Syllabus

For

M. Sc. Biotechnology

Barkatullah University, Bhopal

Barkatullah University, Bhopal
M.Sc. – Biotechnology

Course Curriculum: 2007-08

Code	Title of the Paper	Theory	Practical
SEMESTER I:			
BT-101	Cell Biology	100	
BT-102	Structure, function & Metabolism of Bimolecules	100	
BT-103	General & Applied Microbiology	100	
BT-104	Bioinstrumentation	100	
BT-105	Laboratory-I		100
SEMESTER II:			
BT-201	Molecular Genetics	100	
BT-202	Basic Enzymology & Enzyme Technology	100	
BT-203	Molecular Biology	100	
BT-204	Immunology & Animal Cell Culture	100	
BT-205	Laboratory-II		100
SEMESTER III:			
BT-301	Genetic Engineering	100	
BT-302	Biostatistics and Bioinformatics	100	
BT-303	Plant Biotechnology	100	
BT-304	Bioprocess & Biochemical Engineering	100	
BT-305	Applied Biotechnology	100	
BT-306	Laboratory-III		100
SEMESTER IV:			
BT-401	Project Work/Dissertation	300	
	Training in a National Lab/Private industry/parent department for six months		
	Evaluation, presentation skill and defence	200	
		Total:	**2100**

SEMESTER -IV

BT-401	Advance in Fermentation and Food Biotechnology	100
BT-402	Advance Immunology and Immunodiognostics	100
BT-403	Principles of Drug Designing	100
BT-404	Training/Survey/Visit in a private industry/ treatment plant or lab at national or regional level for one month 50 marks for report 50 marks for presentation before external examiner	100
BT-405	Laboratory-IV	100
	TOTAL	500
	GRAND TOTAL	2100

BT-101: Cell Biology

UNIT-I:
General structure of Cell. Historical origins of cell biology: The discovery of cell, development of the cell theory. The molecular evolution. Chemical bonds and functional groups in biological molecules.

UNIT-II:
The structural and functional organization of cell membrane, ionic transport (Passive and active transport) the extra cellular matrix of eukaryote's cell wall.

UNIT-III:
Structure and functions of endoplasmic reticulum, golgi complex, ribosome lysosomes, peroxisomes (glyoxysomes), plastids and mitochondria. Biogenesis of mitochondria and chloroplast.

UNIT-IV:
Steps in cell cycle, cell cycle check points, yeast as model system, cell division control and regulation yeast *cdc* gene. Genes for social control of cell, proto-oncogenes.
Cell signaling: Exocrine, Endocrine, Paracrine and Synaptic strategies of chemical signaling, surface receptor mediated transduction (DAG, Ca^{+2}, c-AMP, G-Proteins)

UNIT-V:
Cytoskeleton and cell motility: Microtubules, microfilaments and intermediate elements. Nuclar ingredients: Nuclear membrane, Nature of the genetic material, proteins associated with nuclei. Packaging of genetic material: nucleosome model, Organization of Chromatin: chromosome structure.

RECOMMENDED BOOKS:

1. Molecular Biology of Cells, (2002), 4th Edition; Albert's *et al*.
2. Molecular Cell Biology (2004),Lodish *et al*.
3. Cell and Molecular Biology; Concepts & Experiments (2004).Karp,G.
4. The Cell: A molecular Approach (2004), Cooper,G.M
5. Cell & Molecular biology, de Robertis & df Robertis.
6. Cell proliferation and apoptosis (2003); Hughes & Mehnet.
7. Biochemistry & Molecular Biology of plants (2004); Buchanan *et al*.
8. Lehninger Principles of Biochemistry, (2005) Nelson & Cox.

BT-102: Structure, Function & Metabolism of Bimolecules

UNIT-I:

Some important properties of water: The law of Mass action; Dissociation of water and its ion product. pH, Bronsted Acids, ionization of weak acids and bases; Henderson-Hasselbalch equation, Titration curves and buffering action, physiological buffers. Principle of Thermodynamics.

UNIT-II:

Carbohydrates: Classification, structure, function and properties of sugars, storage polysaccharides and cell walls.Glycolysis, gluconeogenesis, HMP shunt and glycogen metabolism. Synthesis of cellulose and starch.Oxidative phosphorylation, compartmentation on respiratory metabolism. Regulation of carbohydrate metabolism.

UNIT-III:

Proteins- Amino Acids: essential and non essential amino acids; common, rare and non-protein amino acids; acid base properties and chemical reactions of amino acids; stereochemistry and absorption spectra of amino acids.Biosynthesis and degradation of following amino acids: alanine, serine, lysine cysteine, arginine, methionine, tryptophan, phenylalanine glutamine.Proteins: Primary, secondary, tertiary and quaternary structure of proteins. Optical and chemical properties of peptides and small proteins.Hydrolysis of proteins: Action of different proteases. Regulation of amino acid metabolism.

