BHARATHIDASAN UNIVERSITY
TIRUCHIRAPPALLI – 620 024

M. Phil. Biochemistry (FT / PT) PROGRAMME
(For the candidates to be admitted from the academic year 2007-2008 onwards)

Semester I

	Title of the Course	Marks			Credits
		IA	UE	Total	
Course -I	General Biochemistry	25	75	100	4
Course - II	Plant and Microbial Biochemistry	25	75	100	4
Course- III	Research Methodology and Biostatistics	25	75	100	4

Semester II

Course – IV	Elective (Any one)	25	75	100	4
	1 Clinical Biochemistry 2 Protein Engineering and Enzyme Technology 3 Bioinformatics 4 Genetic Engineering and Molecular Techniques				
	Dissertation and Viva-Voce Viva Voce 50 marks Dissertation 150 marks			200	8

QUESTION PAPER PATTERN (Course I – IV)

Part - A: Five questions from each unit.. Each question carries 3 marks. (5 x 3 = 15)

Part – B: One "EITHER OR" questions from each unit Each question carries 6 marks (5 x6 = 30).

Part – C: One question from each unit. The candidate has to answer three questions out of five questions. Each question carries 10 marks. (3 x 10 = 30)

M. Phil. BIOCHEMISTRY SYLLABUS

COURSE I - GENERAL BIOCHEMISTRY

Unit 1
Carbohydrates

Structure and classifications of carbohydrates- mono, di and polysaccharides- Homopolysaccharides. occurrence, structure and biological functions of Cellulose, starch and glycogen. Heteropolysaccharides . structure and biological role of glycosaminoglycans, proteoglycans and bacterial cell wall polysaccharides. Carbohydrate metabolism- fate of pyruvate under aerobic & anaerobic condition, glycolysis, gluconeogenesis, HMP Shunt, glycogen synthesis & breakdown, glycogen debranching enzyme, regulation of carbohydrate metabolism.

Unit 2
Lipids

Definition and classification of lipids. Fatty acids classification, structure and properties. Structure and biological functions of phospholipids, sphingolipids, glycolipids. Biomembrane structure. Steroids. structure, properties, functions of cholesterol, sex hormones, bile acids, phytosterol and cytosterol. Brief outline of membrane composition and structure. Fatty acid oxidation. Regulation of fatty acid metabolism. Ketone bodies, synthesis of triacylglycerol, glycerophospholipids & prostaglandins.

Unit 3
Proteins

Classification of protein -based on solubility, shape, composition, and function. Structure of proteins, primary, secondary, tertiary and quartenary. Globular proteins . hemoglobin and myoglobin. Fibrous proteins- keratin and collagen. Properties of proteins in aqueous solutions: isoelectric pH, electrophoretic mobility, hydrolysis of proteins, denaturation and renaturation of proteins, protein stability and protein folding. Amino acid deamination- transamination, oxidative deamination; urea cycle & its regulation. Heme biosynthesis & degradation.

Unit 4

Nucleic acid

Structure of purines, pyrimidines, nucleosides and nucleotides. DNA double helical structure. A, B and Z forms of DNA. DNA super coiling twists and linking number. Properties of DNA: buoyant density, viscosity, hypochromicity, denaturation and renaturation. the cot curve; C-value paradox and complexity of genomes. RNA-types and biological role. Secondary, tertiary structures of RNA. (Three dimensional structure of tRNA).

Unit 5

Enzymes

Definition of enzyme. Factors affecting enzymatic reaction. Enzyme Kinetics. Derivation of Michaelis-Menten equation for uni-substrate reactions, Km and its significance. Enzyme specificity, nature of non-enzymatic and enzymatic catalysis. Enzyme inhibition- irreversible and reversible competitive, noncompetitive, uncompetitive, mixed inhibitions. Multifunctional enzyme, multienzyme complexes. Metal dependent and metalloenzymes and oligomeric enzymes. Isoenzymes and zymogens.

