

**UNIVERSITY OF MUMBAI**

No. UG/ 87 of 2017-18

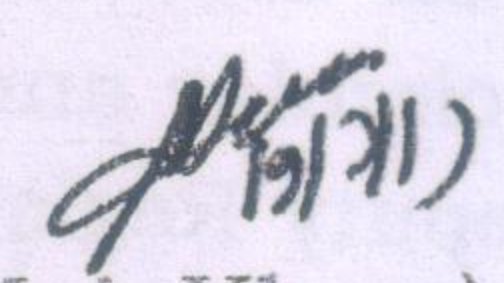
**CIRCULAR:-**

A reference is invited to the syllabi relating to Master of Science (M.Sc) degree course **vide** this office Circular No.UG/108 of 2013-14, dated 26<sup>th</sup> March, 2014 and the Head of the University of Department of Bio-Technology, the Principal of the affiliated Colleges in Science and Heads of the recognised Science Institution concerned are hereby informed that the recommendation made by the Board of Studies in Biotechnology at its meeting held on 7<sup>th</sup> January,2017 has been accepted by the Academic Council at its meeting held on 11<sup>th</sup> May, 2017 **vide** item 4.236 and that in accordance therewith, the revised syllabus as per the (CBCS) for Sem I & II of M.Sc programme in the course of Bio-Technology. Which is available on the University's web site ([www.mu.ac.in](http://www.mu.ac.in)) and that the same has been brought into force with effect from the academic year 2017-18.

MUMBAI- 400032

21<sup>st</sup> July, 2017

To

  
(Dr.M.A.Khan)  
REGISTRAR

The Head of the University of Biotechnology, the Principal of the affiliated College in Science and the head of the recognized science Institutions concerned.

**A.C/4.236/11/05/2017**

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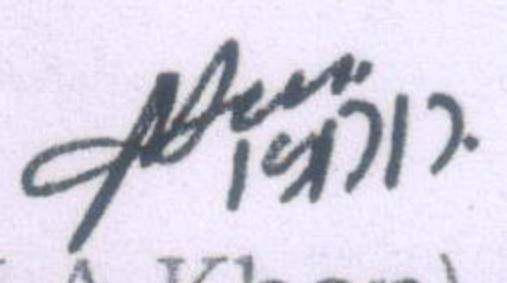
No. UG/ 87 -A of 2017

MUMBAI-400 032

21<sup>st</sup> July, 2017

Copy forwarded with Compliments for information to:-

1. The Co-ordinator, Faculty of Science,
2. The Offg. Director, of Board of Examinations and Evaluation,
3. The Director of Board of Student Development.,
4. Professor-cum-Director, Institute of Distance and Open Learning (IDOL).
5. The Co-Ordinator, University Computerization Centre,

  
(Dr.M.A.Khan)  
REGISTRAR

....PTO



Academic Council : 2/2017

Item No :

# UNIVERSITY OF MUMBAI



**Syllabus for Sem III & IV**

**Program: M.Sc.**

**Course: Biotechnology**

(Credit Based Semester and Grading System with effect

**M.Sc.**  
**BIOTECHNOLOGY**

**SEMESTER- III**

<b>Course Code</b>	<b>UNIT</b>	<b>PTC and ATC</b>	<b>Credits</b>	<b>L / week</b>
<b>PSBT301</b>	<b>I</b>	Introduction to primary and secondary metabolism, important pathways leading to biosynthesis of secondary metabolites in plants, Metabolic products produced from in vitro culturing of plant cells, selection of plant cells/ tissues for production of a specific products, culture system in secondary plant product, Biosynthesis- batch, continuous cultures, immobilized plant cell, Biotransformation of precursors by cell culturing, metabolic engineering for production of secondary metabolites, Hairy root culture, elicitation	<b>4</b>	<b>1</b>
	<b>II</b>	Cryopreservation -Principle and types. Germplasm conservation, Transgenic plants-Edible vaccine, Golden rice		<b>1</b>
	<b>III</b>	Biology of cultured cells Culture vessels, Culture Media, Microbial contamination, cross contamination. Cryopreservation		<b>1</b>
	<b>IV</b>	Primary culture: Types, isolation of tissues, culturing of different cells. Cell lines: Development, Subculture and propagation, immortalization of cell line, cell line designation, selection of cell lines, routine maintenance, Cytotoxicity Transformation Culture of tumor cells		<b>1</b>
<b>Course Code</b>	<b>UNIT</b>	<b>Medical microbiology</b>	<b>Credits</b>	<b>L / week</b>
<b>PSBT302</b>	<b>I</b>	Chromosomal disorders-	<b>4</b>	<b>1</b>

