UNIVERSITY OF MUMBAI
No.UG/35 of 2010

CIRCULAR:-

A reference is invited to the Ordinances, Regulations and syllabi relating to the Bachelor of Science (B.Sc.) degree course in Biotechnology under the revised pattern vide this office Circular No.UG/44 of 2006, dated 24th February, 2006 and the Directors/Heads, recognized Science Institutions and the Principals of the affiliated Colleges in Science concerned are hereby informed that the recommendation made by the Ad-hoc Committee appointed by the Academic Council to advise it in all matters relating to the B.Sc. & M.Sc. degree course in the subject of Biotechnology at its meeting held on 19th September, 2009 has been accepted by the Academic Council at its meeting held on 20th November, 2009 **vide** item No.4.1 and that, in accordance therewith, the syllabus and Pattern of Question Papers (Theory & Practicals) has been revised for T.Y.B.Sc.(6 units & 3 units) in the subject of Biotechnology is as per Appendix and that the same has been brought into force with effect from the academic year 2010-2011.

MUMBAI-400 032
18th February, 2010

PRIN. K. VENKATARAMANI
REGISTRAR

To,

The Directors/Heads, recognized Science Institutions and Principals of the affiliated Colleges in Science concerned.

A.C./4.1/20.11.2009

****

No.UG/35-A of 2010, MUMBAI-400 032 18th February, 2010

Copy forwarded with compliments for information to :

1) The Dean, Faculty of Science.
2) The Controller of Examinations.
3) The Co-ordinator, University Computerization Center.

FOR 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 Personal Assistants to the Vice-Chancellar, the Pro-Vice-Chancellor, the Registrar and the Assistant Registrar, Administrative, 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, Enrollment, Eligibility and Migration Section (3 copies), the Deputy Registrar, Statistical, Affiliation Section (2 copies), the Professor-cum-Director, Institute of Distance and Open [illegible] (10 copies) the Director University [illegible]

Enclosure to Item No. 4.1
20/11/200

UNIVERSITY OF MUMBAI

Revised Syllabus

&

Pattern of Question Paper
(Theory & Practicals)

For

T.Y.B.Sc.

(6 Units & 3 Units)

in

Biotechnology

(With effect from the academic year 2010-2011)

LIST OF EQUIPMENTS:

1. Basic facilities of a laboratory equipped with burners in which 18 students can work simultaneously, laminar air floor, and computers (minimum 10) with internet facility.
2. Hot Air oven, Incubator, Water Baths, Colorimeter, Microscopes with oil immersion lens (minimum 15), Magnetic stirrer, Refrigerator, pH meter, Centrifuge, Monopan Balance, Electronic Balance, Rotary Shaker, Vertical and Horizontal Electrophoresis units (at least 5), power pack for running 5 units at a time, micropipettes, UV Transilluminator and Spectrophotometer.
3. Glass ware and necessary chemicals as well as culture media will be required as per the protocols of practical given in the syllabi.

LIBRARY:

1. The Library must have books as prescribed for each paper.
2. A separate budget of Rs. 20,000/-per year must be provided to procure the prescribed books.

UNIVERSITY OF MUMBAI

Revised syllabus for T.Y.B.Sc. in Biotechnology

(with effect from the academic year 2010-2011.)

UNIT STRUCTURE OF THE SYLLABUS

PAPER I CELL BIOLOGY AND MEDICAL MICROBIOLOGY
PAPER I: IMMUNOLOGY, BIOCHEMISTRY AND INSTRUMENTATION
PAPER III MOLOECULAR BIOLOGY
PAPER IV APPLICATIONS OF BIOTECHNOLOGY

Paper	UNIT	Title	Work Load		Total Marks	
			Theory Period	Practical Period	Theory	Practical
I	*Unit I*	*Cell Biology*	*4*	*4*	*100*	*50*
	Unit II	*Animal Tissue Culture*				
	Unit III	*Medical Microbiology*				
	Unit IV	*Population Genetics, Biostatistics and Bioinformatics*				
II	*Unit I*	*Immunology*	*4*	*4*	*100*	*50*
	Unit II	*Biochemistry*				
	Unit III	*Endocrinology*				
	Unit IV	*Instrumentation*				
III	*Unit I*	*Basic Molecular Biology*	*4*	*4*	*100*	*50*
	Unit II	*Principles of gene cloning*				
	Unit III	*Recombinant DNA technology*				
	Unit IV	*Genetically modified organisms*				
IV	*Unit I*	*Fermentation process and products*	*4*	*4*	*100*	*50*
	Unit II	*Bioprocess Technology*				
	Unit III	*Plant biotechnology*				
	Unit IV	*Environmental Biotechnology*				

PAPER I- CELL BIOLOGY AND MEDICAL MICROBIOLOGY

UNIT I: CELL BIOLOGY

Topic	Subtopics	No of lectures
1. Cytoskeleton	Microtubules, microfilaments, and intermediate filaments. Polymerization dynamics. Role of microtubules in mitosis, cell motility and as drug target.	10
2. Cell membranes, permeability and interaction	Cell membrane – Fluid mosaic model. Cell permeability, Transport mechanism. Differentiation of the cell membrane: microvilli, tight junction, desmosomes. Intercellular communications and gap junctions. Cell coat, extracellular material, functions of cell coat and cell recognition: recognition molecule, cellular interaction and cAMP. Cell surface of cancer cells: surface changes, loss of control of growth, viruses as oncogenic agents	10
3. Signal transduction	Protein kinase. G protein and secondary messengers such as cAMP, calmodulin and Calcium, phosphatidyl inositol	05
4. Apoptosis	Process, factors which regulate apoptotic death in normal cells. Significance of Apoptosis	05

