

SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL



Master of Science (M.Sc.)

BIOTECHNOLOGY

Syllabus

SCHEME - M.Sc. BIOTECHNOLOGY

SEMESTER	CODE NO.	SUBJECT	THEORY	CCE	TOTAL
FIRST	MBT101	CELL BIOLOGY	80	20	100
	MBT102	MICROBIOLOGY	80	20	100
	MBT103	BIOCHEMISTRY	80	20	100
	MBT104	BIOINSTRUMENTATION	80	20	100
	MBT105	LAB 1			50
	MBT106	SEMINAR 1		50	50
			TOTAL	320	130
SEMESTER	CODE NO.	SUBJECT	THEORY	CCE	TOTAL
SECOND	MBT201	MOLECULAR BIOLOGY	80	20	100
	MBT202	ENVIRONMENTAL BIOTECHNOLOGY & ANIMAL CELL CULTURE	80	20	100
	MBT203	IMMUNOLOGY	80	20	100
	MBT204	BASIC ENZYMOLOGY & ENZYME TECHNOLOGY	80	20	100
	MBT205	LAB 2			50
	MBT206	SEMINAR 2		50	50
			TOTAL	320	130
SEMESTER	CODE NO.	SUBJECT	THEORY	CCE	TOTAL
THIRD	MBT301	GENETIC ENGINEERING	80	20	100
	MBT302	BIostatISTICS & BIOINFORMATICS	80	20	100
	MBT303	PLANT BIOTECHNOLOGY	80	20	100
	MBT304	BIOPROCESS & BIOCHEMICAL ENGINEERING	80	20	100
	MBT305	LAB 3			50
	MBT306	SEMINAR 3		50	50
			TOTAL		130
SEMESTER	CODE NO.	SUBJECT	THEORY	CCE	TOTAL
FOUR	MBT401	ADVANCED IN FERMENTATION & FOOD BIOTECHNOLOGY	80	20	100
	MBT402	APPLIED BIOTECHNOLOGY	80	20	100
	MBT403	ENTERPRENEURSHIP IN BIOTECHNOLOGY	80	20	100
	MBT404	DISSERTATION		100	100
	MBT405	PRESENTATION		100	100
		TOTAL	240	260	500

M.Sc - BIOTECHNOLOGY
SEMESTER – I
SUBJECT - CELL BIOLOGY
SUBJECT CODE - 101

Unit I

Cell membrane: physiochemical properties; Molecular Organization- asymmetric Organization of lipids, proteins and carbohydrates: Biogenesis and Functions, Transport of small molecules across cell membranes: types and mechanisms, Active transport by ATP powered pumps: types, properties and mechanisms, Transport of proteins into Mitochondria and Chloroplast.

Unit II

Protein targeting and Molecular mechanisms of Vesicular transport, Intracellular digestion: ultra structure and function of lysosomes Nutrient uptake and excretion. Transport by Vesicle formation: Endocytosis and Exocytosis, Human physiology (digestive system, endocrinology, reproduction, stress and adaptation, nervous system, respiratory system).

Unit III .

Cell Motility and Shape I: Structure and function of microfilaments, Cell motility and Shape II: Structure and Function of Microtubules and Intermediate Filaments, Intra cellular communication through Cell Junctions: Occluding Junctions, Anchoring, junctions and Communicating Junction, Inorganic ions.

Unit IV

Molecular Mechanisms of Cell-Cell Adhesions: Ca dependent cell-cell adhesions, Molecular Mechanisms of Cell-Cell Adhesions: Ca independent cell-cell adhesions, Extracellular Matrix of animals: Organization and Functions, Extracellular Matrix Receptors on animal cells: Integrins.

Unit V

Cell Signaling: Signaling via G-Protein linked and enzyme linked cell surface receptors, MAP kinase pathways, Interaction and Regulation of signaling pathways. Bacterial chemo taxis and quorum sensing, Eukaryotic Cell Division Cycle: Different Phases and Molecular Events, Control of Cell Division Cycle: In yeast and mammalian cells, Apoptosis: Phases and significance, Morphological and Biochemical changes associated with apoptotic cells, Apoptotic Pathways and regulators, Cancer

Recommended Books:

1. Molecular biology of cells, (Alberts *et al*)
2. Molecular cell biology(Lodish *et al*)
3. The Cell: A molecular approach (Cooper GM)
4. Cell and molecular biology (De Robertis, Df Robertis)
5. Cell proliferation and apoptosis (Hughes and Mehnet)

M.Sc. - BIOTECHNOLOGY
SEMESTER – I
SUBJECT – BIOCHEMISTRY
SUBJECT CODE – 102

Unit I

Biochemistry: The molecular logic of living organisms, The cell and its biochemical organization, Intra and inter molecular forces electrostatic interactions and Hydrogen bonding interactions, vander Waals and Hydrophobic interactions, Disulphide bridges, Role of water and weak interactions, Chemical foundations of Biology- pH, pK, acids, bases, buffers, weak bonds & Covalent bonds, Principles of thermodynamics.

