



R.K.D.F. UNIVERSITY, BHOPAL

M.Sc. (Biotechnology)

REVISED SYLLABUS 2019-2020

SCHEME

Semester – I

No	Subject Code	Subject Title	Marks Allotted						
			Assignment Marks		Theory Marks		Practical Marks		Total Marks
			Max	Min	Max	Min	Max	Min	
1	MBT 511	CELL BIOLOGY	20	8	80	32	-	-	100
2	MBT 512	BIOMOLECULES AND METABOLISM	20	8	80	32	-	-	100
3	MBT 513	MICROBIAL PHYSIOLOGY AND GENETICS	20	8	80	32	-	-	100
4	MBT 514	IMMUNOLOGY	20	8	80	32	-	-	100
5	MBT 515	PRACTICAL I (BASED ON MBT 511 & MBT 512)	-	-	-	-	50	20	50
6	MBT 516	PRACTICAL II (BASED ON MBT 513 & MBT 514)	-	-	-	-	50	20	50
Total			80	32	320	128	100	40	500



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Syllabus Semester – I

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc. (Biotechnology)	CELL BIOLOGY	MBT- 511

UNIT- 1:

Cell: Cell as a basic unit - classification of cell types - cell theory - organization of plant and animals cells - comparison of microbial, plant and animal cells. **Ultra structure of cells** - sub-cellular organization - structure and function of cell membranes, cytosol / Endoplasmic reticulum, nucleus, cytoskeleton, ribosomes, mitochondria and chloroplast, vacuoles, peroxisomes, lysosome, cell wall. Molecular, structural/functional organization. The central dogma, Evidence that DNA is the genetic material, Structure of its.

UNIT- 2:

Chemical bonds Building blocks of macromolecules: amino acids, purine and pyrimidine bases, fatty acids and sugars, and small molecules of biological importance: vitamins and minerals, proteins, carbohydrates and lipids. Biochemical structures: proteins, nucleic acids, and lipids. Secondary structure, tertiary structure. Ramachandran plot, structure-function correlations, anatomy of biological macromolecules.

UNIT- 3:

DNA damage, repair and recombination. DNA modification enzymes-methylation, demethylases, DNAses, gyrases, topoisomerase, restriction endonucleases. RNA transcription-phage, E.coli and eukaryotes (RNA polymerase-structure and mode of action. Structure of chromatin-nucleosomes, solenoids, scaffolds, histone modification, transcription,condensation and decondensation. Nucleo-cytoplasmic transport of ribonucleoproteins Structure of tRNA, rRNA, pre-mRNA and mRNA-processing; exon, intron. Structure of genes-promoters, enhancers, TATA box, transcription initiation and termination sites, consensus sequences. Structure of ribosomes Genetic code, translation, polypeptide folding and modifications.

UNIT- 4:

Structure and organization of genome: structure of globin, insulin, IgG and r DNA genes,structure and function of chromatin, DNA replication. Sequencing: nucleic acids and proteins. Transcription: structure of a transcriptional UNIT-, mRNA and coding sequence. Transcription and processing of rRNA and Mrna Capping, polyadenylation and splicing reaction Regulatory signal elements: promoter, hLh motifs. Transcription factors. Translation: ribosomes and tRNAs. Mechanism and regulation of protein synthesis Post Translational modification of proteins, inhibitors of protein synthesis

UNIT- 5:

Cell dynamics, cytoskeleton and cell surface. Extracellular matrix Cell-cell interactions and cell-matrix interaction Celldifferentiation Apoptosis The transformed cell



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BOOKS :

1. Cell and molecular biology-Concept and experiment. 2nd edn., Harris,D(Ed.), Karp, G.1999. John wiley & sons, New York.
2. Principles of cell and molecular biology. 2nd edn., Mclaughlin,S., Trost,K., Mac Elree,E.(eds), Kleinsmith,L.J.& Kish, V.M., 1995. Harper Collins Publisher, New York.
3. Molecular biology of the cell.3rd edn., Alberts,B., Bray,D., Lawis,J., Raff,M., Roberta, K., Watson, J.d(eds.), 1994. Garland Publication, Inc., New York.
4. Cell and Molecular Biology. 8th edn., De Robertis, E.D.P. and De Roberts, E, M.F.1995. B.I.Waverly Pvt. Ltd., New Delhi.
5. Introduction to Molecular Biology, Peter Paoella, 1998. Mc Graw-Hill.
6. Molecular Cell Biology, Media connected W.H.Freeman and company.
7. Genes.VIII Lbwin, B.
8. The Biochemistry of nucleic acids. Adams et al.
9. Molecular Biology and Genetic engineering G. Uptani, P.K.
10. Molecular Biology of the gene. Watson et al.
11. Lehninger Principles of Biochemistry Nelson and Cox.
12. Principles of Genetics Gardner, Simmons and Snustad

PRACTICAL CELL BIOLOGY

Introduction to measurements: balances and pipetting. Preparation of solutions of given normality and its standardization. pH meter: buffering capacity of a buffer, indicators. To determine the pKa value and hence the Dissociation constant of a given acid by using pH meter. Determination of the amount of amino nitrogen by the formal titration method

Colorimetry: To determine dissociation constant of a given indicator, Colorimetrically and to prepare buffer solutions in the pH range of 2.2 to 8.0 Spectrophotometry: Double-beam and recording spectrophotometry, derivatives and difference spectra: Indicators, cytochromes, hemoglobin. To find out the absorption spectrum of a given chromophore and/or oxidized and reduced forms (sodium nitrite and borohydrate).

a) Hemoglobin and methemoglobin

b) NAD and NADH c) Spectrophotometer absorption spectrum, activity of the fraction or 260/280 ratio.

Estimation of protein: Lowry, Biuret and Bradford methods, standard curves, linear regression and assessment of ranges and reliability.

Enzyme assays: (LDH, β -galactosidase, acid phosphatase, arginase, succinic dehydrogenase) time, temperature, protein concentration, cofactors. LDH : Km and Vmax,



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BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc. (Biotechnology)	BIOMOLECULES AND METABOLISM	MBT- 512

UNIT- I

Chemical foundations of Biology –pH, pK, acids, bases, buffers, weak bonds, covalent bonds. Principles of thermodynamics. Classes of organic compounds and functional groups-atomic and molecular dimensions, space filling and ball and stick models. Macro molecular and supra molecular assemblies. Macromolecules in biology: Properties of water

UNIT- II

Amino acids and peptides-classification, chemical reactions and physical Properties.Sugars - classification and reactions. Heterocyclic compounds-and secondary metabolites in living systems - nucleotides, pigments, isoprenoids Separation techniques for different biomolecules

UNIT- III

Physical techniques in proteins, nucleic acids and polysaccharides structure analysis (UV, IR, MMR, LASER, MASS, Fluorescence spectroscopy, Differential calorimetry, X - ray Crystallography, Ultra Centrifugation, Electron cryomicrography, Scanning Tunneling microscopy.