REFERENCE:

Sr. No	Name of the Books	Author	Publishers
1	Cell And Molecular Biology	De Robertis	Lippincott Williams & Wilkins
2	Cell And Molecular Biology: Concepts and Experiments *5th Edition*	Gerald Karp	Wiley International Student version
3	Lehninger Principles Of Biochemistry *5th Edition*	Michael M. Cox, David L Nelson	W H Freeman and Company
4	Molecular Biology Of The Cell *3rd Edition*	Bruce Alberts , Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, James Watson	Garland Publishing, Inc

UNIT II: ANIMAL TISSUE CULTURE

Topic	Subtopics	No of lectures
1. Introduction	Introduction to tissue culture. Advantages and limitations. Application of tissue culture	05
2. Design and layout	Sterile handling area, incubation, hot room, service bench, preparation, storage.	05
3. Equipments, glassware and Sterilization	Biosafety Cabinet, CO_2 incubator, autoclave, hot air oven, etc. Glassware, plastic ware, pipetting device, tissue culture vessels	05
4. Tissue culture Media	Physiochemical properties, Balance Salt Solution, complete media, serum, Serum, Serum Free Medium - Advantages and Disadvantages	05
5. Types of cell Culture	Organ culture, primary cultures and cell lines with examples, Stem cell cultures - therapeutic cloning, carcinoma stem cells, germ cell culture, uses.	10

REFERENCE:

Sr. No	Name of the Books	Author	Publishers
1	Principles and Practice of Animal Tissue Culture	Sudha Gangal	Universities Press
2	Culture Of Animal Cells *4th Edition*	Ian Freshney	A John Wiley & Sons, Inc., Publication
3	Basic Cell Culture *2nd Edition*	J M Davis	Oxford University Press

UNIT III: MEDICAL MICROBIOLOGY

Topic	Subtopics	No of lectures
1. Microbial flora of healthy host	Origin of normal flora, normal flora and human host, Gnotobiotic life, effect of antimicrobial agents, distribution and occurrence of the normal flora, skin, eye, respiratory tract, mouth, intestinal tract, GI tract. Epidemiological markers, role of host in infectious diseases,	10
2.Infectious diseases	Bacterial infections-Typhoid (Sal. typhi, S. para type A and B) and Tuberculosis. Fungal infection- Candidiasis (oral and vaginal) and Tinea infection Life cycle of Protozoans-Amoebiasis and Malaria	10
3. Antimicrobial Drugs	Spectrum of Antimicrobial activity, Mode of action of Antimicrobial drugs - Inhibition of Cell wall Synthesis (Penicillin, Ethambutal) - Inhibitors of Protein Synthesis (Aminoglycosides, Tetracyclines, Chloramphenicol,) - Injury to Plasma membrane (Polymyxin B) - Inhibitors of Nucleic Acid Synthesis (Nalidixic Acid, Norfloxacin, Ciprofloxacin) - Competitive Inhibitors (Sulfonamides) Concept of drug resistance	10

REFERENCE:

Sr. No	Name of the Books	Author	Publishers
1	Alcamo's Fundamentals Of Microbiology *5th Edition*	Jeffrey C Pommerville	Jones and Bartlett Publishers
2	Microbiology *6th Edition*	Prescott, Harley, Klein	McGraw-Hill Higher Education
3	Foundations In Microbiology *2nd Edition*	K. Talaro and A. Talaro	Wm. C. Brown Publishers
4	Microbial Life	Jerome Perry, James Staley,Stephen Lory	Sinauer Associates, Publishers
5	Microbiology *4th Edition*	Michael Pelczar, Roger Reid E Chan	TATA McGRAW Hill Publishings
6	Microbiology: An Introduction 8th Edition	G. Tortora, B. Funke, C. Case	Benjamin-Cummings Publishing Company;

UNIT IV: POPULATION GENETICS, BIOSTATISTICS AND BIOINFORMATICS

Topic	Subtopics	No of lectures
1. Population genetics	Genetic structure of population, the Hardy-Weinberg law, genetic variation in space and time, genetic variation in natural population, change in genetic structure of population, summary of the effects of evolutionary processes on genetic structure of population and conservation of genetic resources, molecular genetic techniques and evolution.	10
2. Biostatistics	Central tendency, standard deviation, coefficient of correlation, regression analysis, chi square, hypothesis testing, Z-test, t-test.	10
3. Bioinformatics	Introduction to Bioinformatics, Scope of bioinformatics, bioinformatics and the internet, useful bioinformatics sites on the www, data explosion, sequencing DNA,RNA and proteins, determination of protein structure, file formats, annotated sequence databases, miscellaneous databases, data retrieval with Entrez, Database searches- FASTA and BLAST, genbank sequence database. Tools used in bioinformatics related to biotechnology	10