Introduction to Coenzymes. Coenzymes structure and function- mechanism of pyridine nucleotides, flavin nucleotides, coenzyme A, pyridoxal phosphate, thiamine pyrophosphate, tetrahydrofolate and B12 coenzymes.

Reference:

1. Stryer, L. Biochemistry. W. H. Freeman & Co.5th edition.
2. Voet, D. and Voet, J.G., Biochemistry, John Wiley & Sons 3rd edition.
3. Lehninger, Principles of Biochemistry, Kalyani Publishers.
4. West, E.S. and Todd, W.R., 4th edition. Text Book of Biochemistry.
5. Conn, E.E. and Stumpf, P.K., Outlines of Biochemistry, John Wiley & Sons.1987.
6. Mathews, C.K. and Van Holde, K.E., Biochemistry. Benjamin Cummings Publs.
7. Zubay, L. Principles of Biochemistry, W.M.C. Brown Publs.
8. Charlotte W. Pratt, Essential Biochemistry, John Wiley & Sons.

COURSE II - PLANT AND MICROBIAL BIOCHEMISTRY

Unit-I

Plant hormones - Structural and functional relationship of plant hormones, growth regulating substances and their mode of action. Molecular effects of Auxin, gibberllic acids, ethylene, absicic acid and cytokinins in the regulation of seed dormancy, germination, growth, development and embryogenesis. Phytochemical and biochemical properties of phytochrome, photoperiodism and the phytochrome regulation of flower induction. Ethylene induced fruit ripening. Role of plant secondary metabolites like flavanoids, alkaloids and isoprenodies.

Unit-2

Phytochemicals in prevention of cancer and other chronic disease. Antioxidant effect and health promoting properties of phytochemicals.Chemical modifiers of phytochemicals used as anticancer drugs. Antibodies and, pharmaceutical production in plants and importance of micronutrients. Chemotherapy: Biochemical mode of action of antibiotics- penicillin and Chloramphenicol. Action of alkaloids, antiviral and antimalarial substances. Biochemical mechanism of drug resistance.

Unit-3

Soil microorganisms and microbial growth. Growth curve and phases of growth. Nutritional patterns among bacteria, biological nitrogen fixation, physical and chemical requirements for preservation of cultures. Antimicrobial agents-physical and chemical agents, preservatives. Organic pharmaceuticals- their role as preservatives and food additives. Clinical uses of Antimicrobial drugs - Respiratory, urinary, gastrointestinal, general nervous system, skin and soft tissue.

Unit- 4

Biotechnological potentials of microbes - production of SCP, fuel (ethanol), pharmaceuticals (antibiotics, vaccines), biofertilisers (BGA), biopesticides (Bacillus thuringiensis), biopolymers, and biosurfactants. Biology of micro-organisms of importance and use in Biotechnology -Streptomyces, yeasts (Saccharomyces, Hansenula), Spirulina and Penicillium. - Disposal of Microbes and biosafety. Bioremediation and bioleaching.

Unit- 5

Drug metabolism: Chemical pathways of drug metabolism. Phase I and Phase II reactions, role of cytochrome P450, non-microsomal reactions of drug metabolism, drug metabolizing enzymes. Chemotherapy: Biochemical mode of action of antibiotics- penicillin and Chloramphenicol. Action of alkaloids, antiviral and antimalarial substances. Biochemical mechanism of drug resistance. Adverse responses and side effects of drugs: Allergy, Drug intolerance, Drug addiction, drugs abuses and their biological effects.

Reference

1. Delin, Plant Biochemistry.5th edition.
2. Hans Valter Heldt, Plant Biochemistry, Elsevier Publs.3rd edition.2005.
3. Pelzar et al., Microbiology . Concepts and applications, McGraw Hill.
4. Casida, Prescott and Dunn, Industrial Microbiology.
5. Jawetz, Melnick and Adelbergs, Medical Microbiology, Lange Med.
6. Principles of medicinal chemistry . W.O. Foye.
7. Pharmacology by Satoskar. A.
8. A text book of Pharmacology and Pharmacotherapeutics by R.S. Satoskar, S.D.Bandarkar Ainapure