Unit II

Carbohydrates: classification, structure, functions; homo and hetero polysaccharides, animal, plant and microbe specific polysaccharides, Lipids: Classification, nomenclature, structure and property of fatty acids, Simple lipids- Triglycerids, fats and Waxes, Compound lipids- classification, structure, distribution, and biological importance, role of prostaglandins, leukotrienes and thromboxans, Sterols- Cholesterol, role in biological system. Terpenes and phenols, Functions; Lipids associated with disease, diagnosis and treatment. Lipoproteins and biological membrane, micelles and liposomes.

Unit III

Nucleic acids: Structure, Properties of purines and pyrimidine bases, DNA : Structure, conformation, prokaryotic and eukaryotic DNA, nucleotides, Chromosomal and extra chromosomal DNA, RNA: Structure, types and function of mRNA, tRNA, Ribozymes: structure and functions, Amino acids- classification, structure, property, Zwitter ion, titration curve and biologically important amino acids Polypeptides- Conformational properties of polypeptides, protein sequencing methods, Proteins: Classification, Primary structure, nature of peptide bond, Ramchandran plot, and secondary structure, hydrogen bonding, salt bridge, disulphide bonds, hydrophobic and hydrophilic interaction in proteins and role of these bonds in protein folding, α -helix, β -sheet, and beta turns structures etc. Tertiary and quaternary structure. Biological role of proteins. Proteins associated with diseases, diagnosis and treatment. Separation purification and criteria of homogeneity, End group analysis Folding-unfolding equilibrium and denaturation of proteins Prions- Structure role and association with disease.

Unit IV

Enzymes; General characteristics and Catalytic power of enzymes and their classification, Energy considerations, Factors affecting enzyme activity, Enzyme kinetics, Michaelis-Menten equation, Allosteric enzymes and their regulation, Methods of enzyme assay: Continuous & Sampling techniques, coupled kinetic assays, Significance of enzyme turn over number, Specific activity, Enzyme purification techniques, Criteria of purity and tabulation of data, Characterization of purified enzymes, Vitamins and cofactors: Structure, distribution, interaction and biological properties, Hormones- structure, distribution and function, Phenols – structure and biological property, Alkaloids – structure and biological properties.

Unit V

Enzyme immobilization: Experimental procedures and effect on kinetic parameters, Uses of enzymes in Industries, textiles, leather and food, Use of purified enzymes in Biosensors, Development of enzyme sensor for clinical diagnosis with specific examples.

Recommended Books:

1. Lehninger Principle of biochemistry (Nelson and Cox)
2. Biochemistry (Stryer L)
3. Textbook of Biochemistry (Devlin Thomas M)
4. Fundamentals of Biochemistry (Voet *et al*)
5. Practical Biochemistry (Plummer)

M.Sc. - BIOTECHNOLOGY
SEMESTER – I
SUBJECT – MICROBIOLOGY
SUBJECT CODE- 103

Unit I

Microscopy (light microscopy, resolving power of different microscopes, ESR, ETR), Classification of Microorganisms: Bacterial & Fungal Classification, Morphology and fine structure of eubacteria, archebacterial cell wall and fungal cell Wall, Cyanobacteria : General account and their economic importance, Mycoplasma and diseases caused by them

Unit II

Sterilization: Physical and chemical methods, Preparation of culture media, pure culture techniques and microbial staining, Microbial growth: Bacterial growth curve, Mathematical expression, measurement of growth and factors affecting growth, Microbial Nutrition: Nutritional classification of Microorganisms, Different carbon and Nitrogen sources, mode of nutrition, transport of nutrition across the bacterial membrane, Oxygen toxicity: Study of catalase, peroxidase, superoxide dismutase, mechanism of oxygen toxicity/ Taxonomic classification of microbes using molecular markers- 16rRNA typing.

Unit III

Virus organization, Types, Isolation, cultivation, identification and viral replication, Structure and morphology of bacteriophages, lytic and lysogenic cycle, Life cycle of DNA viruses: SV 40, RNA viruses: Retroviruses, Plant viruses: TMV, Gemini, CMV, Human Viruses: Influenza (SARS), Herpes Simplex virus, Rubella.

