

TUMKUR UNIVERSITY
B. Sc., BIOTECHNOLOGY SYLLABUS (CBCS)

Structure of B.Sc., Degree Course:

The B.Sc. Degree course is three year course consisting of six semesters. Each semester is of 18 weeks duration, excluding examination period. In Biotechnology, there shall be eight theory papers and six practical. Each theory paper will consist of 60 hrs (I to IV Semester) and 45 hrs (V and VI semester) of instruction. Each practical will consist of 9 to 15 experiments.

B.Sc. Programme: Course Matrix for semester I-IV

Sl no	Course No. in Sem	Title of the paper	Type of instruction & hrs per week/ Course	Credits	Hrs of Exam (SEE) per course/ Sem	Max. Marks for IA/ Course/ Sem	Max. Marks for SEE per Course/ Sem	Max. Marks per Course/ Sem
1	1.3	Cell biology and Genetics	T 4	4	3	10	90	100
2	1.4	Cell biology and Genetics - <i>Practical-I</i>	P 4	2	3	-	50	50
3	2.3	Microbiology & Biostatistics	T 4	4	3	10	90	100
4	2.4	Microbiology & Biostatistics- <i>Practical-II</i>	P 4	2	3	-	50	50
5	3.3	Biochemistry and Biophysical Techniques	T 4	4	3	10	90	100
6	3.4	Biochemistry and Biophysical Techniques <i>Practical-III</i>	P 4	2	3	-	50	50
7	4.3	Molecular Biology and Bioinformatics	T 4	4	3	10	90	100
8	4.4	Molecular Biology and Bioinformatics <i>Practical-IV</i>	P 4	2	3	-	50	50
Open Elective								
9		Biotechnology and Human Welfare and/or Nanobiotechnology	T-2/P-4	2	3	-	50	50

B.Sc. Programme: Course Matrix for semester V /VI

Sl no	Course Number in Sem	Title of the paper	Type of instruction & hours per week/ course	Credits	Hours of Exam(SEE) per course/sem	Max. Marks for IA/ Course/ Sem	Max. Marks for SEE per course/ Sem	Max. Marks per course/ Sem
1	5.1	Genetic Engineering	T 3	3	3	10	90	100
2	5.2	Immunology	T 3	3	3	10	90	100
3	5.3	Genetic Engineering/ Immunology <i>Practical-V/VI</i>	P 6	3	3	-	100	100
4	6.1	Plant and Animal cell technology	T 3	3	3	10	90	100
5	6.2	Industrial and Environmental biotechnology	T 3	3	3	10	90	100
6	6.3	Plant and Animal cell technology & Industrial and Environmental biotechnology <i>Practical-VII/VIII</i>	P 6	3	3	-	100	100

SEMESTER – I

1.3 – Cell Biology and Genetics

Hours: 60

Unit -1. Cell Surface Architecture

08 Hrs

Discovery of cell, The Cell theory, Ultrastructure of a eukaryotic cell (plant and animal cell), Ultra structure of cell wall and Plasma membrane-Fluid Mosaic model, Unit Membrane model, Sandwich model, Plasmodesmata, Ionic channels, Voltage gated channels; Gap junctions and tight junctions

Unit – 2. Cellular Organelles

16 Hrs

Ultra Structure and functions of cell organelles – Cytosol and Cytoskeletal structures, Endoplasmic reticulum, Golgi complex, Mitochondria, Chloroplast, Ribosomes, Lysosomes, Peroxisomes, Nucleus- Structural Organization of chromosomes- Ultra structure, Nucleosome model, folded-fibre model, Special types of chromosomes; Salivary gland and Lamp brush chromosomes, Cell cycle, cell division (mitosis and meiosis), Cell Motility, Cell Senescence and Programmed Cell Death.

Unit 3. Principles of Genetics

16 Hrs

Mendel's Experiments and Principles of inheritance, Co-dominance and Incomplete dominance, multiple alleles (ABO blood groups), Multi- factorial inheritance (Skin colour in Man), Interaction of genes (Supplementary factors; Comb pattern in fowls) Complementary genes (Flower colour in sweet peas) Epistasis: Plumage colour in poultry, Sex Determination in Plants and animals (Concepts of allosomes and autosomes, XX-XY, XX-XO, ZW-ZZ, ZO-ZZ types), Cytoplasmic Inheritance: Plastid inheritance in *Mirabilis*, petite characters in yeast and kappa particles in paramecium.

