

UNIVERSITY OF MUMBAI

No.UG/ 309 of 2004

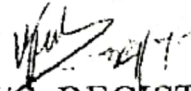
CIRCULAR.

A reference is invited to the Ordinances, Regulations and Syllabi relating to the Bachelor of Science (B.Sc.) degree in Bio-technology course under the revised pattern vide this office Circular No.UG/98 of 2002 dated 22nd February, 2004 and the Principals of the affiliated colleges in the Faculty of Science are hereby informed that the recommendation made by the Faculty of Science at its meeting held on 23rd February, 2004 has been accepted by the Academic Council at its meeting held on 2nd April, 2003 vide item No. 4.26 and that in accordance therewith the syllabus in the subject of Biotechnology at the T.Y.B.Sc. examination will be as per Appendix and that the same has been brought into force with effect from the academic year 2004-2005.

Mumbai 400 032

29th July, 2004.

To.


for V.C. REGISTRAR

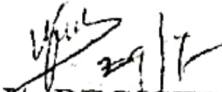
The Principals of the affiliated colleges in the faculty of Science..

A.C. No.4.26/02.04.2004

No UG/309-A of 2004

29th July, 2004.

Copy forwarded with Compliment to The Dean, Faculty of Science, for information.


for V.C. REGISTRAR.

Copy to :

The Director, Board of College and University Development, the Controller of Examinations/the Deputy Registrar (Eligibility & Migration Section), the Director of Students Welfare, the Personal Assistants to the Vice-Chancellor, the Pro-Vice-Chancellor, the Registrar and the Assistant Registrar, Administrative sub-centre, Ratnagiri, for informations.

The Controller of Examinations (10 copies), F. & A. O. (Accounts Section) Fort. (2 copies), Record Section (5 copies), Publication Section (5 copies), D.R., (Enrollment, Eligibility & Migration Section - 3 copies), D.R., (Statistical Unit) (2 copies), D. R., (Accounts Section), Vidyanagari, (2 copies), D. R. (Affiliation Section) (2 copies), Director, U.C.C., I.D.E. Bldg, Vidyanagari, A. R., A. Unit (2 copies) He is requested to treat this as Action taken report on the concerned resolution adopted by the Academic Council/Management Council, referred to in the above Circular; and that no separate A.T.R. will be sent in this connection. A. R., CONCOL (2 copies), RUCPU (1 copy), Dy. Acct. (Unit V) (1 copy), In-charge, Central Computing Facility (1 copy), Telephone Operator (1 copy), Secretary, MUASA (1 copy), Superintendent...



UNIVERSITY OF MUMBAI



Syllabus for T.Y.B.Sc. Biotechnology

(with effect from the academic year 2004-2005)

T.Y.B.Sc BIOTECHNOLOGY SIX UNITS

PAPER	TITLE	WORK-LOAD		TOATALMARKS	
		Theory period	Practical period	Theory	Practical
I	Cell Biology, Genetics, General Microbiology, Biostatistics and Bioinformatics	4	4	100	50
II	Immunology, Biochemistry and Instrumentation	4	4	100	50
III	Molecular Biology and recombinant DNA Technology	4	4	100	50
IV	Industrial Biotechnology	4	4	100	50

Note:

1. In addition to the four papers for six units students will be required to take subject related Applied component of two theory papers of 60 marks each and two practical papers of 40 marks each. Students can select any applied component subject as offered at the college for Biological Sciences.
2. For Three Units students will be required to offer Paper-III and Paper-IV and Practical-III and IV

LIST OF EQUIPMENTS.

Autoclave-2.	Tube gel vartical electrophoesis
Hot air Oven.-1.	units(2numbers)
Incubator-2.	Horizontal gel electrophoresis.
BOD incubator-1 with illumination.	UV-Visible Spectrophotometer.
Serological water Bath.-2	Computers atleast two systems with
Colorimeter-1.	internet connectivity.
Thin layer Chromatography kit.	Magnetic stirrer.
Microkjeldhal Apparatus kit.	Microsope with Phase Contrast
Soxhlet Apparaus with heating mentle.	attachments..
Microscpoes with Oil Immersion lens-	Algal Cultivation chamber.
(minimum 15.	Rotary Shaker.
Dark Field Condenser.	Colony counter.
Refrigerated centrifuge with rotor for	Analytical balaces.
Eppendroff tubes.	Monopan balance/Electronic balance.
Shaker water bath.	Centrifuge.
Laminar air flow unit 3ftx3ftx3ft. Horizontal	Refrigerator.
type.	pH meter.
Micropipetes.	Turn table-10.

LIBRARY.

The library must have books as prescibed for each paper.

