BHARATHIDASAN UNIVERSITY
TIRUCHIRAPPALLI – 620 024

M. Phil. BIOTECHNOLOGY (FT / PT) PROGRAMME

(for the candidates admitted from the academic year 2007 - 2008 onwards)

Semester I

	Title of the Course	Marks			Credits
		IA	UE	Total	
Course -I	Research Methodology	25	75	100	4
Course - II	Genomics and Proteomics	25	75	100	4
Course- III	Biomaterial Science	25	75	100	4

Semester II

Course – IV	Elective Biomonitoring of Environmental Pollution	25	75	100	4
	Dissertation and Viva-Voce Viva Voce 50 marks Dissertation 150 marks	200(150+50)			8

QUESTION PAPER PATTERN (Course I – IV)

Part - A: Two questions from each unit (without choice). Each question carries 2 marks. (10 x 2 = 20)

Part – B: One "EITHER OR" questions from each unit Each question carries 5 marks (5 x5 = 25).

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

Course – I – Research Methodology

Microscopy

Light, phase contrast, fluorescence, confocal, scanning and transmission electronic microscopy – Principles and applications. Cytophotometry and flow cytometry, fixation and staining. Atomic force Microscope, Atomic Tunneling Microscope.

Biochemical and Biophysical Methods

Principles of methods for biopolymer structure analysis, X-ray diffraction studies of macromolecules, fluorescence, UV, Visible spectrophotometer, NMR and ESR spectroscopy. Mass Spectrometry, GC-mass spectra Micro array technique, Oxygen electrode, amino acid analyzer, Differential centrifugation and ultra centrifugation.

Chromatography

Principles and applications of gel filtration, ion exchange and affinity chromatography, thin layer and Reverse phase chromatography, high pressure liquid chromatography (HPLC), gas chromatography, Circular Annular Chromatography

Electrophoresis

PAGE, SDS – Page and Agarose gel electrophoresis, Silver staining, Isoelectric focusing, Immunoelectrophoresis. 2D electrophoresis, Gel documentation.

Immunological Techniques

ELISA, ELISPOT Test, Immunodiffusion, Immunoprecipitation – Agglutination Techniques, IFAT, RIA, FAC.

Blotting Techniques

Principles and techniques of Southern, Northern and South – Western techniques and hybridization.

Molecular Tools for Analysis of Genome

Principles and applications of PCR, RFLP, RAPD, AFLP and DNA Fingerprinting. Principle and applications of DNA sequencing – Automated DNA sequencing, Gene silencing and knock outs.

Tracer Techniques

Principles and applications of radioactive isotopes, Autoradiography and Liquid scintillation counter, GM counter.

Statistics

Principles and practice of statistical methods in biotechnological research, Basic statistics, data collection, Significance tests, Students t-test, Analysis of Variance, Correlation Regression, Chi-square Test and Duncan's multiple test.

Bioinformatics Tools

Databases: Sequence, Sequence Analysis and Structure visualization software's; Global vs local alignment – similarity searching – principle and algorithms – pairwise alignment and multiple alignment – database searching – Protein structure prediction – secondary and tertiary and motifs – Proteomic tools at ExPASy server – RNA structure analysis – Plasmid mapping and Primer designing – Prediction of genes, promoters, splice sites and regulatory regions- Genome comparisons, Phylogeny analysis, Pharmacogenomics.

Reference Books:

Molecular Cloning – A laboratory manual (Third Edition) – Joseph Sambrook & David

Laboratory Instrumentation, M. Prakash, C.K.Arora – Anm of Publications Pvt. Ltd.

Experiments for Instrumental methods, A laboratory manual, Charles N.Relly, Donald. T.Saweyer, Robert E.Krieger Huntington, New York.

Instrumental methods of Analysis, Hoburt, H.Willard, Lynme L.Meritt. J.R.John.A.Dean – East West Press Pvt. Ltd.

Life Science in Tools & Techniques, P.S. Bisen / shrutimattur – CBS Publishers.

Fundamentals of biostatistics, Khan & Khanum – Ukaaz Publications.

Bioinformatics. Sequence and Genome Analysis (2001), David Mount, Cold Spring Harbor laboratory Press.