Unit: 4 Linkages and Crossing Over

06 Hrs

Coupling and repulsion hypothesis, Linkage in maize and *Drosophila*, Mechanism of crossing over and its importance, Chromosome mapping – Linkage map in maize.

Unit 5. Mutation

10 Hrs

Types: spontaneous and induced, Mutagens: Physical and chemical, Mutation at the molecular level. Mutations in plants, animals, and microbes for economic benefit of man, General account of structural and numerical aberrations, detection of mutations (Ame's Test).

Unit-6: Human Genetics

04 Hrs

Karyotype in man, inherited disorders - Allosomal (Klinefelter syndrome and Turner's Syndrome), Autosomal (Down syndrome and Cri-Du-Chat syndrome), Pedigree analysis

References:

1. Molecular Biology of cell – Bruce Alberts et al, Garland publications
2. Animal Cytology & Evolution – MJD, White Cambridge University Publicatins
3. Molecular Cell Biology – Daniel , Sceintific American Books.
4. Cell Biology – Jack D.Bruke, The William Twilkins Company.
5. Principles of Gene Manipulations – Old & Primrose, Black Well Scientific Publications.
6. Cell Biology – Ambrose & DorouthyM Easty, ELBS Publications.
7. Fundamentals of Cytology – Sharp, Mc Graw Hill Company
8. Cytology – Wilson & Marrison, Reinform Publications
9. Molecular Biology – Smith Faber & Faber Publications
10. Cell Biology & Molecular Biology – EDP Roberties & EMF Roberties, Sauder College.
11. Principles of Genetics – E.J.Gardener, M.J.Simmons and D.P.Snustad, John Wiley & Sons

1.4 – Cell Biology and Genetics (Practical)

1. Use of Micrometer and calibration, measurement of onion epidermal cells
2. Mitotic and meiotic studies in grasshopper testes, onion root tips and flower buds
3. Chromosomes: Mounting of polytene chromosomes
4. Karyotype analysis – Man and Onion, Man – Normal and Abnormal – Down and Turner's syndromes, Genetic problems
5. Isolation of chloroplasts and mitochondria
6. Vital staining of mitochondria
7. Blood grouping
8. Blood smear – differential staining
9. Study of drosophila life cycle, mutants (Eye colour mutations in drosophila)
10. Study of Barr bodies

*EACH STUDENT IS REQUIRED TO SUBMIT 4 PERMANENT SLIDES (2- MITOSIS & 2-MEIOSIS)

SEMESTER II

2.3 – Microbiology and Biostatistics

Hours: 60

Unit 1. Introduction and Scope of Microbiology

12 Hrs

Definition and history of microbiology, contributions of Antony van Leeuwenhoek, Louis Pasteur, Robert Koch, Alexander Fleming. Importance and scope of Microbiology as a modern Science, Branches of microbiology, five kingdom and three domain classification of microorganisms. Microscopy: Construction and working principles of different types of microscopes – Compound, Dark field, Phase contrast, Confocal, Fluorescence and Electron Microscope (Scanning and Transmission)

Unit 2. Microbial Techniques

10 Hrs

Sterilization: Principles and Applications of Physical Methods. Autoclave, Hot air oven, laminar airflow, Seitz filter, Sintered glass filter, and membrane filter. Radiation Methods: UV rays and Gamma rays. Chemical Methods: Alcohol, Aldehydes, Phenols, Halogens and Gaseous agents. Isolation of microorganisms, types of streaking, serial dilution, pour, spread plate and exposure plate methods. Stains and Staining Techniques: Principles of staining, Types of stains – simple stains, structural stains and Differential stains

Unit 3. Prokaryotic microorganisms

15 Hrs

Concept of microbial species and strains, classification of bacteria based on – morphology (shape and flagella), nutrition, Chemotaxonomy, genetic method and extreme environment, molecular phylogeny. Bacterial diseases of man – Tetanus, Tuberculosis, Pneumonia and Cholera. Microbial Metabolism: Bacterial Photosynthesis: Photosynthetic apparatus in prokaryotes, Photophosphorylation & Dark reaction. Respiration: EMP, HMP and ED Pathways, Krebs's cycle, Oxidative Phosphorylation.

