Unit No	**PAPER – III BT 103 BIOCHEMISTRY**	Instruction Hr	Total Hr
1	**CHEMISTRY OF BIOMOLECULES** • **Carbohydrates-** • Classification, structure, configuration, conformation • Stability, formation of glycosidic bond, disaccharides & oligosaccharides. • Polysaccharides: structural (cellulose, chitin) storage (starch, glycogen, insulin). • Hemicelluloses • Liginins, Pectins • Glycoso-amino-glycans • Blood group substances, glycoproteins, proteoglycans & bacterial cell wall polysaccharides (peptidoglycans). • Amino acids- • Classification, characteristics of amino acids. Essential &Non essential amino acids. • Proteins- • Classification , Structural organization of proteins – primary, secondary, tertiary, quaternary • Ramchandran's plot. • Lipids- • Structure, properties & classification of lipids, fatty acids. Porphyrins	 2 1 1 1 1 1 2 ½ 1 ½ 1 ½ 1 1 ½	15
2	**CHEMISTRY OF BIOMOLECULES – II** • Nucleic Acids: Structure of purines pyrimidine's, nucleosides and nucleotides. • Watson & Crick model of DNA • Different forms of DNA 5Types of DNA • Circular DNA & super coiling. • Types of RNA. Structure of t-RNA. • Denaturation & renaturation of DNA • Melting Curves. Calculation of Tm **Problems**	 2 1 1 2 ½ 1 ½ 2 1 1 1	13
3	**BIOENERGETICS** • Law of thermodynamics • Biological oxidation, Gibbs energy, free energy changes • redox potential & phosphate potential. • High energy compounds • Glycolytic Pathway • TCA Cycle • Oxidative Phosphorylation • Photophosphorylation • Electron Transport Chain • Glyoxylate Cycle • Pentose Phosphate Pathway	 1 ½ 1 ½ 1 1 1 1 1 1 1 1 1 1 1	17

	• Gluconeogenesis • Photosynthesis.-Photosystems. Light & Dark Phases. • C3 & C4 Pathways • CAM Pathways • Bioluminescence • Fatty acid Metabolism -β- Oxidation of fatty acids	1 ½ 1 ½ 1 1 1	
	ENZYMOLOGY • Introduction – special characteristics of enzymes co-factors specificity of enzymes. • Nomenclature & classification of enzymes • Steady state concept – Importance of Km &Vmax. • Michaelis-Menton equation- Factors affecting the rate of the reaction • Enzyme activation. • Types of Enzyme inhibitions. Enzyme inhibitors • Properties of enzymes: isolation methods& purifications. Regulation- Hill equation, cooperativitiy, Multiple sites on an enzyme.	½ 1 1 1 1 1 ½ 1 ½ 1 1 ½ 1 ½ 1 1 1 ½	15
			60

Unit No	**PAPER – III BT 203 IMMUNOLOGY**	Instruction Hr	Total Hr
1	**BASICS OF IMMUNOLOGY, IMMUNITY** • Introduction Immunlogy, Immunity, Immune System • Types of Immunity- Innate Immunity Acquired Immunity. • Cells of the Immune System B & T Lymphocytes, Natural Killer cells, Lymphocytes, Dendritic cells, Leucocytes – Granulocytes and Agranulocytes T-cell sub-sets ,The Antigen Presenting Cells • Organs of the Immune System : - Primary lymphoid organs Bone marrow and Thymus - Secondary lymphoid organs lymph nodes, spleen Mucosal-associated lymphoid tissue- Peyers patches, Tonsils • Antigens - Introduction Immunogenicity ,Antigenicity, - Immunogenicity versus Antigenicity Factors that influence immunogenicity • Haptens and the study of Antigenicity • Epitopes - Properties of B-cell epitopes and T-cell epitopes,	1 2 2 2 1 ½ 1 ½ 1 1 1 ½ 1 1 1 ½	17
2	**UNIT II IMMUNOGLOBULINS** • Basic structure of Immunoglobulins Immunoglobulin domains-variable region and constant region domains. • Immunoglobulin classes Types- IgG, IgM IgA, IgD and IgE functions of Ig classes • Antigenic determinants on immunoglobulins • Antigen-antibody reactions – Precipitation, Agglutination RIA ELISA- Sandwich ELISA, Dot ELISA Western Blot, Immunoprecipitation, Immunoflourescence • Monoclonal & polyclonal Antibodies Hybridoma Technology- Formation and selection of hybrid cells Production of Monoclonal Antibodies and their clinical uses	1 1 1 1 ½ 1 1 1 1 1 1 ½ 1 1	13
		1	