Unit IV

Infection and disease, types of infection, Mechanism of pathogenesis of bacterial and Viral disease, Staphylococcal and Clostridial food Poisoning, Bacterial Diseases: Salmonellosis and Shigellosis, Fungal Diseases: Histoplasmosis, Aspergillosis and Candidiasis, Viral diseases: Chicken Pox, Hepatitis B and Poliomyelitis.

Unit V

Host microbe interaction, Symbiosis, Antibiosis, Commensalisms, Competition, Mycorrhiza and its importance, Role of microbes in N, P and C cycle, Bacterial Recombination: Transformation, conjugation, transduction, Plasmids and Transposons, Chemotherapeutic agents: Classification of Antibiotics, Broad and narrow spectrum antibiotics; Antibiotics from prokaryotes, Anti-fungal and antiviral antibiotics, mode of action of antibiotics and mechanism of drug resistance, origin of drug resistance.

Recommended Books:

1. Microbiology (Prescott, Harley & Klein)
2. Microbiology (Tortora F)
3. Foundation in microbiology (Talaro & Talora)
4. Principles of microbiology (Atlas R M)
5. Pharmaceutical microbiology (Purohit & Saluja)

M.Sc. - BIOTECHNOLOGY
SEMESTER – I
SUBJECT – BIOINSTRUMENTATION
SUBJECT CODE- 104

Unit I

Principle and application of microscopy, Light, Phase contrast, Fluorescence microscopy, Scanning and Transmission Electron Microscopy, Confocal Microscopy, Cytometry and Flow cytometry, Patch clamping, advance of microscopy, Microtomy and its application.

Centrifugation, Preparative and analytical centrifuge, Sediment analysis, RCF, Density gradient ultracentrifugation.

Unit II

Chromatographic techniques: Theory and application of chromatography, Paper chromatography, TLC, Gel filtration chromatography, Affinity chromatography, Ion exchange chromatography, Gas chromatography and HPLC

Unit III

Electrophoretic techniques: Theory and application of Electrophoresis, Agarose gel electrophoresis, SDS- PAGE, Dimensional electrophoresis, Iso electric focusing, Immuno-diffusion, Immuno-electrophoresis, RIA, ELISA, Southern Northern and western blotting.

Unit IV

Spectroscopic Techniques: Theory and application of UV and Visible spectroscopy, Fluorescence spectroscopy, MS, NMR, ESR, Atomic absorption spectroscopy, X- Ray spectroscopy, Raman spectroscopy, MALDI.

Unit V

Radio- isotopic techniques: Introduction to Radioisotopes, Radioactive decay- Type and measurement, Principle and application of GM counter, Solid and liquid Scintillation counter, Autoradiography, Radiation dosimetry, Biological application of Radioisotopic techniques.

Recommended Books:

1. Principle of instrumental analysis (Skoog & West)
2. Biophysical chemistry(Upadhyay & Nath)
3. Principle and techniques – Practical biochemistry (WalkerJ & Wilson K)
4. Physical Biochemistry (Freilder)
5. Biochemical technique- Theory & Practice (Robyt & White)

M.Sc. - BIOTECHNOLOGY
SEMESTER – II
SUBJECT – MOLECULAR BIOLOGY
SUBJECT CODE- 201

Unit I

DNA as Genetic material, Chemical structure and base composition of Nucleic acid, Double helical structure of DNA, Different forms of DNA, DNA Supercoiling, Properties of DNA, DNA Denaturation and Renaturation, RNA- Structure, Type and Function.

Unit II

General features of DNA Replication, Enzyme and Protein of DNA Replication, Models of DNA replication- Conservative, Semi- conservative and Dispersive, Prokaryotic and Eukaryotic DNA replication Mechanism, Replication in Phages, Reverse Transcription.

Unit III

Mechanism of transcription in Prokaryote and Eukaryote, RNA polymerases and Promoters, Post transcriptional process of tRNA, rRNA and mRNA(5' capping 3' Polyadenylation and splicing), RNA as an enzyme Ribozyme.

Unit IV

Genetic Code: Evidence and properties; Wobble hypothesis, Translation: Successive stages of protein synthesis in prokaryotes and eukaryote, Post-translational Modification: Types and Significance, Regulation of Gene Expression in Eukaryotes: cis- acting DNA element, Chromatin Organization and regulation of gene expression, RNA editing; Gene Alteration; DNA methylation and gene regulation, Regulation of gene expression by hormones, regulation of gene expression at translationa level.

Unit V

Transposable elements in Prokaryotes and Eukaryotes: Types and Significance, Oncogenes and Tumor Suppressor Genes: Properties and Significance, Mutation and DNA repair, chromosomal aberration.

