

SOLAPUR UNIVERSITY, SOLAPUR**M. Sc. Part – II: BIOTECHNOLOGY****Sem III and Sem IV****Syllabus**

(With effect from June 2011)

Subject Code	Name of the Subject	Lectures	Total Marks
	SEMESTER-III		
MBT 301	Genetic Engineering	48	100
MBT 302	Immunology	48	100
MBT 303	Fermentation Technology-I	48	100
MBT 304	Plant Biotechnology	48	100
MBT PR 301	Laboratory Course V		100
MBT PR 302	Laboratory Course VI		100
	SEMESTER-IV		
MBT 401	Animal Cells in Biotechnology	48	100
MBT 402	Industrial and Environmental Biotechnology	48	100
MBT 403	Bioinformatics	48	100
MBT 404	Microbial Fermentation Technology	48	100
MBT PR 401	Laboratory Course VII		100
MBT PR 402	Laboratory Course VIII (Project Work)		100

SEMESTER- III

MBT 301	Genetic Engineering	48
UNIT I	<p>DNA & Basics Of Recombinant DNA Technology Structure of DNA: A-,B-,Z-, and triplex DNA, measurement of properties, spectrophotometric, CD, AFM, and electron microscope analysis of DNA structure. Restriction analysis: Types of restriction enzyme, Type I, II and III, restriction modification systems, type II restriction endonucleases and properties, isoschizomers and neoschizomers, mcr/mrr genotypes, Cohesive and blunt end ligation, linkers, adaptors, homopolymeric tailing. Labeling of DNA: Nick translation, random priming, radioactive and non-radioactive probes, use of Klenow enzyme, T4 DNA polymerase, bacterial alkaline phosphatase, polynucleotide kinase. Hybridization techniques: Northern, Southern, Western and Colony hybridization, Fluorescence in situ hybridization Restriction maps and mapping techniques, DNA fingerprinting, chromosome walking & chromosome jumping DNA-Protein Interactions: Electro mobility shift assay, DNase I footprinting, methyl interference assay</p>	12
UNIT II	<p>Cloning Vectors Gene Cloning Vectors: Plasmids, bacteriophages, Cloning in M13 mp vectors, phagemids, Lambda vectors; insertion and replacement vectors, EMBL, RDASH, Rgt10/11, RZAP etc. Cosmid vectors. Artificial chromosome vectors (YACs, BACs), Animal Virus derived vectors- SV-40, vaccinia/bacculo & retroviral vectors. Expression vectors; pMal, GST, pET-based vectors. Protein purification; His-tag, GST-tag, MBP-tag etc. Restriction proteases, intein-based vectors. Inclusion bodies, methodologies to reduce formation of inclusion bodies. Baculovirus and Pichia vectors system</p>	12
UNIT III	<p>Cloning Methodologies Insertion of Foreign DNA into Host Cells: Transformation, Transfection: Chemical and physical methods, liposomes, microinjection, macroinjection, electroporation, biolistics, somatic cell fusion, gene transfer by pronuclear microinjection, Plant transformation technology: Basis of tumor formation, hairy root, features of Ti and Ri plasmids, mechanism of DNA transfer, role of virulence genes, use of Ti and Ri as vectors. Cloning and expression in yeasts (Saccharomyces, Pichia etc.), animal and plants cells, methods of selection and screening, cDNA and genomic cloning, expression cloning, jumping and hopping libraries, southwestern and far western cloning, yeast two hybrid system, phage display, Construction of cDNA libraries in plasmids and screening methodologies, Construction of cDNA and genomic DNA libraries in lambda vector. Principles in maximizing gene expression, Site-directed mutagenesis.</p>	12

