

UNIVERSITY OF MUMBAI

No.UG / 166 of 2008

CIRCULAR :-

A reference is invited to the Ordinances, Regulations and syllabi relating to the Master of Science M.Sc (Parts – I & II) degree course vide Pamphlet No. 175 and to this Office Circular No. 271 of 2002 dated 24th June 2002 and the Head, University Department of Life Sciences, the Principals of the affiliated Colleges in Science and the Directors/ Heads of the recognized Institutions concerned are hereby informed that the recommendation made by the Ad-hoc Committee appointed by the Academic Council to advise it on all matters relating to the Courses of study and examination in the subject of Biotechnology at the B.Sc. and M.Sc. degree Course at its meeting held on 5th February, 2008 has been accepted by the Academic Council at its meeting held on 27th February 2008 vide item No. 4.21 and that, in accordance therewith, the syllabus in the subject of Biotechnology at the M.Sc. (Part-I) examination is revised as per Appendix and that the same will be brought into force with effect from the academic year 2008-2009.

MUMBAI-400 032

22nd April, 2008.

for I/c REGISTER

To,

The Head, University Department of Life Sciences, the Directors/Heads of recognized Science Institutions concerned and the Principals of the affiliated Colleges in Science.

A.C./4.21/27.02.2008

No.UG/166-A of 2008,

MUMBAI-400 032

22nd April, 2008

Copy forwarded with compliments for information to :-

- 1) The Dean, Faculty of Science.
- 2) The Convener, Ad-hoc Committee in Biotechnology.
- 3) The Controller of Examinations,
- 4) The Co-Ordinator, University Computerization Centre,

for I/c. REGISTRAR

Copy to :-

The Director, Board of College and University Development, the Deputy Registrar (Eligibility and Migration Section), the Director of Students Welfare, the Executive Secretary to the Vice-Chancellor, the Pro-Vice-Chancellor, the Registrar and the Assistant Registrar, Administrative sub-center, Ratnagiri for information.

The Controller of Examinations (10 copies), the Finance and Accounts Officer (2 copies), Record Section (5 copies), Publications Section (5 copies), the Deputy Registrar, Enrolment, Eligibility and Migration Section (3 copies), the Deputy Registrar, Statistical Unit (2 copies), the Deputy Registrar (Accounts Section), Vidyanagari (2 copies), the Deputy Registrar, Affiliation Section (2 copies), the Director, Institute of Distance Education (10 copies), the Director University Computer Center (IDE Building), Vidyanagari, (2 copies) the Deputy Registrar (Special Cell), the Deputy Registrar, the Assistant Registrar, Academic Authorities Unit (2 copies) and the Assistant Registrar, Executive Authorities Unit (2 copies). They are requested to treat this as action taken report on the resolution adopted by the Academic Council referred to in the above Circular and that, no separate Registrar Constituent Computing Unit (2 copies), at Registrar Constituent Computing Facility (1 copy), Superintendent, Post



UNIVERSITY OF MUMBAI



Revised Syllabus

in

Biotechnology

at the

M.Sc. (Part-I)

(With effect from the academic year 2008-2009)

Revised Syllabus

(With effect from the Academic Year 2008-2009)