3	**UNIT III MAJOR HISTOCOMPATIBILITY COMPLEX (MHC).** • General organization and inheritance of MHC; MHC Haplotypes. • The structure of - MHC class-I MHC class-II molecules Organization of MHC class I and class II genes Peptide binding of MHC molecules. • Antigen processing pathways • Polymorphism of MHC class I • Polymorphism of MHC class II molecules • The role of HLA typing in organ transplantation • Cellular distribution of MHC molecules • MHC molecules and immune responsiveness	1 ½ 1 ½ 1 ½ 1 1 2 1 1 1 ½ 1 1	15
4	**UNIT IV THE HUMORAL AND CELL-MEDIATED IMMUNE RESPONSES.** • The structure and functions of T-cell receptors (TCR) • The TCR-peptide-MHC tri-molecular complexes • B-cell activation and proliferation by Thymus independent and Thymus dependent antigens • *In vivo* sites for induction of humoral response • B-cell differentiation • class-switching and generation of plasma cells and memory cells. • Cell-mediated immune response: General properties of effector T-cells Direct cytotoxic response Experimental assessment of cell-mediated cytotoxicity • Disorders of immune systems • Hypersensitivity • Immunosuppression • Transplantation • Vaccines, conventional, subunit & recombinant. • Immunotoxins • Tumor Immunology	1 1 ½ 1 ½ 1 1 1 1 1 1 1 1 1 1 1 1 1	17
			62

Unit No	**BT 302 BIOPROCESSTECHNOLOGY**	Instruction Hr	Total Hr
1	**FUNDAMENTALS OF BIOPROCESS ENGINEERING.** • Introduction to bioprocess engineering Fermentation, Fermenter • Bioprocess kinetics : Quantitative description of cellular process • Bioprocess kinetics : Quantitative description of cellular process • Kinetic modeling Model structures-types of systems • Material balances – concepts of material balance in different systems • Energy balances • Mass balances for ideal bioreactors- Laws of Conservation of mass • Mass balance equation • Problems	1 1 1 1 2 2 1 1 1 1	13
2	**UPSTREAM PROCESS** • Designing of bioreactors • Bioreactor types • Continuous Stirred tank Bioreactor • Air Lift Bioreactor- Two types 1) Internal loop 2) External loop • Bubble column, Fluidized bed Bioreactor • Packed bed Bioreactor, Photobioreactor • design configurations, design features, Batch and Continuous • Transport phenomenon in bioprocess system: • Mass transfer • Fick's law for mass • Heat transfer • Fourier's law for heat- in different systems • Oxygen transfer – Equation • Oxygen transfer in Lab and Pilot system • Shear stress effects and energy inputs in bioreactors. • Sterilization of media • Design of sterilization process (batch and continuous) • sterilization of bioreactor, feed and liquid waste • sterilization of air, exhaust air	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	18
3	**DOWNSTREAM PROCESS AND PRODUCT RECOVERY.** • Downstream processing:Introduction , A multi stage operation . • Unit operations: solid liquid separation: filtration, centrifugation • Filter aids, flocculation, foam separation • Recovery of intracellular components: Mechanical • Non-mechanical (chemical and enzymatic methods). • Concentration of biological products : Evaporation, liquid-liquid extraction • Aqeous two phase system (ATPS) membrane filtration • Pervaporation, perstraction, precipitation, adsorpotion etc. • Purification of product: chromatography methods: Size exclusion chromatography • Ion exchange	1 1 1 1 1 1 1 1 1 1	15