UNIT IV	<p>PCR and Its Applications Primer design, Fidelity of thermostable enzymes, DNA polymerases, multiplex, nested, reverse transcriptase , real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products, T-vectors, proof reading enzymes, PCR in gene recombination, deletion, addition, overlap extension, and SOEing, site specific mutagenesis, PCR in molecular diagnostics, viral and bacterial detection, PCR based mutagenesis. Applications Sequencing methods: Enzymatic DNA sequencing, Chemical sequencing of DNA, principle of automated DNA sequencing, RNA sequencing. Chemical Synthesis of oligonucleotides. Gene silencing techniques: Introduction to siRNA and siRNA technology, micro RNA, construction of siRNA vectors, principle and application of gene silencing. Gene knockouts and Gene Therapy: Creation of knock out mice, disease model, somatic and germ-line therapy in vivo and ex-vivo, suicide gene therapy, gene replacement, gene targeting Other applications: Transgenics, Genome projects and their implications, application in global gene expression analysis. Applications of recombinant DNA technology in medicine, agriculture, veterinary sciences.</p>	12
	<p>References:- 1. Sambrook J, Fritsch E. F. and Maniatis (1989) Molecular cloning, vol. I, II, III, II nd edition, Cold spring harbor laboratory press, New York. 2. DNA Cloning : A practical approach D.M. Glover and D.B. Hames, RL Press, Oxford, 1995 3. Molecular and cellular methods in Biology and Medicine, P.B. Kaufman, W. Wu , D. Kim and L.J. Cseke, CRC Press Florida 1995 4. Methods in Enzymology Guide to Molecular Cloning Techniques, Vol. 152 S.L. Berger and A. R. Kimmel, Academic Press Inc, San Diego, 1996 5. Methods in Enzymology Gene Expression Technology, Vol. 185D. V. Goedel, Academic Press Inc, San Diego, 1990 6. DNA Science: A First Course in Recombinant Technology, D. A. Mickloss and G. A Freyer, Cold Spring Harbor Laboratory Press, New York, 1990 7. Molecular Biotechnology, 2nd Ed. S. B. Primrose, Blackwell Scientific publishers, Oxford, 1994 8. Milestones in Biotechnology, Classic Papers on Genetic Engineering, J. A. Davis and W. S. Reznikoff, Butterworth-Heinemann Boston 1992 9. Route Maps in Gene Technology, M. R. Walker, and R. Rapley, Blakwell Science, Oxford, 1997 10. Genetic Engineering : An Introduction to Gene Analysis and Exploitation in Eukaryotes, S. M. Kingsman, Blackwell Scientific Publications, Oxford, 1998</p>	

MBT 302	Immunology	48
UNIT I	<p>Immunology – fundamentals and anatomy of immune system</p> <p>A) Immunity – Innate and acquired immunity. Components of innate and acquired immunity.</p> <p>B) Antigen, Haptens, adjuvants, mitogens. Antibodies – structure, functions.</p> <p>C) The anatomy of the immune response: - Cells and organs of immune system. Regulation of immune response – Humoral and Cell mediated response.</p>	12
UNIT II	<p>Immunity to Infection</p> <p>A) Antigen processing and presentation, MHC, complement system.</p> <p>B) Bacterial, viral, protozoal and parasitic infections with reference to (Diphtheria, influenza virus, malaria and helminthes) with specific representative examples of each group.</p> <p>C) Vaccines – Active and passive immunization, DNA vaccines, multivalent subunit vaccines, synthetic peptide vaccines.</p>	12
UNIT III	<p>Clinical Immunology</p> <p>A) Hypersensitivity: - Type I, II, III, and IV reactions. Autoimmunity – organ specific and systemic autoimmune diseases. Treatment of autoimmune diseases.</p> <p>B) Transplantation and tumor immunology: - Graft rejection, tissue typing, Immunosuppressive therapy and clinical transplantation. Tumor antigens, cancer immunotherapy.</p> <p>C) Immunodeficiency diseases - Phagocytic, humoral, cell mediated deficiencies and SCID. AIDS- causes, syndrome, diagnostic tools, treatment and development of vaccine</p>	12
UNIT IV	<p>Immunotechnology</p> <p>A) Antigen antibody interactions – Principles, types and applications of agglutination, precipitation, complement fixation, viral neutralization, immunodiffusion, immunoelectrophoresis, ELISA and RIA.</p> <p>B) Monoclonal antibodies – Hybridoma technology and various cellular technologies.</p> <p>C) Automation in immunological techniques – auto analyzers used in immunology, FACS etc.</p>	12
	<p>References: -</p> <p>A) Kuby : Immunology; RA Goldsby, Thomas J. Kindt, Barbara A. Osborne.</p> <p>B) Immunology by Roitt I. M., Brostoff J. and Male D. Gower medical publishing London.</p> <p>C) Fundamentals of immunology 4th ed., Paul 1999, Lippencott Raven.</p>	