PAPER I: Biochemistry

Unit	Topic	Subtopic	No of lectures
I	Proteins and amino acids	General properties of amino acids; peptide bond characteristics; optical activity; non-standard amino acids and their specialized function. Primary structure of proteins and their determination – end group analysis; cleavage of disulphide bond; separation, purification, characterization of polypeptide chain; amino acid composition determination; specific peptide cleavage reactions; separation and purification of peptides, sequence determination, peptide mapping Secondary structure – peptide group, Ramachandran plot, helical structure, beta structure; fibrous and globular structure. Protein stability – electrostatic forces, hydrogen bond, hydrophobic interaction, disulphide bond, protein denaturation, stability of thermostable proteins. Quaternary structure – subunit interaction, symmetry, subunit composition determination	15
	Hemoglobin	Structure and mechanism, function, abnormalities, allosteric regulation; Comparison to myoglobin	15
II	Lipids	Properties of lipid aggregates – micelles and bilayer, liposomes, bilayer dynamics Lipoproteins – structure, function and dysfunction in Alzheimer's and Atherosclerosis	10
	Biological membrane	Membrane proteins, transport of substances through the membrane, supra-molecular assembly.	10
	Neuro-chemistry	Anatomy and functions of neuron, organization of Brain, neuronal Pathways and systems, propagation of nerve impulse, ion conducting channels, neuronal metabolism, synapses and gap junction, neurotransmitters, neurotoxins, mental illness and drugs, addictive and psychotropic drugs; odor, taste, & hearing; the chemistry of thinking, circadian cycles and sleep	10

III	Carbohydrate metabolism	HMP, uronic acid pathway, glycogenolysis and glycogen storage diseases	8
	Lipid metabolism	Synthesis of essential fatty acids, mycolic acid	4
	Protein metabolism	Biosynthesis of essential amino acids Metabolic breakdown of amino acids leading to Krebs cycle intermediates Disorders of amino acid metabolism	10
	Nucleic acid metabolism	Biosynthesis and degradation of purines and pyrimidines with regulation, deficiency diseases	8
IV	Plant metabolism	Ultrastructure of chloroplast, photosystems I and II, cyclic and Non-cyclic photophosphorylation (detail), C-3 cycle and C-4 cycles, CAM, glyoxalate pathway, photosynthetic formation of hydrogen Nitrogen fixation and role of nitrogenase	10
	Intermediary metabolism	Integration of metabolic pathways through Krebs cycle and energy metabolism	5
	Inborn errors of metabolism	Disorders of carbohydrate metabolism E.g., <i>glycogen storage disease</i> , Disorders of amino acid metabolism E.g., <i>phenylketonuria</i> , <i>maple syrup. urine disease</i> , <i>glutaric acidemia type I</i> , Disorders of organic acid metabolism (organic acidurias) E.g., <i>alcaptonuria</i> , Disorders of fatty acid oxidation and mitochondrial metabolism E.g., <i>medium chain acyl dehydrogenase deficiency (glutaric acidemia type 2)</i> , Disorders of porphyrin metabolism E.g., <i>acute intermittent porphyria</i> , Disorders of purine or pyrimidine metabolism E.g., <i>Lesch-Nyhan syndrome</i> , disorders of mitochondrial function E.g., <i>Kearns-Sayre syndrome</i> , Disorders of peroxisomal function E.g., <i>Zellweger syndrome</i> , Lysosomal storage disorders E.g., <i>Gaucher's disease</i>	10
	Bioluminescence	Sources of bioluminescent material, mechanism in specific organisms, application	5

References:

Sr.No	Title of the Book	Author	Publisher
1	Biochemistry, 5 th edition	J. Berg, J. Tymoczko & L. Stryer	W. H. Freeman & Company
2.	Biochemistry, 4 th Edition	G. Zubay	Wm .C. Brown
3	Biochemistry, The chemical reactions of living cells, Volume I and II.	David E. Metzler	Elsevier
4.	Lehninger's Principles of Biochemistry, fourth edition.	Nelson and Cox	Macmilan Worth
5.	Biochemistry third edition, 2004	Donald Voet and Judith Voet.	John Wiley and sons, Inc
6.	Textbook of Biochemistry with clinical correlations, Fifth Edition	Thomas Devlin	John Wiley and sons, Inc
7.	Fundamentals of biochemistry	A C Deb	New Central Book Agency
8.	Biochemistry, second ed.	Mathews, Van Holde	The Benjamin/ Cummins publishing Company
9.	Biochemistry, fourth and fifth ed	Campbell and Farrell	Thomson Brooks/Cole
10.	Harpers Illustrated biochemistry, 26 th Edition	R Murray, D Granner, P Mayes	McGraw Hills
11	Diagnostic Recognition of Genetic Disease	William I Nyhan, Nadia A Sakati	Library of Congress cataloging in publication data.