UNIT-IV:

Nucleic acids: general structure and functions of purines, pyrimidines, nucleosides, nucleotides; hydrolysis of nucleic acids. Biosynthesis of purines and pyrimidines, nucleosides and nucleotides. Degradation of purines and pyrimidines.Nucleic acid-protein supramolecular complexes, Salvage pathway

UNIT-V:

Lipids: Classification, nomenclature and structure of fatty acids, triacylglycerols, sphingolipids and phospholipids, waxes, glycolopids and sterols.Beta-oxidation of fatty acids, biosynthesis of fatty acids and triacylglycerols.Lipid proteins system and transport of lipoproteins of blood plasma. Regulation of lipid metabolism.

RECOMMENDED BOOKS:

1. Lehninger Principles of Biochemistry (2005), Nelson & Cox.
2. Biochemistry (2004); Stryer, L.
3. Text book of Biochemistry (1997), Devlin,Thomas, M.
4. Biochemistry (1993) Zubay,G.
5. Biochemistry Fundamentals, Voet *et al*.
6. Biochemistry, Friedfider,D.
7. Practical Biochemistry, Plummer.

BT-103: General & Applied Microbiology

UNIT-I:

Introduction to Microbiology: Historical background & scope, structure of peptidoglycan, Difference between prokaryotic and eukaryotic organisms, Method of Microbiology: Pure culture techniques, sterilization techniques, principle of microbial nutrition, perpetration of culture media, enrichment culture techniques for isolation of microbes.

UNIT-II:

Classification of Bacteria: Basic principle and techniques used in bacterial classification. Phylogenetic polyphasic taxonomy and numerical taxonomy. New approaches of bacterial taxonomic classification including genetic methods, Ribotyping, Ribosomal RNA sequencing characteristic of primary domains.

UNIT-III:

Viruses: General characteristics, Morphology, Classification and structure of plant, animal and bacterial viruses, Cultivation of viruses, a brief account of Adenoviruses, Herpes, Retrovirus, Viroids and prions.

Microbial Growth: The definition of growth, bacterial generation time, specific growth rate and yield measurement, Monoauxic, Diauxic and synchronized growth curve. Factor affecting microbial growth. Culture collection & maintenance of culture. Sporulation in bacteria.

UNIT-IV:

Control of Microorganism by Physical &chemical agents: Antimicrobial agents, Sulfa drugs, Antibiotics (penicillin and cephalosporin) Broad Spectrum antibiotics, antibiotics from prokaryotes, Anti fungal antibiotics, Mode of action (a brief account), resistance of antibiotics (a brief account)

UNIT-V:

Microbial Ecology: Microbial flora of soil, Interaction among soil microorganisms. Nitrogen fixation (a brief account), Symbiotic association-types, functions and establishment of symbiosis. A. *niger, yeast, pseudomonades putida*,

RECOMMENDED BOOKS:

1. Alcamo's Fundamental of Microbiology, (2004); Pommerville *et al*.
2. Microbiology (1996); Prescott, Harley & Klein
3. Microbiology (2004); Tortora,F.
4. Foundation in Microbiology (1996);Talaro & Talora.
5. Food Microbiology (2004); Adam , M.R.
6. Principles of Microbiology (1994); Atlas,R.M.
7. Pharmaceuticals Microbiology (2003); Purohit & Saluja.
8. Microbiology: A Lab Manual, Cappuccino *et al*.
9. Brock Biology of Microbiology, Martinko,M.T & Parker,J.

BT-104: Analytical Techniques in Biotechnology

UNIT-I:

Microscopic Techniques: Principles and Applications of Light, Phase Contrast, Fluorescence Microscopy, Scanning and Transmission Electron Microscopy, Confocal Microscopy, Cytophotomatry and Flow Cytometry, patch clamping, advances of microscopy.

Centrifugation: Preparative and Analytical Centrifuges, Sedimentation analysis RCF, Density Gradient Centrifugation.

UNIT–II:

Chromatography Techniques: Theory and Application of Paper Chromatography, TLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, GLC and HPLC.

UNIT–III:

Electrophonetic Techniques: Theory and Application of PAGE, Agarose Gel Electrophoresis 2DE, Iso-electric Focusing, Immuno diffusion, Immuno Electrophoresis , ELISA , RIA , 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, LASAR , Raman Spectroscopy . MALDI

UNIT–V:

Radio-isotopic Techniques : Introduction to Radioisotopes and their Biological Applications , Radioactive Decay – Types and Measurement , Principles and Applications of GM Counter , Solid and Liquid Scintillation Counter, Autoradiography, RIA , Radiation Dosimetry .