MBT 303	Fermentation Technology-I	48
UNIT I	Upstream Processing Microbial cell growth, kinetics and Stoichiometry, various Methods for growth measurement, Strain improvement by mutation, genetic engineering, etc. Overproduction of metabolites, alternative carbon and nitrogen sources and their composition. Development of inoculum for industrial fermentation, design of industrial production media. Alternate metabolic routines for utilization of carbon sources with their regulation and inter-linkage especially for glucose and hydrocarbons, preservation and maintenance of microbes.	12
UNIT II	Fermentation Design of fermenter, construction materials, various sterilization techniques for solid, liquid and gases, aeration and agitation, foam, auxillary equipments. Control of various parameters – online and offline monitoring, rheological properties of fermenter, role of computer in fermenter operation	12
UNIT III	Types of Fermentations: Batch, fed-batch and continuous fermentation. Types of fermenters, solid state fermentation, Submerged or deep aerated fermentation, scale up and scale down, process economics, fermentation economics. Effluent treatment.	12
UNIT IV	Downstream Processing Principle, methodology, instrumentation an applications of cell homogenization techniques liquid-liquid extraction centrifugation, filtration, , distillation, ultrafiltration, precipitation, adsorption chromatography, ion exchange chromatography, gel filtration and affinity chromatography in clarification, concentration, isolation and purification of various metabolites from fermented media	12
	References:- 1) Moo-Young M. ed. (1985) Comprehensive Biotechnology vol: I & II, Pergamon Press N.Y. 2) Ratledge C and Kristiansen B. eds. (2001) Basic Biotechnology 2 nd ed. Cambridge Univ Press Cambridge. 3) Old R.W and Primose S.D (1995) Principles of Gene Manipulation 5 th ed. Blackwell Scientific Pub. Oxford. 4) Bailey J.E and Ollis D.F. (1986) Biochemical Engineering Fundamentals 2 nd ed. McGraw Hill Book Company, N. Delhi. 5) Aiba S, Humphrey A. E. and N. F. Millis (1973) Biochemical Engineering, 2 nd Edition University of Tokyo Press, Tokyo, Japan. 6) Stanbury P.F., Whitaker A, and Hall S.J. (1997) Principles of Fermentation Technology 2 nd ed. Aditya Books Pvt. Ltd, N.Delhi. 7) Mukhopadhaya S.N. (2001) Process Biotechnology Fundamentals. Viva Books Pvt. Ltd. N.Delhi. 8) Rehm H.J and Reed G. (1985) Biotechnology vol. I & II. VCH, Basel. 9) Stainer R. Y. Ingrahm J. L., Wheelis M. L. and Painter P. R. (1987) General Microbiology 5 th Edition, Macmillan Press Ltd. London	

