

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M. Sc. Biotechnology
(Five Years Integrated Course)

Course Outline: Semester-IX

(With effect from Academic Year 2015-16)

Theory:

BT: 3001	Advances in Bioinformatics
BT: 3002	Advances in Molecular Biology
BT: 3003	Entrepreneurship Development
BT: 3004	Cell and Tissue Culture Technology-II

Practical:

BTP: 3005	Bioinformatics and Molecular Biology
BTP: 3006	Cell Culture Technology-II

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M. Sc. Integrated Biotechnology

Syllabus: Semester -IX

BT-3001: Advances in Bioinformatics

UNIT-1: Sequence Analysis:

1.1 Pairwise Sequence Alignment:

- 1.1.1 Definition & Significance of Sequence Alignment.
- 1.1.2 Concept of Alignment, Scoring Matrices (PAM & BLOSUM).
- 1.1.3 Models for Sequence Alignment: Global alignment, Local Alignment, Gap Penalty.
- 1.1.4 Methods for sequence alignment: Dot matrix method, Dynamic Programming algorithm (Smith waterman & Needleman Wunch algorithm), Heuristic method.
- 1.1.5 Tools for Pairwise sequence alignment: BLAST, FASTA.

1.2 Multiple Sequence Alignment:

- 1.2.1 Introduction to Multiple sequence alignment.
- 1.2.2 Methods of Multiple sequence alignment (Sum of Pairs, Progressive, Iterative), Evaluating Multiple sequence alignment.
- 1.2.3 Application of Multiple sequence alignment.
- 1.2.4 Tools for Multiple sequence alignment: Clustal W, Clusta X.

UNIT-2: Molecular Phylogeny:

- 2.1 Phenotypic & Molecular Phylogeny, Mechanism of Molecular Phylogeny, Representation of Phylogeny, Molecular Clocks.
- 2.2 Methods of Phylogeny (Cladistic methods – Maximum parsimony, Maximum Likelihood & Distance Method (UPGMA, NJ and Fitch Margoliash method), Validation methods (Bootstrap)
- 2.3 Tools for Phylogenetic analysis (PHYLIP).

UNIT-3: Bioinformatics at DNA level:

3.1 Gene Prediction Method:

- 3.1.1 Introduction to Gene Prediction (Finding of Genes, Finding of Exons, Exon to prediction of genes).
- 3.1.2 Types of Gene Prediction Programs (Splice site Prediction, Homology based gene prediction & Ab initio gene prediction)
- 3.1.3 Type of gene Prediction methods-Laboratory based approach, Feature based approach, Homology based approach & Statistical & HMM based approach - Markov Process & HMM - components of profile HMM, Building HMM, HMM scoring algorithm, HMM architecture, Application of HMM.
- 3.1.4 Tools for Gene Prediction – GLIMMER, GENSCAN.

UNIT-4: Bioinformatics at Protein level and Advances in bioinformatics:

4.1 Protein Structure Prediction & Modelling:

- 4.1.1 Methods for Secondary structure prediction: Chou Fasman, GOR and Protein structures evaluation (Procheck). Softwares for Secondary structure prediction.
- 4.1.2 Protein Modeling: methods of Protein Modeling, Homology Modeling, Threading or fold recognition and Ab-initio structure prediction methods.
- 4.1.3 Tools for Protein structure prediction (Predict Protein), Tools for protein structure modelling – Swiss Model.

4.2 Advances of Bioinformatics:

- 4.2.1 Structural bioinformatics in drug designing, Application of QSAR in computer aided drug designing, Molecular Docking, AUTODOCK.