A separate budget of Rs.10,000/-per year must be provided in addition to procure the prescribed books.

Paper I
Cell Biology, Genetics, General Microbiology, Biostatistics and
Bioinformatics

Unit 1 : Cell Biology 30

1. Cell membranes and permeability: Molecular models of the cell membrane, cell permeability. Differentiation of the cell membrane, intercellular communications and gap junctions. Cell coat and cell recognition, cell surface and cancer cells.(10)
2. The cytoskeleton and cell motility: Microtubules, microfilaments and intermediate filament.(5)
3. Cellular and molecular Biology of muscle: Structure of striated muscle fiber. Organization of the contractile system, regulation and energetics of muscle contraction. (5)
4. General characteristics of cell differentiation: Localisation of cytoplasmic determinants in eggs, nucleoplasmic interactions, molecular mechanisms of cell differentiation. (10)

References: Cell and Molecular Biology by De Robertis

Cell and Molecular Biology by Karp G, 2002, John Wiley and Sons

Molecular Biology of the Cell 1994, Alberts B, Bray D, Lewis J, Raff M,

Robertis K and Watson J D. Garland Publishing Inc.

Unit II: General Microbiology : 30

1. Ultrastructure of Prokaryotic cell: Cell wall, cytoplasmic membrane, nuclear material and replication. Bacterial endospores: structure, formation, germination and functions. Bacterial cellular reserve materials. Cell appendages: types, structures and functions. (10)
2. Different groups of prokaryotes: Blue green algae, Archebacteria, Eubacteria, Actinomycetes, Rickettsia and Chlamydia, Mycoplasma.(10)
3. Virology: Discovery, structure of virus particle, classification and enumeration, cultivation, plant, animal and bacterial virus.(10)

References:

Fundamentals of Microbiology by Frobisher. Saunders Company

Microbiology by Pelzar and Reid.

General Microbiology by Powar and Dagainawala. Himalaya Publication.

Microbiology By Ingrahm Thompson Learning.

Microbiology by Stanier.

Unit III : Genetics : 30

1. Mendelian Genetics in Humans: Pedigree analysis, examples of human genetic traits (02)
2. Extensions of genetic analysis: Multiple alleles, modification of dominance relationship, genetic interactions, essential genes, lethal genes, the environment and gene expression. (08)
3. Genetic mapping in Eukaryotes: Linkage and crossing over, mapping of chromosomes using three point cross, tetrad analysis in *Neurospora*, mapping the human genome. (10)
4. Gene function: Gene control of enzyme structure, genetically based enzyme deficiencies in humans, phenylketonuria, albinism, Lesch-Nyhan syndrome, Tay-Sachs disease, gene control of protein structure, cystic fibrosis, genetic counseling. (10)

References: Genetics: Russel Peter J. The Benjamin/Cummings publishing company.

Genetics: Strickberger Prentice Hall India Pvt Ltd.

Principles of Genetics, 2002, R H Tamarin. 7th eds. Tata Mc GrawHill

Unit IV : Biostatistics and Bioinformatics: 30

Biostatistics: 20

1. Central tendency, standard deviation, coefficient of correlation, regression analysis, chi square, hypothesis testing, Z-test, t-test .

References: Mathematics for Biological Sciences Jagdish Arya and Ladner

Biostatistics by Alvin Lewis East West Edition.

Biostatistics by Mahajan

2. Introduction to Bioinformatics: 10

- i.) Use of INTERNET and WWW and data searches.
- ii.) Tools used in Bioinformatics related to Biotechnology- NCBI data model. Services offered by NCBI and EBI.

Paper IV

Industrial Biotechnology

Unit I : Microbial Biotechnology : (30)

Microbial Growth Kinetics (

1. Physiology of microbial growth

- i) Defining growth, description of growth process from raw material to cell mass, description of underlying biochemical processes and their control that leads to balanced growth.
- ii) Methods of study of microbial growth.
- iii) Modeling growth process- batch, continuous, arithmetic growth, defining growth rate, generation time, effect of different variables like nutrient concentration, pH, temperature etc, derivation of relevant equations, Monod equation, efficiency of growth - growth yield, modelling chemostat and turbidostat.
- iv) Application of growth modeling in industrial processes design and control.