MBT 304	Plant Biotechnology	48
UNIT I	<p>Plant Physiology and Basic Techniques in Plant Tissue Culture Plant Nutrition: Role of microelements and micronutrients in plant metabolism, Functions & Deficiency diseases. Plant Hormones: Types & Mechanism of Action. Role of Plant Hormones in growth & development of Plants. Introduction to Cell & Tissue Culture. Design & lab setup of Plant Tissue Culture laboratory Tissue culture Media (Composition preparation) Initiation and Maintenance of callus & Suspension culture, single cell clones.</p> <p>Micro propagation 1. Organogenesis, Somatic Embryogenesis, Synthetic seeds. 2. Shoot tip culture/ Auxiliary bud culture, Rapid clonal propagation 3. Embryo Culture & Embryo Rescue. 4. Acclimatization of Plants. Somaclonal Variations /Invitro mutagenesis Selected successful examples of Plants of Diverse Origin using Tissue Culture technology, Rescue of endangered plants</p>	12
UNIT II	<p>Protoplast Culture, Anther Culture and Cryopreservation 1. Protoplast Isolation, Culture, Fusion, Selection of Hybrid Cells and Regeneration of Hybrid Plants, Symmetric and Asymmetric hybrids. 2. Anther, Pollen and Ovary culture for production of Haploid Plants and Homozygous lines. 3. Cryopreservation, Slow growth & DNA Banking for germ plasm Conservation.</p>	12
UNIT III	<p>Plant Transformation Technology & its applications. 1. Basics of Tumor formation, Hairy root, features of Ti & Ri Plasmid ,Mechanism of DNA transfer role of Virulence gene, Use of Ti & Ri as vectors, Binary vectors, Use of 35s & other promoters genetic markers methods of nuclear transformation viral vectors & their applications, Multiple gene transfers vector less or direct DNA transfer ,Use of reporter gene, Particle bombardment ,electroporation, Microinjection, transformation of monocots, Transgene stability & gene silencing in Plant transformation</p> <p>2. Applications of Plant Transformation for Productivity & performance Herbicide resistance like atrazine, Insect resistance Bt gene, non Bt like protease inhibitors, Virus resistance, disease resistance, antibiotic stress, post harvest losses long shelf life of fruits & flowers.</p> <p>3. Chloroplast transformation, Advantage vectors & success with tobacco & potato</p>	12

UNIT IV	<p>Applications of Plant Biotechnology</p> <ol style="list-style-type: none"> 1. Commercial micro propagation. 2. Metabolic engineering & Industrial products Plant secondary metabolites, control mechanisms & manipulation of Phenyl Propanol pathway, Shikimate pathway, Alcoloids, Industrial enzymes, Biodegradable plastics, Therapeutic proteins, lysozomal enzymes, Antibodies, edible vaccines, Purification strategies, oleosin partitioning technology 3. Integration of Genetic Engineering of Plants in Agriculture Diseases resistant, Biotic & Abiotic stress resistant, Enhancement of nutritional value of crop Plants & molecular farming, Applications in Biodiversity conservation 	12
	<p>References:-</p> <ol style="list-style-type: none"> 1. An introduction to Plant Tissue Culture 2nd edn. Razdan, M. K, Science Publishers, USA. 2. Textbook of plant biotechnology, Chawala P.K.2002,Oxford&IBH,New Delhi. 3. Bhojwani, S. S. and M. K. Razdan 1996.Plant Tissue Culture:Theory and Practice, Elsevier Pub. 4. Chrispeels, M. J. 2002.Plant Tissue Culture:Genetical Aspects. Jones and Bortlett Publishers, International. 5. Chopra V. L. et al 1999. Applied Plant biotechnology. Science Publishers Inc. 6. Verpoorte, R. and A.W. Alfermann (Eds) 2000.Metabolic Engineering of plant secondary metabolism, lower Academic Publisher. 	