UNIT- IV

Lipids: classification of lipids, fatty acids, essential fatty acids, triglycerols, phospholipids, glycolipids, lipoprotein, sterols, amphipathic lipids, digestion absorption transportation and utilization, functions sourceand requirement, effect of deficiency.

UNIT- V

Water and its properties, enzymes coenzymes, metabolism of carbohydrate, amino acids and lipids, inborn errors of metabolism. Bio-energetics and oxidative phosphorylation. Blood clotting – biochemistry, bodyfluids – pH and acid base balance and their importance in clinical biochemistry,muscle contraction. Techniques in the study of proteins, carbohydrates and lipids.

BOOKS

1. Lehning Principles of Biochemistry N. elson, D .L and Cox, M .M.
2. Biochemistry Stryer
3. Biochemistry Zubay, G
4. Fundamentals of Biochemistry. Jain, J .L.
5. Fundamentals of Biochemistry. Voet, D and Voet, J.G.
6. Biochemistry. F reifelder, D .
7. Fundamentals of Biochemistry. Deeb, A .C.



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PRACTICAL BIOMOLECULES AND METABOLISM

Titration of amino acids Colorimetric determination of pK Model building using space filling/ball and stick models Reactions of amino acids, sugars and lipids Isolation, purity determination and quantitation of cholesterol, DNA and mRNA Quantitation of Proteins and Sugars Analysis of oils-iodine number, saponification value, acid number UV, Visible, Fluorescence and IR spectroscopy, Absorption spectra Separation techniques - Centrifugation, Chromatography (Gel permeation, Ion exchange, TLC etc. and Electrophoresis



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Syllabus Semester – I

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc. (Biotechnology)	MICROBIAL PHYSIOLOGY AND GENETICS	MBT- 513

UNIT-I

History, Taxonomy and classification:

History and Scope of microbiology- Contributions of pioneers, Introduction to major groups of microorganisms, fields of Microbiology, Spontaneous generation versus biogenesis hypothesis, Whittaker's classification system, prokaryotes. Introduction to Bergey's manual of determinative and systematic classification, Bacterial nomenclature.

UNIT-II

Nutritional requirements of micro-organisms, mode of nutrition, phototrophy, mixotrophy, saparophytic, symbiotic and parasitic organisms, microbial growth and population kinetics, methodology for measuring growth and growth regulation. Physical and chemical control of microbes.

UNIT-III

Glycolytic pathways, tricarboxylic acid cycle, energy production, oxidative phosphorylation, energetics of chemolithotrophs and autotrophs and transport.

UNIT-IV

Gene transfer mechanism in microbe's transformation, transduction, conjugation, and Recombination.

UNIT-V

Basic concepts, action of pathogens, human pathogenic viruses and bacteria, Gram-positive and Gram-negative Bacilli of medical importance. Miscellaneous bacterial agents of disease; DNA and RNA viruses and their diseases, Fungal diseases. Life cycle of some important pathogens like- Malaria, hepatitis, filaria, Kalazar and AIDS.

BOOKS:

1. Microbiology. Prescott, L. M., Harley, J. P. and Klein, D. A.
2. Brock Biology of Microorganisms M. Artinko C. M. T. and Parker, J. M.
3. Microbiology P. elczar, C. M. J. C, han E, . C. S. and Krieg, N. R.
4. General Microbiology S. tanier C, . S. Microbiology- laboratory manual Cappuccino J, . G. and Sherman N. and Weseleey A, . dison.
6. Experiments In Microbiology, Plant Pathology And Biotechnology. Aneja, A. R.
7. Microbial metabolism. Doelle.
8. Microbiology an Infroduction. Tortora.
9. Microbiology Fundamentals and Applications. Atlas, R. M.
10. General Microbiology, Stainer, RY, Ingraham, JL, Wheelis, ML., and Painter, PR. The Macmillan Press Ltd., (2000).
11. Principles of Microbiology, Atlas RM, Mosby, (1995).
12. Microbiology, Davis BD et al., Harper and Row, (1990).
13. Microbiology-Principles and exploration, Black JG, Prentice Hall, (1999).



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14. Microbial Biotechnology, Glazer AN, Nikaido H, WH Freeman and Company, (1995).

PRACTICAL MICROBIAL PHYSIOLOGY AND GENETICS

Preparation of liquid and solid media for growth of microorganisms Isolation and maintenance .of organisms by plating, streaking and serial dilution methods. Slants and stab cultures. Storage of microorganisms Isolation of pure cultures from soil and water Growth; Growth curve; Measurement of bacterial' population by turbidometry and serial dilution methods. Effect of temperature, pH and carbon und nitrogen sources on growth. Microscopic examination of bacteria, yeast and molds and study of organisms by Gram stain, Acid fast stain and staining for spores Study of mutations by Ames test. Assay of antibiotics und demonstration of antibiotic resistance Analysis of water for potability and determination of MPN Bacterial transformation Biochemical characterization of selected microbes Transduction One step growth curve of coliphage Isolation of Plasmids 14C02 fixation by photosynthetic



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Syllabus Semester – I

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc. (Biotechnology)	IMMUNOLOGY	MBT- 514

UNIT- I

Introduction Phylogeny of Immune System- Innate and acquired immUNIT-y Clonal nature of immune response Organization and structure of lymphoid organs Nature and Biology of antigens and super antigens.

UNIT- II

Antibody structure and function Antigen - antibody interactions Major histocompatibility complex BCR & TCR, generation of diversity. Complement system Cells of the Immune system: Hematopoiesis and differentiation

UNIT- III

Lymphocyte trafficking, B-Lymphocytes, T-Lymphocytes, Macrophages, Dendritic cells, Natural killer and Lymphokine -activated killer cells, Eosinophils, Neutrophils and Mast Cells Regulation of immune response:Antigen processing and presentation, generation of humoral and cell mediated immune responses:Activation of B- and T. Lymphocytes

UNIT- IV

Cytokines and their role in immune regulation:T-cell regulation, HHC restriction Immunological tolerance Cell - mediated cytotoxicity; Mechanism of T cell and NK cell mediated lysis, antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity Hypersensitivity

UNIT- V

AutoimmUNIT-y Transplantation ImmUNIT-y to infectious agents (interacellular parasites, helminths & viruses) Tumor Immunology AIDS and other Immunodeficiency Hybridoma Technology and Monoclonal antibodies

BOOKS

1. Molecular biology of the Cell, Alberts B., Bray D., Lewis J., Ralf M., Roberts K. and Watson J.D., Garland Publishing Inc. (2001).
2. Kuby Immunology, Goldsby R.A., Kindt Thomas J., Osbarne B.A., WH Freeman & Company, (2000).
3. Immunology-Understanding the Immune System Elgert K.D, Wiley Liss, (1996).
4. Roitt's essential Immunology, Roitt I.M. and Delves P.J., Blackwell Science Ltd., (2001).
5. Immunology 6th Edition, Roitt I., Brostoff J. and Male D., Mosby Harcourt Publishers, (2001).

