UNIVERSITY OF MUMBAI
No.UG/133 of 2009

CIRCULAR :-

A reference is invited to the Ordinances, Regulations and syllabi relating to t Master of Science (M.Sc. Parts I & II) degree course **vide** Pamphlet No.175 and to t office Circular No.UG/249 of 2003 dated 16th June, 2003 and the Head, Universi Department of Life Sciences, the Principals of the affiliated colleges in Science and t Director/Heads of the recognized, Institutions concerned are hereby informed that recommendation made by the **Ad-hoc** Committee appointed by the Academic Counci advise it on all matters relating to the courses of study and examinations in the subject Biotechnology at the B.Sc. and M.Sc. degree course at its meeting held 17th January, 2009 has been accepted by the Academic Council at its meeting held 13th February, 2009 **vide** item No. 4.6 and that, in accordance therewith, the syllabus the M.Sc.(Part – II) Biotechnology degree course . is revised as per **Appendix** and th the same has been brought into force with effect from the academic year 2009-2010.

MUMBAI-400 032
4th May,2009

PRIN. K. VENKATARAMANI
REGISTRAR

To,

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

A.C/4.6 /13.02.2009

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No.UG/133-A of 2009, MUMBAI-400 032 4th May, 2009

Copy forwarded with compliments for information to :-

1) The Dean, Faculty of Science.
2) The Chairman, Ad-hoc Board of Studies in Biotechnology,
3) The Controller of Examinations,
4) The Co-ordinator, University Computerization Center.

04/05/09

(D. H. KATE)
DEPUTY REGISTRAR,
(U.G./P.G.Section)

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 Personal Assistant to 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(5copies) 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

Enclosure to Item No. 4.6
13.2.2009

UNIVERSITY OF MUMBAI

Revised Syllabus for the

M.Sc. (Part II)

In

Biotechnology

(W.e.f. the academic year 2009-2010)

M.Sc. (Part-II) in Biotechnology

(Revised Syllabus w.e.f. academic year 2009-2010)

UNIT STRUCTURE OF THE SYLLABUS

Paper V Computational Biotechnology		Paper VI Cell Biotechnology		Paper VII Manufacturing processes and medical diagnostics.		Paper VIII Environmantal Biotechnology And Legislation	
Unit	Topic	Unit	Topic	Unit	Topic	Unit	Topic
I	Biostatistics	I	Plant tissue culture	I	Bioprocess Technology And Its Applications	I	Environ mental biotech-nology
II	Computer Application	II	Animal cell culture	II	Microbial Products	II	Ecology
III	Bioinformatics	III	Develop-mental Biotechnology	III	Medical diagnostics	III	IPR
VI	Bioinformatics	VI	Nano-technology	VI	Pharmaceutic al biotechnology	VI	IPR

PAPER V: COMPUTATIONAL BIOTECHNOLOGY

Unit	Topic	Subtopic	No of lectures
I	**Biostatistics**	1. Statistical population, sample from population, Random sample. 2. Confidence intervals 3. Central Tendency: Mean, Median and Mode, Standard Deviation 4. Gaussian Distribution and testing for normality, Non-parametric tests (Sign test, Wilcoxon test, Mann-Whitney Test, Krushkal-Whllis test,), transforming data to create Gaussian Distribution, Testing for normality 5. Chi square test, contingency table 6. Hypothesis testing:- Theory of errors- Type I and Type II errors, Null hypothesis, P values-one v/s two tail P values, t-test(paired & unpaired), z-test, Test of Significance. 7. Comparing three or more groups- Introduction to ANOVA, One way ANOVA, repeated measures ANOVA, Friedman Test. 8. Correlation and Regression: Linear and multiple Correlation and Regression.	30
II	**Computer Application**	1. Role of computers in health care and clinical decisions 2. Information system development 3. Clinical data bases 4. Computer-based patient records or diagnosis. 5. Spreadsheet and their applications. 6. Basic C programming 7. Introduction to statistical software like MiniTab, SAS. 8. Algorithm. Computer program for random no. generations 9. Design of experiments. And statistical analysis of biological data.	30
III	**Bioinformatics**	1. Organization of biological data, databases (raw and processed), Quering in data bases. 2. Primers in biology(Designing of primers, kinds of primers) 3. Gene finding, motif finding and multiple sequence alignment.	30