	• column-chromatography • chromato-focussing, affinity chromatography • Product formulation: Crystallization • Drying, lyophilization. • Process integration	1 1 1 1 1	
4	**BIOPROCESS CONTROL MEASUREMENT AND AUTOMATION**. • Classes of sensors: Introduction • In-line, on-line and off-line sensors. • Physical and chemical sensors for media • Physical and chemical sensors for gases • Instrumentation and principles for measurement of temperature • Instrumentation and principles for measurement of flow rate, pressure • Instrumentation and principles for measurement of agitation shaft power • Instrumentation and principles for measurement of foam sensing, biomass • Instrumentation and principles for measurement of dissolve oxygen, pH • Instrumentation and principles for measurement carbon dioxide • Automation and control system: manual control, automatic control • PID control and complex control systems. • Application of computers in bioprocess engineering: Data logging analysis and control. • Process economics : Cost benefit analysis	 1 1 1 1 1 1 1 1 1 1 1 1 1 1	14
			60

Unit No	**BT 401 INDUSTRIAL BIOTECHNOLOGY**	Instruction Hr	Total Hr
1	**BIOPROCESS & FERMENTATION TECHNOLOGY** • Introduction of Industrial biotechnology & bioprocess engineering • Fermentation design- overview of aerobic • Anaerobic fermentation process. • Fermentation process and factors affecting fermentation process. Bioreactor: Bioreactor types • Continuous Stirred tank Bioreactor • Air Lift Bioreactor- Two types 1) Internal loop 2) External loop • Bubble column, Fluidized bed Bioreactor • Packed bed Bioreactor, Photobioreactor • Design- design configurations, design features, Batch and Continuous • kinetics &Transport phenomenon in bioprocess system • Kinetic modeling Model structures- Material balances • Mass transfer • Heat transfer • Oxygen transfer • Shear stress effects and energy inputs in bioreactors. • Sterilization of media • Sterilization of air • Design of Fermentation media. Substrates used as Carbon • Substrate used as nitrogen sources	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	19
2	**ISOLATION, SELECTION AND PRESERVATION OF INDUSTRIAL MICROORGANISMS** • Industrial cultures – Bacteria, Algae • Fungi, Actinomycetes. • Primary and secondary screening of microorganisms for industrial products. • Isolation and Screening • Preservation of microorganisms for industrial products- types • Strain development – mutation • Selection &Recombination • Recombination techniques	1 1 1 1 1 1 1 1	08
3	**DOWNSTREAM PROCESS AND PRODUCT RECOVERY.** • Downstream processing:Introduction , A multi stage operation . • Unit operations: solid liquid separation: filtration, centrifugation • Filter aids, flocculation, foam separation • Recovery of intracellular components: Mechanical • Non-mechanical (chemical and enzymatic methods). • Concentration of biological products : Evaporation, liquid-liquid extraction • Aqeous two phase system (ATPS) membrane filtration • Pervaporation, perstraction, precipitation, adsorption • Purification of product: Chromatography	1 1 1 1 1 1 1 1 1 1	17

	• Chromatography methods: Size exclusion chromatography • Ion exchange • column-chromatography • Chromato-focussing, affinity chromatography • Immobilized ion metal chromatography, Resins • Product formulation: Crystallization • Drying, lyophilization • Process integration	1 1 1 1 1 1 1 1	
4	**PRODUCTION OF MICROBIAL PRODUCTS** • Organic acids – citric acid • Acetic acid • Gluconic acid • Amino acids – glutamic acid • Alcohols & beverages – ethanol • Beer, wine Production • Enzymes – proteases • Lipases • Cellulases • Pectinases • Antibiotics – penicillin • Erythromycin • Biosensors • Vaccines –hepatitis-B, polio • Vitamins – B 12 • Dairy products – cheese, yoghurt	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	16
			60