2. Environmental Biotechnology Waste treatment: Nature of industrial waste, liability of industry and environmental implications, review of industrial waste treatment: example from various representative industries. Monitoring methods and criteria used for measuring success of waste treatment. (10)

3. Study of typical processes: Production of alcohol, wine, cheese, yogurt, bread, organic acid, antibiotic production, enzymatic transformation of steroids and organic compounds (aqueous and non aqueous). (10)

References:

- Casida L E "Industrial Microbiology (1999). New age International (P) Ltd, New Delhi
- Stanbury P F., Whitler A. & Hall S J (1997) "Principles of Fermentation Technology", 2nd edition, Aditya Books Pvt Ltd, New Delhi.
- Crueger W and Crueger A (2000) Fermentation Microbiology and Biotechnology, 2nd edition Panima Publishing Corporation, New Delhi.
- EL Mansi E M T and Bryce CFA (2000) Fermentation microbiology and Biotechnology "Taylor and Francis Ltd. New Delhi
- Environmental Biotechnology by Omenn G E (1987) Plenum Press.

Unit II: Bioprocess Technology : 30

1) Bioprocess development stages: discovery and selection of a potential product, screening programs for selection of suitable biological system, process parameter study and their standardization. (10)

- 2) Bioreactors: Design and configuration, Pneumatic and Mechanically stirred, mass transfer, shear effects, associated instrument for measurement and process control.(10)
- 3) Sterilization: Industrial, reactor sterilization, air and work area sterilization.(02)
- 4) Down stream processing: Steps involved one example from microbial, plant and animal product.(08)

References.

- Plant Cell and tissue culture in liquid systems (1991): Payne G F, Bringi V, Prince C L and Shuler M L. Hanser Publishers.
- Kriggsman J Product recovery in bioprocess technology (1992) Butterworth Heinemann.
- Basic Biotechnology by Colen Ratledge and Bjorn Kristiansen, 2001, Cambridge
- Higgins I J, Best D J and J Jones 9eds) Biotechnology :Principles and applications, 1985, Blackwell Scientific publications, oxford, London, Edinburg.

Unit III: Plant and Animal Biotechnology : 30

1.Plant cell cultures as a system for production of fine chemicals: why culture plant cells, plant suspension cultures, medium constituents, enhancement of product formation by elicitation, permeabilisation of plant cells for product release, biotransformations, hairy root cultures (15)

2.Vaccines : Subunit vaccines: Herpes simplex vaccine, Foot and Mouth Disease, Peptide vaccines, Genetic immunization: DNA vaccines, Attenuated vaccines (Cholera, Salmonella, Leishmania), Vector vaccines. (15).

Unit IV: Quality assurance and Entrepreneurship in Biotechnology: 30

1. Quality assurance (15)

- a) Quality assurance vs quality control
- b) GMP, GLP principals for uniform quality
- c) Concept of ISO certification and standards
- d) Methods of QA applied for production process.

2. Entrepreneurship in Biotechnology: Industrial/commercial aspects (15)

1. Areas of biotechnology that are already commercialized and are in the process of commercialization, demonstrating the scope of the subject, major biotech industries in India.
2. Future course of developments in Biotechnology.

Indian Biotech Industry. A status Report, 2003. Biotech Support Services

Practical I

Cell Biology, Genetics, General Microbiology, Biostatistics and Bioinformatics

Cell Biology:

1. Study of stains and fixatives for study of plant and animal cells (Haematoxylin, Safranin, phloroglucinol, eosin, methylene blue, acetocarmine, acetoorceine).
2. Localisation of mitochondria by Janus green staining.
3. Blood cells : Separation of blood cells, differential count using Haemocytometer.
4. Testing of cell viability using trypan blue and TTC staining.
5. Cytological identification of cancer cells (permanent slide)

Genetics:

1. Problems based on linkage and crossing over, tetrad analysis in *Neurospora*.
2. PDB treatment of Onion root tips and study of mitosis.
3. *Drosophila* culture and study of phenotypic traits like wing type, eye colour.
4. Study of genetically based enzyme deficiencies in human (PKU, albinism, Lesch Nyhan syndrome and Tay-Sachs disease)
5. Permanent slide- Sickle cell anaemia

General Microbiology

1. Studies on morphological and cultural characteristics of *Streptomyces*, *Nocardia*, *Clostridium*, *Bacillus*, Blue green algae.
2. Staining of endospores, metachromatic granules, lipid granules, cell wall, capsule and spirochetes
3. Egg inoculation technique for cultivation of viruses (demonstration)

Biostatistics:

1. Central tendency: Mean, median and mode
2. Data representation, frequency polygon, histogram, pie diagrams.
3. Calculation of standard deviation
4. Coefficient of correlation
5. Regression analysis
6. Normal deviate test (Z-test)
7. Test of significance of means paired and unpaired t test.
6. Graphical representation of data using Excel, calculation of mean, standard deviation, insertion of error bars, coefficient of correlation.