		Karyotyping, G banding, Chromosome analysis, variations, chromosome painting		
	<b>II</b>	Infections of Respiratory tract- Pneumonia, Tuberculosis. Nosocomial- Psuedomonas. Viral infections-HIV, Hepatitis. Fungal-Candidiasis		<b>1</b>
	<b>III</b>	Molecular diagnostics for Pneumonia, Tuberculosis, Pseudomonas, HIV, Hepatitis. Candidiasis		<b>1</b>
	<b>IV</b>	Biofilms in medicine		<b>1</b>
<b>Course Code</b>	<b>UNIT</b>	<b>Clinical Studies</b>	<b>Credits</b>	<b>L / week</b>
<b>PSBT303</b>	<b>I</b>	Types of clinical trials, single blinding, double blinding, open access, randomized trials and their examples, interventional study, ethics committee and its members, cross over design, etc and Institution Ethics Committee / Independent Ethics Committee;	<b>4</b>	<b>1</b>
	<b>II</b>	Pre clinical toxicology: General principles, Systemic toxicology (Single dose and repeat dose toxicity studies), Carcinogenicity, Mutagenicity, Teratogenicity, Reproductive toxicity, Local toxicity, Genotoxicity, animal toxicity requirements.		<b>1</b>
	<b>III</b>	New drug discovery process- purpose, main steps involved in new drug discovery, process, timelines of each steps, advantages and purposes of each steps, ethics in clinical research, unethical trials, thalidomide tragedy, Phase-I, II, III, IV trials. Introduction and designing -Various phases of clinical trials -Post Marketing surveillance - methods		<b>1</b>
	<b>IV</b>	Medical Writing : Literature Search & Medical Articles, Contract writing, Publication, Abstracts, Bibliography, Clinical Study Reports; Principles and softwares in CDM (Clinical data management)		<b>1</b>
<b>Course Code</b>	<b>UNIT</b>	<b>Developmental Biology</b>	<b>Credits</b>	<b>L / week</b>
<b>PSBT304</b>	<b>I</b>	Human Embryonic development: Events during fertilization, in-vitro fertilization, Zonapellucidaa, glycoprotein, Oelemma protein and their role in fertilization, sperm	<b>4</b>	<b>1</b>

		antigens and their functional significance. Molecular and biochemical events during sperm function		
	<b>II</b>	Post fertilization events: early embryonic development, establishing multi-cellularity, formation of blastula, embryonic germ layer, tracking of migrating cells.		<b>1</b>
	<b>III</b>	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 embryo transfer technology.		<b>1</b>
	<b>IV</b>	Infertility and reproductive vaccines. Frontiers in contraceptive research. Cryopreservation of sex gametes and embryos. Ethical issues related to embryo research.		<b>1</b>
<b>PSBTP301</b>	<b>PTC and ATC</b>		<b>2</b>	<b>4</b>
<b>PSBTP302</b>	<b>Medical microbiology</b>		<b>2</b>	<b>4</b>
<b>PSBTP303</b>	<b>Clinical Studies</b>		<b>2</b>	<b>4</b>
<b>PSBTP304</b>	<b>Developmental Biology</b>		<b>2</b>	<b>4</b>

### Practicals for Semester III

All experiments should have references of standard books/ journals/ authentic websites

Sr No.	Experiment
1	PTC Media preparation Seed sterilization, Callus induction Isolation and induction of anther cultures using hibiscus Protoplast isolation Somatic embryogenesis
2	ATC Trypsinization, Staining of animal cells  -Monolayer formation (fibroblast)  To assay the radical scavenging activity of a tissue hydrolysate -DPPH method  Techniques of cell preservation
3	Toxicology - MTT assay
4	Study and present a published clinical case report
5	Medical diagnostic – Identification of organisms from specimens (Multiple drug resistant <i>S. aureus</i> , <i>Pseudomonas spp.</i> , <i>Klebsiella pneumoniae</i> , <i>E. coli</i> ). Staining of Biofilms
6	Candling, Observing chick embryo- stages of development; prepared slides/ preserved specimens
7.	Developmental Biology- Visit to laboratory/ video lectures for latest developments in the field. To be documented

