GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering
Subject Code: 3170416
Genomics and Proteomics
7TH SEMESTER

Type of course: Professional Elective

Prerequisite: Basic Knowledge of Cell Biology and Molecular Biology

Rationale: The objective of this course is to give an introduction to Genomics and other global Omics technologies, the theory and practical aspects of these technologies and the applications of these technologies in the field of biotechnology.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	00	0	100

Contents:

Sr. No.	Topics	Teaching Hrs.
1	**Genomics and methods in genomics** Organization and structure of genomes in prokaryotes, eukaryotes, and organelles (chloroplast, mitochondrion); Genome mapping methods (genetic and physical); RAPD , RFLP, SNP analyses; Fluorescence in-situ Hybridization (FISH) techniques; Advances in gene finding and functional prediction; Chain termination and chemical degradation sequencing methods. Genome-wide association (GWA) analysis; Comparative Genomic Hybridization (CGH); Massively parallel Signature Sequencing (MPSS); Whole genome shot-gun sequencing and its applications; Introduction of Next Generation Sequencing (NGS).	20
2	**Transcriptomics and methods in transcriptomics** Introduction, Basic principles and design, cDNA and oligonucleotide arrays, DNA microarray, Instrumentation and structure; Designing a microarray experiment - The basic steps, Types of microarray - expression arrays, protein arrays, Comparative Genomic Hybridization (CGH) arrays,	20

	Resequencing arrays; Different platforms (Affymetrix, Agilent etc.); Data Processing and Normalization - Algorithms of data processing and Normalization; Tools used to normalize; Microarray databases – NCBI; GEO (Gene Expression Omnibus), ArrayExpres (EBI); Functional Analysis: Differential gene expression; Gene Ontology functional enrichment tools, Pathway analysis (KEGG Database); Applications of Microarray technology; case studies.	
3	**Proteomics and methods in proteomics** Overview of protein structure-primary, secondary, tertiary and quarternary structure, Relationship between protein structure and function; Outline of a typical proteomics experiment, Identification and analysis of proteins by 2D analysis, Spot visualization and picking; Tryptic digestion of protein and peptide fingerprinting, Mass spectrometry : ion source (MALDI, spray sources), analyzer (ToF, quadrupole, quadruple ion trap) and detector; Post translational Modifications: Quantitative proteomics, clinical proteomics and disease biomarkers, mass spectral tissue imaging and profiling; Proteinprotein interactions: Surfaceomes and Secretomes, Solid phase ELISA, pull-down assays (using GST-tagged protein) tandem affinity purification, far western analysis, by surface plasmon resonance technique; Yeast two hybrid system, Phage display, Protein interaction maps, Protein arrays-definition; applications- diagnostics, expression profiling	20

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
05	**05**	**10**	**25**	**25**	**0**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. S.P. Hunt and F. J. Livesey, (2000) Functional Genomics.

2. Twyman R. M. (2004), Principles of Proteomics. Taylor & Francis.

3. Voit, E.O., 2000 Computational Analysis of Biochemical Systems: a Practical Guide for Biochemists and Molecular Biologists. Cambridge University Press.

4. Primrose, S. B., Twyman, R. M., Primrose, S. B., & Primrose, S. B. (2006). Principles of Gene Manipulation and Genomics. Malden, MA: Blackwell Pub.

5. Liebler, D. C. (2002). Introduction to Proteomics: Tools for the New Biology. Totowa, NJ: Humana Press.

6. Campbell, A. M., & Heyer, L. J. (2003). Discovering Genomics, Proteomics, and Bioinformatics. San Francisco: Benjamin Cummings.

Course Outcome:

Sr. No.	CO Statement	Marks % Weightage
CO-1	To acquire knowledge and understanding of fundamentals of genomics and proteomics, transcriptomics and their applications in various applied areas of biology.	33.33%
CO-2	To Know the application of various Omics technologies.	33.33%
CO-3	To use various tools of omic technologies.	33.34%

LIST OF Tutorials:

1. Tutorials based on genomics
2. Tutorials based on transcriptomics
3. Tutorials based on proteomics

List of Open Source Software/learning website:

1) NPTEL

2) Open course lectures /virtual labs