		4. Protein sequence analysis (theory and algorithms) 5. Protein structure analysis and applications.	
IV	**Bioinformatics**	1. Gene expression profiling and its applications. 2. Microarray technology and basics. 3. Microarray analysis and organization of data 4. Human genome analysis 5. Proteomics. 6. Exploration of data bases, retrieval of desired data, BLAST etc. 7. Gene clusters and fusions, consensus sequences, exon intron finder, sequence logo.	30

References

Sr No	Title of the Book	Author	Publisher
1	A Introduction to Biostatistics (Second Edition-2005)	N. Gurumani	M J P Publishers
2	Basic Biostatistics (2003)	B. Burt Gerstman	Jones and Bartlett Publishers
3	Biostatistics: Afoundation For Analysis In Health Sciences (7th Edition 1999)	Wayne W. Daniel	John Wiley & Sons Inc.
4	Fundamentals of Biostatistics (2006)	Veer Bala Rastogi	Ane Books India
5	Biostatistics- The Bare Essentials (Second Edition 2000)	Nosman Streiner	B. C. Decker Inc.
6	Computer Based Decision Making in Medicine	E. A. Shortifile	American Elsevier
7	Bioinformatics : Sequence and Genome Analysis (Second Edition 2004)	David W. Mount	Coldspring Harbor Laboratory Press
8	Bioinformatics and Functional Genomics (2003)	Jonathan Pevsner	John Wiley & Sons Publications

PAPER VI: CELL BIOTECHNOLOGY

Unit	Topic	Subtopic	No of lectures
I	Plant tissue culture	1. Secondary plant products: Secondary metabolites of plant factors affecting the production in culture, secondary metabolites in culture and hairy roots. 2. Enhancement of product formation using biotic and abiotic elicitors. Product secretion natural and induced from suspension cultures. 3. Biotransformations using cell cultures for eg Vaniline production from capsicum 4. In vitro storage of germplasm, cryopreservation. 5. Metabolic engineering in plants: Introduction, examples, details of production of golden rice 6. Biofuels: microalgae, transgenic jatropa	30
II	Animal cell culture	1. Biology of cultured cells 2. Culture vessels, Culture Media, Microbial contamination, cross contamination. 3. Organ culture: Methods, behavior, of organ explant, and utility of organ culture 4. Primary culture: Types, isolation of tissues, culturing of different cells. 5. Cell lines: Development, Subculture and propagation, immortalization of cell line, cell line designation, selection of cell lines, routine maintenance, Cytotoxicity cryo-preservation 6. Cellular functions: Normal and Cancerous cells, apoptosis, Immortalization and genetic instability. Industrial production of interferon & erythropoeitin	30
III	Developmental Biotechnology	1. Human Embryonic development: Events during fertilization, in-vitro fertilization, Zonapellucidaa, glycoprotein, Oelemma protein and their role in fertilization, sperm antigens and their functional significance. Molecular and biochemical events during sperm function 2. Post fertilization events: early embryonic	30

		development, establishing multi-cellularity, formation of blastula, embryonic germ layer, tracking of migrating cells. 3. Molecular mechanism of sex hormone action and regulation of gene expression. Implantation and endometrium antigens involved in implantation. Immunology of pregnancy. Superovulation, embryo culture and embryotransfer technology. 4. Infertility and reproductive vaccines. Frontiers in contraceptive research. Cryopreservation of sex gametes and embryos. Ethical issues related to embryo research.	
IV	**Nano-technology**	1. Introduction, synthesis of nanomaterials, biological methods, use of microbial system & plant extracts, use of proteins & templates like DNA. 2. Characterization of nanomaterials, analysis techniques, properties of nanomechanical, optical, magnetic properties, electrical conductivity, thermal conductivity. 3. Carbon nanotubes 4. Nanorobotiocs devices of nature: ATP synthese, the kinen, myosin, dynein, flagella modulated motion. 5. Nanomedicine: biopharmaceutics, implantable materials, implantable chemicals, surgical aids, diagnostic tools, nanosensors, nano scanning, nano enabled drug delivery system, nanorobotics in medicine. 6. Application of nanomaterials in food,cosmetics, agriculture, environment management.	30

