

## **Discipline Centric Electives (DC) offered by the Department under CBCS**

<b>Course No:</b>	<b>BT-17104 -DCE</b>	<b>Maximum marks</b>	<b>75</b>
<b>Course title:</b>	<b>Biotechniques</b>		
<b>Credits:</b>	<b>Three</b>		

**UNIT-I: Electrophoresis and Blotting Techniques:** Basic principles & types of electrophoresis, Agarose gel electrophoresis, PAGE, SDS-PAGE and isoelectric focusing. Blotting techniques: Southern, Northern, Western, Far-western, South-western and their applications. Determination of antigen antibody concentration by immunodiffusion, immunoelectrophoresis, ELISA.

**UNIT-II: Chromatography:** Theory of Chromatography; Migration. Dispersion. Chromatographic Resolution. Types: Gel filtration, Paper, thin-layer and partition chromatography. Affinity Chromatography: Ion Exchange chromatography, Purification of specific groups of molecules (GST fusion proteins, Poly (His) fusion proteins, Tandem affinity purifications). Chromatin Immunoprecipitation Assay (ChIP assay), Chip Seq.

### **UNIT-III:**

**Centrifugation and Radioactivity:** Basic principles of centrifugation. Types of centrifugation; differential centrifugation and density gradient centrifugation. Determination of Sedimentation Coefficient. Ultra centrifugation: Design and principles of an analytical ultracentrifugation. Isotopes, modes of radioactive disintegration, Radioactive decay, Radiation quantitation and units. Applications of radioactive isotopes in biochemical assays. Radiation hazards and protection.

### **Books Recommended:**

1. Principles & Techniques Biochemistry & Molecular Biology. Wilson & Walker. Cambridge University Press.
2. Principles of Radioactive Techniques, Use & Handling. BARC
3. Biological Centrifugation (The Basics) by Dr John Graham
4. Chromatography: Basic Principles, Sample Preparations and Related Methods by Elsa Lundanes, Leon Reubsaet, Tyge Greibrokk . WILEY.
5. Basics of Centrifugation. ThermoFisher

<b>Course No:</b>	<b>BT-17106 - DCE</b>	<b>Maximum marks</b>	<b>75</b>
<b>Course title:</b>	<b>Biostatistics</b>		
<b>Credits:</b>	<b>Three</b>		

**UNIT I:** General Introduction to Statistics, Basic Concepts. Scope of Statistical methods in Biotechnology. **Sampling methods/strategies:** Sample Selection. Simple Random Sampling, Convenience Sampling, Systematic Sampling, Stratified Random Sampling, Cluster Sampling, etc. Data; types & Uses. Medical/Biological Uncertainties: Surveys and Cross-Sectional Studies. Retrospective Studies, Prospective Studies, Experimental Studies and Quality Control Clinical Trials, Epidemiological Studies. **Measurement of central tendencies:** Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean. Measures of Dispersion: Range, Mean Absolute Deviation, Population Variance and Standard Deviation, Sample Variance and Standard Deviation, Calculating the Variance and Standard Deviation from Grouped Data, Coefficient of Variation (CV).

**UNIT-II: Presentation of variation by figures; data representation:** Histogram, Stem-&-Leaf Plot, Line Diagram, Frequency Polygon, Frequency Curve, Pie Diagram, Bar Diagrams, Scatter Diagram, Box-&-Whisker Plot, Bubble Plot, Growth chart, Dendrogram, Nomogram, Partogram, Pedigree Chart, Cartogram. **Confidence Intervals:** Confidence Intervals, Confidence Intervals for a Single Population Mean, Z and t Statistics for Two Independent Samples. Paired t Test. **Principles of test of significance:** One-Tailed Versus Two-Tailed Tests, p-Values, Type I and Type II Errors, The Power Function, Two-Sample t Test (Independent Samples with a Common Variance). **Students t-test, ANOVA:** Comparison of means in one or two groups (student's t-test). Comparison of means in three or more groups (ANOVA), F-test.