Recommended Books:

1. Genetics: Strickberger M. W
2. Principle of Genetics (2001) 8th edition- Gardener *et al*
3. Microbial Genetics –Fridfleder
4. Advanced Genetics- Miglani G. S
5. Bacterial Genetics- Nancy Trun

M.Sc. - BIOTECHNOLOGY
SEMESTER – II
SUBJECT – ENVIRONMENTAL BIOTECHNOLOGY AND ANIMAL
CELL CULTURE
SUBJECT CODE- 202

Unit I

Environment: basic concepts, Environment pollution: types, methods for measurement of pollution, Population ecology(R & K selection), Waste treatment & Utilization, Biomedical waste and its management, Xenobiotics and its degradation, biosurfactants and biofilms.

Unit II

Integrated pest management- An ecological approach, Bioremediation: In -situ and ex -situ techniques, advantages of bioremediation, Applications of genetically engineered microbes (GEM) in bioremediation, Phytoremediation: Types and its applications, Environmental monitoring: Bioindicators, Biogeography, Global environmental problems, Petroleum biotechnology

Unit III

Biotransformation: Steroids, Mushroom Cultivation, Biofertilizers and its applications, Immobilization of microbial cells and their applications, Conservation biology(principle of conservation , Indian case studies on conservation ,project tiger and biosphere reserve)Biopesticide and its applications, Microbial production of SCP.

Animal cell culture

Unit IV

Introduction and organization of animal cell and tissue culture laboratory, Primary and established cell line cultures ,Serum and protein free defined media and their applications, Introduction to balanced salt solutions and simple growth medium: rationale of composition of medium, role of CO₂ and supplements, Stem cell basics , culture and their application.

UNIT V

Measurement of parameters of growth, Scaling up of animal cell culture, Cell synchronization,3D animal cell culture ,FISH and applications of animal cell culture.

M.Sc. - BIOTECHNOLOGY
SEMESTER – II
SUBJECT- IMMUNOLOGY
SUBJECT CODE- 203

Unit I

1. Immune response: Innate immune mechanisms and characteristics of adaptive immune responses, Immune System: Primary Lymphoid Organs, Secondary, Lymphoid Organ, Cell of immune system: Mononuclear cells and granulocyte, Antigen presenting cells, lymphocytes and their subsets, Antigens,

Unit II

Major histocompatibility systems: Structure of MHC I and II molecules, polymorphism, distribution variation and function, Recognition of antigens by T and B cells, Antigen processing, Role of MHC molecules in Antigen presentation and co-stimulatory signals, T-Cell receptor complex, B-cell receptor complex, Immunoglobulins: molecular structures, types and function of Antigenic determinants on immunoglobulins.

Unit III

Molecular mechanism of antibody diversity, Antigen-Antibody interaction avidity and affinity measurement, Monoclonal antibodies: production, characterization and application in diagnosis, therapy and basic research, Complement System, components, Activation pathway, role of complement system in immune responses.

Unit IV

Cytokines: Structure and functions, cytokine regulation of immune responses, cytokine related diseases and therapeutic applications of cytokines, Cytotoxic T-cell and their mechanism of action, NK cell, Immunoregulation by Antigens, Antibodies, immune complexes, MHC and cytokines, Hypersensitivity: definition, IgE mediated hypersensitivity, mechanism of mast cell degranulation, mediators of type I reactions and consequences. Type II reactions, immune complex mediated hypersensitivity and delayed type hypersensitivity.

Unit V

Autoimmunity: Organ specific diseases, systemic disease, mechanism of autoimmunity, Immunodeficiency Syndrome: Primary Immunodeficiencies and Secondary Immunodeficiencies and their diagnosis and therapeutic approaches, Vaccines: Active and passive immunization, Recombinant vector Vaccines, DNA Vaccines, synthetic peptide Vaccines and sub-unit Vaccine, Immunodiagnostics: development of Immunodiagnostic Kits for infectious and non-Infectious disease with examples. Precipitation techniques, Agglutination, Fluorescence Techniques, ELISA, RIA, Western Blotting and immuno-histochemical techniques.

M.Sc. - BIOTECHNOLOGY
SEMESTER – II
SUBJECT- BASIC ENZYMOLOGY AND ENZYME TECHNOLOGY
SUBJECT CODE- 204

Unit I

Enzyme nomenclature, Enzyme commission numbers and classification of enzyme, Isolation and purification of enzyme, Enzyme activity, Specific activity and turn over numbers.

Unit II

Enzyme kinetics: steady state and pre- steady state, Equilibrium kinetics, Michealis Menten equation and its derivation, Different methods to calculate the K_m and V_{max} and their significance.