Teaching hours	**PAPER – I BT 101 CELL BIOLOGY**	
UNIT I	**INTERNAL ORGANISATION OF CELL**	
Period 1	Introduction to cell biology	
Period 2	Membrane structure – lipid bi layer and membrane proteins	Models of membrane structure Phospholipids, glycolipids, cholesterol Peripheral and Integral membrane proteins, Glycoclyx
Period 3	Electric properties of membrane	
Period 4	Transport across membranes – Passive transport, , carrier proteins Ion channels	Passive Diffusion, Fecilitated diffusion- Glucose transporters across erythrocytes Voltage gatedion channel: Na , KCachannel Ligandgated ion channel: Nicotinic Acetyl choline receptor of muscle cells Mechano gated ion channel
Period 5	Active transport: Na+ Ka+ pump ATPase, ABC transportors,	Sodium potassium pump conformational changes, Calcium ATPase, H^+/K^+ATPase ABC transporte- CFTR
Period 6	ionic gradient	Sodium glucose transport- Symport Na^+-Ca^+antiport
Period 7	Intra cellular compartmentalization – Cytosol, mitochondria, chloroplast	Cytosol chemical composition Mitochondria and chloroplast functions
Period 8	endoplasmic reticulum, peroxisome	Organinzation of Endoplsmic reticulum and functions Peroxisomes structure and functions
Period 9	lysosomes, endosomes	Lysosomes structure and functions Endosomes types and functions
Period 10	Transport of molecules between nucleus and cytosol	Nuclear pore complex, Nuclear localization signal and export signal

Period 11	Transport into mitochondria, Transport into chloroplast	Tim, Tom proteins, Pre sequences Matrix processing peptidase, chaperons Toc, Tic, Transit peptide, Guidance complex Stromal processing peptidase
Period 12	endocytosis and exocytosis	Phagocytosis, Receptor mediated endocytosis Clathrin independent pathway
Period 13	Protein sorting	Singalpeptide of Endoplasmic reticulum Signal Peptide of Golgi complex Glycosylation Mannose 6 phosphate
Period 14	Multi drug resistant efflux forms	ABC, MFS RND Superfamily
Period 15	Structure and functions of mitochondria	Structure, electron transport chain and chemiosmotic coupling
	Structure and function of chloroplast	Structure and Photosysnthesis
UNIT II	**CELL COMMUNICATION**	
Period 1	Overview of extracellular signaling	
Period 2	Basic characteristics of Paracrine, endocrine, autocrine systems	
Period 3	Tight junctions	
Period 4	Gap junctions	
Period 5	Second messengers and their role in signal transduction Camp	
Period 6	lipid derived second messengers (phosphatidyl inositol derived second messenger) & IP3.	

Period 7	Role of calcium as second messenger	
Period8	Cell surface receptors in signal transduction	
Period9	G-protein coupled receptor – structure and function	
Period 10	Ion channel receptors.	
Period 11	Tyrosine kinase linked receptors	
Period 12	Receptors with intrinsic enzyme activity (RTK)	
Period 13	Interaction and regulation of cell signaling pathways	
Period 14	Interaction and regulation of cell signaling pathways	
UNIT III	**CELL CYCLE AND CELL DIVISION**	
Period 1	**Introduction to cell cyle**	
Period 2	Components in cell cycle control - Cyclin, CDKs	
Period 3	Check points in cell cycle	
Period 4	Intracellular control of cell cycle events	
Period 5	phase dependent cyclic CDK complexes eg. Yeast.	
Period 6	Abnormalities in Cell Cycle – Cancer	
Period 7	Mechanics of Cell Division- An over view of M-Phase	
Period 8	Different stages of mitosis	Chain termination and fluorescent labeled dyes
Period 9	Cohesins and Condensins in chromosome segregation	Components, Methodology, Primer design
Period 10	Microtubules in spindle assembly	Types and Applications
Period 11	Structure of kinetoshore	
Period 12	centrosomes and its functions, Sister Chromatid separation	
Period 13	Cytokinensis actin & myosin in the generation of contractile ring	
Period 14	Meiosis – Significance, Chiasma formation - Synaptonemal complex	