#### **Practicals:**

Introduction to MS EXCEL-Use of worksheet to enter data, edit data, copy data, move data. Use of in-built statistical functions for computations of Mean, S.D., Correlation, regression coefficients, t-test, ANOVA. Use of bar diagram, histogram, scatter plots, bubble plot, etc. graphical tools in EXCEL for presentation of data.

#### **Books Recommended:**

1. Introduction to Biostatistics and Research Methods by Sunder Rao and J Richards
2. Medical Statistics by David Machin, Michael J Campbell and Stephen J Walters, John Wiley and Sons

<b>Course No:</b>	<b>BT-17304-DCE</b>	<b>Maximum marks</b>	<b>50</b>
<b>Course title:</b>	<b>Human and Medical Genetics</b>		
<b>Credits:</b>	<b>Two</b>		

**UNIT-I:** Organization and distribution of the human genome: Overview. Human multigene families and repetitive coding DNA. Extragenic repeated DNA sequences and transposable elements. Genes in pedigrees: Genes in pedigree. Complications to the basic pedigree patterns. Factors affecting gene frequencies. Nonmendelian characters. Overview of mutation, polymorphism, and DNA repair. Pathogenic mutations. Nomenclature of mutations and databases of mutations.

**UNIT-II:** Genomic revolution and Research in the post-genome (sequencing) era: History, organization, goals and value of the Human Genome Project. Modern molecular and cytogenetic methods (Modern PCR methods, FISH, MLPA, arrayCGH, Parent of Origin Effects, Prenatal Diagnosis, chorionic villus sampling (CVS), Preimplantation Genetic Diagnosis (PGD)).

**Books Recommended:**

1. Thompson and Thompson: Genetics in Medicine, Elsevier publications.
2. Emery's Elements of Medical Genetics. Elsevier

<b>Course No:</b>	<b>BT-17305-DCE</b>	<b>Maximum marks</b>	<b>75</b>
<b>Course title:</b>	<b>Fundamentals of Systems Biology: Networks and Noise</b>		
<b>Credits:</b>	<b>Three</b>		

**Unit-I**

Introduction to systems biology, Networks-definition, properties of network, structure of biological networks, Cellular networks; genetic and molecular interaction networks-protein interaction networks, protein-DNA interaction networks, significance of cellular networks (combinatorial-out puts, multitasking), Synthetic networks. Systems biology and future medicine

**Unit-II**

Noise-noise and robustness of cellular processes, Sources of noise; Intrinsic and Extrinsic noise, Noise in gene expression; stochastic gene expression, cell-to-cell variation in gene expression (cell-to-cell variation in number of RNA and protein molecules). Single cell measurements -Methods to study cell-to-cell variability of RNA and proteins. Noise and cellular decision-making (microbes to mammals). Non-genetic cellular heterogeneity and response.

**Unit-III**

Proteomics; LC-MS/MS, identification of proteins in complex mixtures and its role in systems biology. Genome sequencing; library preparations, barcoding and sequencing methods (Mi-seq, Hi-seq), Transcriptomics; RNA-seq (method/analysis (determination of RPKM values) and applications. Chromosome conformation capture (3C, 4C, 5C and HiC). Chromatin-immuno precipitation coupled to sequencing (ChIP-seq)

**Books Recommended:**

1. An Introduction to Systems Biology: Design Principles of Biological Circuits by Uri Alon
2. A First Course in Systems Biology by Eberhard Voit

<b>Course No:</b>	<b>BT-17002GE</b>	<b>Maximum marks</b>	<b>50</b>
<b>Course title:</b>	<b>Cancer Immunology</b>		
<b>Credits:</b>	<b>Two</b>		

**Unit I: Oncogenes:** Historical aspects, provirus, protovirus and oncogene hypothesis. Functional class of oncogenes (proto-oncogenes) Mechanism of carcinogenic transformation by oncogenes, viral oncogenes. Tumor suppressor genes-properties, mechanism of tumor suppressor genes in cancer induction with special reference to P53 gene. Inherited cancers

**Unit II: Tumor immunology and cancer diagnostics & therapy:** Tumor immunology –Introduction, Mechanism of immune response to cancer, natural killer cells and cell mediated cytotoxicity. Biochemical, histological and radiological methods for cancer diagnosis Chemotherapy and radiotherapy strategies for cancer treatment. Cancer chemotherapeutic drugs. Types of radiation therapy. Immunotherapy of cancer – Rationale of immunotherapy, Tumor necrosis factor, interleukins, cytokines, interferons, vaccines, monoclonal antibodies.