**SEMESTER IV**

<b>Course Code</b>	<b>UNIT</b>	<b>Nanotechnology</b>	<b>Credits</b>	<b>L / Week</b>
<b>PSBT401</b>	<b>I</b>	Introduction, synthesis of nanomaterials, biological methods, use of microbial system & plant extracts, use of proteins & templates like DNA. Characterization of nanomaterials, analysis techniques, properties of nanomechanical, optical, magnetic properties, electrical conductivity, thermal conductivity.	<b>4</b>	<b>1</b>
	<b>II</b>	Carbon nanotubes Nanorobotics devices of nature: ATP synthase, the kinen, myosin, dynein, flagella modulated motion.		<b>1</b>
	<b>III</b>	Nanomedicine: biopharmaceutics, implantable materials, implantable chemicals, surgical aids, diagnostic tools, nanosensors, nano scanning, nano enabled drug delivery system, nanorobotics in medicine.		<b>1</b>
	<b>IV</b>	Application of nanomaterials in food, cosmetics, agriculture, environment management		<b>1</b>
<b>Course Code</b>	<b>UNIT</b>	<b>GMO and environment</b>	<b>Credits</b>	<b>L / Week</b>
<b>PSBT402</b>	<b>I</b>	Genetically Modified Microorganisms, examples and methods Humulin, ice minus bacteria, GM bacteria in bioremediation, use of PCR as a GMO identification tool, risks and controversies related to use Genetically modified microorganisms. Indian GM research information system,	<b>4</b>	<b>1</b>

	II	<p>About Indian GMO Research Information System (IGMORIS); about the website; Biosafety data of any two approved genes available on the database</p> <p>GE crops- Arabidopsis as a model plant for studies in genetic engineering; Protcols on Food and feed saftey assessments, Acute oral saftey study in rats and mice, sub-chornic feeding study in rodents, Protein thermal satbility, Pepsin digestibility, Live stock feeding study</p>		1
	III	Solid waste treatment, pollution indicators & biosensors biodegradation of xenobiotics, pesticides, phytoremediation		1
	IV	Biodegration of waste from food, textile, petrochem, paper industries, biological detoxification, Removal of oil spillage & grease deposits		1
<b>Course Code</b>	<b>UNIT</b>	<b>Bioinformatics</b>	<b>Credits</b>	<b>L / Week</b>
<b>PSBT403</b>	I	Organization of biological data, databases (raw and processed), Quering in data bases. Primers in biology(Designing of primers, kinds of primers)	4	1
	II	Gene finding, motif finding and multiple sequence alignment. Protein sequence analysis (theory and algorithms) Protein structure analysis and applications.		1
	III	Gene expression profiling and its applications. Microarray technology and basics. Microarray analysis and		1



		organization of data Human genome analysis		
	<b>IV</b>	Proteomics. Exploration of data bases, retrieval of desired data, BLAST etc. Gene clusters and fusions, consensus sequences, exon intron finder, sequence logo.		<b>1</b>
<b>Course Code</b>	<b>UNIT</b>	<b>Biostatistics</b>	<b>Credits</b>	<b>L / Week</b>
<b>PSBT404</b>	<b>I</b>	Statistical population, sample from population, Random sample. Central Tendency: Mean, Median and Mode, Standard Deviation Confidence intervals	<b>4</b>	<b>1</b>
	<b>II</b>	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		<b>1</b>
	<b>III</b>	Test of Significance. 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, Chi square test, contingency table.		<b>1</b>
	<b>IV</b>	Comparing three or more groups- Introduction to ANOVA, One way ANOVA, repeated measures ANOVA, Friedman Test. Correlation and Regression: Linear and multiple Correlation and Regression.		<b>1</b>



### Semester IV Practicals

It is mandatory for students to undergo Hands-on Project training in a established laboratory for 4-6 months; This should involve one or more relevant instrumentation technique. Thesis on the same to be evaluated by the guide alternatively by internal examiner for 50M based on the students performance, written matter and experimentation. A certificate / marklist to be appended with the thesis. External examiner to assess for 50M as a Presentation during practical exams. Marks allotted by Internal examiner would be scaled down if required as per university guidelines.