PRACTICALS IMMUNOLOGY

Blood film preparation and identification of cells, Lymphoid organs and their microscopic organization, Immunization, Collection of Serum Double diffusion and Immune-electrophoresis Radial Immuno diffusion Purification of IgG from serum Separation of mononuclear cells by Ficoll-Hypaque Con-A induced proliferation of thymocytes (by MTT method) Western-blotting ELISA Hapten Conjugation and quantitation Immunodiagnostics (demonstration using commercial kits)



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SCHEME

Semester – II

No	Subject Code	Subject Title	Marks Allotted						
			Assignment Marks		Theory Marks		Practical Marks		Total Marks
			Max	Min	Max	Min	Max	Min	
1	MBT -521	BIOINFORMATICS	20	8	80	32	-	-	100
2	MBT -522	TOOLS AND TECHNIQUES IN BIOTECHNOLOGY	20	8	80	32	-	-	100
3	MBT -523	GENETIC ENGINEERING	20	8	80	32	-	-	100
4	MBT 524(a)/524(b)/524(c)	BIOPROCESS ENGINEERING AND TECHNOLOGY/ GENOMICS AND PROTEOMICS/ MOLECULAR DIAGNOSTICS	20	8	80	32	-	-	100
5	MBT 525	PRACTICAL I (BASED ON MBT 521 & MBT 522)	-	-	-	-	50	20	50
6	MBT 526	PRACTICAL II (BASED ON MBT 523 & MBT 524)	-	-	-	-	50	20	50
Total			80	32	320	128	100	40	500



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Syllabus **Semester – II**

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc. (Biotechnology)	BIOINFORMATICS	MBT- 521

UNIT- I

Computers

An overview of computers, Introduction to Bioinformatics -Bioinformatics- Definition and relation to molecular biology, Potential of bioinformatics, Application of bioinformatics.

Databases

Nucleic acid and Protein databases, Structure databases, Enzyme databases, Specialized(organism and species) databases.

UNIT- II

Introduction to PERL: Scalar variables, strings and numbers, Assignment statements, Arrays, Hashes, Operators, Input from file, Standard Input, Conditional and logical operators, loops, I/O, Input from file named in command line, Regular expression, Pattern matching, Meta symbols, Pattern modifiers, Subroutines. Applications of PERL in Bioinformatics: Storing DNA sequence, DNA to RNA transcription, Finding motifs, Counting nucleotides, Generating random numbers, simulating DNA mutation, generating random DNA, Analyzing DNA

UNIT- III

Biological Sequence Databases: Overview of various primary and secondary databases that deal with protein and nucleic acid sequences. Databases to be covered in detail are GenBank, EMBL, DDBJ, Swiss Prot, PIR, and MIPS for primary sequences. Various specialized databases like TIGR,Hovergen, TAIR, PlasmoDB, ECDC etc., will also be discussed. Preliminary ideas of query and analysis of sequence information.

UNIT- IV

Sequence Comparison Methods: Method for the comparison of two sequences viz., Dot matrix plots, NeedlemanWusch &SmithWaterman algorithms. Analysis of computational complexities and the relative merits and demerits of each method. Theory of scoring matrices and their use for sequence comparison.

UNIT- V

Database Search Algorithms: Methods for searching sequence databases like FASTA and BLAST algorithms. Statistical analysis and evaluation of BLAST results. Pattern Recognition Methods in Sequence Analysis: Concept of a sequence pattern, regular expression based patterns. The use of pattern databases like PROSITE and PRINTS. Concept of position specific weight matrices and their use in sequence analysis. Theory of profiles and their use with special reference to PSIBLAs. Markov chains and Markov models and their use in gene finding. Concept of HMMS, the Forward backward and the Viterbi algorithm. The Baum Welch algorithm for training a HMM. Use of profile HMM for protein family classification.



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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).

PRACTICAL BIOINFORMATICS :

Computational modeling of genomic proteomic, evolutionary tree
designing on databases, network search on genomic and proteomic databases.



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Syllabus Semester – II

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc. (Biotechnology)	TOOLS AND TECHNIQUES IN BIOTECHNOLOGY	MBT- 522

UNIT-I

Microscopy-Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, TEM, SEM, X-Ray Crystallography, X-ray diffraction, Bragg equation. Centrifugation - Basic Principle of Centrifugation, Instrumentation of Ultracentrifuge (Preparative, Analytical), Factors affecting Sedimentation velocity, Standard sedimentation Coefficient.

UNIT—II

Electromagnetic spectrum, Beer Lambert's Law. Photometry, UV/VIS Spectrophotometry, Infrared spectroscopy, Atomic absorption spectroscopy, ESR and NMR spectroscopy. Mass spectroscopy (LC-MS, GC-MS). Fluorescent spectroscopy. Applications of different Spectroscopic techniques in Biology.

UNIT—III

Introduction and types of chromatography, paper, thin layer, gas, Gel permeation, ion-exchange, HPLC, FPLC and affinity chromatography and instrumental details of each. Applications of Chromatographic techniques in Biology.

UNIT—IV

Paper and gel electrophoresis, Polyacrylamide gel electrophoresis (native and SDS), Agarose gel electrophoresis, Blotting- Southern, Western and Northern blotting, Immunoblotting, Immunoelectrophoresis, DNA finger printing and ELISA.

UNIT-V

Nature and types of radiations, preparation of labelled biological samples. Detection and measurement of radioactivity, GM counter, Scintillation counter, Autoradiography, Flow cytometry. Safety measures in handling radioisotopes. RIA, non radiolabelling.

BOOKS :

1. Bioinformatics. Baxevanis A., D. and Quelette, B. F. F. Z
2. Bioinformatics. Des Higgins & Willie Taylor
3. Bioinformatics Methods and protocols. Macsew, S.
4. Bioinformatics Sequence and genome analysis. Mount, D. W.
5. Computer fundamentals. Nagpal, D. P.

PRACTICAL TOOLS AND TECHNIQUES IN BIOTECHNOLOGY:

Introduction and working of Chromatography, electrophoresis, microscopy, Spectroscopy, centrifugation Scintillation counter, Autoradiography



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Syllabus Semester – II

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc. (Biotechnology)	GENETIC ENGINEERING	MBT- 523

UNIT- I

History of Recombinant DNA Technology. Isolation and Quantification of DNA and RNA. Host controlled Restriction -Modification system, Restriction Endonucleases. Cutting and joining of DNA molecules in vitro. Phosphatases, Ligases and Polymerases. Vectors: Plasmid, Bacteriophage, Cosmids, Phagemid and other (SV 40) Virus vectors. Expression Vectors.