Unit 4. General Account acellular organisms

08 Hrs

Viruses – Structure and classification, Plant Viruses –TMV, CaMV, Animal viruses – Hepatitis B, HIV, Bacteriophages- Lambda, T4 Phage, Viroid- Potato spindle tuber viroid, Prions- CJD, Kuru, BSE

Unit 5. Eukaryotic microorganisms

08 Hrs

Salient features, classification, reproduction and economic importance of Protozoa algae and fungi. Fungal and protozoal diseases of plants and animals.

Unit 6. Biostatistics

07 Hrs

Data types, Tabulation and classification of data, Frequency distribution and Graphical representation of data, Measures of central tendencies: Mean, Median, Mode and their properties, Measures of Dispersion: Mean deviation, Variance, Standard deviation and coefficient of Variation, Different models of data presentation with special reference to biological samples, Chi square test, student T test, introduction to SPSS analysis with examples etc.,

References:

1. Microbiology – pelezar, chan, krieg Tata McGraw Hill Publications.
2. Microbiology – concepts and application by Paul A.Ketchum, Wiley Publications
3. Fundamentals of Microbiology- Frobisher, Sauders & toppan publications.
4. Microbiology - Ronald M.Atlas
5. Introductory Biotechnology – R.B. Singh C.B.D. India (1990)
6. Industrial Microbiology – casidal.E.Wiley Eastern Ltd.
7. Fundamentals of Bacteriology – Salley
8. Fontiers in Microbial technology – P.S.Bisen, CBS Publishers
9. Biotechnology: International Trends of perspectives A.T.Bull, G.Holl M.D.Lilly Oxford & TBH publishers
10. General Microbiology-C.B.Powar, H.F. Daginawala, Himalayan Publishing House

2.4 Microbiology (Practical)

1. Study of Compound microscope, Autoclave, Hot air oven, pH meter, Laminar Air flow and centrifuge.
2. Preparation of different types of media (Simple, complex and differential media).
3. Staining Techniques: Simple, Negative staining, Gram staining, Endospore staining and fungal staining
4. Isolation of bacteria and fungi from soil, air, and water –streaking, serial dilution and pour plate methods
5. Counting of microorganisms – Total Count (Haemocytometer)
6. Antibiotic sensitivity test, MIC,
7. Biochemical tests – starch hydrolysis, catalase, oxidase & gelatin liquefaction
8. Study of Rhizobium from root nodules of legumes
9. VAM
10. Isolation and identification of *E. coli*

SEMESTER III

3.3 – Biochemistry and Biophysical techniques

Hours: 60

Unit 1. Carbohydrates

05 Hrs

Structure, Properties, Classification and functions

Unit 2. Lipids

05 Hrs

Structure, Properties, Classification and Functions

Unit 3. Amino acids and Proteins

10 Hrs

Structure, Properties, Classification and functions of amino acids and proteins. Structural organizations of proteins (primary, secondary, tertiary and quaternary structures) reverse turns and Ramachandran plot.

Unit 3. Enzymes

15 Hrs

Introduction, classification, Enzyme kinetics-Importance of enzyme kinetics, Factors affecting enzyme reactions (Temp, pH, ions, changes in structure of proteins) Michaelis-Menton equation derivation, Line-Weaver Burk Plot, merits and demerits. Enzyme inhibition – reversible inhibition (competitive, uncompetitive and non competitive), irreversible inhibition, allosteric enzyme activity, co-enzymes and co-factors

Unit 4 Nucleic acids

05 Hrs

Structure, Properties, classification, and functions of Nucleic acids. Nature of genetic materials, structure of purine, pyrimidine and nucleotides