Period 15	Recombination during meiosis - Recombination nodules	
UNIT IV	**UNIT 4 CELL DEATH PATHWAY**	
Period 1	Introduction to Necrosis	
Period 2	Senescence	
Period 3	Apoptosis - Programmed cell death	
Period 4	Mechanisms of apoptosis	
Period 5	Apoptosis triggered by internal signals	
Period 6	Apoptosis triggered by external signals	
Period 7	Apoptosis in cancer	
Period 8	Apoptosis immune system,	
Period 9	Apoptosis organ transplants	
Period 10	Apoptosis organ transplants	
Period 11	Apoptosis in plants	
Period 12	Apoptosis in plants	
Period 13		
Period 14		
Period 15		

PAPER – IV BT 104 MICROBIOLOGY

Class	Unit & Topic
	UNIT 1: GENERAL CHARACTERS OF MICROORGANISMS
1	The concept of Microbial origin of Fermentations
2	Historical developments in Microbial Biotechnology.
3	Microscopy
4	Types of Microscopy
5	Types of Microscopy
6	Classification of Bacteria
7	Structure and general characters of Bacteria
8	Classification, Structure and general characters Archaea
9	Classification, Structure and general characters Fungi
10	Classification, Structure and general characters Algae
11	Nutrition in Microorganisms
12	Assimilation of nutrients
13	Nutritional groups of microorganisms
14	Microbiological media and their applications
15	Microbiological media and their applications
	UNIT 2: VIRUSES AND THEIR CHARACTERS
1	Classification of viruses
2	Classification of viruses
3	General Characters of viruses
4	General Characters of viruses
5	Structure and replication of Bacteriophage (T2)
6	TMV
7	Measles
8	Measles
9	HIV
10	HIV
11	SV40
12	Prions – Kuru
13	Bovine Spongy Encephalopathy
14	Methods of cultivation of viruses
15	Importance of viruses in biotechnology
	UNIT 3: MICROBIOLOGICAL TECHNIQUES
1	Concept of sterilization.
2	Methods of sterilization
3	Methods of sterilization
4	Sterilization techniques used in Industries
5	Sterilization techniques used in Industries
6	Kinetics of thermal death of cells & spores
7	Concept of pure culture
8	Methods of pure culture development.
9	Methods of preservation of microbial cultures
10	Microbial growth and growth curve
11	Microbial growth and growth curve
12	Exponential growth

13	Synchronous growth
14	Methods of measurement of growth
15	Methods of measurement of growth
	UNIT 4 : RECOMBINATION IN BACTERIA AND VIRUSES
1	Transformation : Competence factors
2	Mechanism of transformation
3	mapping genes by transformation
4	Conjugation
5	Structure of F plasmid, Mechanism of transfer of F plasmid. Hfr,
6	Mechanism of integration of F plasmid into bacterial chromosome
7	Circularization of chromosome
8	Conjugation mapping – different methods
9	Transduction
10	Generalized transduction
11	Lysogenic cycle
12	lytic cycle
13	Specialized transduction – structure of λ phage
14	Mechanism of integration λ phage.
15	Gene mapping by transduction