**Books Recommended:**

1. Basic Immunology: Abul K. Abbas, Andrew H. Lichtman.
2. Janeway's Immunobiology, Garland Science
3. Essential Immunology by Delvis, Martin , Burton and Roitt

<b>Course No:</b>	<b>BT-17001OE</b>	<b>Maximum marks</b>	<b>50</b>
<b>Course title:</b>	<b>Basic Concepts in Biotechnology</b>		
<b>Credits:</b>	<b>Two</b>		

**UNIT-I:** Cell as a basic unit of life, Structure and function of various cell organelles (Plasma membrane, Nucleus, Mitochondria, Chloroplast, Golgi Bodies, Endoplasmic reticulum. Molecules of life: Basic idea of life molecules- DNA, RNA, Proteins, Carbohydrates and Lipids, their structure & functions

**UNIT-II:** Genome organization: Chromosomes, chromatin, Gene, Allele, and DNA. Cell Division: Basic concept of Mitosis & Meiosis. Genetic Information: The flow of genetic information (Central Dogma Concept). Cloning: Basic concept of DNA recombinant technology. Transgenic: Advantages, Issues & concerns. Nobel Prize: Eminent Nobel Laureates & their contribution in Biology.

**Books Recommended:**

Principles of Biochemistry by David David Lee Nelson, Albert L. Lehninger, Michael M. COX , Publisher: W.H. Freeman

<b>Course No:</b>	<b>BT-17005GE</b>	<b>Maximum marks</b>	<b>50</b>
<b>Course title:</b>	<b>Molecular Mechanisms of Plant Life</b>		
<b>Credits:</b>	<b>Two</b>		

**Unit I:** Organization of Shoot & Root apical Meristem. Molecular mechanism of shoot, Root & Leaf development. Phyllotaxy. Transition of flowering: Induction of flowering, Regulatory Pathways of Flowering. Floral meristem & floral development (Arabidopsis & Antirrhium)

**Unit II:** Plant hormones (Auxin, Gibberellin, Cytokinin, Ethylene, Brassinosteroids, Absciscic acid, Strigolactones, Jasmonates, polyamines, Salicylic acid, Nitric oxide) biosynthesis storage, breakdown and transport: physiological effects and mechanism of action. Changing the genome of plants-transgenic plants (methods, advantages & concerns).

**Books recommended**

1. Handbook of Plant Science by Keith Roberts (Volume I & II), Wiley-Interscience
2. Molecular life of plants by Russel Jones, Helen Ougham, Howard Thomas, Susan Waaland, Wiley-Blackwell

<b>Course No:</b>	<b>BT-17006GE</b>	<b>Maximum marks</b>	<b>50</b>
<b>Course title:</b>	<b>Bioinformatics</b>		
<b>Credits:</b>	<b>Two</b>		

**UNIT-I:** Introduction and Biological databases: Introduction: What Is Bioinformatics? Goal. Scope. Applications. Limitations. Introduction to Biological Databases : What Is a Database? Types of Databases. Biological Databases. Pitfalls of Biological Databases.

**UNIT-II:** Sequence Alignment: Pairwise Sequence Alignment. Sequence Homology versus Sequence Similarity. Sequence Similarity versus Sequence Identity. Methods. Scoring Matrices. Statistical Significance of Sequence Alignment. Database Similarity Searching: Unique Requirements of Database Searching. Heuristic Database Searching. Basic Local Alignment Search Tool (BLAST). FASTA. Database Searching with the Smith–Waterman Method.