RECOMMENDED BOOKS:

1. Physical Biochemistry: Application to Biochemistry and Molecular Biology – Freilder.
2. Biochemical Technique : Theory and Practice , - Robyt & White
3. Principle of Instrumental Analysis – Skoog & West
4. Principle & Technique – Practical Biochemistry 5th Ed. (2000) - Walker J. & Wilson K.
5. Biochemical Technique Theory & Practical- White, R.
6. Principle of Instrumental Analysis – Skoog *et al*.
7. Microbiology – Fundamental & Application (1995) -Atlas, R.M.
8. Biophysical Chemistry – Upadhyay & Nath.

BT-201: Molecular Genetics

UNIT-I:
History, Scope of genetics, Mendelian law of inheritance, Variations of mendelian analysis, Linkage and crossing over, Linkage mapping, Sex determination and Sex linked inheritance, Gene Mapping.

UNIT-II:
Microbial Genetics: gene transfer mechanism in microbe transformation, transduction, conjugation and recombination, Horizontal gene transfer, genetics of model organism- Neurospora, Yeast and *E.coli*.

UNIT-III:
Mutation: Types of mutation, molecular mechanism of mutation, chromosomal mutations changes-changes in the structure and number of chromosomes, polyploidy, types of DNA repair.

UNIT-IV:
Gene concept: Classical concept, fine structure of gene, molecular concept of the gene, transposons. Pseudo genes, overlapping gene, oncogene, repeated gene, gene amplification, tumor suppressor, genes, molecular basis of cancer.

UNIT-V:
Lytic and Lysogenic cycles, IS, and Tn elements in bacteria, Bacterial plasmids, gene regulation during development, *E coil* recombination system.

RECOMMENDED BOOKS:

1. Genetics: Strickberger, M. W.
2. Principle of Genetics (2001) 8th Ed. - Gardener *et al*.
3. Microbial Genetics (1994) 2nd Ed. - Maloy *et al*
4. Concept of Genetics 7th Ed. (2003) - Klug & Cummings.
5. Microbial Genetics-Fridfleder
6. Advanced Genetics (2002) - Miglani , G. S.
7. Bacterial Genetics (2004) – Nancy Trun

BT-202: Enzyme Technology

UNIT-I:

Introduction to Enzymes: Enzyme nomenclature, enzyme commission numbers, and classification of enzymes. Isolation and purification of enzymes, preparation of purification chart, Enzyme activity, Specific activity and turn over number, Marker enzymes.

UNIT-II:

Enzyme Kinetics: Steady state, pre-steady state, equilibrium kinetics, Michaelis and Menten Equation and its derivation, Different methods to calculate the K_m and V_{max} and their significance.

UNIT-III:

Factor affecting enzyme activity and catalysis: pH, subsrate and enzyme concentration, temperature, coenzyme and cofactors, Mechanism of action of enzymes involving two/more substrates. Role of metal ions in enzyme catalysis. Enzyme inhibition, different types of inhibitors and activators.

UNIT-IV:

Structure and function of enzymes: Lysozyme, chymotrypsin, DNA polymerase, RNase, proteases. Enzyme regulation and control of their activity. Introduction to allosteric enzymes and isozymes.

UNIT-V:

Enzyme Technology: Immobilization of enzymes and their application, commercial production of enzymes, RNA- catalysis, Catalytic antibodies-abzymes, Protein and Enzyme engineering: Design and construction of novel enzymes. Computer aided drug designing and structural analysis of nanoparticles. Structure and Application of protease, lipases, papain, structure dynamics.

RECOMMENDED BOOKS:

1. Enzyme Kinetics (1995) – Palmer
2. Enzyme Kinetics - Dixon
3. Fundamental of Enzymology – Price & Steven
4. The Enzymes Vol. 1 & 2 – Boyer
5. Enzyme Structure & Mechanism – Alan Fersht
6. Enzyme Biotechnology – Tripathi, G.
7. Industrial Enzyme & their Application (1998) –Uhlig, H.
8. Enzyme 3rd Ed. (1979) – Dixon M. & Webb, E.C.
9. Enzyme Kinetics –Voet & Voet

BT-203: MOLECULAR BIOLOGY

UNIT-I:

DNA Structure: DNA as genetic material, Chemical structure and base composition of nucleic acids, Double helical structures. Different forms of DNA, Forces stabilizing nucleic acid structure. Super coiled DNA. Properties of DNA, Renaturation and denaturation of DNA. Tm and Cot curves, Structure of RNA.

UNIT-II:

DNA Replication: General features of DNA replication, Enzymes and proteins of DNA replication. Models of replication. Regulations of DNA replication, Prokaryotic and eukaryotic replication mechanism. Replication in phages. Reverse transcription

UNIT-III:

Transcription: Mechanism of transcription in prokaryotes and eukaryotes. RNA polymerases and promoters. Post-transcriptional processing of tRNA. rRNA and mRNA (5' capping, 3' polyadenylation and splicing). RNA as an enzyme-Ribozyme.