Unit III

pH meter, Substrate and enzyme concentration, Temperature, Co- enzyme and co- factors, Mechanism of action of enzyme involving two or more substrate, Enzyme inhibition, Different types of inhibitors and activators.

Unit IV

Structures and function of Enzymes: Chymotrypsin, Lysozyme, RNAsae, DNA Polymerase, Protease, Enzyme regulation and control of their activity, Introduction to allosteric enzyme and isozyme.

Unit V

Immobilization of enzyme and their application, Commercial production of enzyme, RNA catalysis, Protein and enzyme engineering: Design and construction of novel enzyme, Structure and application of protease, lipase and Papain enzyme.

Recommended Books:

1. Enzyme Kinetics – Palmer
2. Fundamental of enzyme kinetics- Price and Steven
3. The Enzymes vol I & II –Boyer
4. Enzyme Biotechnology – Tripathi G
5. Enzyme Kinetics – Voet & Voet

M.Sc. - BIOTECHNOLOGY
SEMESTER – III
SUBJECT – GENETIC ENGINEERING
SUBJECT CODE- 301

Unit I

The recombinant DNA Technology : General concept and principle of cloning, Enzymes: Nucleases and restriction endonucleases- properties and types, phosphomonoesterases; polymerase; terminal deoxynucleotidyl transferase; poly A polymerase, Linkers, adaptors and homopolymer tailing, prokaryotic host- vector system: Characteristics of E.coli as host; vectors for cloning in E.coli (plasmid, bacteriophage- EMBL, DASH, gt10/11, ZAP etc and plasmid-phage), Other Prokaryotic host vector systems: BAC ,Characteristics of Gram positive and Gram negative organism as host and suitable vectors for cloning; Shuttle Vectors .

Unit II

Design and characteristics of expression vectors for cloning in prokaryotes and factors Those affect expression, Cloning in Yeast: Properties of yeast as host for cloning and different types of vectors, Designed for cloning in yeast, Cloning in animal system: Animal system as a model host, Methods of introduction of Foreign DNA in animal system; Vectors for cloning in animal system- SV-40, vaccinia virus, baculovirus and retrovirus vectors ,pMal, GST, pET based vectors, Pichia based vectors, Plant transformation technology: Features of Ti and Ri plasmids, mechanism of DNA transfer.

Unit III

Methods for Constructing rDNA and cloning: Inserts; vector insert ligation; infection, transferring and cloning, Methods for screening and selection of recombinant clones, DNA Libraries: types, advantages and disadvantages of different types of libraries, Different method for constructing genomic and full length cDNA libraries, Gross anatomy of cloned insert- size, restriction mapping and location.

Unit IV

Fine anatomy of DNA segment- General principle of chemical and enzymatic methods of nucleotide sequence analysis and advantages of automatic gene sequencers, Localization of cloned segments in genomes- molecular and chromosomal location, Methods for determination of copy number of a cloned gene in genome, Mutant construction: Introduction, deletion, insertion and point mutation.

Unit V

Principles and applications of Blotting techniques- Southern, Northern, Western and Eastern blotting; Polymerase Chain reaction and types (multiplex, nested, RT, real time,touch down PCR, hot start PCR, colony PCR), Oligonucleotide, Principle and applications of gel mobility shift assay, DNA fingerprinting and DNA, Foot printing, restriction fragment length polymorphism, Chromosome mapping and Chromosome painting, Application of Recombinant DNA technology in Medicine & Industry.

Si RNA and si RNA technology: Micro RNA Construction of si RNA vectors: Gene Silencing and its applications in agro industry.

RECOMMENDED BOOKS:

1. Molecular Cloning: a Laboratory Manual, J Sambrook, E F Fritsch and T Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
2. Methods in Enzymology Vol.152, Guide to Molecular Cloning Techniques, SL Berger and AR Kimmel, Academic Press, Inc. San Diego, 1998.
3. Molecular Biotechnology (2nd Edn.) S B Primrose, Blackwell Scientific Publishers, Oxford, 1994.
4. Route Maps in Gene Technology, M R Walker and R Rapley, Blackwell Science Ltd, Oxford, 1997.
5. Genetic Engineering, An Introduction to gene analysis & exploitation in eukaryotes, SM Kingsman and A J Kingsman, Blackwell Scientific Publications, Oxford, 1998.

M.Sc. - BIOTECHNOLOGY
SEMESTER – III
SUBJECT – BIOSTATISTICS & BIOINFORMATICS
SUBJECT CODE- MBT302

Unit I

Concept of variable in biological system, Collection, classification, tabulation, graphical and diagrammatic representation of numerical data, Measures of central tendency: Mean, Median and Mode and their relationship, Measures of Dispersion: Range, quartile deviation, Mean deviation, Standard deviation, Skewness and Kurtosis, Probability: Random experiment, events, sample space, Independent and dependent events, Probability distribution and their application, Chi-square, student's f and t distributions, Probability density functions and applications.