References

Sr No	Title of the Book	Author	Publisher
1	Plant Cells in liquid culture (1991)	Payne Shuler	Hanser Publishers
2	Culture of Animal Cells : A Manual Of Basic Techniques (4TH Edition, 2000)	R. Ian Freshney	Wiley-Liss
3	*Principles and Practice of* Animal Tissue Culture (2007)	Sudha Gangal	Universities Press
4	Langman's Medical Embryology (9th Edition 2004)	T. W. Sadler.	Lippincott Williams & Wilkins
5	Essential Developemental Biology (2nd Edition 2006)	J. M. W. Slack	Blackwell Publishing
6	Developemental Biology (8th Edition 2006)	Scott F. Gilbert	Sinauer Associates, Inc.
7	The Nanoscope encyclopedia of nanoscience and nanochehnology, Vol. I (2005)	Dr. Parag Diwan and Ashish Bharadwaj	Pentagon Press New Delhi
8	The Nanoscope encyclopedia of nanoscience and nanochehnology, Vol V (2005)	Dr. Parag Diwan and Ashish Bharadwaj	Pentagon Press New Delhi
9	The Nanoscope encyclopedia of nanoscience and nanochehnology, Vol VI (2005)	Dr. Parag Diwan and Ashish Bharadwaj	Pentagon Press New Delhi
10	Nano forms of carbon and its applications (2007)	Prof. Maheshwar Sharon and Dr. Madhuri Sharon	Manad Nanotech Pvt. Ltd.
11	Biotechnanotechnology lessons from Nature (2004)	David Goodsell	Wiley-Liss A John Wiley and sons
12	Nanotechnology- Basic science and emerging technologies (2005)	Willson Kannangava, Smith, Simmons, Raguse	Oversease Press
13	Texbook of Biotechnology (2005)	R. C. Dubey	S. Chand and Co.
14	Nanotechnology- Principles and practices	S. K. Kulkarni	Capital Publishing Co.

Sr No			
	Culture of Animal Cells : A Manual Of Basic Techniques (4TH Edition, 2000)	R. Ian Freshney	Wiley-Liss
3	*Principles and Practice of* Animal Tissue Culture (2007)	Sudha Ganpal	Universities Press
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6	Developmental Biology (8th Edition 2006)	Scott F. Gilbert	
	and Technology, Vol I (2005)	Ashish Bharadwaj	Pentagon Press New Delhi
8	The Nanoscope encyclopedia of nanoscience and nanochehnology Vol V (2005)	Dr. Parag Diwan and Ashish Bharadwaj	Pentagon Press New Delhi
9	The Nanoscope encyclopedia of nanoscience and nanochehnology, Vol VI (2005)	Dr. Parag Diwan and Ashish Bharadwaj	Pentagon Press New Delhi
10	Nano forms of carbon and its applications (2007)	Prof. Maheshwar Sharon and Dr. Madhuri Sharon	Manad Nanotech Pvt. Ltd.
11	Biotechnanotechnology lessons for		Wiley and sons
	basic ng nologies (2005)	Wilison Kannangara, Smith, Rag	Overseas Press
13	Textbook of Biotechnology (2005)	R. C. Dubey	S. Chand and Co.
14	Nanotechnology Principles and practices	S. K. Kulkarni	Publishing

PAPER VII: MANUFACTURING PROCESSES AND MEDICAL DIAGNOSTICS.

