

# VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

## M. Sc. Biotechnology

[Academic Year of Implementation: 2019-2020]

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### **Course Outline: Semester-IX**

#### Theory:

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

#### Practical:

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

**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**  
M. Sc. Biotechnology Semester–IX

**BT-3001: Advances in Bioinformatics**

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**UNIT-1: MOLECULAR PHYLOGENY**

- 1.1 Phenotypic & Molecular Phylogeny, Mechanism of Molecular Phylogeny
- 1.2 Representation of Phylogeny
- 1.3 Molecular Clocks
- 1.4 Methods of Phylogeny – UPGMA and NJ
- 1.5 Tools for Phylogentic analysis (PHYLIP)

**UNIT-2: GENE PREDICTION**

- 2.1 Introduction to Gene Prediction (Finding of Genes, Finding of Exons, Exon to prediction of genes)
- 2.2 Types of Gene Prediction Programs (Splice site Prediction, Homology based gene prediction & Ab initio gene prediction)
- 2.3 Type of gene Prediction methods-Laboratory based approach, Feature based approach, Homology based approach & Statistical & HMM based approach
- 2.4 Tools for Gene Prediction – GLIMMER, GENSCAN, ORF Finder

**UNIT-3: SECONDARY STRUCTURE PREDICTION & MODELLING**

- 3.1 Methods for Secondary structure prediction: Chou Fasman, GOR
- 3.2 Softwares for Secondary structure prediction – GORIV, JPred4, APSSP2, CFSSP
- 3.3 Methods of Protein Modelling - Homology Modelling, Threading or fold recognition and Ab-initio structure prediction methods
- 3.4 Tools for protein structure modelling – Swiss Model
- 3.5 Ramachandran Plot for evaluation of predicted structure (Concept & Tool – RAMPAGE)

**UNIT-4: ADVANCES IN BIOINFORMATICS**

- 4.1 **Bioinformatics in Drug Designing:**
  - 4.1.1 Structural bioinformatics in drug designing
  - 4.1.2 Application of QSAR in computer aided drug designing
- 4.2 **Primer Designing:**
  - 4.2.1 Primer Selection, Primer Length, Melting Temperature (T<sub>m</sub>), Specificity, Complementary Primer Sequence, G/C content, 3'end sequence
  - 4.2.2 Designing a sequencing primer
  - 4.2.2 Software for *in silico* primer designing: Primer Blast, Primer 3

**REFERENCES:**

1. Zhumur Gosh and Bibekan and Mallick “Bioinformatics: Principle and Application”, Oxford University Press, 2008.
2. Simminder Kaur Thukral and OrpitaBosu, Pap/Cdr edition, “Bioinformatics: Database, Tools and Algorithms”, Oxford University Press, USA, 2007.
3. S. C. Rastogi, N. Mendiratta and P. Rastogi, 2nd Edition “Bioinformatics: Concepts, Skill & Applications”, CBS publisher & Distributor, 2009.
4. N. J. Chikhale and V.S. Gomase, 1st Edition, “Bioinformatics: Theory & Practices”, Himalaya Publishing House Limited, 2007.
5. Lesk, A. K., “Introduction to Bioinformatics” 4th Edition, Oxford University Press, 2013.
6. Rukam S. Tomar, Manoj, V. Parakhia, Sunil V. Patel, B. A. Golakiya, “Molecular Markers and Plant Biotechnology” New India Publishing Agency, 2010.