Unit II

Over view of Bioinformatics: Merger of life sciences with computers, Search engines: Google, Pub Med, NCBI, EMBL, Protein and DNA databases: Swiss port, PIR, OMIM, Embank, ENTREZ, DDJB, MIPS, Hovred, ECDC, Cambridge small molecular crystal structure data bank, Analysis packages: Commercial databases and packages, GPL software for bioinformatics, web based analysis protocol.

Unit III

Sequence Databases: Contents, Structure, and annotation for Human Genome, Databases, Plant Genome Databases, Retrieving and installing a programme (Tree Tool), Multiple sequence alignment programme - Clustal W, X. Genome analysis programs; BLAST, FASTA, CGC, Motif and profile Sequence search, Phylogenetic analysis: Phylogenetic reconstruction, distance matrices, Parsimony, Philip, Data models: Instances and schemes; E-R Model, E-R diagrams, reducing E-R diagrams to tables, network data model.

Unit IV

Methods of prediction of Proteins, DNA, RNA, fold recognition, Ab initio methods for structure prediction, Computer aided drug designing: Basic principles, docking, ADME/TOX, Genome mapping applications: EST and Functional genomics, EST clustering gene discovery, ORF prediction, Use of genome analysis programs, primer designing tools.

Unit V

Cluster analysis; Phylogenetic clustering by simple matching coefficients, Sequence Comparison; Sequence pattern; Regular expression based pattern; Theory of profiles and their use in sequence analysis Markov models, Concept of HMMs; Baum-Welch algorithm; Use of profile HMM for protein family classification; Pattern recognition methods, Structure determination: X-ray crystallography; NMR spectroscopy; PDB (protein data bank) and NDB (nucleic acid data bank), File formats for the storage and dissemination of molecular structure, Drug Design: General ideas

of drug designing, 2D and 3D QASR, concept of a pharmacophore and pharmacophore based searches of ligand databases. Concepts of COMFA. Methods for simulated docking.

RECOMMENDED BOOKS :

1. Bioinformatics: A practical guide to the analysis of genes and proteins. Baxevanis A.D and Ovellette B.F.F., Wiley-Interscience, (2002).
2. Molecular and Biotechnology. A comprehensive desk reference, R.A. Meyes (Ed.) VCH Publishers Inc. (1995)
3. Textbook of Biotechnology Das H.K., Wiley Dreamtech India Pvt Ltd, (2004).
4. Principles of Genome analysis and genomics, Primrose SB, Twyman RM, Blackwell Science(2002).
5. Biostatistics-A foundation for Health Science, Daniel WW, John Wiley (1983).
6. Statistical Methods, Medhi J, Willey Eastern Limited, (1992).

M.Sc. - BIOTECHNOLOGY
SEMESTER – III
SUBJECT – PLANT BIOTECHNOLOGY
SUBJECT CODE- MBT303

Unit-I

Introduction to the techniques of plant tissue culture. Concept of cellular totipotency, Nutritional requirements, single cell culture, micro-propagation, somaclonal variation, somatic embryogenesis and production of embryoids.

Unit-II

Haploid and double haploid production, Protoplast isolation and culture. Somatic hybridization and cybrid production and their applications in crop improvement. Productions of virus free plants using meristem culture.

Unit-III

Basis of tumor formation, hairy roots, features of Ti and Ri plasmids, mechanisms of DNA transfer, role of virulence genes, use of Ti and Ri as vectors, binary vectors, use of 35S and other promoters, genetic markers, use of reporter genes, methods of nuclear transfer, particle bombardment, electroporation, microinjection, transformation of monocots. Transgene stability and gene silencing. Herbicide and insect resistance. Plant Genetic Engineering: Transgenic plants, Genetically modified (GM) plants (Bt cotton, Bt Brinjal)

Unit-IV

Photoregulation and phytochrome regulation of nuclear and chloroplast genes expression, Molecular biology of light and dark reactions of photosynthesis, Genetics of nif genes, Molecular mechanism of nitrogen fixation.

Unit-V

Plant secondary metabolites: Control mechanisms and manipulation of alkaloids and industrial enzymes (Shikimate and PHA pathway), biodegradable plastics, therapeutic proteins, Edible vaccines, purification strategies. Green house Technology. Biotic and Abiotic stress.