Unit	Topic	Subtopic	No of lectures
I	**Bioprocess Technology And Its Applications**	1. Developments in the concept of bioreactor – i) Classification of bioreactors – geometry, mode of operation, state of mixing, energy input ii)Types of bioreactors- floc reactors, film reactors stirred tanks plug flow and recycle reactors, discontinuous, semi-continuous and Continuous reactors. 2. Parameters used for process monitoring with associated instrumentation (pH, temp, pressure, foam sensing & control,redox potential, dissolved oxygen, inlet & exit gas analysis). 3. Aeration, and scale up: Importance of O2 in aerobic fermentation KLa and determination agitation of KLa by SO3 reduction and gaseous techniques. 4. Immobilised biocatalyst and their use in reactors: methods of immmobilisation, industrial perspective – operational considerations, advantages and disadvantages. 5. Solid state fermentation and its applications: Downstream processing and its contribution to process economics.	30
II	**Microbial Products**	Industrial production & application of : 1. Polysaccharides/Micropolymers/biopolymers – xanthan 2. Enzymes: Proteases, Lipases 3. Nutraceutical – probiotics, prebiotics 4. 9.Solid state fermentation- amylase from aspergillus niger, pectninase. 5. Alcohol production: wine production 6. Antibiotics-erythromycin & rifampicin. 7. Production of vitamin B12	30
III	**Medical diagnostics**	1. Introduction to clinical diagnostics, normal & reference values, biological sample collection & preservation, selection of analytical methods, 2. Chromosomal disorder: karyotyping, G banding, 3. Immunodiagnostics: diagnosis of bacterial, viral, parasitic, enteric diseases,	30

		immunoassays, cancer cytogenetics. 4. Immunological detection of organisms and their antigens 5. Molecular diagnostics: viral – Hepatitis, HIV, Bacterial – tuberculosis, nosocomial infections, Fungal- Candida, Dermatophytes, opportunistic infections 6. Biofilms in medicine.	
IV	**Pharmaceutical biotechnology**	1. Introduction 2. Vaccines-the seed lot system, production of bacteria and viral and cellular components of the vaccines, fermentations 3. Blending , filling and drying 4. Quality control 5. Invivo diagnostic –preparations and quality control 6. Immune sera-preparation and quality control 7. Human immuno globulins-source materials, fractionation and quality control. 8. Quality control and quality assurance of sterile products-bioburden, test for sterility, parametric release and pyrogens	30

References

Sr No	Title of the Book	Author	Publisher
1	Fermentation Microbiology & Biotechnology. (2005)	EL- Mansi & CFA Bryce	Taylor & Francis USA.
2	Bioprocess Engineering (2nd Edition 2006)	M. Shuler & F. Kargi	Dorling Kindersley Pvt. Ltd.
3	Entrepreneurship & Business of Biotechnology	S N Jogdand	Himalaya publishing house
4	Manual of Industrial Microbiology & Biotechnology 2nd edition (2004).	Arnold & Julian	ASM press Washington.
5	Process Biotechnology fundamentals 2nd edition (2004)	S N Mukhopadhyay	Viva books pvt ltd.
6	Industrial Microbiology an Introduction	Michael, Neil, John & Gary	
7	Diagnostic Microbiology 5th edition	Elmer Koneman, Stephen Allen	Lippincott
8	Molecular Microbiology: Diagnostic principles & Practice (2004)	Persing, Tenover, Versalone	ASM press Washington DC
9	Pharmaceutical microbiology 7th ed., (2004)	Hugo Russell's	Edited by Stephen P. Denyer, Hodges and Sean P. Gorman

