

बरकतउल्ला विश्वविद्यालय,भोपाल
Barkatullah University, Bhopal

As per model syllabus of U.G.C. New Delhi, Approved by Board of
Studies Biotechnology



जीव विज्ञान संकाय
Faculty of Life Science
पाठ्यक्रम एवं निर्धारित पुस्तकें
Syllabus & Prescribed Books

एम.एस.सी. (बायोटेक्नोलॉजी) तृतीय सेमेस्टर

M.Sc. (Biotechnology) Third Semester

प्रकाशक
कुलसचिव
बरकतउल्ला विश्वविद्यालय,भोपाल

BARKATULLAH UNIVERSITY, BHOPAL

M.Sc. (Biotechnology)

Third Semester Examination Scheme

1. Course Code	:		6. Maximum Theory Marks	:	600
2. Course Name	:	M.Sc. Biotechnology	7. Minimum Passing Percentage	:	36
3. Total Paper	:	05	8. Laboratory	:	100
4. Compulsory Paper	:	05	9. Laboratory Passing Percentage	:	36
5. Laboratory	:	01			

Title of the Paper	Theory		CCE		Total Marks		Practical		Total Marks	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Genetic Engineering	85	31	15	05	100	36	---	---	100	36
Biostatistics and Bioinformatics	85	31	15	05	100	36	---	---	100	36
Plant Biotechnology	85	31	15	05	100	36	---	---	100	36
Bioprocess & Biochemical Engineering	85	31	15	05	100	36	---	---	100	36
Applied Biotechnology	85	31	15	05	100	36	---	---	100	36
Laboratory-III	---	---	---	---	---	---	100	36	100	36

BARKATULLAH UNIVERSITY, BHOPAL

Class - **M.Sc.**
Subject - **Biotechnology**
Paper Name - **BT-301 Genetic Engineering**
Semester - **Third**

MM : 85

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 vectors- use of promoters and expression cassettes, Baculoviruses 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, Sanger's dideoxy chain termination method, High throughput sequencing and pyrosequencing), Automated DNA sequencing, and Organochemical 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, Real time and reverse Transcriptase PCR, Primer 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*

BARKATULLAH UNIVERSITY, BHOPAL

Class	-	M.Sc.
Subject	-	Biotechnology
Paper Name	-	BT-302 Biostatistics and Bioinformatics
Semester	-	Third

MM : 85

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, skewness 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 (χ^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 different areas, and limitation of Bioinformatics. Data mining techniques and its applications – hidden markov model, neural network. Database management system (basic idea). Biological data & databases: Classification of biological database. Nucleic acid sequence database: GenBank, EMBL, DDBJ. Protein Resources: UniProtKB. Expression database: Swiss-2D-PAGE, GEO, ArrayExpress, Secondary sequence databases: PROSITE, Pfam, PRODOM. Structure database: PDB and CATH. Small Molecule database: DrugBank, ChemSpider, PubChem. Specialized Database: KEGG. Data formats: GenBank, UniProt, PDB, FASTA, PHYLIP, ClustalW.

UNIT-IV: Sequence Comparison: Pairwise alignment – Dot matrix methods, Dynamic programming. Concept of gap penalty and scoring matrix-PAM and BLOSUM, Significance, Significance of alignment. Sequence Homology Search: BLAST and FASTA algorithm, various programs and application. Multiple sequence alignment: Concept, Algorithm, tools and importance, Phylogenetic analysis: concept of tree, methods and tools. Gene Prediction methods and tools, primer designing tools, codon usage analysis and tools. Pattern and motif analysis.

UNIT-V: Structural Bioinformatics: Introduction & Importance. Coordinate systems. Visualization & presentation of structure. Molecule Visualization models, Molecular visualization and modeling software (Introductory notes and feature application) – SPDBV, RASWIN, ChemSketch, PyMOL, ArgusLab, AutoDock, Discovery Studio, LeadIT-FlexX. Protein Structure Prediction: Chau-Fasman, GOR, Neural

Network, Homology modeling, Threading method. Protein Folding: Interacting forces, theories of protein folding, methods of protein folding study, protein folding in-vivo. Molecular Modeling – molecule designing, force field types, conformational search methods, Molecular docking – concept and methods. Drug Discovery and drug Designing.

RECOMMENDED BOOKS:

Statistics:

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

Bioinformatics:

1. Bioinformatics: Sequence and Genome Analysis – Cold Spring Harbor Laboratory Press – by David Mount
2. Emerging trends in Bioinformatics - The Book Syndicate Publications - Edited by Irfan A. Khan and Atiya Khanum, Ukaaz.
3. Introduction to Bioinformatics (3rd Edi) – Oxford University Press - by Arther Lark.
4. Molecular Modeling and Drug Design – Topics in Molecular and Structural Biology. CRC Press. J. G. Vinter and Mark Gardner (Edi)
5. Molecular Modeling in Drug Design, Academic Press. N. Claude Cohen (Edi)

BARKATULLAH UNIVERSITY, BHOPAL

Class - **M.Sc.**
Subject - **Biotechnology**
Paper Name - **BT-303 Plant Biotechnology**
Semester - **Third**

MM : 85

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, use of reporter genes, methods of nuclear transfer, particle bombardment, electroporation, microinjection, transformation of monocots, transgene stability and gene silencing for herbicide, insect and salt resistance , Plant DNA fingerprinting - Hybridization ,

Genetic markers, molecular markers, 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.

BARKATULLAH UNIVERSITY, BHOPAL

Class - **M.Sc.**
Subject - **Biotechnology**
Paper Name - **BT-304 Bioprocesses & Biochemical Engineering**
Semester - **Third**

MM : 85

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

UNIT-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 separation, precipitation, centrifugation, cell disruption, chromatography. Product recovery processes and Unit operations. Safety

consideration in downstream 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), Stanbury 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, 2nd edition (2002), Cruger and Cruger
10. Manual of Industrial Microbiology & Biotechnology 2nd edition (1999), Arnold *et al*

BARKATULLAH UNIVERSITY, BHOPAL

Class - **M.Sc.**
Subject - **Biotechnology**
Paper Name - **BT-305 Applied Biotechnology**
Semester - **Third**

MM : 85

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.