PAPER II: Immunology

Unit	Topic	Subtopic	No of lectures
	Introduction to immunology	Historical perspective, Innate and adaptive immunity, Hematopoiesis, Cells of immune system, Organs of immune system, Antigens	2
	Immuno-globulins	Immunoglobulin fine structure, Antibody sequencing – obstacles, Antibody mediated effector function, Immunoglobulin superfamily Multigene organization of Ig gene, Variable region gene rearrangement, Generation of antibody diversity, Class switching among constant region, Synthesis, assembly, and secretion of immunoglobulins	18
	Complement system	Activation, Regulation , Biological consequence of complement activation, Complement deficiency	10
II	MHC	Cellular distribution of MHC molecule. Antigen processing and presentation – exogenous and endogenous antigen processing Self - MHC restriction of T cells Presentation of non-peptide antigens	11
III	Cytokines	Properties, receptors, antagonists, diseases, therapeutic use of cytokines	8
	Regulation of immune response	Generation of humoral and cell mediated immune responses, Activation of B and T lymphocyte, T-cell regulation, Immunological tolerance	11
	Hypersensitivity	Gel and Coomb's Clasification; Type I, II, III, IV hypersensitivity	6
	Autoimmunity	Organ specific, systemic, mechanism, treatment	6
	Transplantation	Basis of Graft rejection, clinical manifestation of graft rejection; immunosuppressive therapy; immune tolerance; clinical transplantation.	6
	Immunity of infectious agents	Viral, bacterial, protozoan, parasitic worms	6
	Tumor immunology	Oncogenes and cancer induction, Tumor of immune system, Tumor antigens, Tumor evasion of immune system, Cancer immunotherapy	6
	Immuno-deficiency	Primary immunodeficiency and secondary immunodeficiency	6

IV	Experimental systems	Experimental animal methods; cell culture systems	6
	Advances in biotherapeutics	Gene therapy, Stem cells, Monoclonal antibodies, Therapeutic proteins, RNAi drug delivery systems.	6
	Diagnostic methods	Advances in molecular and immunological techniques; microarray; advances in fluorescence techniques, Proteomics, genotyping.	6
	Clinical research	Introduction, good clinical practice guidelines, ethical aspects of clinical research, clinical research methodologies and management, regulatory requirements, data management and statistics in clinical research.	8
	Vaccines development	Avian vaccine, tuberculosis, polio, malaria, HIV, HPV vaccine, Plantibodies rubella vaccine.	4

References:

Sr.No	Title of the Book	Author	Publisher
1.	Immunology, fifth Ed	Goldsby, T J. Kindt, Osborne, Janis Kuby	Freeman and company.
2.	Immunology, sixth Ed	Roitt, Brostoff, Male	Mosby, An imprint of Elsevier science Ltd
3.	Cellular and molecular immunology, Fourth edition	Abbas, Abul K & Lichtman	W B Saunders company
4.	Immunology, An introduction, fourth edition.	Ian R Tizard	Thomson
5.	Immunology the experimental series	Wener Luttmann, K Bratke, M. Kupper, D Myrtek	Elsevier
6.	An introduction to Immunology	C V Rao	Narosa Publishing house
7.	Immunology essential and fundamental, Second edition	S Pathak & U Palan	Parveen Publishing House
8.	Elements of Immunology	S C Rastongi	CSB Publishers and distributors
9.	Immunology, fourth edition.	Gordan Reeve and Ian Todd	Blackwell Publishing House
10	Microarray and Microplates	S Ye and I N M Day	Bios