Unit 5. Vitamins and Hormones

05 Hrs

Structure, Properties, classification, and functions of Vitamins and Hormones

Unit 6. Biophysical techniques

15 Hrs

Solutions, pH and buffers: Theory of water ionization and its purity (K_w), pK_a & pK_b acids and bases, Derivation of Henderson-Hasselbalch equation and its significance. Buffers: Criteria for selection of buffers, Types of buffers, Buffers in Biological systems and their mechanism of action. Analytical techniques: Principles and applications of Chromatography (Paper, thin-layer, column and GLC), Centrifugation (RPM and G, Ultracentrifugation), Spectroscopy (UV-Visible, X-ray crystallography, IR, NMR, mass, ESR), Isotopes **and Radioactivity**: Radioactivity, decay laws, Isotopes in Biological studies (Metabolic and physiological tracer studies), GM counters & Scintillation counting.

References:

1. Principles of Biochemistry- AlbertL. Lehninger CBS Publishers & Distributors
2. Biochemistry – Lubert stryer Freeman International Edition.
3. Biochemistry – Keshav Trehan Wiley Eastern Publications
4. Fundamentals of Biochemistry-J.L.Jain S.Chand and Company
5. Biochemistry- Prasaranga, Bangalore University
6. Fundamental of Biochemistry – Dr.A.C.Deb
7. Textbook of Organic Chemistry (A Modern Approach)
8. The Biochemistry of Nucleic acid – Tenth Edition-Roger L.P.Adams, John T. Knowler and David P.Leader, Chapman and Hall Publications

3.4 – Biochemistry and Biophysical techniques (Practical)

1. Estimation of reducing sugars- Glucose, Maltose and lactose by DNS, H J and Somoji's Methods
2. Estimation of lipids
3. Estimation of Amino acids.
4. Estimation of protein by Biuret method and Lowry's method
5. Assay of enzymes activity – Amylase / Protease
6. Estimation of Nucleic acids
7. Estimation of Vitamins
8. Preparation of Buffers-: Tris-Buffer, Citrate-Buffer and Phosphate-Buffer
9. Separation of Sugars, Lipids, amino acid, and Nucleic acids by TLC
10. Estimation of inorganic phosphate by Fiske-Subba row method.

SEMESTER IV

4.3 Molecular Biology and Bioinformatics

Hours: 60

Unit 1: Introduction to Molecular Biology

10 hrs

Scope and History. Central Dogma of Molecular Biology. Structure of DNA-Nucleoside, Nucleotide, Base pairing, Base stacking, Double Helix, features of Watson and Crick model, major and minor groove, Supercoiling- twist, writhe and linking number. Forms of DNA- A, B, Z. Structure and function of mRNA, rRNA, tRNA. Secondary structures in RNA

Unit 2: DNA Replication and Repair

10 hrs

Types and functions of DNA polymerases in Prokaryotic and Eukaryotic replication. Proof reading activity, 5'→3' exonuclease and endonuclease activity, topoisomerase activity, Telomeric DNA replication and Plasmid Replication-theta model, strand displacement model and rolling circle model. DNA Repair- Nucleotide excision repair, base excision repair, mismatch repair, photo-reactivation, recombination repair and SOS repair.

Unit 3: Transcription

10 hrs

Structure of prokaryotic and eukaryotic gene, structure and function of the promoters in mRNA, rRNA, tRNA genes. RNA polymerases in prokaryote and eukaryote, types and function. Transcription of mRNA, rRNA, and tRNA genes in Prokaryote and eukaryote. Post transcriptional processing of mRNA - 5'capping, splicing (including different types), polyadenylation and RNA editing.

Unit 4: Translation

10 hrs

Genetic code and Wobble hypothesis. Translation in prokaryote and eukaryote. Post translational modifications. Principles protein sorting and targeting into endoplasmic reticulum, mitochondria, chloroplast, and nucleus.