UNIT-IV:

Translation: Genetic code, General features, Deciphering of genetic code, Code in mitochondria, Translational mechanism in prokaryotes and eukaryotes, Post translational modification and transport, Protein targeting (signalling) Non ribosomal polypeptide synthesis Antibiotic inhibitors and translation.

UNIT-V:

Regulation of Gene Expression in Prokaryotes and Eukaryotes: Operon concept, Positive and negative control, Structure and regulation of lac, trp and arb operon, regulation of gene expression in eukaryotes (a brief account), anti-sense RNA, RNAi

RECOMMENDED BOOKS:

1. Gene VIII (2005) - Benjamin Lewin
2. Molecular Biology- Turner *et al*
3. The Biochemistry of Nucleic Acid 11th Ed. (1992) – Adams *et al*
4. Molecular Biology of Gene (2004) – Watson *et al*.
5. Microbial Genetics – Friedflelder
6. Molecular Cell Biology 5th Ed. (2004) – Lodish *et al*.
7. Human Molecular biology (2004) – Stefan, S.
8. Biochemistry & Molecular Biology of Plants (2000) – Buchanan *et al*
9. Plant Biochemistry & Molecular Biology – Lea & Leegood.
10. Cell & Molecular Biology- Karp G.

BT-204: Immunology and Animal Cell Culture

UNIT-I:

Immunology: An introduction and historical perspective , antigens and antigenicity , addjuvants , immune system organs , tissues & cell lymphocytes , lymphoid organs , mono nuclear phagocytic system , mycloid system , immunity – active & passive , Natural humoral and cellular immunity.

I**mmunoglobulins:** Structure of IgG (b) , various classes of antibodies , theories of generation of antibodies , Diversity , molecular mechanisms of antibody diversity , monoclonal antibodies (hybridoma technology) , recombinant antibodies, antigen-antibody interaction, class-switching .

UNIT-II:

Complement System: Classical and alternate pathways, Major Histo-compatibility Complex, recognition of antigens by T & B cells, T – cell receptor complex, B – cells receptor complex. Dendritic cells and N cells.

I**mmunological Responses:** Cell mediated immune response, cellular interactions in the immune response – antigen recognition and presentation, cytokines, immunological tolerance, hypersensitivity, anti-immune diseases & AIDS .

UNIT-III:

Autoimmunity: Mechanism and therapeutic approaches, immunodeficiency syndrome and their diagnosis, vaccines-active and passive immunization, whole organism vaccines , macromolecules as vaccines, recombinant vector vaccines, synthetic peptide vaccines and subunit vaccines, DNA vaccines, Immunodiagnostic: precipitation techniques, agglutination, fluorescence techniques.

UNIT-IV:

Animal cell culture: An introduction, concept of aseptic techniques, animal tissue culture media, cell propagation, preservation and storage of cells, detection of contamination, safety consideration in laboratory cell culture.

G**eneral cell culture techniques:** Dispersion and disruption of tissue, monolayer culture technique, measurement of growth and viability of cell, determination of 50% end point titer, Bulk culturing of animal cells, Concept of bioreactors for mass culture of mammalian cell, Micro carrier culture, harvesting and purification methods for end products recovery.

UNIT-V:

Specialized Techniques: Cell immobilization techniques, cell transmission, Amniocentesis, CEA production and its clinical application, Inter-ferons derived from human cells, 3-D animal cell culture and tissue engineering, FISH and application of animal cell culture.

RECOMMENDED BOOKS:

1. Essentials of Immunology – Roitt
2. Immunology 3rd Ed. (1997) – Kuby J.
3. Immunology – An Introduction (2004) –Tizard, I.R., Thompson Pub.
4. Immunology – Roitt.
5. Principle & Practice of Immunoassay 2nd Ed. – Christopher & David
6. Animal Cell Culture (1987) – Freshney, R.T.
7. Culture of Animal Cell (2003) – Freshney, R.T.
8. Animal Cell Culture & Technology – Basic from Background to Bench (2004) Taylor & Fracis.

BT-301: Genetic Engineering

UNIT-I:

Introduction: Historical background, Restriction enzymes and modifying enzymes, Restriction mapping, Construction of chimaeric DNA- staggered cleavage, Addition of poly dA and dT tails, Blunt end ligation, Gene cloning.

UNIT-II:

Cloning and Expression Vectors: Vehicles for gene cloning, Plasmids, Bacteriophages, Cosmids and Phagemids as vectors, P1 vectors, F- factor based vectors, Plant and animal viruses as vector, Artificial chromosomes as vectors (YAC, BAC, PAC and MAC vectors), Expression vactors- use of promoters and expression cassettes, Bacculoviruses as expression vectors, Virus expression vectors, Binary and shuttle vectors.