PAPER III: Genomes, Transcriptomes and Proteomes

Unit	Topic	Subtopic	No of lectures
I	The Human Genome	The content of the human nuclear genome. The human mitochondrial genome. Why is the Human Genome Project Important?	30
	The Repetitive DNA	Tandemly repeated DNA Interspersed genome-wide repeats	
	Mapping Genomes	Genetic and Physical Maps Genetic Mapping: Genes, were the first marker to be used, DNA markers for genetic mapping, Physical Mapping: Restriction Mapping, Fluorescent in situ hybridization (FISH), Sequence tagged site (STS) mapping	
	How Genome Evolve	Genomes-The First 10 Billion Years: The origin of genomes. Acquisition of New Genes: Acquisition of new genes by gene duplication, Acquisition of new genes from other species. Non-coding DNA and Genome Evolution: Transposable elements and genome evolution, The origins of introns The Human Genome- the Last 5 Million Years.	
II	Assembly of the Transcription Initiation Complex	The importance of DNA-binding Proteins: Locating the positions of DNA-binding sites in a genome, purifying a DNA-binding protein. DNA-Protein Interactions during Transcription Initiation: RNA polymerases, Recognition sequences for transcription initiation, Assembly of the transcription initiation complex. Regulation of Transcription initiation: Strategies for controlling transcription initiation in bacteria, Control of transcription initiation in eukaryotes.	15
	Synthesis and Processing of RNA	Synthesis and Processing of mRNA: Synthesis of bacterial mRNAs, Synthesis of eukaryotic mRNAs by RNA polymerase II, Intron splicing. Synthesis and processing of Non-coding RNAs: Transcript elongation and termination by RNA polymerases I and III, Cutting events involved in processing of bacterial and eukaryotic pre-rRNA and pre-tRNA, Introns in eukaryotic pre-rRNA and pre-tRNA. Processing of Pre-RNA by Chemical Modification. Degradation of mRNAs Transport of RNA within the Eukaryotic Cell.	15

III	Synthesis and Processing of the Proteome	The Role of tRNA in Protein Synthesis: Aminoacylation i.e. the attachment of amino acids to tRNAs, codon-anticodon interactions i.e. the attachment of tRNAs to mRNAs. The Role of the Ribosome in Protein Synthesis: Ribosome structure, Initiation of translation, Elongation of translation, termination of translation. Post-translational Processing of Proteins: Protein folding, Processing by proteolytic cleavage, Processing by chemical modification, Inteins. Protein Degradation.	15
	Regulation of Genome Activity	In prokaryotes: regulation of transcription initiation, regulation after transcription initiation In eukaryotes: recruitment of protein complexes to genes by activators, combinatorial control, transcriptional repressors, signal transduction and control of transcriptional regulators, Genome rearrangements, gene silencing by modification of histones and DNA, RNAs in gene regulation. Regulation of Genome Activity During Development: Sporulation in <i>Bacillus</i>, Vulva development in <i>Caenorhabditis elegans</i>, Development in <i>Drosophila melanogaster</i>.	15
IV	DNA vectors	Cosmid vectors, Phagmids, BACs, PACs. Choice of vectors. Vectors for making ssDNA for sequencing. Expression vectors, Vectors for making RNA probes, Vectors for maximizing protein synthesis, vectors to facilitate protein purification, vectors to promote protein solubilization, vectors to promote protein export, Cloning strategies, Cloning in <i>S. cerevisiae</i>, Gene transfer to animal cells.	30

References:

Sr.No	Title of the Book	Author	Publisher
1	Gene VII	Benjamin Lewin	Oxford Publishers
2.	Genome, Second edition	T A Brown	Bios Scientific
3	Principles of Gene Manipulation.	Old and Primrose	Blackwell Science
4.	Principles of genetics	Simmons, Gardner	John Wiley and sons, Inc
5.	Biochemistry third edition, 2004	Donald Voet and Judith Voet.	John Wiley and sons, Inc
6.	Molecular biology of the gene	T D. Watson and others	Pearson education ltd.
7.	The Cell, a molecular approach	G M Cooper	Library of Congress cataloging in publication data.
8.	An introduction to genetic analysis	Griffiths, A. and Miller J	Freeman
9.	Molecular cell biology	Lodish.H, Berk A	John Wiley and sons, Inc
10.	Molecular cloning, Vol I, II , III	Sambrook J, Russell.	CSHL Press
11	Gene cloning and DNA analysis	T A Brown	Bios Scientific