REFERENCE:

Sr. No	Name of the Books	Author	Publishers
1	Essential iGenetics	Peter J Russell	Pearson Education
2	An introduction to Biostatistics *2nd Revised Edition*	N. Gurumani	MJP Publishers
3	Basic Biostatistics: Statistics for Public Health Practice	B. Burt Gerstman	Jones and Bartlett Publishers
4	Principles and applications of statistics in biosciences	D V Kamat	
5	Methods in Biostatistics	B K Mahajan	Jaypee Brothers
6	Biostatistics: A Foundation for Analysis in the Health Sciences *7th Edition*	Wayne W Daniel	John Wiley & Sons, Inc., Publication
7	Biostatistics: The Bare essentials *2nd Edition*	Geoffrey Norman, David Streiner	BC Decker Inc
8	Bioinformatics *2nd Edition*	A. Baxevanis and Ouellette	John Wiley & Sons, Inc.,

			Publication
9	Bioinformatics And Molecular Evolution	Paul Higgs and Teresa Attwood	Blackwell Publishing
10	Introduction to Bioinformatics	T K Atwood and D J Parry-Smith	Pearson Education Ltd
11	Bioinformatics Instant Notes	D RnWesthead, J H Parish and R M Twyman	Viva Books Private ltd
12	Bioinformatics: Sequence, Structure and databanks *Indian Edition*	Des Higgins and Willie Taylor	Oxford University Press

PAPER II-IMMUNOLOGY, BIOCHEMISTRY AND INSTRUMENTATION

UNIT I: IMMUNOLOGY

Topic	Subtopic	No of lectures
1. Innate and acquired immunity	First, second and third line of defense. Mechanism of innate immune response. Natural - Active and passive immunity. Artificial immunity - Active and passive immunity.	04
2. Cells and organs of immune system	Cells of immune system – lymphoid cells, NK cells, mononuclear phagocytes, granulocytic cells Organs of immune system – primary lymphoid organs, secondary lymphoid organs	05
3. Antigens and Antibodies	Properties of antigen, adjuvant, epitopes. Basic structure classes & sub- classes of antibodies with their biological activity (tabulated), complement, antigenic determinants on immunoglobulins.	04
4. Membrane receptors for antigens	MHC–Class I and class II molecule. TCR– structure of TCR and its role, TCR accessory membrane molecule–CD4 and CD8. BCR– structure with the heterodimer, and accessory membrane molecule–B7	07
5.Immunotechnology	Principles of Antigen-antibody interaction. Types of reactions - precipitation, agglutination, flocculation reaction. Immunoassay - RIA with types, ELISA with types and ELISPOT Immunoprecipitation. Immunoflorescence – direct, indirect, FACS. Immunobloting. Diagnostic tests – complement fixation test, Coomb's test.	10

REFERENCE:

Sr. No	Name of the Books	Author	Publishers
1	Immunology *5th Edition*	Janis Kuby, Richard Goldsay, Thomas Kindt, Barbara Osborne	W H Freeman and Company
2	Immunology *6th Edition*	Ivan Roitt, Jonathan Brostoff, and david Male	Mosby
3	Immunology : An Introduction *4th Edition*	Ian Tizard	Thomson
4	Immunology: Essential and Fundamental *2nd Edition*	S Pathak and U Palan	Capital Publishing Company
5	An Introduction to Immunology	C V Rao	NarosaPublishing House

UNIT II: BIOCHEMISTRY

Topic	Subtopic	No of lectures
1. Carbohydrate metabolism	Biosynthesis of starch, sucrose, glycogen from glucose. Gluconeogenesis. Conversion of galactose into glucose, galactosemia. Biosynthesis of heteropolysaccharides - peptidoglycan synthesis	12
2. Lipid metabolism	Lipogenesis – fatty acyl synthase complex, synthesis of palmitic acid from acetyl CoA. Synthesis of unsaturated, even, odd fatty acids. Synthesis of triacylglycerol. Synthesis of membrane phospholipids. Cholesterol synthesis from acetyl CoA; atherosclerosis	12
3.Aromatic compound	Special pathways for primary attack on organic compounds by microbes (β-ketoadipate pathway)	06

REFERENCE:

Sr. No	Name of the Books	Author	Publishers
1	Lehninger Principles Of Biochemistry *5th Edition*	Michael M. Cox, David L Nelson	W H Freeman and Company
2	Biochemistry 3rd Edition	Voet Donald & Voet, Judith	John Wiley & Sons, Inc
3	Biochemistry: The Chemical Reactions of Living Cells. Volume- I & II *2nd Edition*	David E Metzler	Academic Press
4	Fundamentals of Biochemistry	J L Jain, Sunjay Jain, Nitin Jain	S. Chand & Company Ltd
5	Harper's Illustrated Biochemistry *26th Edition*	Rober Murray, Daryl granner, Peter Mayes, victor Rodwell	McGraw Hill
6.	General microbiology (5th ed)	Roger Stanier, John L. Ingraham, mark L. Wheeli, Page R. Painter	MacMilan Press Ltd