Unit 5: Gene Regulation and Recombination

10 hrs

Principles of gene regulation- activators, co-activators, suppressors, co-suppressors, moderators, silencers, insulators, enhancers. Operon-*lac* operon, *trp* operon, recombination in prokaryotes- transformation, conjugation and transduction. Plasmids and their types, plasmid copy number and incompatibility, Episomes. Transposable elements (insertion sequence and transposons, Integrons and Antibiotic Resistant genes), iRNA, siRNA, microRNA

Unit 6: Bioinformatics

10 hrs

Introduction to bioinformatics, Concept and structure of databases, Introduction to the human genome project and components of the genome. Introduction to the gateway sites (NCBI, EMBL and DDBJ) Types of nucleic acid sequences-Genbank: Protein Data Bank (PDB) -in the context of protein structural biology, Introduction to sequence analysis, significance, motif analysis and phylogenetic comparisons Concept and methods of sequence comparisons in general: FASTA, BLAST

and CLUSTALW, pairwise sequence comparison, Scoring matrices, Gap Penalties, Global Alignment, Local Alignment, Introduction to -omics.

References:

1. Glick, B.T and Pasternak J.J (1998) Molecular biotechnology, Principles and application of Recombinant DNA, Washington D.C. ASM press.
2. Howe.C. (1995) Gene Cloning and manipulation, Cambridge University Press, USA
3. Lewin, B., Gene VI New York, Oxford University Press.
4. Rigby, P.W.J. (1987) Genetic Engineering Academic Press Inc. Florida, USA.
5. Sambrook et al (2000) Molecular cloning Volumes I,II, & III Cold spring Harbor Laboratory Press, New York, USA
6. Walker J.M. and Gingold, E.B. (1983) Molecular Biology & Biotechnology (Indian Edition) Royal Society of Chemistry U.K
7. Karp.G (2002) Cell & Molecular Biology, 3rd Edition, John Wiley & Sons; INC

4.4: Molecular Biology and Bioinformatics – Practical

1. Estimation of DNA by DPA method.
2. Estimation of RNA by Orcinol method.
3. Isolation of chromosomal DNA from animal tissues, plant and Bacteria.
4. Isolation of plasmid DNA.
5. Bacterial transformation
6. Extraction and estimation of protein from animal goat liver/muscle sourced by salt precipitation, Organic solvent method.
7. Extraction and estimation of protein from animal or plant source (Green gram/Pea) by salt precipitation & Organic solvent method.
8. Protein separation by Polycrylamide Gel Electrophoresis (PAGE)
9. Nucleic acid (DNA/RNA) separation by agarose gel electrophoresis
10. Sequence alignment (FASTA, BLAST)
11. ROS MOL

SEMESTER V

5.1 – Genetic Engineering

Hours: 45 Hours

Unit 1. Tools for genetic engineering

07 hrs

Restriction enzymes and its types, DNA ligases, Reverse transcriptase, Gene cloning vectors and its types, *in vitro* construction of recombinant DNA molecules (pBR 322, pUC 19), Artificial chromosomes.

Unit- 2. Transformation techniques

06 hrs

Calcium chloride, Electroporation, microinjection, and biolistic methods. Screening and selection of recombinant host cells –marker genes, biochemical and Immunological screening and colony hybridization

Unit 3. Principles of Cell-based DNA Cloning-Genomic DNA and cDNA cloning

07 hrs

Unit 4. Expression of cloned DNA in prokaryotes and eukaryotes

05 hrs

Unit 5. Gene engineering techniques

10 hrs

Hybridization- Principles and applications, Amplifying DNA, Cloning and its importance, Primers, probes DNA and Protein microarrays. Introduction to proteomics, genomics and metabolomics

Unit 6. Application of r-DNA technology

10 hrs

Production of Insulin, Production of recombinant vaccines – Hepatitis – B, Production of GM foods and crops, Ethics and safety of GMO's

Reference:

1. Glick, B.R & Padernak J.J (1994) Molecular Biotechnology, Principles and Applications of Recombinant DNA, American Society for Microbiology, Washington D.C
2. Christopler H. (1995) Gene cloning and Manipulating, Cambridge University Press
3. Nicholl, D.S.T (1994) An Introduction of Genetic Engineering, Cambridge University Press.
4. Old. R.W. and Primrose, S.B. (1986) Principles of Gene manipulation, An introduction to genetic engineering (3rd Edition) Black well Scientific Publications
5. Watson J.D. Hopkins, N.H Roberts, J.W.Stectz J.A and Weiner A.M(1988). Molecular biology of society for Microbiology
7. Lewin b. (1994) Genes VI, New York,Oxford University Press.