MBT PR 301	Laboratory Course V	
	<ol style="list-style-type: none"> 1. Estimation of IAA 2. Determination of activity of enzyme IAA oxidase 3. Estimations amino acids(arginine and histidine) and vitamins(vitamin A and vitamin C) 4. Induction of beta galactosidase in <i>E. coli</i>. 5. Study of mutations by Ames test. 6. Assay of antibiotics and demonstration of antibiotic resistance. 7. Isolation of organic acid and amine producers and biochemical characterization of isolated microbes. 8. One step growth curve of coli phages. 9. Isolation of Streptomycin resistant mutants. 10. Bacterial Transformation. 11. Transduction. 12. Conjugation. 13. Isolation of genomic DNA 	
MBT PR 302	Laboratory Course VI	
	<p>Plant tissue culture.</p> <ol style="list-style-type: none"> 1. Preparation of Media. 2. Surface Sterilization 3. Organ Culture 4. Callus Culture, organogenesis. 5. In vitro rooting and acclimatization. 6. Protoplast isolation and culture. 7. Anther Culture/ Production of haploids. 8. Cytological examination of regenerated plants. 9. Agrobacterium culture, selection of tranformants, GUS assay. 10. Synseed preparation <p>Immunological techniques</p> <ol style="list-style-type: none"> 11. Double diffusion. 12. ELISA <ol style="list-style-type: none"> i) Antibody capture ii) Antigen capture iii) Dot Elisa 13. Precipitin Reaction - Ring test - Immunodiffusion. 14. Immunofluorescence 15. Latex Agglutination 16. Radial Immunodiffusion. 17. Rocket Immunodiffusion. 	

	<p>References:-</p> <ol style="list-style-type: none">1. Practical Biochemistry : An Introductory Course by Fiona Fraiss.2. Methods in Enzymology Vol. I by S.P.Colowick and N.O.Kaplan eds.3. Basic Biochemical Methods 2nd ed by R.R.Alexander and J.M.Griffith4. Biochemical Methods 2nd ed. by S.Sadasivam and A. Manickam.5. Hawk's Physiological Chemistry ed. by Bernard L Oser.6. A Textbook of Practical Biochemistry by David Plummer.7. Laboratory Manual in Biochemistry by S. Jayaraman.	
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SEMESTER- IV

MBT 401	Animal Cells in Biotechnology	48
UNIT I	<p>1. Laboratory and introduction of cells:</p> <ul style="list-style-type: none"> • Equipments and Materials for animal Cell Culture Technology • Design of Tissue Culture Laboratory • Equipments : Laminar Flow Hoods, CO₂ incubator, Open and closed cultures, Microscopes, centrifuge, Refrigerators and Freezers, pipetting aids, Miscellaneous small items of Equipments, Materials, filters, Miscellaneous Items. • Basic Aseptic Techniques • Storage shipping and safety <p>2. Characters of cells and behavior:</p> <ul style="list-style-type: none"> • Cells and tissue types • Behavior of cells in culture: Primary cell lines permanent/Established cell lines/Transformed cell lines • Tumor/cancer originated cells 	12
UNIT II	<p>3. Growth media</p> <ul style="list-style-type: none"> • Physical requirements and Nutritional Requirements of Cells and growth media and cell culture growth kinetics • Natural media • Basal salt solution (BSS)-Various types • Minimum Essential Medium(MEM) • Antibiotics in media • Serum dependent defined media • Serum independent defined media – Cell specific media • pH, bulk ions, trace ions, CO₂, O₂ tension , Ascorbic acid, sugars, Vitamins coenzymes. <p>4. Basic Techniques of mammalian cell culture</p> <ul style="list-style-type: none"> • Open and closed cell-cultures • Primary Cell culture – Isolation and separation of cells, viable cell count, maintenance of cell culture, maintenance of stock culture, Antibiotic free stock cultures • Types of cell cultures – Monolayer, Suspension, Clonal culture, Mass culture micro carrier culture (monolayer), Stem cell cultures (ESC) 	12
UNIT III	<p>5. Biology and Characterization of cultured cells</p> <ul style="list-style-type: none"> • Karyotyping • Contamination Testing of Culture • Viability measurement and cytotoxicity • Measurement of growth parameters • Cell cycle analysis and Synchronization of cultures <p>6. Cell surgery Methods</p> <ul style="list-style-type: none"> • Preparation of anucleated cells and polykaryon cells • Preparation of ghost RBCs. • Preparation of mini cells, micro cells • Surgical manipulation of in vitro fertilization 	12
UNIT IV	<p>7. Cell Fusion Methods</p> <ul style="list-style-type: none"> • Cell fusion techniques • Hybridoma cell preparations and their properties • Use of Hybridoma technology: e.g. M AB and other related techniques • Mini cells, micro cells and anucleated cells in fusion and their application. <p>8. Tissue Engineering :</p> <ul style="list-style-type: none"> • Capillary culture Units • Techniques for culturing differentiated cells : Reconstituted basement membrane rafts, feeder layers. <p>9. Use of Animal Cells in Culture</p> <ul style="list-style-type: none"> • Mutant cell preparation • Evaluation of Chemical carcinogenicity, Cell malignancy Testing • Toxicity Testing, Karyotyping and cytogenetic characterization • Production of metabolic products • ESC applications • Pluripotent stem cell applications 	12