PAPER IV: Biophysics and Advanced Analytical Techniques

Unit	Topic	Subtopic	No of lectures
I	DNA Topology	Different types of DNA, - A/B/C/Z and RL form of double helical DNA, Triple Helix, Nucleic acid binding protein – Leucine Zipper, Zinc fingers, OB fold, Beta Barrel, Helix-turn-helix, Helix-loop-helix. Linking number, Supercoiling, Topoisomerases.	15
	Protein secondary Structure	Description and significance of different secondary structures, structural motifs and domains present in the proteins. Protein folding. The different pathways of protein folding and its co-relation with protein stability. Mechanism action of molecular chaperons, heat shock proteins, ribosomes, etc. Stabilizing the proteins structure and function.	15
II	X-Ray Crystallography	X-Ray Diffraction: structure factor express, ion, electron density equation, phase problems, Patterson function, molecular replacement method, heavy atom method, isomorphous replacement method, refinement procedure and interpretation of results. Data collection: Method of data collection of crystal containing small molecule, factors affecting the measurement of integrated intensities, photographic methods, diffractometers, area detectors and image plates.	15
	Spectroscopy	UV, IR, Raman ORD and CD, spectroscopy, basic principles, instrumentation and use. NMR/ESR: classical description of magnetic resonance in terms of precession moments, relaxation process, Bloch equation for line width and shape, spin Hamiltonian, ESR spectrometer, spin labeling in biological molecules, NMR: spectrometer instrumentation, pulsed and Fourier transformed NMR, scalar and dipolar broadening, line multiplicity, ring current shifts factors affecting relaxation time, Karplus equation and use of NMR for conformational study, Mossbauer spectroscopy, Resonance absorption in biological samples. Line shape, line width, chemical shifts, quadruple and magnetic splitting in Mossbauer spectra of biological molecules.	15

III	Analytical Techniques used in Protein Chemistry	Different analytical techniques used for purification and determining the molecular size, shape, diffusion and sedimentation, gel filtration, Viscosity, light scattering, small angle scattering methods, Capillary isoelectric focusing electro spray ionization mass spectrometry (CIEF-ESI-MS), 2-D Page, Electrospray MS/MS (Nanospray and LC/MS/MS), MALDI-TOF-MS, Biochips (DNA Chips, Protein Chips and Sensor Chips).	15
	Other Important Techniques	Electron microscopy, Confocal Microscopy, Electrochemical techniques used in environmental biotechnology, Flow cytometry, PCR (primer design, Reagents, Temperature cycling), Nested PCR, Arms PCR, Inverse PCR, PCR SCCP, Real Time PCR.	15
IV	Membrane biogenesis and macromolecular organization	Structure and assembly of different components of membrane, reconstitution of membrane, orientation of membrane proteins, solubilization of the membrane by using different detergents, Membrane mimicry, Liposome structure and their uses in drug targeting.	15

References:

Sr.No	Title of the Book	Author	Publisher
1	Biochemistry, second ed.	Mathews, Van Holde	The Benjamin/ Cummins publishing Company
2.	Biochemistry third edition, 2004	Donald Voet and Judith Voet.	John Wiley and sons, Inc
3	Molecular biology of the gene	T D.Watson and others	Pearson education Ltd.
4.	Gene VII	Benjamin Lewin	Oxford Publishers
5.	Biophysics	V Pattabhi, N Gautham	Narosa
6.	Biophysics, An Introduction	R Cotterill	John Wiley and sons, Inc
7.	Principles of instrumental analysis	Skoog, Holler, Nieman.	Thomson
8.	Basic Biophysics 2004	Daniel M	Student Edition
9.	PCR protocols, 2 nd ed	Bartlett & Stirling	Humana
10	Introduction to Protein science Architecture, Function and Genomics	Arthur M Lesk	Oxford