SEMESTER V

5.2 Immunology

Hours: 45 Hrs

Unit 1. History and scope of Immunology

05 hrs

Types of Immunity- Innate and Acquired immunity. Humoral, Cell Mediated Immunity, Cell and organs of immune responses and their functions

Unit 2. Antigens and Antibodies

10 hrs

Antigens-Types, haptens, epitopes, adjuvants, and Factors influencing antigenicity, Antigen processing and presentations. Antibodies- Structure, types, properties and functions of immunoglobulins.. Production of antibodies (Poly and Monoclonal)

Unit 3. Complement system and MHC molecules

10 hrs

Components of complement system and complement pathways. Types of MHC molecules and their functions

Unit 4. Antigen- Antibody reactions

10 hrs

In vivo and *In vitro* reactions – Precipitation, agglutination, Immuno-electrophoresis, Labelled antibody (RIA, ELISA and Immunofluorescent techniques).

Unit 5. Hypersensitivity and its types

10 hrs

Unit 6. Immunization- herd/community, Passive and Active immunization, immunization schedules. Types of Vaccines – Inactivated, Attenuated and Recombinant vaccines – Peptide and DNA Vaccines

Reference:

1. William, E. Paul (1989) fundamental immunology, 2nd Edition Raven Press, New York.
2. William, R. Clark(1991) the Experimental Foundations of Modern Immunology (4th Edition) John Wiley and Sons, New York.
3. Ivan, M, roitt (1994) Clackwell Scientific Publications, London.
Animal Cell Biotechnology
1. Ian Freshney (4th Edition)
2. Buttler. Elements of Biotechnology – P.k. Gupta (1st Edition -2000) Rastogi Publications.

5.3 Genetic Engineering/ Immunology Practical-V/VI

1. Isolation of genomic DNA from bacteria, plant and animal source
2. Isolation of plasmid DNA from *E. coli*
3. PCR
4. Restriction digestion of plasmid DNA
5. Separation of DNA by Gel Electrophoresis
6. SDS-PAGE
7. Replica plating
8. Transformation
9. Blood grouping

10. Differential Count of WBC
11. Widal Test
12. VDRL test
13. ELISA – Demonstration
14. Dot Elisa
15. Ochterlouny Double diffusion (ODD)
16. Rocket immunoelectrophoresis
17. Separation of serum and plasma from the blood
18. Precipitation of Immunoglobulins by ammonium sulphate

SEMESTER VI

6.1 – Plant and Animal cell technology

Hours: 45

Unit 1. Plant tissue culture

08 hrs

In vitro methods in plant tissue culture, aseptic Techniques. Types of nutrient media and use of growth regulators (Auxins, Cytokinins and Gibberellins). *In vitro* fertilization – Ovary and Ovule culture. Micropropagation of elite species. Organ Culture – Anther, Embryo and Endosperm culture and their applications.

Unit 2. Protoplast Culture

08 hrs

Isolation, regeneration and viability test, somatic hybridization, methods of protoplast fusion – chemical and electro fusion, practical application of somatic hybridization and cybridization. Somaclonal variation and their significance. *In vitro* production of secondary metabolites – Techniques and significance.

Unit 3. Transgenic plants

08 hrs

Technique of transformation – biological (Agrobacterium mediated), physical and chemical methods. Applications of transgenic plants. Edible vaccines. Role of tissue culture in agriculture, horticulture and forestry

Unit 4. Animal cell culture

08 hrs

Media and its components - Primary Culture – Cell lines, and cloning disaggregation of tissue, isolation of tissue, enzyme disaggregation, and mechanical disaggregation. Secondary Culture – transformed animal cells and continuous cell lines. Growth factors – Promoting proliferation of animal cells EGF, FGF, PDGF, IL-1, IL-2, NGF and erythropoietin.

Unit 5. Transgenic animals

08 hrs

Transfection of animal cell lines. Selectable Markers and Transplantation of Cultural Cells. Expression of Cloned proteins in animal cell – Expression vector, over production and downstream processing of the expressed proteins. Production of Vaccines in animal Cells. Production and Applications of monoclonal antibodies. Production of transgenic animals

Unit 6. Biotechnology and Intellectual property rights:

05 hrs

Patents, trade secrets, copyright, trademark, Geographical indications, WIPO, TRIPS. Procedure involved in patenting biotechnological inventions.