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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**  
M. Sc. Biotechnology Semester–IX

**BT-3002: Advances in Molecular Biology**

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**UNIT-1: ADVANCES IN GENE STRUCTURE AND FUNCTIONS**

- 1.1 Total Gene Numbers: In Bacteria and Eukaryotes
- 1.2 Gene number in Humans and the Y Chromosome
- 1.3 Distribution of genes and other sequences in genome
- 1.4 Introduction to Gene clusters and repeated sequences
- 1.5 Essential genes and study of expressed genes
- 1.6 Satellite and Mini-satellite DNA: In Arthropods and Mammals

**UNIT-2: ADVANCES IN RNA BIOLOGY**

- 2.1 Riboswitches and noncoding RNAs
- 2.2 Bacterial Regulator RNAs: CRISPR-CAS system
- 2.3 miRNA, siRNA and piRNA
- 2.4 Mechanism of RNAi
- 2.5 Mechanism of splicing in Group I and Group II introns
- 2.6 Catalysis by RNase P and Viroid RNA

**UNIT-3: DNA BASED MOLECULAR BIOLOGY TECHNIQUES**

- 3.1 PCR and its applications
- 3.2 Real-time Quantitative PCR
- 3.3 Southern blotting as diagnostic tool
- 3.4 Analysis of Repeative DNA Sequences
- 3.5 cDNA Microarrays and its medical applications
- 3.6 Analysis of SNPs

**UNIT-4: PROTEIN BASED MOLECULAR BIOLOGY TECHNIQUES**

- 4.1 Introduction to peptide synthesis on solid-phase
- 4.2 Protein Microarray Technology
- 4.3 Epitope mapping
- 4.4 Recombinant Monoclonal Antibodies
- 4.5 Quantum dots
- 4.6 Overview of Antibody Phage Display

**REFERENCES:**

1. Krebs J, Goldstein E, Kilpatrick S, Lewin B. Lewin's Genes XI. Burlington, MA: Jones and Bartlett; 2014.
2. Walker J, Rapley, R. Molecular Biomethods Handbook, 2<sup>nd</sup> Ed., Humana Press; 2008.

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M. Sc. Biotechnology Semester–IX

**BT-3003: Biotechnology Entrepreneurship Development**

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**UNIT-1: BIOTECHNOLOGY ENTREPRENEURSHIP**

- 1.1 **Introduction:** Significance of the Biotechnology Entrepreneur, Integration of two distinctly different disciplines: Science & Business, Biotechnology entrepreneurship versus general entrepreneurship, Essential biotechnology versus entrepreneurial characteristics, Backgrounds of biotechnology entrepreneurs, Driving forces in decision making and learning from failure.
- 1.2 **Fuel, Feed and Heal the world through Biotechnology Entrepreneurship:** Industrial and Environmental Biotechnology, Food and Agricultural Biotechnology, Health Biotechnology.

**UNIT-2: FINANCE**

- 2.1 **Sources of Finance:** Source of development finance, Project financing, Institutional financing to Entrepreneurs, Financial institutions, Role of consultancy organizations.
- 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, Scheme of Assistance for Biotech Industry under existing Gujarat Biotech Policy.

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

- 1.1 Shantha Biotech: Unleashing Biotechnology in India.
- 1.2 Aravind Eye Hospital: Making a Dent in Global Blindness.
- 1.3 Centocor: Diagnostics Company on Monoclonal Antibodies.
- 1.4 Suguna Poultry Farm Ltd: Hard work, No compromise, No excuse.
- 1.5 The Surat Transformation: Urban Renewal.

**REFERENCES:**

1. Biotechnology Entrepreneurship (2014) Craig Shimasaki, Academic Press, USA.
2. Dynamics of Entrepreneurial Development and Management (2005) Vasant Desai, Himalaya Publishing House.
3. Making Breakthrough Innovation Happen: How Eleven Indians Pulled of the Impossible (2009) Porus Mushi, Harper Collins Publishers India.
4. The CII Entrepreneur Hand Book: Practical Advice for Starting a New Business (2010) Sushila Ravindranath, Westland Ltd.
5. 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. Biotechnology Semester–IX

**BT-3004: Cell & Tissue Culture Technology-II**

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**UNIT-1: GENE EXPRESSION AND REGULATION IN PLANTS**

- 1.1 *In-silico* analysis of the promoter to find out cis-acting elements, Promoter-reporter construct to validate promoters *in-vivo*, DNA Foot Printing, Finger Printing, Gel Shift Analysis.
- 1.2 Inducible Expression System and Control of Transgene Expression through Inducible Promoters.
- 1.3 Ribozwitches, Aptamers and their Applications.
- 1.4 Telomerase Structure and Function.