COURSE III - RESEARCH METHODOLOGY & BIOSTATISTICS

Unit 1

Research . definition, importance & need for research ethics, selection of topic, hypothesis. Research schedules, Sample collection techniques,. Data collection . review of literature & its use in designing a research work. Mode of collection of literature . year books, books & monographs, journals, conference proceedings, abstracting & indexing journals, notes & index cards, internet, magazines, CD- ROMS. Preparation of manuscript- plan of the report, designing of methodology, interpretation of data & thesis layout. Scientific writing . characteristic of scientific writing, essential features of an abstract, presentation of data, writing of results & discussions. Computer application in scientific research . World Wide Web. Finding scientific articles . Pub med . public biological databases. Power point features, slide preparation.

Unit 2

Chromatography - principle, instrumentation and application of column chromatography, ion exchange chromatography, Gel filtration, thin layer chromatography, affinity chromatography. Gas chromatography**.** HPLC, FPLC. General principle of electrophoresis . native and SDS PAGE, gradient gels, isoelectric focusing, 2D PAGE, membrane blotting of protein detection and recovery. Agarose gel electrophoresis, DNA sequencing gel, membrane blotting of nucleic acid, Hybridization of DNA dot blot and fluorescent in situ hybridization FISH, RFLP. PCR, RT-PCR and applications: Yield quantification analysis.

Unit 3

Differential centrifugation, Ultracentrifuges. Analytical and preparative ultracentrifuges. instrumentation and applications. Analysis of sub cellular fractions and determination of relative molecular mass. sedimentation velocity and sedimentation equilibrium. Units and types of radioactivity. Detection and measurement of radioactivity. radio active isotopes and their half life of isotopes. Solid and liquid scintillation counting, quenching and quench correction, scintillation cocktails and sample preparation. Cerenkov counting. Autoradiography. Applications of radioisotopes in research and therapy. Radiation hazards, radiation dosimetry.

Unit 4

Laws of absorption and absorption spectrum. Principle, instrumentation and applications of UV, visible spectrophotometer and spectrofluorimetry. Atomic spectroscopy.principle and applications of atomic flame and flameless spectrophotometer. Use of lasers for spectroscopy. Basic principles of turbidimetry. Basic principles and application of mass spectrometry. Basic principles and applications of NMR, ESR, ESI-MS, MALDI TOF, GC MS, CD- dichroism, X-ray diffraction, etc.

Unit 5

Biostatistics- Measures of Central tendency . means (arithmetic, harmonic & geometric) median and mode. Methods of sample collection data, classification & tabulation , diagrammatic representation- pie diagram, bar diagram, graphical representation . histogram, less than & more than O give curve .Correlation Co-efficient, levels of significance, Student .t. test, .Chi. square and goodness of fit. the normal N distributions, ANOVO.

Reference

1. Anderson, Durston, Polle (1970) Thesis and assignment writing Wil Eastern Limited
2. Beveridege.B. (1979) The Art of Scientific investigation, W.E.Norton. & Co.New York
3. Biostatistical analysis . J.H.Zar, 4th edition.Pearson Education,Inc.India.
4. Braun, R.P. Introduction to instrumental analysis, McGrawHill.
5. Wilson & Walker, Principles and Techniques of Biochemistry and Molecular Biology . 6th Edn, Cambridge Univ. Press.

ELECTIVE I.1 - CLINICAL BIOCHEMISTRY

Unit 1

Carbohydrate metabolism:

Carbohydrate metabolic disorders: Sugar level in normal blood-maintenance of blood sugar concentration. Definition, etiology, metabolic changes with clinical correlations and treatment- hypoglycemia, hyperglycemias, Hypoglycemic agents glycosuria, fructosuria, galactosaemia, diabetes mellitus classification, complications; diabetic coma, diabetic ketoacidosis, lactic acidosis and glycogen storage diseases. Glucose Tolerance Test. Insulin tolerance test .