Reference:

1. Ravishankar G.A and Venkataraman L.V(1997) Biotechnology applications of Plant Tissue & cell culture. Oxford & IBH Publishing co., Pvt Ltd.
2. Bhan (1998) tissue Culture, Mittal Publications, New Delhi.
3. Islan A.C (1996) Plant Tissue Culture, Oxford & IBH Publishing Co., Pvt. Ltd.
4. Lydiane Kyte & John Kleyn (1996) Plants from test tubes. An introduction to Micropropagation (3rd Edition) timber Press, Partland.
5. Kumar H.D (1991) A test book book on Biotechnology (2nd Edition). Affiliated East West Press Private Ltd. New Delhi.
6. Chrispeel M.J. and Sdava D.E. (1994) Plants, Genes and agriculture, Jones and Barlett Publishers, Boston.
7. Reinert J. and Bajaj y.P.S (1997) Applied and fundamental Aspects of Plant Cell, Tissue, and Organ Culture, Narosa Publishning House.

SEMESTER VI**6.2 – Industrial and Environmental Biotechnology****Hours: 45 Hrs****Unit 1. Introduction to industrial Biotechnology****08 hrs**

Basic principles of fermentation technology, Screening and Isolation of Microorganisms, maintainance of strains improvement (Mutant selection, Recombinant DNA methods).

Unit 2. Fermentation technology**10 hrs**

Fermentation Media, Natural and synthetic Media. Fermenters and its operation, Type of Fermentation Solid State, submerged fermentation and continious fermentation, Immobilized enzyme and cell bioreactors, Process Development – Shake flask fermentation, Downstream processing (DSP), Distingration of cells, Separation, Extraction, Concentration and purification of products

Unit3. :Production of Microbial and plant products**08 hrs**

Microbial production of Alcohol, Antibiotic, enzymes, SCP, SCO, Vitamin, xanthan gum and Polyhydroxyalkonoides (PHA). Food additives – Safforn and Capasicin

Unit 4. Introduction to Enviornmental Biotechnology**06hrs**

Modern fuels- Biofuels (Biogas, Microbial hydrogen Production, Gasohol). Bioremediation and its types, Bioleaching. Biofertilizers and its types, Biopesticides

Unit 5. GMO's and Environment**05 hrs**

Environmental significance of genetically modified microbes, plants and animals

Unit 6. Waste manangement**08 hrs**

Treatment of municipal waste and Industrial effluents, solid waste manangement (Composting and Vermi composting)

References:

Industrial Biotechnology

1. Sullia S. B& Shantharam S: (1998) General Microbiology, Oxford & IBH Publishing Co. Pvt. Ltd.
2. Bisen P.S (1994) Frontiers in Microbial Technology, 1st Edition, CBS Publishers.
3. Glaser A.N & Nilaido.H (1995) Microbial Biotechnology, W.H Freeman & Co.
4. Prescott & Dunn (1987) Industrial Microbiology 4th Edition, CBS Publishers & Distributors.
5. Prescott & Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers.

6.3: Plant & Animal cell tech.gy/Industrial & Environmental biotech. Practical-VII/VIII

1. Preparation of culture media (plant and animal)
2. Production of Callus and suspension Culture
3. Plant Protoplast Isolation
4. Plant propagation through Tissue culture (shoot tip and Nodal culture)
5. Planting and Maintenance of Medicinally important plants and its medicinal importance
(1 student, 2 Plants compulsory)
6. Preparation of Synthesis seeds
7. Anther Culture
8. Trypsinization of animal tissue
9. Animal cell culture of trypsinized cells
10. Preparation of wine.
11. Production and Estimation of Alcohol by specific gravity method
12. Algal and fungal culture – Spirulina, Agaricus, Yeast and Apergillus
13. Production and Estimation of citric acid from Aspergillus culture.
14. Production and Estimation of lacatic acid
15. Immobilization of yeast cells.
16. Immobilisation of invertase
17. MPN test
18. Vermi Composting
19. Biopesticides assay