UNIT- II

Design and characteristics of expression vectors for cloning in prokaryotes and factors that 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. Libraries: types, advantages and disadvantages of different types of libraries; Different methods 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 footprinting, 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



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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.

PRACTICALS GENETIC ENGINEERING

Bacterial culture and antibiotic selection medias. Prepration of competent cells.

Isolation of plasmid DNA.

Isolation of lambda phage DNA .

Quantitation of nucleic acids.

Agarose gel electrophoresis and restriction mapping of DNA

Construction of restriction map of plasmid DNA.

Cloning In plasmid/phagemid vectors.

Preparation, of helper phage and its titration\

Preparation of single stranded DNA template

DNA sequencing

Gene expression in E. coli and analysis of gene product

PCR and Reporter Gene assay (Gus/CAT/b-GAL)



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Syllabus Semester – II

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc. (Biotechnology)	BIOPROCESS ENGINEERING AND TECHNOLOGY	MBT- 524(a)

UNIT-I

Fundamentals of Industrial Microbiology

General concepts of industrial microbiology, Primary and secondary screening, Strain development strategies, Sterilization of fermentor, media and air.

Fermentor Design

Types of fermentations processes, Design of typical batch fermentor, Factors affecting fermentor design, Control of agitation, aeration, pH, temperature and dissolved oxygen, Types of fermentors.

UNIT-II

Types of fermentation process, analysis of batch fed batch and continuous bioreactions, biotransformation, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidized, photo bioreactors etc.) Measurement and control of bioprocess parameters

UNIT-III

Downstream processing: introduction, removal of microbial cells and solid matters, foam separation, precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane process, drying and crystallization, effluent treatment

UNIT—IV

Industrial production of chemicals: alcohols, acids (citric, acetic and gluconic), solvents (glycerols, acetone, butanol), antibiotics (penicillin, streptomycin, tetracycline) amino acids (lysine, glutamic acid), single cell proteins.

UNIT-V

Food Biotechnology: Food spoilage and preservation process, dairy products, wine, beer and other alcoholic Beverages and formulated plant products, petro crops, food from water, fungal protein food from yeast, hybrid seeds, conventional breeding of plant for food production. Transformation of steroids and non steroid compounds. Mushroom -types, isolation and culture.

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, PanimaPublishing Corp.
6. Stanbury P.F, Ehitaker H, Hall S.J (1997) Priciples of Fermentation Technology., Aditya



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BOOKS (P) Ltd.

7. S.N.Jogdan (2006) Industrial Biotechnology, Himalaya Publishing House

PRACTICAL BIOPROCESS ENGINEERING AND TECHNOLOGY

1. Trypsinization of monolayer and subculturing.
2. Cryopreservation and thawing of cell lines.
3. Preparation of metaphase chromosomes from cultured cells.
4. Isolation of industrially important microorganisms.
5. Determination of thermal death point (TDP) and thermal death time (TDT) of microorganism for design of a sterilizer.
6. Determination of K_m and V_{max} of urease/arginase activity by M.M and L.B. plots, respectively.
7. Determination of K_i of urease/arginase activity by M.M and L.B. plots, respectively.
8. (a) Determination of growth curve of a given microorganism and also determines substrate degradation profile.
(b) Compute specific growth rate (μ), growth yield ($Y_{x/s}$) from the above.
9. Comparative studies of Ethanol production using different substrates.
10. Isolation of industrially important microbes from the environment
11. Determination of TDP & TDT of microorganisms for a design of a sterilizer
12. Determination of growth curve of a industrial organism and compute substrate, degradation profile, specific growth rate & growth yield
13. Screening and enrichment for a primary / secondary metabolite from the environment
14. Strain improvement for higher yield of a product
15. Random and strategic screening for a metabolite
16. balancing experiments
17. Alcohol fermentation using different substrates and its down stream process.



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BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc. (Biotechnology)	GENOMICS AND PROTEOMICS	MBT- 524(b)

UNIT I

Brief overview of prokaryotic and eukaryotic genome organization; extra-chromosomal DNA: bacterial plasmids, mitochondria and chloroplast. Genomes: Size, physical structure, genome analysis, gene duplication.

UNIT -II

Genetic and physical maps, markers for genetic mapping; methods and techniques used for gene mapping, physical mapping, linkage analysis. Tools for studying DNA/genes: Enzymes for DNA manipulation, molecular cloning, DNA libraries, fluorescent in situ hybridization (FISH), denaturing gradient gel electrophoresis (DGGE), somatic cell hybridization, radiation hybrid maps, *in situ* hybridization, comparative gene mapping.

UNIT-III

Human Genome Project, genome sequencing projects for microbes, plants and animals, accessing and retrieving genome project information from the web.

UNIT-IV

Mapping of genome: Molecular markers as tools for mapping, restriction fragment length polymorphism (RFLP), randomly amplified polymorphic DNA (RAPD), simple sequence length polymorphism (SSCP), amplified fragment length polymorphism (AFLP).

UNIT-V

Functional genomics: entire genome expression analysis-microarrays, expressed sequence tags (ESTs), serial analysis of gene expression (SAGE), single nucleotide polymorphism (SNP). Transcriptome analysis for identification and functional annotation of gene, Contig assembly, chromosome walking and characterization of chromosomes, mining functional genes in genome, gene function- forward and reverse genetics, gene ethics; protein- protein and protein-DNA interactions; protein chips and functional proteomics; clinical and biomedical applications of proteomics; introduction to metabolomics, lipidomics, metagenomics and systems biology.



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BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc. (Biotechnology)	MOLECULAR DIAGNOSTICS	MBT- 524(c)

UNIT-I

Genome Biology in Health & Disease DNA, RNA, Protein: An overview; chromosomal structure & mutations; DNA polymorphism: human identity; clinical variability and genetically determined adverse reactions to drugs.

UNIT- II

Genome: Resolution, Detection & Analysis PCR: Real-time; ARMS; Multiplex; ISH; FISH; ISA; RFLP; DHPLC; DGGE; CSCE; SSCP; Nucleic acid sequencing: new generations of automated sequencers; Microarray chips; EST; SAGE; microarray data normalization & analysis; molecular markers: 16S rRNA typing; Diagnostic proteomics: SELDI-TOF MS; Bioinformatics data acquisition & analysis.

UNIT-III

Diagnostic Metabolomics Metabolite profile for biomarker detection in the body fluids/tissues under various metabolic disorders by making use of LCMS & NMR technological platforms.

UNIT-IV

Detection & Identity of Microbial Diseases Direct detection & identification of pathogenic-organisms that are slow growing or currently lacking a system of invitro cultivation as well as genotypic markers of microbial resistance to specific antibiotics.