UNIT-III:

Isolation Sequencing and Synthesis of Genes: Methods of gene isolation, Construction and screening of genomic and cDNA libraries, Chromosome walking, Chromosome jumping, Transposone tagging, Map based cloning, DNA sequencing Techniques (Maxam Gilbert's chemical degradation methods and Sanger's dideoxy chain termination method), Automated DNA sequencing, and Organochernical gene synthesis.

UNIT-IV:

Molecular Probes and PCR: Molecular probes, Labeling of probes, Radioactive vs. Non radioactive labeling, Uses of molecular probes. Polymerase Chain Reaction- basic principle, Modified PCR (Inverse PCR, Anchored PCR, PCR for mutagenesis, asymmetric PCR, RTPCR, PCR walking), Gene cloning Vs. Polymerase chain reaction; Applications of PCR in biotechnology, Ligase chain reaction.

UNIT-V:

Molecular Markers and DNA Chip Technology: Molecular-Markers-types and applications, Construction of molecular maps (genetic and physical maps), DNA chip Technology & Microarrays (a Brief account).

Genomics and Proteomics: Whole genome sequencing and functional genomics (a brief account), Applications of genomics and Proteomics with special reference to *Arabidopsis* and Rice.

RECOMMENDED BOOKS:

1. Genomes (2002)2nd edition Brown,T.A.
2. Principles of Gene Manipulation (1994), Old and Primerose
3. Gene Cloning: An introduction, Brown
4. A Passion for DNA: Genes, Genome & Society(2000),Watson
5. Genetic Engineering: An Introduction to Gene Analysis and Exploitation In eukaryotes (1998), Kingsman & Kingsman
6. Molecular Cloning: A Laboratory Manual (2000),Sambrook & others
7. Molecular Genetics of Bacteria- Dale
8. Genes & Genomes (1991), Singer & Berg
9. Molecular Biotechnology (1996), Glick & Pasternak
10. Plant Molecular Biology (Vol.I and II 2002), Gilmartin & Bowler
11. Recombinant DNA (1992), Watson *et al*

BT-302: Biostatistics and Bioinformatics

UNIT-I:

Introduction and definition of Biostatistics. Concept of variables in biological systems. 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. Coefficient of variation, skew ness and kurtosis.Probability: Random experiment, events, sample space, mutually exclusive events, independent and dependent events. Various definitions of probability, addition and multiplication theorems of probability (only statement), Random variables (discrete and continuous). Probability density functions and its properties.

UNIT-II:

Some probability distributions such as binomial, Poisson and normal (Basic idea about these distributions) and their applications.Concept of populations and sample. Simple random sampling without replacement. Definition of simple random sample. Chi-square (X^2), student's t and f-distributions (derivations not required) their properties and uses. Concept of standard error.Correlation and Regression, linear and quadratic regression Analysis of variance: One- way and two-way classifications with single observation per cell.

UNIT-III:

Introduction to Bioinformatics: Definition, role, scope and limitation of Bioinformatics. Different branches of Bioinformatics. Terminologies: Internet Browser, Software, hardware, database, Network NicNet, Inflibnet, EMBnet, Operating System, algorithm. Biologicasl data & databases: Biological data type, Classification of biological database, sequence database: GenBank, EMBLDDBJ, PIR, SWISS-PROT. Secondary nucleotide and protein sequence databases: ExInt, TIGR, EPD, CUTG, GOBASE, PROSITE, PRINTS, BLOCKS, Pfam, PRODOME. Structure database: PDB, CSD, CATH, SCOP, FSSP, Specialised Database: KEGG, ENZYME, REBASE. Study odf data entry formats: GenBank, EMBL, DDBJ, Swiss-Port, PIR, PDB, FASTA, MSA, PHYLIP

UNIT-IV:

Sequence Analysis: Introduction, methods (HMM & ANN) and significance. Nucleic acid sequence analysis: Principle and software tools. Protein Sequence Analysis: Principle and software tools. Sequence Comparison: Pair wise algorithms-Introduction and significance. Methods of alignment: Dot matrix, Dynamic Programming, Heuristic algorithm (FASTA & BLAST). Scoring matrix: PAM and BLOSUM, Concept of Gap penalty. Multiple Sequence Alignment:

Introduction, Significance and various algorithms. Phylogenetic Analysis: Introduction & Importance, Phylogenetic tree, methods of Phylogenetic analysis.

UNIT-V:

Structural Bioinformatics: Introduction & Importance. Experimental Structure determination: X-ray, NMR and electron microscopy. Coordinate systems. Visualization & presentation of structure. Geometric Analysis of structure. Structure comparison. Protein structure prediction: secondary structure prediction, tertiary structure prediction. Protein folding. Nucleic acid structure: RNA structure prediction: principle and tools: DNA structural polymorphism. Molecular modeling and dynamics, computer aided drug designing.