UNIT III: ENDOCRINOLOGY

Topic	Subtopic	No of lectures
1. Hormones	Introduction, classification-based on structure, mode of action. Mechanism of steroid hormone action with receptors (internal and external)- cascade.	04
2. Amino acid derived hormones, peptide, protein hormones	Structure of active form, storage, release, transport, physiological action and disorder of thyroxine, oxytocin, vasopressin, insulin, glucagon, adrenalin and nor-adrenalin.	16
3. Steroid hormones	Structure of active form, storage, release, transport, physiological action and disorder of steroid hormones - Sex hormones (Male and Female Reproductive System, Oogenesis, Spermatogenesis, & Menstrual cycle), adrenal cortex hormones.	10

REFERENCE:

Sr. No	Name of the Books	Author	Publishers
1	Principles Of Biochemistry *5th Edition*	Michael M. Cox, David L Nelson	W H Freeman and Company
2	Fundamentals of Biochemistry	J L Jain, Sunjay Jain, Nitin Jain	S. Chand & Company Ltd
3	Harper's Illustrated Biochemistry *26th Edition*	Rober Murray, Daryl granner, Peter Mayes, victor Rodwell	McGraw Hill
4	Biochemistry	Satyanarayan	Books and Allied (p) limited
5	Anthony's Anatomy & Physiology *14th Edition*	Gary Thibodeau and Kevin Patton	Mosby

UNIT IV: INSTRUMENTATION

Topic	Subtopic	No of lectures
1. Centrifugation	Principle of centrifugation. Rotor design and selection. Preparative centrifugation - differential, rate-zonal, isopycnic, equilibrium isodensity centrifugation with applications. Density gradient centrifugation – nature of gradient, formation, sample application and collection. Analytical ultracentrifuge.	08
2. Spectroscopy	Principle of Beer and Lambert's law. Visible and ultraviolet spectroscopy – instrumentation, applications. Double beam spectroscope	04
3. Column Chromatography	Principle, working and applications of GC, affinity, ion exchange, gel permeation, HPLC	08
4. Tracer technique	Detection techniques – GM counter, scintillation counter, autoradiography. Applications of radioisotopes in biology	10

REFERENCE:

Sr. No	Name of the Books	Author	Publishers
1	A biologists Guide to Principles and Techniques of Practical Biochemistry	William and Wilson	Edward Arnold Publishers Ltd
2	Bioinstrumentation	L Veerakumari	MJP Publishers
3	Practical Biochemistry: Principles and Techniques *5th Edition*	Keith Wilson and John Walker	Cambridge University Press
4	Biophysical Biochemistry: Principles and Techniques	Avinash Upadhyay, Kakoli Upadhyay and Nirmalendu Nath	Himalaya Publishing House

PAPER III-MOLECULAR BIOLOGY

UNIT I: BASIC MOLECULAR BIOLOGY

Topic	Subtopic	No of lectures
1. Operon concept	Regulation of gene expression in bacteria - *Lac* operon and *trp* operon. Regulation of gene expression in bacteriophages lambda phage lytic and lysogenic cycle.	12
2. Genetic mapping in bacteria and bacteriophages	Molecular basis of transformation, conjugation and transduction. Mapping genes in bacteriophages, fine structure analysis of rII mutants	12
3. Transposable elements in prokaryotes and Eukaryotes:	Transposons, IS elements, Jumping genes in Maize.	06

REFERENCES:

Sr. No	Name of the Books	Author	Publishers
1	Essential iGenetics	Peter J Russell	Pearson Education
2	Principles of Genetics *8th Edition*	Eldon Gardner, Michael Simmons and Peter Snustad	John Wiley & Sons, Inc
3	Microbial Genetics *2nd edition*	Stanly Maloy, John Cronan and David Freifelder	Narosa Publishing House
4	Genetics *3rd Edition*	Monroe Strickberger	Prentice Hall of India
5	Gene Structure and Transcription	D Rickwood	IRL Press
6	Gene IX	Benjamin Lewin	Jones and Bartlett Publishers
7	Basic Genetics	Daniel Harlt, David Freifelder and Leon Snyder	Jones and Bartlett Publishers

UNIT II: PRINCIPLES OF GENE CLONING

Topic	Subtopic	No of lectures
1. Details of enzymes involved in gene cloning and their mode of action	Restriction endonucleases - types, nomenclature, target sites, nature of cut ends, host control restriction and modification, star activity, isoschizomers, application of restriction enzymes. Ligases – activity, blunt and sticky end ligation, source and applications. Alkaline phosphatases, polynucleotide kinase, Terminal transferase, Reverse transcriptase – source, Mode of action and applications. DNA Polymerase with applications – Klenow fragment (synthesis of probe using random priming and nick translation), T4 DNA polymerase, *Taq* polymerase. Nuclease –DNAse I, SI nuclease, Mung bean nuclease, RNAse H	15
2. Cloning vectors	High & Low copy number plasmids (regulating factor). Plasmid cloning vectors – pUC 19 and pBR322, Lambda phage, M13 bacteriophage vector, Cosmid vector, Shuttle vector, Ti plasmid.	15

REFERENCES:

Sr. No	Name of the Books	Author	Publishers
1	Essential iGenetics	Peter J Russell	Pearson Education
2	Genetics *3rd Edition*	Monroe Strickberger	Prentice Hall of India
3	Gene Structure and Transcription	D Rickwood	IRL Press
4	Molecular Biotechnology: Principles and Applications of Recombinant DNA Technology *3rd Edition*	Bernard Glick and Jack Pasternak	ASM Press
5	Principals Of Gene Manipulation *6th Edition*	S B Primrose, r M Twyman and R W Old	Blackwell Scientific Publications
6	Gene Cloning & DNA Analysis *5th Edition*	T A Brown	Blackwell Publishing
7	Genomes *3rd Edition*	T A Brown	Bios Scientific Publishers Ltd
8.	Biotechnology, fundamentals and application. 4th ed	S S Purohit	Agrobios India

UNIT III: RECOMBINANT DNA TECHNOLOGY

Topic	Subtopic	No of lectures
1. cDNA and genomic DNA cloning	Cloning of cDNA, construction of cDNA and genomic libraries. Analysis of gene and transcripts- Southern hybridization, DNA sequencing (Sanger's and Maxam Gilbert method), Polymerase chain reaction, DNA fingerprinting	10
2. Application of recombinant DNA technology	Diagnosis of genetic diseases – Cystic fibrosis, Sickle cell anemia Gene therapy – somatic and germ line gene therapy, Commercial products – insulin Vaccines: Subunit Vaccines -HSV, FMD, Peptide Vaccines, Attenuated Vaccines-Cholera, Vector Vaccines-Vaccinia virus, Genetic Immunization.	20

REFERENCES:

Sr. No	Name of the Books	Author	Publishers
1	Essential iGenetics	Peter J Russell	Pearson Education
2	Genetics *3rd Edition*	Monroe Strickberger	Prentice Hall of India
3	Gene Structure and Transcription	D Rickwood	IRL Press
4	Molecular Biotechnology: Principles and Applications of Recombinant DNA Technology *3rd Edition*	Bernard Glick and Jack Pasternak	ASM Press
5	Gene IX	Benjamin Lewin	Jones and Bartlett Publishers
6	Principals Of Gene Manipulation *6th Edition*	S B Primrose, r M Twyman and R W Old	Blackwell Scientific Publications
7	Gene Cloning & DNA Analysis *5th Edition*	T A Brown	Blackwell Publishing
8	Genomes *3rd Edition*	T A Brown	Bios Scientific Publishers Ltd

UNIT IV: GENETICALLY MODIFIED ORGANISMS

Topic	Subtopic	No of lectures
1. Transgenic plants	Artificial (Direct DNA uptake by protoplast, electroporation, liposome mediated, and particle gun transformation) and Natural method of gene transfer (*Agrobacterium* and virus). Transgenic plants for improving seed quality protein, insect resistance (*Bt* genes), and golden rice, Edible vaccines.	10
2. Transgenic animals	Fish, Mice and Sheep, transgenic mice methodology, retroviral method, DNA microinjection method, engineered embryonic stem cell method.	10
3. Ethical and regulatory issues	Intellectual property rights-introduction, trade secret, patents, copyright, plant variety protection, TRIPS, patenting genes and DNA sequences, gene patents and genetic resources, patenting related to genetically modified organisms, management of IPR, benefits from IPR, problems from IPR.	10

REFERENCES:

Sr. No	Name of the Books	Author	Publishers
1	Essential iGenetics	Peter J Russell	Pearson Education
2	Gene Transfer To Animal Cells	R M Twyman	Bios Scientific Publishers
3	Molecular Biotechnology: Principles and Applications of Recombinant DNA Technology *3rd Edition*	Bernard Glick and Jack Pasternak	ASM Press
4	Principles of Plant Biotechnology: An Introduction to Genetic Engineering Of Plants	Mantell S H, Mathews J A and Mc Kee.	Blackwell Scientific Publications.
5	Plant Biotechnology: The Genetic Manipulation of Plant	Adrian Slater, Nigel Scott and Mark Fowler	Oxford University Press
6	Principals Of Gene Manipulation *6th Edition*	S B Primrose, r M Twyman and R W Old	Blackwell Scientific Publications
7	Genomes *3rd Edition*	T A Brown	Bios Scientific Publishers Ltd
8	IPR: Unleashing the Knowledge Economy (2003)	Prabuddha Ganguli	Tata Mcgraw Hill publication
9	Entrepreneurship & Business of Biotechnology	S N Jogdand	Himalaya Publishing House

PAPER IV- APPLICATIONS OF BIOTECHNOLOGY

UNIT I: FERMENTATION PROCESSES AND PRODUCTS

Topic	Subtopic	No of lectures
1. Dairy microbiology	Milk - normal flora, changes in the flora, enumeration, oxidation reduction potential, factors affecting bacteriological quality, preservation of milk and milk products, pasteurization, Starter culture - general characteristic of Lactic acid bacteria, characteristics of starter culture. Use of genetically modified starter culture. fermented milk products- cultured butter milk, yogurt. Butter- composition, types, manufacture, sweet cream and ripened cream butter, spoilage and defects in butter. Cheese- Principle of cheese making, steps of manufacture, types, cheddar and swiss cheese, spoilage and defects.	12
2. Beverages	Beer- types, element of the brewing process, fermentation, spoilage. Wine- introduction, parameters, yeast, bacterial processes during wine making-malolactic fermentation, wine defects.	08
3.Other fermentations	Ethanol, penicillin, semi-synthetic penicillin, streptomycin, vinegar, citric acid, L-glutamic acid, L-lysine.	10