UNIT- V

Detection of Inherited Diseases Exemplified by two inherited diseases for which molecular diagnosis has provided a dramatic improvement of quality of medical care: - Fragile X Syndrome: Paradigm of the new mutational mechanism of the unstable triplet repeats, von-HippelLindau disease: recent acquisition in the growing number of familial cancer syndromes. Quality Assurance & Control Quality oversight; regulations and approved testing.

List of practicals

1. To access scientific data from Literature data bases (PUBMED, LITDB, Medline)
2. To access nucleic acid databases for retrieval of gene sequence.
3. To access protein databases for retrieval of amino acid sequence of target protein.
4. To perform pair wise sequence alignment using Dot matrix.



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5. To perform multiple sequence alignment using BLAST.
6. To perform multiple sequence alignment using CLUSTAL-W and to find conserved sequences using JAL view.
7. To prepare Phylogenetic tree and Cladogram using CLUSTAL-W.
8. 3D protein structure prediction and structure refinement using Swiss-PDB viewer Double diffusion, Immuno-electrophoresis and Radial Immuno diffusion.
9. SDS-PAGE, Immunoblotting, Dot blot assays.
10. Blood smear identification of leucocytes by Giemsa stain.
11. Separation of leucocytes by dextran method.
12. Demonstration of Phagocytosis of latex beads.
13. Separation of mononuclear cells by Ficoll-Hypaque.
14. Immunodiagnostics using commercial kits.
15. Plasmid extraction, vector and Insert Ligation.
16. Preparation of competent cells.
17. Transformation of E.coli with standard plasmids, Calculation of transformation efficiency.
18. Confirmation of the insert by Colony PCR and Restriction mapping.
19. Expression of recombinant protein, concept of soluble proteins and inclusion body formation in E.coli, SDS-PAGE analysis
20. Single Nucleotide Polymorphism in health and disease.



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SCHEME

Semester – III

No	Subject Code	Subject Title	Marks Allotted						
			Assignment Marks		Theory Marks		Practical Marks		Total Marks
			Max	Min	Max	Min	Max	Min	
1	MBT 531	ANIMAL BIOTECHNOLOGY	20	8	80	32	-	-	100
2	MBT 532	PLANT BIOTECHNOLOGY	20	8	80	32	-	-	100
3	MBT 533	HUMAN GENETICS AND HUMAN GENOME	20	8	80	32	-	-	100
4	MBT 534	SOCIAL, ETHICAL, LEGAL AND MANAGEMENT ISSUES	20	8	80	32	-	-	100
5	MBT 535	PRACTICAL I (BASED ON MBT 531 & MBT 532)	-	-	-	-	50	20	50
6	MBT 536	PRACTICAL II (BASED ON MBT 533 & MBT 534)	-	-	-	-	50	20	50
Total			80	32	320	128	100	40	500



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Syllabus Semester – III

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc. (Biotechnology)	ANIMAL BIOTECHNOLOGY	MBT- 531

UNIT—I

History of animal cell culture, Laboratory requirements for animal cell culture, Sterilization techniques. Media used for animal cell culture, Types of cell culture (Primary and Secondary), to established cell lines, Stem cells

UNIT-II

Media and reagents: Types of cell culture media, Ingredients of media, Physiochemical properties, Antibiotics, growth supplements, Foetal bovine serum; Serum free media, Trypsin solution, Selection of medium and serum, Conditioned media, Other cell culture reagents, Preparation and sterilization of cell culture media, serum and other reagents.

UNIT-III

Different types of cell cultures, Trypsinization, Cell separation, Continuous cell lines, Suspension culture, Organ culture. Development of cell lines, Characterization and maintenance of cell lines, stem cells, Cryopreservation, Common cell culture contaminants.

UNIT-IV

Stem cell research: Current status and application in medicine. Application of animal cell culture for in vitro testing of drugs; Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins. Production of recombinant hemoglobin, blood substitutes, Artificial blood, General account of in vitro regulation of blood cells production.

UNIT-V

Gene transfer technology in animals: Viral and non-viral methods, Production of transgenic animals and molecular pharming, current status of production of transgenic animals. Animal cloning: Techniques, relevance and ethical issues.

BOOKS :

1. Freshney, Culture of Animal Cells, 5th Edition, Wiley-Liss, 2005
2. Ed. John R.W. Masters, Animal Cell Culture - Practical Approach, 3rd Edition, Oxford University Press, 2000.
3. Ed. Martin Clynes, Animal Cell Culture Techniques., Springer, 1998.
4. B.Hafez, E.S.E Hafez, Reproduction in Farm Animals, 7th Edition, Wiley- Blackwell, 2000.
5. Louis-Marie Houdebine, Transgenic Animals: Generation and Use, 1st Edition, CRC Press, 1997.

PRACTICALS ANIMAL BIOTECHNOLOGY

1. Primary cell culture
2. Continuous cell culture
3. Drug/Toxicity testing
4. MTT assay
5. Morphological characterization of cell death
6. Acridine orange/Ethidium bromide staining
7. Biochemical characterization of cell death
8. DNA laddering assay



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Syllabus Semester – III

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc. (Biotechnology)	PLANT BIOTECHNOLOGY	MBT- 532

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: Secondary metabolite types (alkaloids, terpenes [include IPP synthesis: Classic pathway and Alternate pathway for IPP synthesis in plastids], tannins, lignans pigments, lipids); Selection of callus cultures, Bioreactor types: 8 Stirred-tank (hollow paddle), roller drum, immobilized, membrane, surface – immobilized; elicitation, permeation.

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 Mredit, 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.



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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.

PRACTICAL PLANT BIOTECHNOLOGY

1. Assessment of genetic variation related to plant taxa using allozyme method
2. Tissue culture methods-media preparation, sterilization, inoculation of explants, callus culture, suspension cultures, anther and ovule cultures.
3. Isolation of protoplasts, viability test for protoplasts, protoplast culture.
4. Working gel documentation system and analysis of electrophoretic gels.
5. Quantification of DNA and RNA in plant tissues by spectrophotometer method.



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Syllabus Semester – III

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc. (Biotechnology)	HUMAN GENETICS AND HUMAN GENOME	MBT- 533

UNIT- I

History and development of human genome. Concepts of genome organization - split genes, overlapping genes, unique sequences, repetitive sequences, pseudogenes, Transposons, conserved genes. Population Genetics Genes and chromosome-structure, function and inheritance. Repetitive DNA in human genome-Alu and SINE repeats. Functional organization of centromeres and telomeres, telomerases and centrosomes Methods for genetic study in man – pedigree analysis, chromosomal analysis, biochemical analysis.

UNIT- II

Somatic cell genetics (somatic cell hybrids, radiation hybrids, monochromosome hybrid panels, gene mapping, hybridoma technology, polyclonal and monoclonal antibodies), molecular genetic analysis. Tissue culture techniques, long-term and short-term cultures, lymphoblastoid cell lines; congenital abnormalities; clinical aspects of autosomal and sex chromosomal disorders; inborn errors of metabolism, haemoglobinopathies.