RECOMMENDED BOOKS:

Statistics:

1. An Introduction Biostatistics Glover
2. An Introduction Biostatistics- Mishra & Mishra, Kalyani Publication

Bioinformatics:

1. Bioinformatics databases and Algorithms -N. Gantham
2. Bioinformatics- David Mount
3. Emerging trends in Bioinformatics Irfan A. Khan
4. Introduction to Bioinformatics- Arther Lark.

BT-303: Plant Biotechnology

UNIT-I:

Plant tissue culture: Cleaning, sterilization, sterile handling of tissue culture of plant. Nutritional requirement for in vitro culture. Concept of cellular totipotency, single cell culture, micro propagation, somoclonal variation and its application for plant improvement, somatic embryogenesis, anther and ovule culture, haploid and double-haploid production.

UNIT-II:

Protoplast culture: Isolation ,fusion and culture, somatic hybridization, selection system for hybrids , cybrid production and their application in crop improvement, cryobiology of plant cell culture and establishment of gene banks, production of virus free plants using meristem culture.

UNIT-III:

Plant cloning vectors: Ti and Ri plasmid and viral vectors (CaMV based vectors, Gemini virus, TMV based vectors). Mechanism of DNA transfer, role of virulence genes, use of 35S promoters, genetic markers, use of reporter genes, methods of nuclear transfer, particle bombardment, electroporation, microinjection, transformation of monocots, transgene stability and gene silencing , herbicide , insect and salt resistance , Plant DNA fingerprinting - Hybridization and PCR based markers (RFLP, SSRs, RAPD, QTLS , SCARS , AFLP etc.)

UNIT-IV:

Biological nitrogen fixation and biofertilization, molecular mechanism of nitrogen fixation, genetics of nif gene.

Plant diseases- general account, biological control of pests and disease, biopesticides, seed production technique, plant cell culture for the production of useful secondary metabolism-pigments, perfumes , flavor, pharmacologically important compounds, biodegradable plastics. Automation in Plant Tissue Culture for its commercial application.

UNIT-V:

Transgenic plants, commercial status and public acceptance, Bio-safety guidelines for research involving GMO’s, benefits and risks. Socio economic impact and ecological consideration of GMO’s, Gene flow, IPR and IPP. Patenting of biological.

RECOMMENDED BOOKS:

1. Plant Tissue Culture: Theory & practice a revised edition(2004) Bhojwani & Rajdan
2. Plant Biotechnology (2000),Hammond *et al*
3. Plant Tissue Culture –Bhojwani, S.S.
4. Plant Cell & Organ culture(2004) Gamberg, O.L
5. Principles of Plant Biotechnology, Montell, *et al*
6. Plant Cell Culture (2003) Evans D.A.
7. Plant Molecular Biology- vol.I and II, Gimartin & Bowler
8. Genetic Engineering of Crop Plants, Lycett G.W. & Grierson D.

BT-304: Bioprocesses & Biochemical Engineering

UNIT-I:
Introduction to Bioprocesses Engineering. Isolation, Preservation & Maintenance of Industrial microorganisms. Factors that influence solid- state fermentation. Kinetic of microbial growth an death, Media for industrial fermentation.

UNIT-II:
Air and media sterilization, safety in fermentation laboratory.Strain improvement of industrially important microorganism. Bioreactors: Principle, Kinetics, types, design, analysis and application.Types of fermentation processes: analysis of batch, Fed-batch and continuous Bioreactions, stability of microbial reactions.

UNTT-III:
Aeration and Agitation systems for bioreactor.Flow behavior of fermentation fluids Gas-Liquid mass transfer, Solid and Liquid-phase mass transfer and Heat transfer. Measurement and control of bioprocess parameters.

UNIT-IV:
Downstream processing: Introduction, removal of microbial cells and solid matter. Foam reparation, precipitation, centrifugation, cell disruption, chromatography. Product recovery processes and Unit operations. Safety consideration in down stream processing Bioprocess economics

UNIT-V:
Classification of product formation, Product synthesis kinetics, Mass balance in bioprocesses system, Energy balance in Bioprocess system.