REFERENCES: REFERENCES:

1. Mount, D.W., “Bioinformatics: Sequence and Genome analysis”, Cold Spring Harbour Laboratory Press, 2001.
2. Zhumur Gosh and Bibekanand Mallick “Bioinformatics: Principle and Application”, Oxford University Press, 2008.
3. Simminder Kaur Thukral and Orpita Bosu, Pap/Cdr edition, “Bioinformatics: Database, Tools and Algorithms”, Oxford University Press, USA, 2007.
4. S.C. Rastogi, N. Mendiratta and P. Rastogi, 2nd Edition “Bioinformatics: Concepts, Skill & Applications”, CBS publisher & Distributor, 2009.
5. N. J. Chikhale and V.S. Gomase, 1st Edition, “Bioinformatics: Theory & Practices”, Himalaya Publishing House Limited, 2007.
6. Lesk, A. K., “Introduction to Bioinformatics” 4th Edition, Oxford University Press, 2013.

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Syllabus: Semester -IX

IBT-3002: Advances in Molecular Biology

UNIT-1: Understanding Model Organisms:

- 1.1 Prokaryotic organism: *Escherichia coli*.
- 1.2 Unicellular Eukaryotic organism: *Saccharomyces cerevisiae*.
- 1.3 Multicellular Eukaryotic organisms: *Neurospora crassa*, *Arabidopsis thaliana*, *Caenorhabditis elegans* and *Mus musculus*.

UNIT-2: Analyzing Genomes:

- 2.1 Mapping Genomes:
 - 2.1.1 Genetic Mapping: Genes as markers, DNA marker, Linkage analysis.
 - 2.1.2 Physical Mapping: Restriction mapping, FISH, Sequence tagged site mapping
- 2.2 Sequencing Genomes:
 - 2.2.1 Methodology for DNA Sequencing: Chain termination DNA sequencing, Alternative methods for DNA sequencing.
 - 2.2.2 Assembly of a Contiguous DNA Sequence: Shotgun method, Clone contig method, Whole-genome shotgun sequencing.
 - 2.2.3 Next Generation Sequencing-Overview.
- 2.3 The Human Genome Projects:
 - 2.3.1 The mapping phase.
 - 2.3.2 Sequencing of human genome.
 - 2.3.3 Future of Human Genome Projects.

UNIT-3: Human Genomics:

- 3.1 Finding Human Disease Genes: Cloning of Human Disease Genes, Cloning of the Fragile X Gene, Genetic basis of Alzheimer Disease, Detection of Copy Number Polymorphisms in Chromosomes, SNP-based Diagnosis, Definitive diagnosis of Mutations in Breast Cancer, Use of RNAi to inhibit over growth of Blood Vessels.
- 3.2 Genetic Basis of Cancer: Environmental factors, Cancer as Genetic Disease, Failure of Apoptosis, Requirement of New Blood vessels for Tumour Growth, Microarrays Reveal Changes in the Genomes of Cancer cells, Telomerase inhibition can Kill Cancer Cells, Microarray Gene Expression Analysis for indication of drug response in Breast Cancer, Human Cancer Genome Project.

UNIT-4: DNA Fingerprinting and Forensics:

- 4.1 Hypervariable and Variable Tandem Repeat Loci to identify Individuals.
- 4.2 Standard for Forensic Applications: Short Tandem Repeats.
- 4.3 Use of Multiplex PCR Amplification and Fluorescent Tags.
- 4.4 Uniqueness of DNA profile: Calculated using the frequencies of the STR Alleles.
- 4.5 SNPs in Forensic Applications.
- 4.6 DNA Profiling: Identification of Victims of Mass Disasters, Resolves Suspected Scientific Fraud.

REFERENCES:

1. Introduction to Genetic Analysis, Griffiths, Wessler, Lewontin, Gelbart, Suzuki and Miller, Eighth edition, Freeman and Company.
2. Genomes, T. A. Brown, John Wiley and Sons PTE Ltd.
3. Gene VIII (2004) Benjamin Lewin, Pearson Education International, NJ.
4. Recombinant DNA: Genes and Genomes-A short course (Third Edition) J. D. Watson, R. M. Myers, A. A. Caudy, J. A. Witkowski, W. H. Freeman and Company, New York, USA.

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IBT-3003: Entrepreneurship Development

UNIT-1: ENTREPRENEURSHIP & FUNDAMENTALS OF PROJECT MANAGEMENT:

1.1 Introduction: Essence of Entrepreneurship, Concept and theories of Entrepreneurship, Entrepreneurial traits and motivation, Nature and importance of Entrepreneurs, Tips for an Entrepreneur.