**Books Recommended:**

1. Developing Bioinformatics Computer Skills by Cynthia Gibas, Per Jambeck
2. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Second Edition by Andreas D. Baxevanis, B. F. Francis Ouellette
3. Bioinformatics: Sequence and Genome Analysis by David W. Mount

<b>Course No:</b>	<b>BT-17201-CR</b>	<b>Maximum marks</b>	<b>100</b>
<b>Course title:</b>	<b>Plant Biotechnology</b>		
<b>Credits:</b>	<b>Four</b>		

**UNIT-I:** General structure, organization & Molecular basis of Shoot Apical Meristem(SAM) & Root Apical meristem (RAM). Totipotency of Plant cell, Plant cell cycle, Role of various hormones in regulating plant cell cycle, Micropropagation (Seed V/S Soma), Stages & methods of micropropagation. Production of virus free plants. Tissue culture media (Composition & preparation), Role of micro, macro nutrients & other components present in tissue culture media, Commonly used media (Murashige and Skoog etc) Initiation and Maintenance of callus and suspension culture, Single cell clones Organogenesis: Basis, applications & control of Somaclonal variation. Somatic embryogenesis- acquisition of embryogenic competency, factors & genes influencing the embryogenic competency of cell during somatic embryogenesis, Synthetic seeds. Embryo rescue.

**UNIT-II:** Protoplast isolation (mechanical & enzymatic methods), maintenance, purification, viability, Culture and fusion (Spontaneous & induced fusion, sodium nitrate, calcium ion, PEG, electrofusion). Identification & Selection of hybrid cells and regeneration of hybrid plants; Symmetric & Asymmetric hybrids, Cybrids-formation and applications. Anther, pollen and ovary culture for the production of haploid homozygous lines, Molecular mapping, Introduction to genetic and physical maps, physical mapping

**UNIT-III:** Plant Transformation Technology; Morphology of Agrobacterium tumefaciens, Features of Ti Plasmids, Opines and its Types, Basis of tumor formation, Factors influencing binding of Agrobacterium to plant, Mechanism of T-DNA transfer & Role of virulent proteins in (Formation of T-DNA strand, movement of T-Complex & Integration of T-DNA into Plant genome), Features of Binary vectors & its Types (pBIN19, pGreen, pCambia, etc), Promoters used in Ti vectors (CaMV 35S and other promoters), Use of reporter genes (Opine synthase, CAT, GUS, LUX, GFP) and selectable markers (antibiotic & herbicide resistant genes, Metabolic intermediates etc) Generation of marker free plants (using Cre-Lox & other Excision techniques), Vector less or direct DNA transfer (Particle bombardment, Electroporation, WHISKERS, Pollen tube entry, Floral dip, Liposome mediated, etc). Plant transformation for productivity and performance with special example of Herbicide resistance (Glyphosate & Phosphinothricin resistance), Insect resistance (Bt based plants), Disease resistance (Role of R-proteins & other molecules), long shelf fruit and flowers, Stress tolerance (water deficit stress, Role of osmoprotectants and other molecules).

**UNIT-IV:** Molecular farming: Methodology involved in the production of Golden rice, Metabolic engineering of carbohydrates (Starch and fructan production), lipids (production of shorter & longer chain fatty acids, Modification of the degree of saturation). Production of Biodegradable plastic, Production Therapeutic protein in plants (Hirudin, Glucocerebrosidase, etc), Purification strategies for proteins-Oleosin partitioning Technology, Plantibodies (full length, scFv, Minibody, Diabody, Bispecific) Edible Vaccines, Manipulation of Shikimate pathway for the production of Vitamin E, Chloroplast Transformation (Mechanism & Advantages), Principle & applications of Gene termination technology, Concerns about Genetically modified plants

**Books Recommended:**

1. Plant Biotechnology: The Genetic Manipulation of Plants Adrian Slater Nigel W. Scott Fowler: Oxford University Press.
2. Introduction to Plant Biotechnology: H S Chawla: Science Publishers, Inc.
3. Plant propagation by Tissue Culture : Edwin F. George, Michael A Hall: Springer-verlag.
4. Agrobacterium: From Biology to Biotechnology: Tzfira, Tzvi, Citovsky, Vitaly: Springer verlag