RECOMMENDED BOOKS:

1. Biochemical Engineering, Aiba *et al*
2. Biochemical Engineering Fundamentals, Baily and Ollis
3. Principles of Fermentation Technology (1997),Stanebury P.F, and Whitaker
4. Fermentation Biotechnology-Principles, Process and Products(1998),Ward,O.P
5. Process Engineering in Biotechnology, Jackson A.T.
6. Bioreaction Engineering Principles, Nielson & Villadson
7. Industrial Microbiology (1992)4th edition,Prescott & Dunn
8. Microbial Biotechnology (1998) Glazer & Nikaido
9. A Text Book of Industrial Microbiology,2nds edition (2002),Cruger and Cruger
10. Manual of Industrial Microbiology & Biotechnology 2nd edition (1999), Arnold *et al*

BT-305: Applied Biotechnology

UNIT-I:

Industrial Biotechnology: Microbial strain of industrial importance, microbial production of antibiotics (penicillin , streptomycin & tetracycline),Vitamins (Vit B12), amino acids (glutamic acid) & enzymes (amylase, protease, invertase & pectinase), microbial production of alcoholic beverages (whisky & brandy), vinegar, citric acid, acetic acid, glycerol, acetone, foods–SCP, Biotransformation of steroids and pesticides.

UNIT-II:

Agricultural Biotechnology: Role of biofertilizers and biopesticides in sustainable development, petrocrops, aquaculture, Improvement of nutritional value of seed storage protein, starch, oil. Transgenic plants for increased shelf life molecular mapping of genes of agricultural importance, sericulture, transgenic fish Plant Variety Protection Act, Plant breeders rights, International Convention on biological diversity.

UNIT-III:

Food Biotechnology: Prokaryotic & Eukaryotic based products (fermented meats, milk products , yoghurt, cheese, cereal, wine, beer), Impact of biotechnology on microbial testing of food, current/traditional methodology and new approaches (use of gene probes, RDT, Bioluminescence), Safety evaluation of genetically engineered enzyme/novel food products, Natural Control of Micro Organism and preservation, Biogums, Bio-colours Fumaric acid, sweetener, fat substitutes, natural & modified starch, fats & oils food.

UNIT-IV:

Environmental Biotechnology: Environmental pollution and their management, concept of Global Warming and Ozone depletion (Ecofarming, Green house effect & acid rain), Waste water treatment, solid waste management, conventional & modern fuels & their environmental impact, Bioremediation, Biodegradation of xenobiotic compounds, Biomineralization, Biotechnological approaches for preserving biodiversity (Gene banks ,Germ Plasm Banks & their management).

UNIT-V:

Frontiers in Biotechnology: Stem Cell Technology, Human Cloning Ethical issues & risks associated with it, Nano biotechnology:– Introduction to nanoscience, size matter, tools for measuring nanostructure Biosencer development and application, Nanofabrication, Nanotech impact on types of DNA chips & their production, SNP and genome mismatch signals, functional proteomics – RT PCR Human Genome Project , Bioterrorism.

RECOMMENDED BOOKS:

1. Fundamental of food Biotechnology (1996). Lee, B.H.
2. Biotechnology & Food Ingredients (1991) Goldberg, I & Williams, R.
3. Food Biotechnology: Micro Organisms (1995) Hui, Y.H.
4. Biotechnology: Food Fermentation Vol. I & II (1999), Joshi, V.K. & Pandey, A.
5. Pesticide Microbiology, Hill I.R. & Asight, S.J.L.
6. Biotech in Industrial Waste treatment & Bioremediation (1996) Hickey, R.F. Smith, G.
7. Biodegradation & Bioremediation: Soil Biology (2004). Singh, A., Word, O.P.
8. Environmental Biotechnology (1998), Agarwal, S.K.
9. Plant Biotechnology & Molecular Markers (2004) Shrivastava *et al*
10. Agricultural Biotechnology (1998) Altman, A.
11. Plant Biotechnology: The Genetic Manipulation of Plant (2004) Adrianstater *et al*
12. Legal Aspect of Gene Technology (2004) Brian, C.
13. The GMO Hand Book: Genetically Modified Animals, Microbes & Plant (2004) Sarad, R.P.
14. Food & Vegetable Biotech (2004) Valpuseta
15. A passion of DNA, Watson J.D.
16. DNA Microarrays & gene expression, Baldi, P & Hatfield, G.W.
17. Nanobiotechnology- Next Big Idea, Mark et al
18. Gene Cloning, Brown, T.A.

BT-401-Advances in Fermentation and Food Biotechnology

MM-100

UNIT-I

Characterization and Techniques of fermentation systems. Role of Fermentation, Biochemistry of Fermentation-Fermentation of Carbohydrates, Protein. Lipid Metabolism, Formation of favour.

UNIT-II

Advanced continuous fermentation for anaerobic microorganisms, Fermentation process development of carbohydrate based therapeutics, Bioprocess development for detoxification and decolorization ,Fermentation process validation.

Genetic manipulation of industrially important microorganisms-Methods of reproduction Recombination, strain modification, Stabilization of transformants, Autonomous replication. Production of foreign protein, Commercial production of plant proteins in microorganisms. Economics of fermented products.

UNIT-III

Microorganisms involved in natural fermentation , Microbial succession . Sources of Food spoilage ,Food Toxicology, Food Processing and preservation.