1.2 Project Management: Search for a Business Idea, Concept of project and classification, project identification, project formulation, project design and network analysis, project report, project appraisal.

UNIT-2: FINANCE:

2.1 Sources of Finance: Source of development finance, Project financing, Institutional financing to Entrepreneurs, Financial institutions, Role of consultancy organizations, TIIIC Guidelines for financial assistance.

2.2 Financial Analysis: Ratio analysis, Investment process, Break even analysis, Profitability analysis, Budget and planning process.

UNIT-3: MARKETING:

3.1 Marketing Channels: Methods of marketing, Marketing channels, Marketing Institutions and Assistance, E-commerce: Benefits of E-commerce brand and Opportunities in India.

3.2 Setting up a Small Scale Industry: Location of an enterprise, Steps for starting a Small Industry, Incentives and Subsidies, Exploring Export Possibilities.

UNIT-4: BREAKTHROUGH-WHO MADE IT-GAME CHANGERS:

4.1 Shantha Biotech: Unleashing Biotechnology in India.

4.2 Aravind Eye Hospital: Making a Dent in Global Blindness.

4.3 An Indian Revolutionary in Silicon Valley-Cirrus Logic.

4.4 Suguna Poultry Farm Ltd: Hard work, No compromise, No excuse.

4.5 The Surat Transformation: Urban Renewal.

REFERENCES:

1. Dynamics of Entrepreneurial Development and Management (2005) Vasant Desai, Himalaya Publishing House.
2. Making Breakthrough Innovation Happen: How Eleven Indians Pulled of the Impossible (2009) Porus Mushi, HarperCollins Publishers India.
3. The CII Entrepreneur Hand Book: Practical Advice for Starting a New Business (2010) Sushila Ravindranath, Westland Ltd.
4. The Game Changers: 20 extraordinary success stories of Entrepreneurs (2013) Y. Modi, R. Kumar & A. Kothari, Random House Publishers India Pvt. Ltd.

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M. Sc. Integrated Biotechnology

Syllabus: Semester -IX

IBT-3004: Cell & Tissue Culture Technology-II

UNIT-1: GENE EXPRESSION AND REGULATION IN PLANTS:

- 1.1 Types of Plant Promoters, Enhancers and Terminators, heterologous promoters, Promoters, and Reporter Systems. Dna Foot Printing, Finger Printing, Gel Shift Analysis, Dna Microarray
- 1.2 Inducible Expression System and Control of Transgene Expression through Inducible Promoters.
- 1.3 Ribozwitches, Aptamers and their Applications; Telomerase Structure and Function.
- 1.4 Chloroplast Genes Expression, Chloroplast Transformation, Genome editing and its applications.

UNIT-2: APPLICATION OF PLANT CELL CULTURE SYSTEM:

- 2.1 Hairy Root Cultures: Establishment of hairy root cultures, Properties of hairy roots, Genetics of transformation, The genes responsible for hairy root formation, Factors influencing the transformation, Screening and Confirmation of transformation, Applications of Hairy root cultures.
- 2.2 Biotransformation using plant cells and organ cultures, Biotransformation using immobilized cell culture, Genetic engineering approaches towards biotransformation, Advantages of biotransformation, Factors influencing biotransformation.
- 2.3 Immobilization of plant cells: Types and methods of immobilization, Advantages and Disadvantages.

UNIT-3: CRYOPRESERVATION AND TOXICITY STUDIES:

- 3.1 Principle of Cryopreservation, Vitrification, Design and Control of Stocks.
- 3.2 Cell counting, Rate of macromolecule synthesis, Cytometry, Cell Proliferation and Plating Efficiency.
- 3.3 Cytotoxicity and Genotoxicity.