RECOMMENDED BOOKS :

1. Plant molecular biology, Grierson and S.N. Convey, 1988. Blackie
2. Genetic engineering of crop plants, G.W. Lycett and D. Grierson (Eds.), 1990.
3. Plants, Genes and Agriculture, M. J. Chrispeeds and D.F. Sadava, 1994. Jones and Barlett.
4. Molecular Biotechnology - Principles and Applications in Recombinant DNA, Glick and Paster mark, 2002. Panima Publishing Co-operation.

5. Molecular cloning- a lab manual, Manites Vol I-III.
6. Biotechnology - V, Rajeshwari S. Setty and G. R. Veena, 2003. New age International Publishers (p) Ltd., New Delhi.
7. Genetic engineering of plants, Kosuage, T. and Meredit, C.P., 1989. Hollaender Plenum Press.
8. Conservation and genetic resources, Virchow, D., 1998. Springer Verlag, Berlin.
9. Molecular plant development from gene to plant, Pester Westhoff.
10. Molecular genetics of plant development, Howell, S. H.
11. Methods in Plant molecular biology. A laboratory course manual by (Ed.) Oak Nakuga, 1995. Cold spring Harbour Laboratory Press.
- M.Sc. Biotechnology: Syllabus (CBCS) 17 .
12. Plant Genetic Transformation and Gene expression, (Eds.) J. Draper et al., 1988. Blackwell scientific publications, Oxford.
13. Plant molecular biology. Manual, S.B. Gelvin, R.A. Sehil Peroort and D.P.S. Verma (Eds.), 1991. Kluwer Academic Publishers, Doredrect.

M.Sc. - BIOTECHNOLOGY
SEMESTER-III
SUBJECT-BIOPROCESS ENGINEERING AND TECHNOLOGY
SUBJECT CODE- MBT304

Unit I

Introduction to bioprocess engineering, Isolation, preservation and Maintenance of Industrial microorganisms. Kinetics of microbial growth and death, Media for industrial fermentation. Air and media sterilization.

Unit II

Aeration and Agitation systems for bioreactor, Safety in fermentation laboratory, Strain improvement of industrially important microorganism., Bioreactors: Principle, Kinetics, types, design, and application.

Unit III

Flow behaviour of fermentation fluids, Gas-Liquid mass transfer, significance of K_a , and Heat transfer, Automation for monitoring and control.

Unit IV

Downstream processing: Introduction, removal of microbial cells and solid matter, foam reparation, precipitation, centrifugation, cell disruption, chromatography, Extraction:-solvent, two phase, liquid extraction, Product recovery processes, Crystallization, packaging and quality assurance, Classification of product formation, Product synthesis kinetics

Unit V

Microbial Production of antibiotics: Penicillin, Microbial Production of Vitamins & amino acids (Vit B12 & Glutamic acid, Microbial production of enzymes: Amylase, Microbial production of alcoholic beverages: Distilled alcoholic beverages-Beer, microbial production of Vinegar Microbial production of Organic acids: Citric acid & Acetic acid Microbial production of solvents: Ethanol and acetone, Microbial production of food –SCP

RECOMMENDED BOOKS

1. Sullia S. B & Shantharam S: (1998) General Microbiology, Oxford & IBH Publishing Co. Pvt.Ltd.
2. Glaser A.N & Nilaido.H (1995) Microbial Biotechnology, W.H Freeman & Co.
3. Prescott & Dunn (1987) Industrial Microbiology 4th Edition, CBS Publishers & Distributors.
4. Prescott & Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers.
5. Crueger W. & Crueger A. (2000) A text of Industrial Microbiology, 2nd Edition, Panima Publishing Corp.
6. Stanbury P.F, Ehitaker H, Hall S.J (1997) Principles of Fermentation Technology., Aditya BOOKS (P) Ltd.
7. S.N.Jogdan (2006) Industrial Biotechnology, Himalaya Publishing House

M.Sc. - BIOTECHNOLOGY
SEMESTER-III
SUBJECT- ADVANCED IN FERMENTATION & FOOD BIOTECHNOLOGY
SUBJECT CODE- MBT401

Unit I

Role of fermentation, Biochemistry of fermentation: Carbohydrate, Protein and Lipid metabolism, Formation of flavor, Fermentation system: Characterization, and techniques of fermentation system, Continuous fermentation for anaerobic micro organism.

Unit II

Industrially important micro organism for food application, reproduction genetic manipulation, recombination, strain improvement, Commercial production of enzyme and hormone in micro organism.