**UNIT-2: APPLICATION OF PLANT CELL CULTURE SYSTEM**

- 2.1 Plant Expression Vectors: Advantages of Conventional cloning Vs site-specific recombination based cloning methods (Gateway Technology)
- 2.2 Functional analysis of genes: Activation tagging: A tool for plant gene discovery; Plant protein-protein interaction: Yeast Complementation, Yeast two hybrid, Pull down assay, BiFC; Tilling and eco-tilling.
- 2.3 Chloroplast Genes Expression, Chloroplast Transformation,
- 2.4 Genome editing and its applications.

**UNIT-3: ANIMAL CELL CULTURE TECHNOLOGY & TRANSGENIC ANIMALS**

- 3.1 Cytotoxicity and Genotoxicity
- 3.2 Cell death and its regulation
- 3.3 Stem cells: Embryonic stem cells, adult stem cells, Induced pluripotent stem cells and regenerative therapy
- 3.4 Cell synchrony, organ culture, Histotypic culture
- 3.5 Introduction to transgenic animals; Techniques and Applications of animal Transgenesis

**UNIT-4: CANCER BIOLOGY**

- 4.1 Basic properties of a cancer cell
- 4.2 The causes of cancer
- 4.3 Tumor-suppressor genes and oncogenes
- 4.4 Immunotherapy and Inhibition of cancer promoting proteins
- 4.5 Angiogenesis

**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. Adrain Slater, Nigel Scott and Mark Flower A.Plant Biotechnology – The Genetic manipulation of Plants, Oxford University Press.
6. Ian R. Freshney, Culture of animal cells: a manual of basic technique and specialized applications, 6<sup>th</sup> Ed., Willey Blackwell pub.
7. Houdebine L.M., 2003, Animal Transgenesis and Cloning, John Wiley and Sons, Ltd.
8. Karp G., Cell and Molecular Biology: concepts and experiments, 7<sup>th</sup> Ed.

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M. Sc. Biotechnology Semester–IX

**BTP-3005: Bioinformatics & Molecular Biology**

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1. Creation of Cladogram/Phylogram using Simple Phylogeny/NJPLOT.
2. Predict ORF using ORF Finder.
3. Predict secondary structure using GORIV/JPred4.
4. Perform Homology modelling using Swiss model.
5. Perform evaluation of predicted protein by Rampage.
6. Perform Primer designing using Primer 3 / Blast Primer.
7. Separation of  $\lambda$  DNA digests using low-melting agarose electrophoresis, post-electrophoretic DNA elution from gel and purification by solvent /agarase enzyme method.
8. Isolation of chromosomal DNA from *Saccharomyces cerevisiae* / *Aspergillus niger*.
9. *In vitro* amplification of specific DNA fragments by Polymerase Chain Reaction.
10. SDS-PAGE separation of protein mixture, Silver/Coomassie staining of SDS-PAGE gel.

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M. Sc. Biotechnology Semester–IX

**BTP-3006: Cell Culture Technology-II**

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1. Direct organogenesis (*In vitro* clonal Propagation) of any plant of agriculture/medicinal/horticultural importance.
2. Indirect organogenesis of plant of commercial importance.
3. Isolation of RNA from suitable plant source.
4. Assay of glutathione s-transferase (GST) and polyphenol oxidase (PPO).
5. Evaluation of Total antioxidant Capacity (TAC) of plants.
6. To perform Genotoxicity by Micronucleus assay and DNA fragmentation assay.
7. To perform Cytotoxicity by MTT/XTT or MTS assay.
8. Estimation of GST activity in serum/cell lysates.
9. Study of effect of cytotoxic chemicals on cells by different marker parameters (Super Oxide Dismutase and Catalase).
10. To estimate Lactate Dehydrogenase activity from cells.

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