UNIT-4: ADVANCES IN ANIMAL CELL CULTURE TECHNOLOGY:

- 4.1 Stem Cells, Embryonic Stem cells, Adult stem Cells, Induced Pluripotent Stems Cells (IPs), Regenerative Therapy.
- 4.2 Cell interaction and Phenotypic expression, Organ Culture, Histotypic culture and organotypic Culture.
- 4.3 Autoradiography, Cell synchrony, Somatic Cell Fusion.

REFERENCES:

1. Primrose S.B. and Twyman R.M., Principles of Gene Manipulation and Genomics; (7th Edition) Blackwell Publishing
2. Genomes, T. A. Brown, Oxford: Wiley-Liss; 2002
3. Old R.W. and Primrose S.B. Principles of Gene Manipulation: An Introduction to Genetic Engineering. University of California Press.
4. Gene IX by B. Lewin. Jones & Bartlett Learning, 2008.
5. Ciddi Veerasham, (2004) Medicinal Plant Biotechnology CBS publishers in New Delhi.
6. Introduction to Plant Biotechnology. 2nd edition. H.S.Chawla. Oxford & IBH publishing Co. Pvt. Ltd. New Delhi.

7. Adrain Slater, Nigel Scott and Mark Flower A.Plant Biotechnology – The Genetic manipulation of Plants, Oxford University Press.
8. Ian Freshney, Culture of Animal Cells (Fifth Edition), Wiley-Leiss.
9. Jannie P. Mather and Peneolpe E. Roberts, Introduction to Cell and Tissue Culture, Plenum Press.
10. A. Doyle and B. Griffith, Cell and Tissue Culture: Laboratory Procedures in Biotechnology, Wiley publications.
11. D. C. Darling and S. J. Morgan (1994) Animal cell culture and media, Bios Scientific Publishers Limited.
12. C. D. Helgason and C. L. Miller, Basic Cell Culture Protocols, Humana press.
13. Basant Kumar Sinha and Rinesh Kumar, Principles of Animal Cell Culture, International Book Distribution Co.
14. B.D. Singh, Expanding Horizons of Biotechnology, Kalyani Publishers.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M. Sc. Integrated Biotechnology Syllabus: Semester -IX PRACTICALS

BT-3005: Bioinformatics & Molecular Biology

1. Identification of microorganisms using Pairwise Sequence Alignment.
2. Identification of ORF using ORF Finder.
3. Creation of Cladeogram / Phylogram using NJ & UPGMA method.
4. Perform Homology modeling using SwissModel.
5. Evaluation of predicted structure by Procheck and Ramachandran Plot.
6. Perform *In-silico* Primer designing using Primer.
7. DNA detection and characterization by gel electrophoresis.
8. To perform restriction digestion of DNA.
9. Isolation of chromosomal DNA from *Saccharomyces cerevisiae*.
10. Southern transfer of DNA from agarose gel onto nitrocellulose or nylon membrane.
11. *In vitro* synthesis of specific DNA fragments with the polymerase chain reaction.
12. SDS-PAGE analysis of:
 - (a) Membrane Bound proteins.
 - (b) Molecular weight determination of protein.

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M. Sc. Integrated Biotechnology Syllabus: Semester -IX PRACTICALS

BT-3006: Cell Culture Technology-II

1. Direct organogenesis (*In vitro* clonal Propagation) of any plant of agriculture/medicinal/ horticultural importance.
2. Indirect organogenesis of plant of commercial importance.
3. Assessment of clonal fidelity of tissue culture raised plants.
4. Assay of glutathione s-transferase (GST) and polyphenol oxidase (PPO).
5. Isolation of protoplasts.
6. Evaluation of Total antioxidant Capacity (TAC) of plants.
7. Study of effect of cytotoxic chemicals on cell lines by different marker parameters (Sulforhodamine-B, Super oxide Dismutase, Catalase, etc.).
8. Study of effect of genotoxic chemicals on cells lines by different marker parameters (G2 assay, DNA fragmentation, Comet, etc.).
9. Characterization of cell line by isozyme analysis.
10. To estimate Lactate Dehydrogenase Activity from cell lines.
11. To study morphological differentiation from primordial cells using appropriate differentiation medium.
12. To study Transfection in Animal Cell Culture.

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