Unit 2

Lipid Metabolism

Lipid metabolic disorders . Plasma lipoproteins- lipoproteinemias, lipid metabolism in liver and adipose tissue. Fatty liver. Hypo and hyper cholesterolemia. Assessment of risk factors for atherosclerosis Lipid storage diseases, ketosis./atherosclerososis, Clinical features and laboratory findings in disorders of triglycerides, lipoproteins and cholesterol metabolism.investigation and principles of treatment of hyperlipidemias.

Unit 3

Nitrogen Metabolism

Overview of amino acid and nucleotide metabolic disorder . nitrogen balance, proteinuria, multiple myeloma, Wilson.s disease. Phenyl ketonuria, alkaptanuria, tyrosinosis, albinism, hart nub.s disease, Fan conic syndrome, cystinuria. . Hyperuricemia, Gout . complications, Lesch nyhan syndrome, Orotic aciduria, _ephritic_.

Unit 4

Endocrine Disorders

Disorders of endocrine system. Disorders of thyroid-hypothyroidism, hyper thyroidism , pituitary-cushing syndrome, diabetes insipidus, ,gigantism,acromegaly ,dwarfism, myxedema, adrenal cortex .aldosteronism ,hyperaldosteronism and sex hormones. Disturbances in blood clotting mechanisms- hemophilia and anemia.

Unit 5

Organ function tests-

Hyper, hypo and achlorhydria. Liver function tests-VanderBergh reaction, icteric index.glucose tolerance, galactose tolerance,fructose toleranceand epinephrine tolerance test hippuricacid.test and prothrombin time test .Jaundice .hemolytic,hepatic and obstructive jaundice. Renal function tests-urea clearance,creatinine and inulin clearance test Biochemical findings in nephritis and _ephritic syndrome. Normal and abnormal constituents of urine.

Reference:

1. Stryer, L. Biochemistry. W. H. Freeman & Co.
2. Voet, D. and Voet, J.G., Biochemistry, John Wiley & Sons.
3. Murray et al. Harper.s Biochemistry 25th Edn. McGraw Hill.
4. Lehninger, Principles of Biochemistry, Kalyani Publishers.
5. Thomas M. Devlin. Biochemistry with Clinical Correlations.
6. Benjamin Lewin, Genes VIII.
7. Helmrich, Biochemistry of cell signaling, Oxford Univ. Press.
8. Gomperts, Signal transduction.

ELECTIVE I.2
PROTEIN ENGINEERING AND ENZYME TECHNOLOGY

Unit-1

Peptide bonds, forces stabilizing primary, secondary, tertiary and quaternary structure of proteins. Reverse turns and Ramachandran plot. Principles for structure and function of proteins. Structure analysis of proteins, protein folding/ stability.

Unit -2

Methods for isolation purification and characterization of enzymes.
Immobilization of enzymes and their applications, An overview of common genetic techniques related to protein engineering. Abzymes and their applications Enzyme electrodes, biosensors and their applications, ELISA, EMIT

Unit 3

Enzymes in pharmaceutical industry, leather industry, detergent industry, food industry, research, therapeutic and clinical diagnosis. Sources of industrial enzymes, thermophilic enzymes, peptic enzymes, lipases, Proteolytic enzymes in meat. Enzymes as thrombolytic agents, anti-inflammatory agents, debriding agents and digestive aids.

Unit 4

Enzyme and protein engineering: General introduction to protein engineering, Site-specific and multiple amino acid substitutions. Functional and structural consequences and limitations Strategies and approaches. Application of molecular modeling and structure predictions to protein engineering Molecular modeling Molecular mechanical calculations and geometry optimization Overview of current methods in prediction of secondary and tertiary structure from sequence.

Unit 5

Engineering with unnatural amino acid analogs
Site-specific incorporation of amino acid analogs by in vitro methods
De novo protein design & artificial proteins:
Approaches used in designing and constructing novel proteins
Use of scaffold proteins
Energy status of a protein molecule.