UNIT-IV

Composition and nutrition of fermented products. Microbial toxins –control of mycotoxin and algal toxin in food. Sensory evaluation of fermented food. Bioreactors in food fermentation. Packaging of fermented food products.

UNIT-V

Protein engineering in food technology: methods, targets and applications in foods. Biosensors. Biological monitoring of foods, waste management and food processing. HACCP and hurdle technology.

Recommended Books:

Fermentation biotechnology - B.C.Saha

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

Food microbial fundamentals and frontiers – Doyle, Beuhat and Montville.

BT-402- Advance Immunology and Immunodiagnostics

MM-100

UNIT-I

Antigen Processing and Presentation – Self MHC restritation of T cells, Role of APC, Endogenous and Exogenous antigen, Peptide generation in endocyticvehicles, proteosome.

UNIT-II

T cell Receptor- Early studies, isolation ,structure TCR multigene families. Mechanism of TCR DNA rearrangement. Allelic exclusion of TCR genes, Alloreactivity of T-cell. TCR coupled signaling pathway, Co-stimulation signals,T-cell differentiation.

UNIT-III

Molecular mechanism of antibody diversity, Antibody Engineering, Monoclonal antibodies: Production, characterization and application in diagnosis therapy and basic research. Complement system, complement deficiencies Role of Complement in immune response-Immunity to bacteria, fungi, protozoa & worms.

UNIT-IV

Cytokines: Cytokine related and therapeutic application of cytokines,cytotoxic T-cells & and their mechanism of action, Immunoregulation mediated by antigens,antibodies,immunecomplexes,Hypersensitivity type-1,2,3,4.Tumor immunology.

UNIT-V

Transplantation Immunology, Immunodiagnostics-ELISA, Blotting, Immunohistochemistry and Immunocytochemistry.Fluorescent labelling (Direct and indirect), Biotinylation, Immunogold deviatves. Biosensor assay, assay for Complement, Circulatory immune complex and effector cells, Gene targeting.

Recommended Books:

1. Immunology-Roitt et.al.
2. Immunochemistry- Kear and Thorpe.
3. Immunology-Abbas.
4. Cellular and Molecular Immunology-Abbs, Lichtman and Pober.
5. Immunology-Tizzard.

BT-403-Principles of Drug Designing

MM-100

UNIT-I

Organized drug discovery & development: pharmacological microbial, recombinant, biochemical and molecular level screening system and their construction strategies, alternative strategies in lead identification, lead optimization, preclinical, clinical trails, patenting & clearance for application.

UNIT-II

Receptor versus Enzyme mediated drug action:, SAR and its quantitative description;QSAR, molecular principles in agonist and antagonist action.

UNIT-III

Thermodynamic and structural principles, objective & approaches in the native ligand modification; molecular graphic and dynamical method in peptide and protein mimicry; morphinans versus eukephalins paradigm example of a peptidomimetic, other illustative example from current literature.

UNIT-IV

Drug design by receptor site fit, active site simulation using PDB structure data and homology modeling graphical and computational active site fits exploiting small structure data libraries and commercial software; concept of perturbation free energy & its practical application.

UNIT-V

Enzyme catalytic principle; a recapitulation, affinity labels, principles of suicide inactivation, design strategies scope and limitations,, illustrative examples of hydrolases , PLP based enzyme, isomerases & redox enzymes, practise & principle of transtion state mimicry. Synthetic peptide libraries, peptide libraries through phage display: application in epitope a agretope mapping & in synthetic vaccine designing.

Recommended Books:

1. Comprehensive medicinal chemistry (Vol. I-VI) Academic press,.Hansch
2. Ansel's Pharmaceutical Dasage formes a Drug delivery system-8th . Alen Popovich & Ansel
3. Drug Design-Kulkarni & BotharaS

BT-405 LABORATORY-IV

M.M-100

1. Immuno diffusion.
2. Immuno electrophoresis.
3. Study of agglutination & rosette formation.
4. PAGE on native gel & study of isozyme by activity staining.
5. Permanent slide on mammalian physiology.
6. Determination of aspartate content is given sample by enzymatic method.
7. To immobilize chymotrypsin on agarose gel beads by Oxirane method.
8. Production of monoclonal antibody against purified protein.
9. To detect nitrate reductive in leaf extracts by immnuno diffusion test.
10. To detect antibodies in sera by competitive ELISA.
11. Identification of bacteria by using fluorescent antibody techniques (FAT).
12. Quality testing of milk by resazuring test.
13. Determination of phasphatase activity in butter, whey, milk powder.
14. Microbiological analysis of food production.
15. Presumptive test for coliform in butter.
16. Analysis of mycotoxin in fungal contaminated food materials.

Note: 70% of the above list should be compulsorily performed.