References:-

1. Kuchler, R.J., Biochemical Methods in cell culture and Virology, Dowden, Huchinson and Ross, Inc. Strausberg, USA, 1977
2. Morgan, S.I. Animal cell culture, 1993, Bio Scientific Publishers Ltd, Oxford.
3. Freshney, R.I. Culture of Animal cells: A Manual of Basic Technique, 1994, John Wiley and Sons Inc. Publication, USA.
4. Butler, M. Mammalian, cell Biotechnology: A Practical Approach (1991), IRL Press, Oxford.
5. Jenni P. Mather and David Barnes, eds; Animal cell culture Methods, Methods in cell Biology, vol.57, Academic Press.
6. Cell Culture: Methods in enzymology, Vol-58, Academic Press 1979 or recent.

MBT 402	Industrial and Environmental Biotechnology	48
UNIT I	Industrial fermentation and production General methods of production, SIP, purification, and applications of Organic acids: Citric acid, Amino acids: Glutamic acid Isolations of new antibiotics, hybrid antibiotics, lactum antibiotics, peptides antibiotics. Enzymes: Lipase, acylase Polymers: Polysacchride- Alginate, Pullulan Lipids – PHB, PHA Biomass: SCP and SCO Solvent: Acetone	12
UNIT II	Biotransformation Introduction, types of reaction involved, procedures and applications with respect to steroids, antibiotics and peptides. Immobilization of microbial cells and enzymes-techniques, stability, uses, and applications Microbial leaching: Chemistry, organisms used, and applications	12
UNIT III	Environmental biotechnology Water, air pollution and its control by biotechnological means Biotechnology and waste management Aerobic and anaerobic treatment Degradation of xenobiotics from the environment Bioremediation Effluent treatment: Types, microbes used, types of ETP plants Microbial, biochips, bioplastics Bioinsecticides, biofertilizers Microbial flavour, dyes, surfactants, bio-terrorism.	12
UNIT IV	Intellectual property and ethical issues: Intellectual property rights (IPR) , patents, trademarks, copy right, secrets, IPR and plant genetic respurces (PGR), patenting of biological materials, international conventions, international coopettion obligation with patenet applications, implication of patening, current issues, hybridoma technology etc. patening of higher plants and animals, transgenic organisms and isolated genes, patening of genes and DNA sequences, plant breeder's right and farmer's right.	12
	Reference:- <ol style="list-style-type: none"> 1. Baily & Ollis Biochemical Enginnering fundamentals, Tata Mcgraw 2. Stanbury & Whittekar Principles of Fermentation technology, Pergamon Press, Oxfordm. 3. Creuger & Creuger, Biotechnology, A Text bhook of Industrial Microbiology, Sinaeur Associates, 4. H. J. Rehm & reed G, Biotechnology: A Comprehensive treatise, V 5. L.E. Cassida, Industrial Microbiology Wiley Eastern 6. Applied Microbiology Series, 7. Veith W. F. Bioprocess Engineering Kinetics, Mass transport, Reactors, and Gene Expression, John Wiley & Sons. 8. Atkinson B Biochemical Reactors Pion Ltds, London. 9. Davies, J. E. and Demian, A. L. Manual of Industrial Microbiology and Biotechnology 2nd Edition, ASM, Pub. 10. Colin Ratledge and Bjorn Kristiansen Basic Biotechnology, 2nd edition , Cambridge University, Press. 11. Alexander M. Biodegradation and Bioremediation. Academic Press, 12. Saylor, G. S. Sanseverino, J and Davis, K. L. Biotechnology iin the Sustainable Environment. Plenum Press, New York. 	