REFERENCE:

Sr. No	Name of the Books	Author	Publishers
1	Applied Dairy Microbiology *2nd Edition*	Elmer H Marth and James L. Steele	Mercel Dekker Inc, New York
2	Fundamentals of Food Microbiology *4th Edition*	Bibek Ray and Arun Bhunia	CRC Press
3	Fermentation: A Practical Approach *Indian Edition*	B McNeil and L M Harvey	Oxford University Press
4	Fermentation Microbiology & Biotechnology	EL- Mansi & CFA Bryce	Taylor & Francis USA.
5	Bioprocess Engineering *2nd Edition*	M. Shuler & F. Kargi	Dorling Kindersley Pvt. Ltd.

6	Manual of Industrial Microbiology & Biotechnology *2nd Edition*	Julian E Davies and Arnold L Demain	ASM press Washington.
7	Prescott & Dunn's Industrial Microbiology *4th Edition*	Gerald Reed	CBS Publishers
8	Industrial Microbiology	L.E. Casida	John Wiley & Sons Inc
9	Industrial microbiology	A H Patel	MacMilan India Ltd

UNIT II: BIOPROCESS TECHNOLOGY

Topic	Subtopic	No of lectures
1. Types of Bioreactors and control	Tower fermenter, Air-lift fermenter, deep-jet fermenter, bubble column fermenter, Membrane bioreactor, packed column fermenter. Sensor probes, foam control, valve and steam traps, different ports	10
2. Process development	Innoculum development (bacterial and fungal)- introduction, criteria for the transfer of innoculum, development of inocula for yeast processes (brewing and baking), development of inocula for bacterial processes, mycelia processes, sporulation on solidified media, sporulation on solid media, sporulation in submerged culture, use of spore inocula, inoculums development for vegetative fungi. Scale up and scale down- Scale up of aeration/agitation regimes in stirred tank reactors, the scale-up of air-lift reactors, scale down method.	08
3. Down stream processing	Recovery and purification, strategies, separation of insoluble products (filteration), cell disruption, separation of soluble products (centrifugation, chromatography, solvent extraction), finishing steps for purification (drying, crystallization) Whole broth processing.	12

REFERENCE:

Sr. No	Name of the Books	Author	Publishers
1	Biotechnology: A Textbook of Industrial Microbiology *2nd Edition*	Wulf Crueger and Anneliese Crueger	Panima Publishing Corporation
2	Fermentation: A Practical Approach *Indian Edition*	B McNeil and L M Harvey	Oxford University Press
3	Fermentation Microbiology & Biotechnology	EL- Mansi & CFA Bryce	Taylor & Francis USA.
4	Bioprocess Engineering *2nd Edition*	M. Shuler & F. Kargi	Dorling Kindersley Pvt. Ltd.
5	Manual of Industrial Microbiology & Biotechnology *2nd Edition*	Julian E Davies and Arnold L Demain	ASM press Washington.
6	Principles of Fermentation Technology *2nd Edition.*	P. Stanbury, A. Whitaker, S. Hall	Butterworth Heineman An An Imprint of Elsevier

7	Prescott & Dunn's Industrial Microbiology *4th Edition*	Gerald Reed	Science CBS Publishers
8	Industrial Microbiology	L.E. Casida	John Wiley & Sons Inc

UNIT III: PLANT BIOTECHNOLOGY

Topic	Subtopic	No. of lectures
1. Introduction to plant tissue culture	Historical aspect of plant cell, tissue and organ culture. PTC lab, aseptic techniques, nutritional components of tissue culture medium. Initiation and maintenance of callus, organogenesis, virus elimination. Plant cell culture as a system for production of fine chemicals, why culture plant cells, plant suspension cultures, elicitation, permeabilisation of plant cell for product release, biotransformation and hairy root cultures. Micropropagation, somatic embryogenesis, synthetic seed.	15
2. QA, QC and ISO	Quality assurance vs. quality control. GMP, GLP principles for uniform quality. Concept of ISO certification and standards. Methods of QA applied for production process (pharmaceuticals)	05
3.Entrepreneurship in Biotechnology	Industrial/commercial aspects Areas of biotechnology that are already commercialized and are in the process of commercialization, demonstrating the scope of the subject, major Biotechnology industries in India.	05
4.Biofertilizer and Biopesticide	Introduction, advantages over chemical, enlist and production of *Rhizobium* and *Bacillus thuringenesis*	05

REFERENCE:

Sr. No	Name of the Books	Author	Publishers
1	Plant Cell and Tissue Culture in Liquid Systems	G Payne, V Bringi, C Prince and M Shuler	Hanser Publishers
2	Experiments in Plant Tissue Culture *2nd Edition*	John Dodds and Lorin Roberts	Cambridge University Press
3	Plant Biotechnology	K G Ramavat	S Chand & Company Ltd
4	Handbook of Plant Tissue CulturePlant Cell	A F Mascarenhas	Indian Council of Agricultural Research
5	Plan Cell Culture: The Basics from Background to Bench	D E Evans, J O D Coleman and A Kearns	Bios Scientific Publishers

