractionation	(1 week)
49. Factors effecting enzyme activity	(15 days)
	a) Enzyme concentration
	b) Substrate concentration
	c) pH
	d) Temperature
	e) Inhibitors
50. Purification of Enzymes (15 days)

Training in Clinical Biochemistry Lab

Plasma Iron and Iron binding capacity
 Plasma sodium and potassium
 Urinary 17 ketosteroids
 Urinary V.M.A estimation.
 Stone analysis

University Examination Pattern

1. At the end of I year (Preliminary Course)

Same as I MBBS as per latest M.C.I. regulations, except that there will be University Examination only in Theory and not in Practicals at the end of the one year course.

2. At the end of III year (Final Year)

Theory

Paper I: 3 hrs, Marks-100.

Paper II: Duration- 3 hrs, Marks-100.

Paper III: Duration- 3 hrs, Marks-100.

Oral examination

General viva voce and practical bench viva.

Practicals: Duration- 2 days, Marks-300.

Books Recommended

1. Biochemistry Ed Lubert Stryer. W.H. Freeman and Company, New York.
2. Principles of Biochemistry. Ed Lehninger, Nelson and Cox. CBS publishers and distributors.
3. Harper's Biochemistry. Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell. Appleton and Lange, Stamford, Connecticut.
4. Textbook of Biochemistry with Clinical Correlations. Ed. Thomas M. Devlin. Wiley-Liss Publishers.
5. Genes VI. Ed Benjamin Lewin. Oxford University Press.
6. Tietz Textbook of Clinical Chemistry. Ed Burtis and Ashwood. W.B. Saunders Company.
7. Principles and techniques of practical biochemistry. Ed Keith Wilson and John Walker. Cambridge University Press.
8. Biochemistry. Ed Donald Voet and Judith G. Voet. John Wiley & sons, Inc.
9. Molecular Cloning- A Laboratory Manual. J. Sambrook, E.F. Fritsch and T. Maniatis. Cold Spring Harbor Laboratory Press.
10. Molecular Cell Biology, H. Lodish, A. Berk, S.L. Zipursky, P. Matsudaira, D. Baltimore, J. Darnell
11. Bio-technology 1st edition. U. Satyanarayan. Books & Allied Publisher (p) Ltd. Kolkatta.