MBT 403	Bioinformatics	48
UNIT I	<p>PROTEOMICS: PROTEIN SEQUENCE DATABASES AND ANALYSIS: Protein sequence information, composition and properties, physicochemical properties based on sequence, sequence comparison, Primary databases, Secondary databases. Pairwise sequence alignment, gaps, gap-penalties, scoring matrices, PAM250, BLOSUM62, local and global sequence alignment, multiple sequence alignment, useful programs, ClustalW, BLASTp.</p> <p>PROTEOMICS; STRUTURAL DATABASES, PROTEIN STRUCTURE PREDICTION: Structural databases; Protein Data bank (PDB), Nucleic Acid Data Bank (NDB), Molecular modeling Data Bank (MMDB). Homology modeling, prediction of protein structure from sequences, Secondary structure, three-dimensional structure prediction, protein folding and functional sites, protein folding classes.</p>	12
UNIT II	<p>GENOMICS: NUCLEOTIDE SEQUENCE DATABASES AND ANALYSIS: Human Genome project; rough and final draft of HGP, goals of the HGP, Genes, genomes, nucleotides, DNA sequences. Sequence databases: GeneBank, EMBL Nucleotide sequence databank, DNA Data Bank of Japan (DDBJ), database formats. Recombinant DNA technology, restriction enzymes, resource for restriction enzyme (REBASE), similarity search. Polymerase chain reaction, primer selection for PCR, BLASTn, application of BioEdit.</p> <p>GENOMICS: GENE IDENTIFICATION: Genome information and special features, coding sequences (CDS), untranslated regions (UTR's), cDNA library, expressed sequence tags (EST). Approach to gene identification; masking repetitive DNA, database search, codon-bias detection, detecting functional sites in the DNA. Internet resources for gene identification, detection of functional sites, gene expression. Construction of maps, genetic map, physical map.</p>	12
UNIT III	<p>STRUCTURAL BIOLOGY: Nucleic acids, ribose-ring puckering, RNA folding, conformational study, amino acids, proteins, Ramachandran plot, α-helix, β-sheets, 3_{10}-helix, loops, membrane proteins, protein-ligand interactions, biophysical aspects of proteins and nucleic acids.</p> <p>MOLECULAR MODELING: Introduction, molecular mechanics, force field, potential energy functions, energy minimization, single point calculations, full-geometry optimization, conformational search, docking, molecular dynamics simulations, molecular modeling packages.</p>	12
UNIT IV	<p>MICROARRAYS: Concept of microarrays; spotted arrays, oligonucleotide arrays, designing the experiment, Microarray design, microarray experimentation, Applications of microarray technology. Mass spectroscopy for protein analysis, MALDI-TOF, Electrospray ionization (ESI), Tandem mass spectroscopy (MS/MS) analysis; tryptic digestion and peptide</p>	12

	fingerprinting (PMF), Protein Micro array in protein expression, profiling and diagnostics, drug target discovery PHYLOGENETIC ANALYSIS: Evolution, elements of phylogeny, methods of phylogenetic analysis, Phylogenetic tree of life, comparison of genetic sequence of organisms, phylogenetic analysis tools- Phylip, ClustalW.	
	References:- 1. Introduction to Bioinformatics, (Atwood, T. K. and Parry-Smith, D. J). 2. An introduction to Computational Biochemistry. (C. Stain Tsai, A JohnWiley and Sons, Inc., publications). 3. Developing Bioinformatics Computer Skills. (Cynthia Gibas and Per Jambeck). 4. Bioinformatics Methods and Applications Genomics, Proteomics and Drug Discovery. (Rastogi S. C. Mendiratta, and Rastogi P.) 4. NCBI Web site: http://www.ncbi.nlm.nih.gov	