6	Plant Cell, Tissue and Organ Culture: Fundamental Methods	O L Gamborg and G C Phillips	Narosa Publishing House
7	Entrepreneurship & Business of Biotechnology	S N Jogdand	Himalaya publishing house
8	Pharmaceutical Microbiology *7th Edition*	Hugo Russell's	Edited by Stephen P. Denyer, Hodges and Sean P. Gorman

UNIT IV: ENVIRONMENTAL BIOTECHNOLOGY

Topic	Subtopic	No of lectures
1. Renewable energy sources	Energy status and shortage of energy, renewable sources of energy - biomass as source of energy, Hydrogen gas production, biogas production in various bioreactors. Petrocrops as source of energy. Biofuel	12
2. Industrial waste and their management	Nature of industrial waste, industrial waste treatment of dairy, distillery (brewery), antibiotic industry, Environmental implications of the above industrial waste. Monitoring methods and criteria used for measure success of waste treatment, COD, BOD, Total solid, pH, temp, TDS, heavy metals. Phytoremediation and microbial remediation.	12
3. Environmental acts and awareness	Acts concerning land, water, air, History and amendments. Pollution control boards and their role. Social movements. Role of NGOs, World scenario	06

REFERENCE

Sr. No	Name of the Books	Author	Publishers
1	Biotechnology: Environmental Process I *Volume 11a*	H J Rehm and G Reed	Wiley -VCH
2	Environmental Biotechnology *2nd Edition*	Alan Scragg	Oxford University Press
3	Environmental Biotechnology- Basic Concepts and Applications	Indu Shekhar Thakur	I. K. International Pvt. Ltd.
4	Environmental Biotechnology	M. H. Fulekar	Oxford & IBH Publishing
5	Law of Protection of Environment and Prevention of Pollution	Dr. R G Chaturvedi and Dr. M M Chaturvedi	The Law Book (p) Ltd. Allahabad

PRACTICALS

Paper I

1. To determine the total count of RBC and WBC
2. Determination of Differential count of WBCs
3. To determine percentage viability of cells.
4. To study cytological differentiation of cancer cells using permanent slide
5. Osmotic fragility of RBC
6. Study of instruments and equipment used in animal cell culture (Inverted microscope, CO_2 incubator, Laminar air flow, bacteria proof filter, T flask)
7. Trypsinization of tissues and viability testing.
8. Central tendency: mean, median and mode
9. Data representation, frequency polygon, histogram, pie diagrams
10. Regression analysis
11. Normal deviate test (z-test)
12. Test of significance of means paired and unpaired t test
13. Graphical representation of data using Excel, calculation of mean, standard deviation, insertion of error bars, coefficient of correlation, regression coefficient.
14. Internet usage, search of data bases.
15. Antibiotic sensitivity test using agar cup method, paper disc method and ditch method.
16. To determine synergistic action of two drugs.

Paper II

1. Important laboratory practices: lab safety, pipettes and pipettman solutions, dilutions, dilution factors, standard graph (computer aided representation).
2. Preparation of molar and normal solutions.
3. Determination of antigen identity by Ouchterlony's method.
4. Qualitative and Quantitative determination of Typhoid using Widal test.
5. Determination of human blood group by ABO and Rh antigen.
6. Demonstration of ELISA.
7. Estimation of sugar by GOD-POD
8. Estimation of serum cholesterol.
9. Estimation of SGOT and SGPT.
10. Density gradient centrifugation for separation of blood cells.
11. Estimation of proteins by Lowry's method.

Paper III

1. To isolate plasmid DNA from bacteria.
2. To quantify plasmid DNA by UV –Visible spectrophotometry and chemical method
3. To isolate gDNA from plant source.
4. To construct restriction map from the provided data.
5. To interpret the autoradiogram obtained by DNA sequencing by Sanger's method.
6. To prepare heat killed TAB vaccine and check its sterility
7. Explain genetic phenomenon (mobile genetic elements in maize)
8. To transfer DNA by Southern blotting (demonstration)
9. Demonstration of PCR
10. To isolate antibiotic resistant mutants by Replica Plate technique
11. DNA estimation by DPA method

Paper IV

1. Sterilization techniques (dry, wet, chemical and membrane)
2. To prepare medium for Plant tissue culture.
3. Sterilization of seeds and aseptic germination of seeds
4. Sterilization of explants and inoculation on appropriate culture medium for callus induction and organogenesis
5. Establishment of plant cell suspension
6. Encapsulation of axillary buds and regeneration on medium
7. Isolation of antibiotic producing organism-(Wilkins-Overlay Method)
8. Sterility testing of pharmaceutical products (injectibles).
9. Microbiological analysis of milk by MBRT and RRT
10. Phosphatase test for milk
11. Determination of BOD and COD in the given water sample.
12. Preparation of alginate beads
13. Encapsulation of Yeast and estimation of invertase
14. Bioassay of Penicillin.
15. Extraction of biopolymer.
16. Production of biofertilizers.