Practical I

1. Separation of betalains by gel filtration.
2. Study of Hemoglobin banding pattern from normal/ Thalassemia/ SCA samples by electrophoresis.
3. Detection of Phenylalanine for PKU by spot test and chromatography done with std. Phenylalanine.
4. Protein estimation by Bradford's method (calibration curve and quantification)
5. Purification of protein by ammonium sulphate fractionation, dialyze and separate using PAGE, eg- Invertase purification from active dry yeast and confirm activity by using DNSA reagent
6. Isolation of bioluminescent organisms from fish.
7. Isolation of chloroplast by sucrose density gradient centrifugation.
8. Demonstration of Hill's reaction using DCPIP.
9. Detection of LDH Isozymes from muscle by electrophoresis.
10. Study of protein complexes using PAGE and detection with CBB and Silver staining.
11. Extraction of lipids from any oil seed using soxhlet apparatus and its quantification.

Practical II:

1. Perform Affinity chromatography for purification of antibodies from serum.
2. Perform serum electrophoresis (horizontal)
3. Perform Radial Immunodiffusion for quantification of antigen.
4. Preparation of ELISA plate
5. Perform DOT ELISA
6. Perform Western blotting
7. Perform DOT-blot for protein
8. Separation of lymphocytes
9. Demonstration of phagocytosis.
10. Demonstration Practicals – Flow Cytometry, ELISA reader, etc.

* Study questions from Kuby, Roitt or Tizard

Practical III

1. Extraction of genomic DNA from bacteria, blood and plant material.
2. To set up a restriction digestion reaction
3. To set up a ligation reaction using insert and vector
4. Perform transformation of bacteria using any plasmid
5. Expression of recombinant proteins
6. Bacterial conjugation for transferring a scorable phenotype from donor to recipient cells.
7. To perform replica plate technique
8. Study of mutation by Ames's Test

Practical IV

1. To validate Autoclave, Balance, Micropipette, Centrifuge, Colorimeter, Spectrophotometer, Biosafety Cabinet, pH meter on the basis of following:
 - i. Strategies of method validation
 - ii. What and why of method validation
 - iii. Regulatory requirements
 - iv. IQ, OQ and PQ of instruments
 - v. Use of reference standards
 - vi. Issue of method transfer
 - vii. Inter and intra laboratory validation.
 2. To calibrate measuring containers.
 3. Viscosity studies of proteins (Std BSA & varying concentration of urea)
 4. Preparation of Liposomes for drug delivery
 5. Micellar separation of protein
 6. Crude preparation of membranes from ghost RBC's, study of 'AT'ases as a marker enzyme.
 7. To perform 2-D electrophoresis
 8. PCR amplification.
 9. Quality Assurance
 10. GC of any modern drug from the plasma and its formulation (Dichlorofenac - Na)
 11. Quantization of nucleic acids (UV Spectrophotometer)
 12. HPLC of modern drugs like paracetamol, Dichlorofenac
 13. To study therapeutic drug monitoring for antianalgesic, antipyretic/anti-inflammatory drugs using HPLC
- *4 Present a seminar on any research paper obtained from a recent (past 5 years) journal with reference to any topic of choice.

ANNUAL EXAMINATION PATTERN

Paper I	Biochemistry	75 marks
Paper II	Immunology	75 marks
Paper III	Genomes, Transcriptomes and Proteomes	75 marks
Paper IV	Biophysics and Advanced Analytical Techniques	75 marks
Practicals 50 marks each (inclusive of Viva-voce and journal)		200 marks
Theory and practical total marks		500 marks

ANNUAL THEORY EXAMINATION ASSESSMENT PATTERN

1. Every paper will have 5 questions of 15 marks each.
2. 4 questions will be from 4 of the 4 units in curriculum. There shall be internal choice as per UGC guidelines.
3. Fifth questions shall consist of any one essay or any three notes/short question from any of the units.
4. Candidate is required to attempt all 5 questions (total marks 75 marks). Duration of three hours.

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