UNIT- III

Human genome mapping – genetic mapping, physical mapping-restriction fragment length polymorphism, pulse field gel electrophoresis, yeast artificial chromosomes, bacterial artificial chromosomes, P1 derived artificial chromosomes, expressed sequence tags, sequence-tagged sites, microsatellites and single nucleotide polymorphisms.

UNIT- IV

Inherited human diseases-single gene diseases, complex traits. Identification and isolation of disease genes – positional cloning, functional cloning, DNA and cDNA microarrays. Human genetics-background and history, types of genetic diseases and clinical impact, Genetic variations – mutation, genome polymorphism, diversity, DNA and genetic markers, Mendelian Inheritance, Non-Mendelian inheritance patterns-mitochondrial inheritance, genome imprinting, isodisomy and epigenetics, Genetics of metabolic disorders, Multifactorial inheritance – common diseases and Analysis of qualitative & quantitative traits, Genetic susceptibility in multifactorial disorders.

UNIT- V

Yeast two-hybrid system. Statistical methods for genetic analysis of complex traits. Cancer genetics. Immunogenetics; pre-natal diagnosis-chorionic villus sampling, amniocentesis Pre-implantation diagnosis. Genetic counselling. Gene therapy-concept, vectors, gene targeting and tissue-specific expression Ethics and human genetics. Introduction to pharmacogenomics and toxicogenomics.

BOOKS :

1. Principles of Gene manipulation (1994) Old R.N. and Primrose S.B.
2. From Genes to Clones (1987) Winnaeker E.L.
3. Recombinant DNA (1992) Watson J.D., Witreowski J., Gilman M. and Zooller M.



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4. An Introduction to GeNETIC Engineering: Nicholl, D.S.T.
5. Molecular Biotechnology (1996) Pasternak
6. The Biochemistry of Nucleic acid(1996)Adam et al
7. Genetic Engineering (1998)Janke k. swtlow

PRACTICAL HUMAN GENETICS AND HUMAN GENOME

1. PCR amplification of genomic DNA.
2. Reverse-transcription – polymerase chain reaction.
3. Western Blot of regulatory protein of cell cycle / apoptosis.
4. Preparation of metaphase chromosomes from cultured lymphocytes and cell lines.
5. Genetic fidelity of tissue culture plants with RAPD markers.
6. Isolation of nuclei and analysis of chromatin- i) determination of mononucleosomal size ii) chromatin gel electrophoresis
7. Endonuclease digestion of nuclei and analysis of DNA fragments by agarose gel electrophoresis
8. Thermal melting of DNA DNA: a) isolation of DNA (nuclear and Mt) b) Agarose gel electrophoresis c) detection of DNA modifications: i) restriction endonuclease digestions and separation of fragments by gel chromatography and density gradient centrifugation ii) Base composition analysis of DNA. To find out the capacity and nature of the given ion-exchange resin (ion exchange chromatography). Gel filtration chromatography. DEAE cellulose chromatography of DNA. 2- D gel electrophoresis of proteins and isoelectrofocusing.



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Syllabus Semester – III

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc. (Biotechnology)	SOCIAL, ETHICAL, LEGAL AND MANAGEMENT ISSUES	MBT- 534

UNIT- I

IPR - patents and copyrights. Patentability of life forms with special reference to Microorganisms, Pharmaceutical industries, Biodiversity, Naturally occurring substances. Human genome and IPR. Issue on IPR in Public-Private partnership. Availabilities of Patent facilitating funds, Substantive Patent Law Treaty (SPLT), Word patent, European Patent.

UNIT- II

Social- genetic discrimination: insurance and employment, human cloning, foeticide, sex determination. Religious consideration in stem cell therapy The WTO and other international agreements; Intellectual properties, copyrights, trademarks, trade secrets, patents, geographical indications, etc; Protection of plant variety and farmers right act; Indian patent act and amendments, patent filing; Convention on biological diversity; Implications of intellectual property rights on the commercialization of biotechnology products.

UNIT- III

Ethical: somatic and germ line gene therapy, clinical trials, the right to information, ethics committee function. Social and ethical issues Ethics in human stem cell research FDA product and regulatory considerations in stem cell

UNIT- IV

Biosafety - Biosafety and risk assessment issues; Regulatory framework; National biosafety policies and law, The Cartagena protocol on biosafety, WTO and other international agreements related to biosafety, Cross border movement of germplasm; Risk management issues - containment.

UNIT- V

Management-Planning, Organizing, Leading & Controlling; Concepts and characteristics of information; Importance of MIS; Communication - type, channels & barriers; Financial management, planning and control.

BOOKS

1. A Lexicon of medicinal plants in India, D.N.Guhabakshi, P.Sensarma and D.C.Pal, 1999. Naya prokash - publications.
2. Glossary of Indian medicinal plants, R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956. C.S.I.R, New Delhi.
3. Ethnobotany The Renaissance of Traditional Herbal Medicine, Rajiv K.Sinha, 1996. INA SHREE publishers.
4. The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984. International Book Distributors.
5. Herbal plants and Drugs, Agnes Arber, 1999. Mangal Deep Publications.



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6. Contribution to Indian Ethnobotany by Editor S.K.Jain, 1991 Scientific Publishers.
7. New Natural products and Plants drugs with Pharmacological, Biological (or) Therapeutical activity, H.Wagner and P.Wolff, 1979. Springer, New Delhi.
8. Ayurvedic drugs and their plant source, V.V.Sivarajan and Balachandran Indra, 1994. Oxford IBH publishing Co.
9. Ayurveda and Aromatherapy, Miller, Light and Miller, Bryan, 1988. Banarsidass, Delhi.
10. Principles of Ayurveda, Anne Green, 2000. Thorsons, London.
11. Pharmacognosy, Dr.C.K.Kokate et al.1999. Nirali Prakashan.
12. Biotechnology and Patent protection, Beier, F.K., Crespi, R.S. and Straus, T., 1985. Oxford and IBH Publishing Co, New Delhi.
13. Intellectual Property rights on Biotechnology, Singh K, BCIL, New Delhi
14. www.ipr-helpdesk.org/
15. www.patentoffice.nic.in/ipr/patent/patents.htm
16. www.bangalorebio.com/GovtInfo/ipr.htm

PRACTICAL SOCIAL, ETHICAL, LEGAL AND MANAGEMENT ISSUES

IPR - patents and copyrights, Ethical: somatic and germ line gene therapy, clinical trials, Management-Planning, Organizing, Leading & Controlling