B.Sc. Biotechnology Theory Question Paper Pattern

Tumkur University B.Sc Degree Examinations

(CBCS)

Biotechnology

Time: 3 Hrs

Max. Marks: 90

PART-A

Answer any **TEN** of the following

2X10= 20

- 1)
- 2)
- 3)
- 4)
- 5)
- 6)
- 7)
- 8)
- 9)
- 10)
- 11)
- 12)

PART-B

Answer any **SIX** of the following

6X5= 30

- 13)
- 14)
- 15)
- 16)
- 17)
- 18)
- 19)
- 20)

PART-C

Answer any **FOUR** of the following

4X10= 40

- 21)
- 22)
- 23)
- 24)
- 25)
- 26)

B.Sc Biotechnology (CBCS) Practical Question Paper Pattern

For Semester I-IV

The distribution of marks in practical shall be as follows.

- | | |
|----------------------------|----------|
| 1. Major Experiment | 12 marks |
| 2. Minor Experiment | 8 marks |
| 3. Minor Experiment | 8 marks |
| 4. Spotters A, B, C, D & E | 12 marks |
| 5. Practical record | 05 marks |
| 6. Viva | 05 marks |

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Total 50 marks
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For Semester V-VI

The distribution of marks in practical shall be as follows.

- | | |
|------------------------|----------|
| 1) Experiment- Major | 40 marks |
| 2) Experiment-Minor | 25 marks |
| 3) Spotters (3 number) | 15 marks |
| 4) Practical record | 10 marks |
| 5) Viva | 10 marks |

.....
Total 100 marks
.....

Open Elective: Biotechnology and Human Welfare

Hours 30

UNIT I

8 Hrs

Definition and introduction to biotechnology, branches and scope of biotechnology, developmental stages of biotechnology. Types of living organisms- cellular and acellular.

UNIT II

8 Hrs

Industry: Protein engineering: enzyme and polysaccharide synthesis, activity and secretion, Alcohol and antibiotic production. Production of industrially important products: amino acids, Proteins, vitamins, SCP. Agriculture: N₂ fixation: Plant diseases and transfer of resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

UNIT III

8 Hrs

Environments: Xenobiotics and their degradation; Superbug, agricultural wastes and their management, development of biodegradable polymers such as PHB. Waste as a source of energy and food.

UNIT IV

3 Hrs

Health: e.g. new generation diagnostics and therapeutic agents, recombinant vaccines. Gene therapy, diagnostics, human genome project and ELS1. ABO system of blood grouping.

UNIT V

3 Hrs

Forensic science: Solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing.

Open Elective: Nanobiotechnology

Hours 30

Unit 1: Introduction to Nanobiotechnology

8 hours

Introduction to nanotechnology, Development of Nanobiotechnology, Nanomaterial in biotechnology - nanoparticles, quantum dots, nanotubes and nanowires etc., Applications of molecular recognition elements in nanosensing of different analytes

Unit 2: Properties and Characterizations:

8 hours

Optical (UV-Vis/Fluorescence), X-ray diffraction, Imaging and size (Electron microscopy, light scattering, Zetapotential), Surface and composition (ECSA, EDAX, AFM/STM etc)
Vibrational (FT-IR and RAMAN), SERS, Magnetic, Electrical and Electrochemical

Unit 3: Applications of Nano-Materials in Biosystems

8 hours

Proteins - Lipids - RNA and DNA, Protein Targeting - Small Molecule/Nanomaterial - Protein Interactions, Nanomaterial-Cell interactions-Manifestations of Surface Modification (Polyvalency)

Unit 4: Nanomaterials and Diagnostics/Drug Delivery and Therapeutics

3 hours

MRI, Imaging, Surface Modified Nanoparticles, MEMS/NEMS based on Nanomaterials, Peptide/DNA Coupled Nanoparticles, Lipid Nanoparticles For Drug Delivery

Unit 5: Nanomaterials and Toxicity Evaluation

3 hours

Definition and scope, Acute and chronic toxicity, selective toxicity, does synergism and antagonism, Cytotoxicity, Genotoxicity, *In vivo* tests/assays etc.