MBT 404	Microbial Fermentation Technology	48
UNIT I	Basic design of fermenter: Fermenter Body, Aeration and Agitation, Baffles and Spargers. Fermentation media: Functions of media components, media rheology and Newton's law of viscosity, Optimization of medium.	12
UNIT II	Gas diffusion: Oxygen and Mass Balance Transfer relationship, Factors affecting gas diffusion. Different types of fermentors: Airlift, tower, double cone, Waldhof type, Acetator and cavitators. Types of fermentations: Solid Surface culture type, Liquid surface culture, submerged fermentations. Batch, Continuous and Fed Batch fermentations.	12
UNIT III	Cultures: Isolation, Screening, Yield improvement by changing culture techniques, Strain improvement and preservation. Growth kinetics and yield kinetics. Controls of fermentation: Principles of control system design, Flux control analysis, Command controls, Biosensors. Fermentation control options- Knowledge based system (KBS), Artificial neural networks (ANN) and Genetic algorithm (GA).	12
UNIT IV	Modeling of fermentation processes: Modeling bioprocesses, Approaches and techniques of mathematical modeling. Upstream processing and Down stream processing. Process validation and quality assurance.	12
	References:- Fermentation Microbiology and Biotechnology by M. El-Mansi and C. Bryce Principles of Fermentation technology by Whitekar, Stanbury and Hall Modelling and Control of fermentation processes by J.R. Leigh	

MBT PR 401	Laboratory Course VII	
	<ol style="list-style-type: none"> 1. Biofertilizer Production. 2. Restriction Digestion. 3. In Vitro Ligation. 4. Southern blotting. 5. Northern blotting. 6. Production of Organic acids by fermentation. 7. Microbial etaching 8. Biomass SCP from Fungi, Algae. 9. Gene expression studies. 10. GFP cloning. 11. PCR 12. Western blotting 13. RFLP 14. RAPD 15. Effluent treatment- physical, chemical & biological. 16. Isolation of chlorophyll a and b - study of ratio in different plant materials and Absorption spectrum. 17. Estimation of citric acid by using alkali method. 18. Isolation, purification and characterization of alpha amylase from microbial Source. 19. Isolation of industrially important organisms for microbial processes. 20. Comparative studies of ethanol production using different substrates and byproduct detection. 21. Microbial production of antibiotics. 22. Laboratory scale fermentation of antibiotics. 23. Microbial production of amino acids. (Isolation of amino acid producers, production and quantification of amino acids.) <p>Bioinformatics.</p> <ol style="list-style-type: none"> 24. Using RasMol through command line. 25. Pair-wise sequence alignment. 26. Multiple sequence alignment. 27. Introduction of BioEdit. 28. Construction of three-dimensional model by using SPARTAN. 29. Model Building and Energy minimization. 30. Introduction to Chimera. 31. Molecular Docking and Drug designing. 	

	<p>Reference:-</p> <ol style="list-style-type: none">1. Practical Biochemistry : An Introductory Course by Fiona Frai.2. Methods in Enzymology Vol. I by S.P.Colowick and N.O.Kaplan eds.3. Basic Biochemical Methods 2nd ed by R.R.Alexander and J.M.Griffith4. Biochemical Methods 2nd ed. by S.Sadasivam and A. Manickam.5. Hawk's Physiological Chemistry ed. by Bernard L Oser.6. A Textbook of Practical Biochemistry by David Plummer.7. Laboratory Manual in Biochemistry by S. Jayaraman.8. Developing Bioinformatics computer skills – Cynthia Gibas and Per Jambeck9. An introduction to Computational Biochemistry- C. Stan Tsai John Wiley and Sons, Inc. publications.	
MBT PR 402	Laboratory Course VIII (Project Work)	