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SCHEME

Semester – IV

No	Subject Code	Subject Title	Marks Allotted						
			Assignment Marks		Theory Marks		Practical Marks		Total Marks
			Max	Min	Max	Min	Max	Min	
1	MBT 541(a)/541(b)/541(c)	ENZYME AND ENZYME TECHNOLOGY/ NANOBIOTECHNOLOGY/ PHARMACEUTICAL AND DRUG DESIGNING	20	8	80	32	-	-	100
2	MBT 542	STEM CELL BIOLOGY & SOMATIC AND GERM CELL ENGINEERING	20	8	80	32	-	-	100
3	MBT 543	DISSERTATION	-	-	-	-	250	125	250
4	MBT 544	PRACTICAL VII(BASED ON MBT 541 & MBT 542)	-	-	-	-	50	20	50
Total			40	16	160	64	300	145	500



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Syllabus Semester – IV

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc. (Biotechnology)	ENZYME AND ENZYME TECHNOLOGY	MBT- 541(a)

UNIT- I

Properties of Enzymes: Enzymes: Classification, Characteristics, Factors affecting enzyme activity., Application of Enzymes *invitro* and *in vivo*. Numerical classification of enzymes. Different structural conformations of enzyme proteins. Enzymes as biocatalysts, catalytic power, activation energy, substrate specificity, active site, theories of mechanisms of enzyme action. Mechanism of action of lysozyme, chymotrypsin and ribonuclease.

UNIT-II

Enzyme kinetics: Importance of enzyme kinetics, factors affecting rates of enzyme mediated reactions (pH, temperature, substrate concentration, enzyme concentration and reaction time). Derivation of Michaelis - Menton equation and its significance in enzyme kinetic studies. Lineweaver-Burke plot, Haldane-Briggs relationship, sigmoidal kinetics steady state kinetics and transient phases of enzyme reaction

UNIT-III

Enzyme inhibitions - kinetics of competitive, non-competitive & uncompetitive inhibitions; nucleophilic & electrophilic attack; role of metal ions in enzyme catalysis.

UNIT-IV

Immobilized enzymes - principles & techniques of immobilization - commercial production of enzymes; amylases, proteases, cellulose, artificial enzymes, industrial applications, fermentation, enzymes modification, site directed mutagenesis; immobilized enzyme in industrial processes.

UNIT-V

Structure and function of coenzyme - reactions involving TPP, pyridoxal phosphate, nicotinamide, flavin nucleotide, coenzyme A and biotin. Industrial utilization of enzymes, food, detergents, energy, waste treatment, pharmaceuticals and medicine.

BOOKS :

1. L. Understanding Enzymes. Palmer, T.
2. Fundamentals of Biochemistry Jain, J. L.
3. Lehninger Principles of Biochemistry Nelson and Cox
4. General Enzymology. Kulkarni and Deshpande ()
5. Enzyme. Dixon, M. and Webb, E. C.
6. Fundamentals of Biochemistry. A. C. T.
7. Enzyme Kinetics. A modern approach. Marangoni,
8. Fundamentals of Enzymology. P. D. Rice, N. C. and Stevens, L.
9. Enzyme reaction Mechanisms. Welsch.



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10. Enzyme Assays: A practical approach. Eisenthal and Danson
11. Enzyme Biotechnology Tripathi
12. Enzyme Kinetics Dixaon.

PRACTICAL ENZYMOLOGY AND ENZYME TECHNOLOGY

1. Isolation of extra cellular enzymes.
2. Isolation of intra cellular enzymes.
3. Isolation of membrane bound enzymes.
4. Purification of enzymes.
5. Assay of enzyme (protease) activity
6. Enzyme kinetics (V_{max} and k_m values)
7. Immobilization of enzyme



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BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc. (Biotechnology)	NANOBIOTECHNOLOGY	MBT- 541(b)

UNIT- I

Introduction to Nanobiotechnology: History of nanotechnology and its emergence, concept of nanobiotechnology, types of nanoparticles and their properties: quantum dots, polymeric nanoparticles, metal nanoparticles, metal oxide nanoparticles, dendrimers, composites.

UNIT- II

Methods for synthesis of Nanomaterials: Physical, chemical, biological methods: chemical precipitation and coprecipitation, polyol, and borohydrate reduction methods, Sol-Gel synthesis; microemulsions synthesis, hydrothermal, solvothermal synthesis methods, microwave assisted synthesis; sonochemical assisted synthesis, core-shell nanostructure, organic-inorganic hybrid nanocomposites, quantum dot (QDs) synthesis, microbial/plant mediated nanoparticle production: overview and concept of microbial/plant mediated nanoparticle production; methods of microbial/plant mediated nanoparticle production.

UNIT- III

Physiochemical characterization of Nanomaterials: Optical (UV-Vis/Fluorescence), X-ray diffraction, imaging and size (Electron microscopy- TEM, SEM; light scattering- DLS, NTA; zeta potential)

UNIT-IV

Applications of Nanomaterials: Proteins, lipids, RNA and DNA; protein targeting -small molecule/nanomaterial - protein interactions; nanomaterial-cell interactions- manifestations of surface modification (polyvalency). nanomaterials and diagnostics/drug delivery and therapeutics: peptide/DNA coupled nanoparticles; lipid nanoparticles for drug delivery; inorganic nanoparticles for drug delivery; metal/metal oxide nanoparticles (antibacterial/antifungal/antiviral activities); anisotropic and magnetic particles (Hyperthermia). MRI, imaging surface modified nanoparticles; MEMS/NEMS based on Nanomaterials; applications of nanobiotechnology: nanomedicines, nanoparticles for diagnostics and imaging, food science (food processing, food packaging, detection of pathogens), nanosensors, nanotechnology for water remediation and purification

UNIT-V

Concerns of Nanomaterials/Nanobiotechnology: Fate of nanomaterials, environmental and health impact of nanomaterials, genotoxicity and cytotoxicity evaluation of nanomaterials, ecotoxicology



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List of practicals

1. Synthesis of TiO₂- PVA nanocomposite.
2. Synthesis of ZnO-PANI nanocomposite.
3. Analysis of single wall carbon nanotubes, double wall and multi wall carbon nanotubes by Raman spectroscopy.
4. Surface Plasmon resonance studies by gold nanoparticles.
5. Photocatalytic degradation of methylene blue using TiO₂ nanoparticles.
6. Characteristic of solar cell as calculation of fill factor, maximum power point and efficiency.
7. Demonstration of H₂-O₂ fuel cells.
8. Analysis of cyclic Voltammogram and calculation of specific capacitance.
9. Synthesis of SnO₂ thin film for gas sensing applications.
10. Grain size estimation by using XRD.
11. Preparation of thick films by screen printing techniques.
12. Modeling and simulation of FINFET
13. Modeling of 1-D resonant tunneling devices.
14. Extraction of protein and estimation by lowezy's method.
15. Isolation of DNA from Bacteria/Plant/Animal material.
16. To study antibacterial/antifungal activity of nanomaterial.
17. Blast the nut/Protein sequence in database.
18. Isolation of plasmid.
19. To study the cytotoxicity of nanomaterial using suitable material (Cell line/Insect culture/Ycant).
20. Restriction digesion and gel electrophoresis.