Bioinformatics

Internet usage

Search of data bases

Practical II

Immunology, Biochemistry and Instrumentation

Immunology:

Antigen –antibody interactions: Blood grouping

Diagnostic kits usage : ELISA, RIA (demonstration)

Biochemistry

1. Important lab practices: Lab safety, solutions, dilutions, dilution factors, units and components, graphing, constant scale, log scale, graphing with computers.
2. Pipets and pipetman.
3. Estimation of glucose (Folin and Wu method), glucose oxidase-peroxidase
4. Protein estimation Bradford's reagent (Spectrophotometric)
5. Estimation of % purity of starch (Willstater method)
6. Estimation of serum cholesterol (Parekh and Jung method)
7. Determination of ascorbic content of fruits (DNPH method)
8. Estimation of adrenaline
9. Estimation of Vitamin A (Carr-Price method).
10. Serum bilirubin and vandenbergh reaction, GOT and GPT assay.
11. Uric acid level of serum, serum urea, serum creatinine, urea and creatinine in urine, phenolsulphanophthalamine test.
12. Extraction of amino acid from suitable source and their separation by paper chromatography (ascending)

Instrumentation

Principle, working and applications of Electrophoresis, Spectrophotometer, HPLC, Shakers, Fermenters.

1. Density gradient centrifugation for isolation of blood cells/chloroplast
2. TLC separation of fatty acids
3. Betalains extraction from storage roots of beet and absorption pattern
4. Gel electrophoresis: Native gel. Extraction and separation of any protein.

Practical III

Molecular Biology and recombinant DNA Technology

1. Aseptic techniques, safe handling of microorganisms, establishing pure cultures, streak plate technique.
2. Preparation of culture medium, stock solutions.
3. Isolation of plasmid DNA (preparation of reagents required for plasmid DNA isolation).
4. Quantification of plasmid DNA.
5. Isolation of plasmid DNA using agarose gel electrophoresis.
6. Restriction enzyme digestion of plasmid DNA and separation of fragments.
7. Isolation of genomic DNA from suitable material and quantification.
8. Agarose gel electrophoresis of genomic DNA.
9. Southern blot transfer technique.
10. Restriction enzyme digestion and construction of restriction map (Problem)
11. DNA sequencing from the provided autoradiogram
12. Identification of genetic phenomenon: Jumping genes in maize, transgenic plants, animals.

Practical IV Industrial Biotechnology

1. Sterilization techniques: Dry heat (Oven), wet (Steam sterilization) using autoclave, ultrafiltration, chemical and laminar air flow.
2. Shake flask culture of microbial cells, growth curve study, calculation of specific growth rate.
3. Extraction and estimation of pectinases from fruits (clarification of fruit juice).
4. Production of yeast biomass and invertase activity.
5. Biotransformation of antioxidants by peroxidases extracted from germinating soybean seeds.
6. Waste water treatment: Removal of organic amines from waste water using peroxidases extracted from germinating soybean seeds.
7. Antibiotic sensitivity tests.
8. Strain selection for antibiotic production (Zone of inhibition)
9. Establishment of callus from suitable plant material, growth curve study in shake flask, fresh weight, dry weight estimation and protein estimation. Calculation of specific growth rate and doubling time.
10. Culturing of *Trichoderma* as suspension culture, extraction of cellulases and study of cellulase activity.
11. Visit to industries to study various types of fermentation like manufacturing of yeast, alcohol, antibiotic etc.

Examination Pattern.

Theory papers.

Each theory paper will be of 100marks and of three hours duration.

Each paper will have five compulsory questions of 20marks each.

Skeleton of Practical.

Paper-I

- | | |
|--|----|
| 1. Separate the blood cells/ viability test | 5 |
| 2. Mitosis (Pretreated material) | 5 |
| 3. Test for biochemical genetics | 5 |
| 4. Biostatistics (data to be provided) | 10 |
| 5. Morphological study of bacteria/endospore components- | 5. |
| 6. Internet data search | 5 |
| 7. Identifications (5) | 10 |
| 8. Journal - | 5 |

Practical II

1. Blood group testing 5
2. Major experiment 10
3. Minor experiment 5
4. Gel electrophoresis (Gel to be prepared by expert) students will load and run the gel, staining. 15
5. TLC/Betalains 5
6. Identifications 5
7. Journal 5

Practical III

1. Plasmid DNA isolation and separation using agarose gel electrophoresis (to be done next day) 20
2. Protein Gel staining from Practical II -5.
3. Identification (5) 10
4. Journal 5
5. VIVA 10

Practical IV

1. Major experiments 15
 2. Plasmid DNA agarose electrophoresis continued from previous day-5
 3. Minor experiments 05
 4. E.coli growth curve study 10
 5. Identification 10
 6. Journal 5
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