EXAMINATION PAPER PATTERN

EXAMINATION PATTERN

- Students opting for 6 Units of Biotechnology (Major) at T.Y.B.Sc level will study Paper I, II, III and IV of 100 marks each and 4 practicals based on these papers of 50 marks each.

- Students opting for 3 Units of Biotechnology at T. Y. B.Sc will study Paper III and Paper IV of 100 marks each and 2 practicals based on these papers of 50 marks each.

Theory Examination

1. 4 papers of 100 marks each of 3 hrs duration as per the prescribed University pattern for B.Sc should be followed. Each paper should cover entire paper in proportionate manner, using number of lectures assigned to the topic as a rough guide lines.

2. Question I will be from Unit I of the paper and Q.2 from Unit II , Q.3 from Unit III , Q.4 from Unit IV while Q.5 will have a short notes from all the Units, I,II,III, and IV of 20 marks. Each Question will carry 30 marks with internal options. Maximum marks with internal option is 30 marks.

Practical Examination

1. **Practical Examination 3 Units**

    a. Practical examination will be held on 3 consecutive days between 10 am and 4 pm. With half an hour lunch break. The Examination will be of 100 marks as per the University guidelines.

    b. Laboratory journal duly signed by the head of the department/ coordinator is required to be submitted by the student. Examiners are required to sign the journal at the end of the examination with the college seal.

2. **Practical Examination 6 Units**

    a. Practical examination will be held on 3 consecutive days between 10 am and 5 pm. With half an hour lunch break. The Examination will be of 200 marks as per the University guidelines.

    b. Laboratory journal duly signed by the head of the department/ coordinator is required to be submitted by the student. Examiners are required to sign the journal at the end of the examination with the college seal.

Question Paper Pattern Practical:

- Practical exam will have 50 marks for each paper. Total marks will be 200 marks
- The practical examination will be conducted for three days.

Practical Papers:

Paper I	Major	25 Marks
	Minor	10 Marks
	Journal	5 Marks
	Biostatistics	10 Marks
	Total	**50 Marks**
Paper II	Major	25 Marks
	Minor	10 Marks
	Journal	05Marks
	Identification	10 Marks
	Total	**50 Marks**
Paper III	Major	25 Marks
	Minor	10 Marks
	Journal	5 Marks
	Viva	10 Marks
	Total	**50 Marks**
Paper IV	Major	25 Marks
	Minor	10 Marks
	Journal	5 Marks
	Spots	10 Marks
	Total	**50 Marks**
Grand Total		**200 Marks**

PAPER-I

Major

1. Antibiotic sensitivity test using agar cup method, paper disc method and ditch method.
2. To determine synergistic action of two drugs.

Minor

1. To determine the total count of RBC and WBC
2. Determination of Differential count of WBCs
3. To determine percentage viability of cells.
4. Osmotic fragility of RBC
5. Trypsinization of tissues and viability testing.

Demonstration

1. To study cytological differentiation of cancer cells using permanent slide
2. Internet usage, search of data bases.

Spots

1. Study of instruments and equipment used in animal cell culture (Inverted microscope, CO_2 incubator, Laminar air flow, bacteria proof filter, T flask)

Problems

1. Central tendency: mean, median and mode
2. Data representation, frequency polygon, histogram, pie diagrams
3. Regression analysis
4. Normal deviate test (z-test)
5. Test of significance of means paired and unpaired t test

PAPER II

Major

1. Determination of antigen identity by Ouchterlony's method.
2. Qualitative and Quantitative determination of Typhoid using Widal test.
3. Estimation of SGOT and SGPT.
4. Estimation of proteins by Lowry's method.

Minor

1. Determination of human blood group by ABO and Rh antigen.
2. Estimation of sugar by GOD-POD
3. Estimation of serum cholesterol.
4. Density gradient centrifugation for separation of blood cells.

Spots

1. Important laboratory practices: lab safety, pipettes and pipettman solutions, dilutions, dilution factors, standard graph (computer aided representation).
2. Preparation of molar and normal solutions.

PAPER III

Major

1. To isolate plasmid DNA from bacteria.
2. To quantify plasmid DNA by UV –Visible spectrophotometry and chemical method
3. To prepare heat killed TAB vaccine and check its sterility
4. To isolate antibiotic resistant mutants by Replica Plate technique

Minor

1. To isolate gDNA from plant source.
2. DNA estimation by DPA method

Demonstration

1. To interpret the autoradiogram obtained by DNA sequencing by Sanger's method.

Spots

1. To construct restriction map from the provided data.
2. Explain genetic phenomenon (mobile genetic elements in maize)
3. Demonstration of PCR

PAPER IV

Major

1. Isolation of antibiotic producing organism-(Wilkins-Overlay Method)
2. Sterility testing of pharmaceutical products (injectibles).
3. Encapsulation of Yeast and estimation of invertase
4. Bioassay of Penicillin.
5. Extraction of biopolymer.

Minor

1. Sterilization of seeds and aseptic germination of seeds
2. Sterilization of explants and inoculation on appropriate culture medium for callus induction and organogenesis
3. Microbiological analysis of milk by MBRT and RRT
4. Phosphatase test for milk
5. Determination of BOD and COD in the given water sample.
6. Preparation of alginate beads

Spots

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