Reference:

1. Lehninger, Principles of Biochemistry, Kalyani Publishers.
2. T. Palmer, Prentice Hall, Understanding Enzymes.
3. Stryer, L. Biochemistry. W. H. Freeman & Co.
4. Voet, D. and Voet, J.G., Biochemistry, John Wiley & Sons.
5. Haefner, Modeling Biological Systems, Springer Publ.

ELCTIVE I.3 - BIOINFORMATICS

Unit - I

Basics of Bioinformatics:

Role of computers in biology (biocomputing) . Origin and overview of bioinformatics . Applications of bioinformatics . National and International Bioinformatics Institutes and Industries - Research in bioinformatics - Job opportunities of bioinformaticians - various OMES and OMICS

Unit - II

Biological Databases:

Literature databases: PubMed, PMC and Public Library of Sciences (PLoS) - Sequence databases: GenBank, DDBJ, EMBL, PIR and Swiss-prot . Pattern and Motif searches: PROSITE, BLOCKS, PRINTS, PFAM . Structure databases: PDB and NDB . Structural classification databases: SCOP, CATH

. Metabolic pathways database: KEGG, BioCyc, MetaCyc, PathDB, Pathguide, Klotho and EMP(Enzymes and metabolic pathways database).

Unit - III

Sequence alignment:

Pairwise sequence alignment - Local and Global alignments . Dotplot - Dynamic programming methods . Scoring or Substitution matrices (PAM and BLOSUM) - Statistics of alignment score - Database searching - FASTA

and BLAST searches - Multiple sequence alignment . ClustalW . T-Coffee . Tools for Drug discovery / drug design

Unit - IV

Genomics and Proteomics:

Genome features of Prokaryote and Eukaryote . Gene finders: GLIMMER and GENSCAN . Genome browser: UCSC - Genome projects: E.coli, A.thaliana and Human - Genomic variations (SNP) . Genome expression (Microarray) .Comparative Genomics: MUMMER

Protein sequence and structure characterization - Proteomics tools in Expasy server. Secondary structure prediction: GOR and Chou Fasman - Tertiary structure prediction: Homology modeling . Protein structure visualization tools: RasMol and Swiss PDB Viewer

Unit - V

Phylogenetic analysis:

Sequence-based taxonomy - From Multiple Alignment to Phylogeny - phylogenetic tree representation - Construction of dendrogram - Computer Tools for phylogenetic analysis: PAUP and PHYLIP.

Reference:

1. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, Baxevanis and B.F. Ouellette. Bioinformatics: A practical Guide to the
2. Analysis of Genes and Proteins, Third edition, Wiley-Interscience. D.W. Mount, Bioinformatics - Sequence and Genome Analysis, 2nd edition, CBS publishers.
3. D. Higgins and W. Taylor (Eds), Bioinformatics- Sequence, structure and databanks, Oxford University Press.
4. M.Campbell & L. J. Heyer, Discovering Genomics, Proteomics & Bioinformatics, Pearson Education.
5. S.R. Pennington & M.J. Dunn, Proteomics . from protein sequence to function, Viva Books Pvt. Ltd.,

Reference Websites:

1. NCBI . www.ncbi.nlm.nih.gov
2. DDBJ . www.ddbj.nig.ac.jp/
3. EMBL . www.ebi.ac.uk/embl/
4. PIR . http://pir.georgetown.edu/
5. SWISSPROT . http://www.expasy.org/sprot/
6. Prosite . http://us.expasy.org/prosite/
7. Blocks . http://www.blocks.fhcrc.org/
8. Pfam . http://www.sanger.ac.uk/Software/Pfam/
9. PDB . http://www.rcsb.org/pdb/
10. NDB - http://ndbserver.rutgers.edu/
11. SCOP . http://scop.mrc-lmb.cam.ac.uk/scop/
12. CATH . http://www.biochem.ucl.ac.uk/bsm/cath/
13. KEGG . http://www.genome.ad.jp/kegg/kegg2.html
14. WBD . http://www.eti.uva.nl/tools/wbd.php
15. BLAST . http://www.ncbi.nlm.nih.gov/BLAST
16. FASTA . http://www.ebi.ac.uk/fasta33/