PAPER VIII: ENVIRONMANTAL BIOTECHNOLOGY AND LEGISLATION

Unit	Topic	Subtopic	No of lectures
I	**Environmental biotechnology**	1. Environment pollution: types, methods for measurement of pollution, pollution indicators & biosensors 2. Solid waste treatment 3. Hazardous waste management: biodegradation of xenobiotics, pesticides, food ,textile, petrochem, paper, industries, leather biological detoxification, phytoremediation. 4. Removal of oil spillage & grease deposits. 5. Biodiversity	30
II	**Ecology**	1. Population ecology and biological control; Community structure and organisation; 2. Sustainable development; Economic importance of microbes, plants and animals. 3. Ecosystem dynamics and management; Stability and complexity of ecosystems; Speciation and extinctions. 4. Environmental impact assessment; Principles of conservation; Conservation strategies; sustainable development	30
III	**IPR**	1. Biotechnology & the law: objective, evolution, basic structure of gene techniques, applications, commercial potential of biotech inventions, rational for IPR protection. 2. Patenting biotech inventions: objectives, concept of novelty, concept of inventive step, microorganisms, and moral issues in patenting biotech inventions. 3. Plant varieties protection: objectives, justification, international position, plant varieties protection in India.	30
IV	**IPR**	1. Protection of geographical indications: objectives, justification, international position, multi lateral treaties, national level, Indian position 2. Protection of traditional knowledge: objective, concept of traditional knowledge, holders, issue concerning, bio-prospecting and bio-piracy, alternative ways, protectability, need for a Sui-generis regime, traditional knowledge digital library	30

		3. Case study related to basamati rice & erythropoietin by Genetech 4. Environmental laws: acts concerning land, water and air. History of amendments. Pollution boars and their role, Socail movements. Role of NGOs. World scenario	

References

Sr No	Title of the Book	Author	Publisher
1	Law Of Intellectual Property Rights	Shiv Sahai Singh	Deep & Deep Publications (p) Ltd
2	WTO And Intellectual Property Rights	By Talwar Sabanna (2007)	Serials Publications
3	IPR: Unleashing the Knowledge Economy (2003)	Prabuddha Ganguli	Tata Mcgrow Hill publication
4	Environmental Biotechnology (2nd Edition, 2005)	Alan Scragg	Oxford University Press
5	Environmental Biotechnology- Basic Concepts and Applications (2006)	Indu Shekhar Thakur	I. K. International Pvt. Ltd.
6	Environmental Biotechnology	M. H. Fulekar	Oxford & IBH Publishing

Practicals

Sr No.	Experiment
1	Multiple alignment - Phylogenetic tree
2	BLAST - orthologs and paralogs , homologs
3	Motif finding
4	KEGG
5	Structure of proteins - identification of chains helices, special groups, metal ions etc. CATH / SCOP classification of a given protein
6	Biostats practical using any of the software available
7	PTC - Media preparation - Seed sterilization - Callus induction - Protoplast isolation - Somatic embryogenesis
8	ATC - Trypsinization - Monolayer formation (fibroblast) - Cytotoxicity - Short term culture of humans lymphocytes for G banding of chromosomes and Karyotyping
9	Preparation of pregnancy detection kit (Demonstration)
10	Growth analysis shake flask – cell yield
11	Protein content of mushrooms on dry weight basis, spawn development
12	Alcohol fermentation: determination of alcohol content, sugar content Cole's method
13	Isolation and purification of specific metabolite and its identification- enzyme assays, bioassay
14	Bioremediation- isolation of metal tolerant organisms & study their growth characteristics and pattern
15	Composting – physical & chemical parameters.
16	Medical diagnostic – Identification of organisms from specimens (Multiple drug resistant *S. aureus, Pseudomonas spps, Klebsiella pneumoniae, E. coli*).
17	Sterility testing of injectable material-saline, injections, etc

ANNUAL EXAMINATION PATTERN

Paper V	**75 marks**
Paper VI	**75 marks**
Paper VII	**75 marks**
Paper VIII	**75 marks**
Practicals (inclusive of Viva-voce and journal)	**100 marks**
Desertation (inclusive of Viva, Presentation, Project Report)	**100 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 each of the 4 units in curriculum. There shall be internal choice .
3. Fifth questions shall comprise of any one essay or any three notes/ short questions from any of the units.
4. Candidate is required to attempt all 5 questions (total marks 75 marks). Duration of three hours.