Unit III

Physical, chemical, enzymatic and microbial food spoilage, Control of food spoilage, Food preservation: Advantages for preserving food, Methods of food preservation: Freezing, Chilling and heat treatment, irradiation and dehydration, chemical preservative, Packaging, Food toxicology: Scope, history and development of toxicology, Naturally occurring toxicants in food (plant and animal), Artificially occurring toxicants in food(mutagens and carcinogens)

Unit IV

Identity, characteristics and source of micro organism in food fermentation, metabolic activity of microorganism and their influence on products, Types of fermented food, Processing of fermented food, bioreactor in food fermentation, Packaging and sensory evaluation of fermented food, Food safety and waste management in food processing.

Unit V

Protein engineering in food technology: New industrial enzyme for food application, immobilized enzyme formation, Enzymatically modified protein for food technology, Application of cold adapted protease for food industry, Enzyme of food and feed application: glucose oxidase, lipase, enzyme supplements in feed; Phytase, glucanase.

RECOMMENDED BOOKS:

Fermentation Biotechnology- B.C. Saha

Biotech food and fermentation – Vol I& II- V. K. Joshi & Ashok Pandey

SEMESTER-IV
SUBJECT- APPLIED BIOTECHNOLOGY
SUBJECT CODE- MBT402

Unit I

Industrial biotechnology

Microbial strain for industrially importance, Microbial production of antibiotics (Penicillin & streptomycin) Vitamin B12, Amino acid(glutamic acid) and enzyme(amylase and protease), Microbial production of alcoholic beverages (whisky & brandy), Vinegar and citric acid, food SCP, Biotransformation of steroids and pesticides.

Unit II

Agricultural biotechnology

Introduction of biofertilizers and biopesticides, Improvemet of neutritional value of seed storage, protein, starch, oil, transgenic plants for increased shelf life, sericulture, transgenic fish plant variety protection act, plant breeder rights.

Unit III

Food Biotechnology

Prokaryotic and eukaryotic based products (fermented meats, milk products, yoghurt, cheese, cereal, wine, beer), Impact of biotechnology on microbial testing of foods, traditional methodology and new approaches (use of gene probe, RDT, Bioluminescence), safety evaluation of genetically engineered enzyme, natural control of micro organism and preservation, biogums, biocolours, sweetner fat substitutes.

Unit IV

Environmental Biotechnology

Environmental pollution and their management, Concept of global warming and ozone depletion, Waste water treatment, solid waste management, conventional and modern fuels nd their environmental impact, Biodegradation of xenobiotic compounds, Bioremediation, biotechnological approach for preserving biodiversity (gene bank, germ plasm bank and their management)

Unit V

Frontier in Biotechnology

Stem cell technology, human cloning ethical issues and risk associated with it, nano-biotechnology- introduction to nanoscience, tools for measuring nano structure, biosensor development and application, nanofabrication, nanotech impacts on type of DNA chip and their production, functional proteomics- RT- PCR, Human genome project, bioterrorism.

Recommended Books

Fundamental of food biotechnology – Lee B.H

Biodegradationa and bioremediation: soil biology- Singh A Word O.P.

Environmental Biotechnology- Agarwal S.K

Agricultural Biotechnology- Altman A

Plant Biotechnology: The genetic manipulation of plant- Adrianstater *et al*

Nanobiotechnology- Next big idea, Mark et al

Gene cloning – Brown T.A

MBT403 ENTREPRENEURSHIP IN BIOTECHNOLOGY

Unit 1

1. Creativity & Entrepreneurial personality and Entrepreneurship in Biotechnology
Organizational structure & Management, Capital Management, Product innovation and management
Government schemes for commercialization of technology (E.g. Biotech Consortium)

Unit 2

1. Basics of production management: Methods of manufacturing-Project/Jobbing, Batch Production, Flow/Continuous production, process production-Characteristics of each method.
Plant location-Importance-Factors affecting location-factory Building-Plant Layout-Installation of Facilities.

2. Operational Research: Linear Programming, PERT and CPM; Production Planning & Control-Scheduling-Gantt Charts-Documentation-Production Work Order.

3. Basics of material management

4. Personnel management E.g., Communication skills; Managerial and personal, training ,etc.

Unit 3

1. Kaizen (Continuous improvement in product & management)

2. Six Sigma

3. Biotech enterprises: Small, Medium & Large

4. Quality control in Biotech industries

Unit 4

1. Govt. regulations for biotech products

2. Public policy, regulatory and ethical challenges facing the biotechnology entrepreneurship

3. Business development for medical products

4. Business development for consumable products

Unit 5

1. Patenting System: WTO, Paris Convention, Indian Legislations

2. Intellectual Property: A. Copy Right & Industrial Properties, Trademarks, Designs, Geographical Indications

3. IPR & Technology transfer, Role of patentee & Licensor

4. Patent process & Patent laws & e-filing