Bioinformatics (2205), N.Gautam, Narosa Publications, And selected articles from Biotechnology Journals

Plant Molecular Biology: A Laboratory Manual – Springer Lab Manual.

Plant Molecular Biology: A Laboratory Manual – Gelvin, Kluwer Academic Press.

Molecular Cloning: A laboratory Manual – Sambrook Fritsch and Maniatis
Basic Biophysics for Biologists – M.Daniel, Agrobotanica.
Biostatistics – P.N. Arora and P.K. Malhothra.
Statistical Methods in Biology - Norman T.S. Bailey, Cambridge University Press,UK.
Understanding Computer Fundamentals – R. Rajagopalan, Tata McCraw – Hill Publishing Company Ltd.

COURSE II - GENOMICS AND PROTEOMICS

Unit I

Introduction to Genomics – Structure and organization of prokaryotic and eukaaryotic genomes – nuclear mitochondrial and chloroplast genomes – Interaction between nuclear and chloroplast genome – Recognition of coding and noncoding regions and annotation os genes. Tools for genome analysis – rDNA, cDNA Genomic library bloting techniques – RFLP, DNA fingerprinting, RAPC, PCR and Automated DNA sequencing. Linkage and Pedigree analysis – Physical and genetic mapping.

Unit II

Genome sequencing projects – Microbes, plants and animals, Comparative genomics of relevant organisms such as pathogens and non- pathogens. Taxonomic classification of organisms using molecular markers – 16S rRNA typing / sequencing. Computational analysis – Sequence analysis – Similarity searches and pairwise alignment - Global and Local alignments - Multiple sequence alignment – Phylogenetics.

Unit III

Functional Genomics – Global gene expression analysis. Microarray – Spotted microarrays and oligonucleotide microarrays – genotyping microarrays – comparative transcriptomics - Differential gene expression, Transplastomics.

Unit IV

Proteomics – definition, identification and analysis of proteins by 2D analysis, mass spectrophotometry, MALDI – TOF, NMR, CD, FTIR, small angle x-ray scattering, differential display proteomics, protein – protein interactions, yeast two hybrid system and phage display.

Unit V

Pharmacogenetics – high throughout screening for drug discovery – identification of drug targets, pharmacophore, pharamacogenetics and drug development. ADME properties, Metabolome and Metabolomics Systems Biology – Model systems, global databases and analyses and statistical modeling.

References:

1. Genomics: The Science and Technology Behind the Human Genome Project (2000), Edited by C.Cantor and C.L. Smith, Wiley-Interscience, New York.
2. Genome analysis – A Practical Approach (1995) by J.M. Davies, Oxford University Press, Oxford.
3. Genome Mapping – A Practical Approach (1997) by P.H. Dear, Oxford University Press, Oxford.
4. DNA microarrays: a practical approach (1999) Edited by M. Schena, Oxford Press, Oxford, England.
5. Twyman,R.M. 2004. Principle of proteomics, BIOS Scientific Publishers, New York, ISBN 1859962734
6. Westermeier,R. and T.Naven.2002 Proteomics in practice: a laboratory manual of proteome analysis, Wiley – VCH, Weinheim, ISBN 3527303545
7. Liebler, D.C. 2002, Introduction to Proteomics: tools for the new biology, Humana Press, Totowa, NJ. ISBN 0585418799
8. Proteome Research: New Frontiers in Functional Genomics (1997), Edited by M.R. Wilkins, K.L. Williams, R.D. Appel and D.F. Hochstrasser, Springer – Veriag, New York.
9. 2-D Proteome Analysis protocols (1998), Edited by A.L.Link, Humana Press, Totowa, NJ.
10 Protein Biotechnology by g.Walsh and D.Headen (1994), John Wiley and Sons.
11. Reviews and Articles from Journals such as Nature, Science, PNAS (USA), Nucleic Acids Research, Trends Series & Current Opinion Series.

COURSE III – BIOMATERIAL SCIENCE

Unit I

Biomaterial Science, a multi disciplinary approach, history of bio-materials, properties of materials. Molecular design & synthesis of bio-materials, Surface characterization of materials, Biodegradable solid polymeric materials, chemistry of biogradable materials-hydrolysis & erosion. Role of water in biomaterials, bio-resourable materials. Degradable matearials with biological recognition in vivo. Recognition of biomaterials by protease, engineering enzyme-mediated degradation of polymers.