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	Nanoparticles - synthesis chemical and biological methods;Spectroscopic analysis
7	Bioremediation- isolation of metal tolerant organisms & study their growth characteristics and pattern
8	Composting – physical & chemical parameters

9                      GMO - Validation - kit based/ demo

<b>PSBTP401</b>	<b>Nanotechnology</b>	2	4
<b>PSBTP402</b>	<b>GMO and environment</b>	2	4
<b>PSBTP403</b>	<b>Bioinformatics</b>	2	4
<b>PSBTP404</b>	<b>Biostatistics</b>	2	4



### 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 (2008)	B. Burt Gerstman	Jones and Bartlett Publishers
3	Biostatistics: A foundation For Analysis In Health Sciences ( 7 <sup>th</sup> Edition 1999)	Wayne W. Daniel	John Wiley & Sons Inc.
4	Fundamentals of Biostatistics (2006)	Veer BalaRastogi	Ane Books India
5	Biostatistics- The Bare Essentials ( Second Edition 2000)	NosmanStreiner	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	ColdSpringHarbor Laboratory Press
8	Bioinformatics and Functional Genomics ( 2003 )	Jonathan Pevsner	John Wiley & Sons Publications

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 ( 4 <sup>TH</sup> Edition, 2000)	R. Ian Freshney	Wiley-Liss
3	<i>Principles and Practice of Animal Tissue Culture</i> (2007)	SudhaGangal	Universities Press
4	Langman's Medical Embryology ( 9 <sup>th</sup> Edition 2004)	T. W. Sadler.	Lippincott Williams & Wilkins
5	Essential Developemental Biology (2 <sup>nd</sup> Edition 2006)	J. M. W. Slack	Blackwell Publishing



6	Developmental Biology (8 <sup>th</sup> Edition 2006)	Scott F. Gilbert	Sinauer Associates, Inc.
7	The Nanoscopeencyclopedia of nanoscience and nanochehnology, Vol. I (2005)	Dr.ParagDiwan and AshishBharadwaj	Pentagon Press New Delhi
8	The Nanoscopeencyclopedia of nanoscience and nanochehnology, Vol V (2005)	Dr.ParagDiwan and AshishBharadwaj	Pentagon Press New Delhi
9	The Nanoscopeencyclopedia of nanoscience and nanochehnology, Vol VI (2005)	Dr.ParagDiwan and AshishBharadwaj	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)	WillsonKannangava, 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	Title of the Book	Author	Publisher
1	Basic and Clinical Pharmacology,	Katzung, B.G.	Prentice hall, International,
2	Clinical Pharmacology	Laurence, DR and Bennet PN	Scientific book agency,
3	Clinical pharmacokinetics	Dr. D.R Krishna, V. Klotz	Pub. Springer Verlab,
4	Remington Pharmaceutical Sciences	Williams and Wilkins	Lippincott
5	Drug interaction	Hamsten	Kven Stockley.
6	Drug interaction	J.K. Mehra	Basic Bussiness Publ, Bombay,
7	Practical Guide to Clinical Data Management	Susanne Prokscha	
8	Clinical pharmacology and drug therapy	Grahame smith & Aronson,	



9	Clinical Data management	Richard Rondel	Wiley
10	Medical Writing	Taylor Robert	Springer

11. <http://igmoris.nic.in/>
12. Protocols for food and feed safety assessments of GE crops      DBT 2008      <http://igmoris.nic.in/files/Coverpage1.pdf>
13. Genetically modified bacteria in agriculture      N Amarger      Biochimie 84 (2002) 1061–1072
14. Detection of genetically modified organisms in foods      Farid E Ahmed      Trends in Biotechnology Volume 20, Issue 5, 1 May 2002, Pages 215–223
15. Genetic analysis, Gene, genomes and networks in eukaryotes.      Philp Meenly      Oxford University press