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BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc. (Biotechnology)	PHARMACEUTICAL AND DRUG DESIGNING	MBT- 541(c)

UNIT-I

Introduction: Introduction to pharmaceutical biotechnology and drug discovery, drug targets: structure and functions; physiochemical properties of drugs; drugs from natural sources. pharmacodynamics, pharmacokinetics and drug metabolism, drug tolerance & intolerance, drug allergy, drug induced side effects with examples. Screening and isolation of bioactive compounds, role of regulatory authorities in drug approvals. The food and drug administration (FDA), investigational new drug application, new drug application; European regulations national regulatory, authorities, European medicines agency and the new EU drug approval system, centralized procedure, mutual, Indian drug regulations, & pharmacopeia, Market issues of drug patenting and licensing in pharma industry.

UNIT-II

Drug action and Resistance: Mechanism of action of anti-diabetic, anticancer, anti- inflammatory and antibiotics (any two drugs of each), mechanisms of drug resistance to antibiotics and anticancer drugs with examples, MDR, XDR or PDR, assay of drug potency- bioassay and immunoassay.

UNIT-III

Process of Drug Development: Target identification and validation, pre-clinical studies-toxicity (cytotoxicity, genotoxicity, reproductive toxicity, carcinogenicity, mutagenicity, and other tests), animal models for in vivo activity of drugs testing, clinical trials: Phase I, II, III and IV.

UNIT-IV

Biopharmaceuticals: Introduction and scope of biopharmaceutical industry, biotherapeutics: various categories of therapeutics like vitamins, antibiotics, hormones, enzymes, hematopoietic growth factors and coagulation factors, interferon's and cytokines for anti-infective and cancer therapy, biopharmaceuticals manufacturing: overview of upstream & downstream processing, production of biopharmaceuticals using synthetic biology approach (eg. Artemisinin).

UNIT-V

Computer aided drug design (CADD): Introduction to CADD, Identification drug targets using molecular modeling, combinatorial libraries and high-throughput screening (HTS), Methods of drug designing: Structure based drug design, Molecular docking: Types and principles, Semi-flexible docking, Flexible docking; Ligand and protein preparation, Macromolecule and ligand optimization, Analysis of docking results and validation with known information. Use of Small-molecule libraries, Natural compound libraries for virtual high throughput screenings. Commonly used docking software. Ligand based drug design Quantitative structure activity relationships; Introduction to chemical descriptors like 2D, 3D and Group-based pharmacophore modelling, pharmacophore-based screenings of compound library, analysis and experimental validation. Concept of quantitative drug design using quantitative structure-activity relationship models (QSAR models), types of molecular modelling for proteins.



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List of practicals

I Limit tests for following ions

Limit test for Chlorides and Sulphates

Modified limit test for Chlorides and Sulphates

Limit test for Iron

Limit test for Heavy metals

Limit test for Lead

Limit test for Arsenic

II Identification test

Magnesium hydroxide

Ferrous sulphate

Sodium bicarbonate

Calcium gluconate

Copper sulphate

III Test for purity

Swelling power of Bentonite

Neutralizing capacity of aluminum hydroxide gel

Determination of potassium iodate and iodine in potassium Iodide

IV Preparation of inorganic pharmaceuticals

Boric acid

Potash alum

Ferrous sulphate

V Assay of the following compounds along with Standardization of Titrant



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(1) Ammonium chloride by acid base titration

(2) Ferrous sulphate by Cerimetry

(3) Copper sulphate by Iodometry

(4) Calcium gluconate by complexometry

(5) Hydrogen peroxide by Permanganometry

(6) Sodium benzoate by non-aqueous titration

(7) Sodium Chloride by precipitation titration

VI. Determination of Normality by electro-analytical methods

(1) Conductometric titration of strong acid against strong base

(2) Conductometric titration of strong acid and weak acid against strong base

(3) Potentiometric titration of strong acid against strong base



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Syllabus Semester – IV

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc. (Biotechnology)	STEM CELL BIOLOGY & SOMATIC AND GERM CELL ENGINEERING	MBT- 542

UNIT- I

Introduction to stem cells - Embryonic Stem Cells, Adult stem cells, Molecular basis Pluripotency and its application, Stem cell niches, Stem cell renewal, Cell cycles regulators in stem cells Introduction to Techniques - Introductory history, Laboratory organization, Maintaining Aseptic environment, Basic concepts in cell culture - cell culture, Cellular Totipotency, Somatic Embryogenesis. In vitro culture : approaches & methodologies - preparation steps for tissue culture, surface sterilization of plant tissue material, basic procedure for aseptic tissue transfer, incubation of culture.

UNIT- II

Epigenetic mechanism of cellular memory, Germ line Stem Cells, Stem Cells and Cloning, Nuclear cloning and Epigenetic reprogramming; Growth Factors and Signal Cascades BMP, Nodal, Wnt, Notch and Retenoid signaling during gastrulation

UNIT- III

Tissue and organ development- Differentiation in early development, Primordial germ cells in mouse and Human, Bone Marrow Mesenchymal Stem Cells , Hematopoietic Stem Cells: Identification, Characterization, Assays and Cell Lineages,

UNIT- IV

Applications- Neurons Stem Cells and Potential Therapies, Spinal cord injury, Strategies Using Cell Therapy to Induce Cardiomyocyte Regeneration in Adults with Heart Disease, Stem cell therapy: Current State and Future Perspectives, Embryo culture, transplantation and teratogenesis.

UNIT- V

Teratomas. Organ culture. Artificial blood. Amniocentesis-karyology and biochemical diagnostics-genetic counselling. Mammalian embryo fusion-allopheny. Transgenesis gene transfers, knock-outs. Somatic cell fusion and somatic cell genetics

BOOKS :

1. Animal Cells Culture and Media, D.C. Darling and S.J. Morgan, 1994. BIOS Scientific Publishers Limited.
2. Methods in Cell Biology, Volume 57, Jennie P. Mathur and David Barnes, 1998. Animal Cell Culture Methods Academic Press.
3. Epithelial Cell Culture, Ann Harris, 1996. Cambridge University Press
4. Animal Biotechnology, M.M. Ranga, 2000. Agrobios, India.
5. Biotechnology, Satyanarayana, U., 2006. BOOKS and Allied (P) Ltd.



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M.Sc. (Biotechnology)

PRACTICAL STEM CELL BIOLOGY & SOMATIC AND GERM CELL ENGINEERING: Aseptic techniques, primary culture, Tissue and organ development, Somatic cell fusion and somatic cell genetics

MBT 15 : DISSERTATION for 3 months