17. CUTALW . http://www.ebi.ac.uk/clustalW
18. T-Coffee . http://igs-server.cnrs-mrs.fr/~cnotred/Projects_home_page/t_coffee_home_page.html
19. GOLD - www.**genomesonline**.org/
20. GLIMMER - www.cbcb.umd.edu/software/**glimmer**/
21. GENSCAN . http://genes.mit.edu/GENSCAN.html
22. UCSC . http://genome.ucsc.edu
23. CMR - http://cmr.tigr.org/tigr-scripts/CMR/CmrHomePage.cgi
24. MUMMER - http://mummer.sourceforge.net/
25. ACT - http://www.sanger.ac.uk/Software/ACT/
26. EXPASY . http://www.expasy.org
27. EMBOSS - http://www.ebi.ac.uk/emboss/
28. RasMol . http://www.umass.edu/microbio/rasmol/
29. SPDBV . http://www.expasy.org/swissmod/SWISS-MODEL.html
30. PAUP - http://paup.csit.fsu.edu/
31. PHYLIP . http://evolution.genetics.washington.edu/phylip.html

ELECTIVE I.4
GENETIC ENGINEERING AND MOLECULAR TECHNIQUES

Unit: 1

Understanding of genetic engineering:
Definition; History and multidisciplinary nature of Genetic Engineering.
Splicing and joining of DNA molecules, DNA enzymes.
Molecular biology of E-coli, bacteriophages and yeast and their uses in genetic engineering. Usage of plasmids and phages as vectors. Model vectors for eukaryotes . Viruses. Gene cloning . concept and basic steps and technique. Construction of genomic and cDNA libraries, chromosome walking.

Unit: 2

Recombinant DNA technology and Gene cloning:

Recombination . types of transposons and transposable elements.
Transgenic plants. Use of Agro bacterium for genetic engineering in plants (like herbicide resistance, stress tolerance etc).
Plant cell cultures for the production of important compounds like primary and secondary metabolites, enzymes, pigments, perfumes, flavors, insecticides, anticancer agents and pharmacologically important compounds. Plant tissues culture
Transgenic animals and animal cloning. Gene transfer methods in animals.

Unit: 3

PCR technique

PCR.principle, RT-PCR, quantitative PCR and in situ PCR. Diagnostic and laboratory applications of PCR. Diagnosis of Cystic fibrosis by multiplex PCR,
Detection of â-Thalassemia mutation using ARMS-PCR. Comet assay.
Monitoring of oncogenes and antioncogenes. Mutagenecity testing.Ame.s test.
DNA finger printing, types, DNA foot printing, RFLP. Applications of DNA fingerprinting. Expression of genes using Micro array techniques.

Unit: 4

Applications in Biotechnology

Development of expression systems for production of recombinant proteins. Application in Disease diagnosis and therapy: Application in plant and animal
systems. Viral vectors for gene delivery. Human genome projects, gene bank and gene therapy. Biotechnology in service of environment- related applications: Pollution control, waste disposal, and biogas.

Unit: 5

Bioethics

Laws and regulations in biotechnology, patent laws and regulations. Genetically modified organisms (GMOs) in developed and developing countries, Environmental release of GMOs, Genetically modified foods . benefits and risks.
Risks for animal and human health . toxicity and food quality, allergy and pathogen drug resistance. Regulations and public acceptance. Ethics in cloning and stem cell research.

Reference:

1. Primrose, Principles of Genome analysis, Oxford Univ. Press.
2. Old & Primrose,. Principles of gene manipulation, 5th Edn. S.B. Blackwell Scientific Publs.
3. Watson, Recombinant DNA, Freeman & Co
4. Glick & Pasternak, Molecular Biotechnology, Panama Publs.
5. Smith, J.E. 1996. Biotechnology, Cambridge Univ. Press.
6. Benjamin Lewin, Genes VII, Oxford Univ. Press.
7. Enderle Blanchard & Bronzino, Introduction to Biomedical Engineering Elsevier Publ.