Unit II

Controlled release devices, controlled release applications in biological engineering & medicine. Programmed / pulsed drug delivery and drug delivery in tissue engineering, applications of regulated & pulsatile release. Biodegradable polymers for tissue engineering.

Unit III

Structure & physical chemistry of hydrogel biomaterials, applications of hydrogels in bioengineering. Associataed forces in physical hydrogels, cross-link structure of hydrogels, Polyelectrolyte hydrogels, pyrolytic carbon for medical implants; covalaents polyelectrolyte hydrogels; Bramon-peppes theory of swelling in ionic hydrogels; silicone bio-material and its chemistry.

Unit IV

Molecular design & synthesis of biomaterials; inorganic biomaterials; biomineralization & biomimetic inorganic crystals. Organic templating of inorganic materialsand bone biomimesis, Molecular devices; single-molecule switches; molecular motors; nano-& micro – scale drug carriers, drug targeting. 'Stealth particles', delivery of drugs to tissues via systematic circulation, Pathological classification of biomaterials, Bioelectrodes.

Unit V

Basic structure of a biosensors, nature of biomaterials, overview of biosensor technology; detection elements, Biosensor to monitor pollution, Role of biosensor in clinical biochemistry, basic structure of a biosensor, nature of biomaterials, cell & tissue based biosensors, Biomedical sensors

Reference:

1. "Molecular Design and Synthesis of Biomaterials", Biological Engineering Division, MIT open Course ware, 27 May 2005.
2. "Biomaterials Science", B. Ratner, A. Hoffman, F. Schoen & J. Lemons, Academic press, New York, 1996

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COURSE IV– ELECTIVE
BIOMONITORING OF ENVIRONMENTAL POLLUTION

Unit I – Environmental Biomonitoring

Environmental monitoring of pollutants – Definition – Objectives – Benefits. Classification of monitoring – Biomonitoring – Ecological effects monitoring – Saprobic system (Microbial system) – Polysaprobic zone, mesosaprobic zone and oligosaprobic zone – Saprobic index – benthic macro invertebratea system – Trent biotic Index-Score system-sequential comparison Index. Mussel waaatch programme

Unit II – Bioindicators and Biomonitoring

Definition – types – accumulation and Indicators – response indicators – Bioconcentration and biomagnification. Characteristics of Bioindicators – Biodiveristy of Indicator organism – Sentinel and migratory – Snails, mollusks, fish, plants, rotifers, fungi, bacteria, benthos, plankton, Insects as bioindicators. Impacts of pollutants on bioindicator species.

Unit III – Bioassays in Biomonitoring

Bioassays – definition – uses – qualitative – quantitative bioassays – Types – acute, subacute, chronic bioassays – $LC_{50,}$ $LD_{50,}$ NOED, NOEC, Selective toxicity ratio – In vivo and In vitro bioassays

Unit IV - Biomarkers in Environmental Biomonitoring

Biomarkers – Definition – Historical aspects of Biomarkers – specificity of biomarkers – relationship of biomarkers to adverse effects – Classification of Biomarkers – Destructive and non-destructive biomarkers – biomarkers at different organizational levels – role of biomarkers in environmental monitoring.

Unit V

Heavy metals monitoring using – AAS, ICP, organic pollutant monitoring using GC, HPLC, GC, Coupled instruments for trace pollutants using GC-ICPMS< GC-MS, HPLC-MS

Reference:

1. Handbook of Ecotoxicology – David J. Hoffman, Barnett A. Rattnet, G. Allen Burton, Jr. John Cairns, Jr. Lewis Publishers, 1995
2. Basic concepts of Environmental Chemistry – Des.W. Connell, Taylor and Francis group, 2005
3. Handbook of Ecotoxicology, Peter Calow, Blackwell Science limited, 1998
4. Principles of Ecotoxicology, C.H. Walker, S.P. Hopkin, R.M. Sibly, D.B. Peakall. Taylor and Francis Group 2001
5. Bioindicators of POPs – Monitoring in Developing countries, Shinsuke Tanabe, Annamalai Subramanian, Kyoto University Press, 2006

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