PAPER IV :BT 204 **BIO-STATISTICS AND ANALYTICAL TECHNIQUES**

Class	Unit & Topic
	UNIT 1 : DESCRIPTIVE STATISTICS
1	• Sampling procedure, homogenization of samples, samples size
2	• Measurement of averages and variation
3	• Measure of central values - Mean
4	• median
5	• mode
6	• Measures of dispersion - range
7	• mean deviation
8	• standard deviation
9	• coefficient of variation
10	• Graphical representation of Data
11	• Graphical representation of Data
12	• Probability, Concept of Probability
13	• Binomial distribution
14	• Normal distribution
15	• Poisson distribution & their applications
	UNIT - 2 QUALITATIVE & QUANTITATIVE VARIABLES
1	• Concept of Test of hypothesis
2	• Null hypothesis
3	• Alternative hypothesis
4	• Chi square test & its applications
5	• Chi square test & its applications
6	• Analysis of Variance and Co-variance
7	• One-Way ANOVA
8	• Two way ANOVA
9	• Large Sample Tests- Z-test of Means & Proportions

10	• Large Sample Tests- Z-test of Means & Proportions
11	• Small sample test
12	• T-test for Means
13	• Paired T-test
14	• F-test
15	• Simple regression & correlation
	UNIT- 3 BASIC TECHNIQUES
1	• Dialysis
2	• Ultrafiltration
3	• Spectroscopy Techniques – UV & Visible
4	• Raman Spectroscopy
5	• Fluorescence
6	• MS (mass spectra)
7	• NMR, PMR, ESR
8	• Plasma Emission spectroscopy
9	• API-electrospray & MADI-TOF
10	• Types of centrifuge - Microcentrifuge
11	• High speed & Ultracentrifuges
12	• Units of radioactivity; Measurement of radioactivity
13	• Geiger-Muller counter
14	• Solid & Liquid scintillation counters
15	• Applications of isotopes in Biotechnology
	UNIT 4 CHROMATOGRAPHY TECHNIQUES
1	• TLC and Paper chromatography;
2	• Chromatographic methods for macromolecule separation - Gel permeation
3	• Ion exchange chromatography
4	• Hydrophobic chromatography
5	• Reverse-phase chromatography
6	• Affinity chromatography
7	• HPLC and FPLC
8	• Criteria of protein purity
9	• Electrophoretic techniques
10	• Theory and application of Polyacrylamide gel electrophoresis
11	• Theory and application of Agarose gel electrophoresis
12	• Capillary electrophoresis; 2D Electrophoresis
13	• Disc gel electrophoresis; Gradient electrophoresis
14	• Pulsed field gel electrophoresis
15	• Protein crystallization

BT 301 BIOINFORMATICS

Class	Unit & Topic
	UNIT 1: FOUNDATIONS OF COMPUTATIONAL BIOLOGY
1	• Computer hardware & software.
2	• Introduction to computer languages – C, C++, JAVA, PERL
3	• Foundations to bioinformatics – History, overview
4	• Foundations to bioinformatics –applications
5	• Bioinformatics data – nucleic acid sequence
6	• protein sequence
7	• Bioinformatics databases –DNA databases
8	• RNA databases
9	• Protein databases
10	• Drug databases
11	• Bioinformatics tools and Resources
12	• Bioinformatics web- portals
13	• free online tools
14	• downloadable free tools
15	• software packages
	UNIT 2: COMPARISON METHODS IN BIOINFORMATICS
1	• Basics of sequence alignment -
2	• Dot-matrix comparison. - match, mismatch, gaps, scoring alignments, gap penalty, protein vs DNA alignment.
3	• Dot-matrix comparison. - match, mismatch, gaps, scoring alignments, gap penalty, protein vs DNA alignment.
4	• Pairwise alignment algorithms – Needleman and Wunch algorithm, Smith Watermann algorithm.
5	• Pairwise alignment algorithms – Needleman and Wunch algorithm, Smith Watermann algorithm.
6	• Pair wise alignment based heuristic algorithms - Blast algorithm, FASTA algorithm
7	• Pair wise alignment based heuristic algorithms - Blast algorithm, FASTA algorithm
8	• Pair wise alignment based heuristic algorithms - Blast algorithm, FASTA algorithm
9	• Multiple sequence alignment algorithms – progressive alignment algorithms, Iterative alignment algorithms
10	• Multiple sequence alignment algorithms – progressive alignment algorithms, Iterative alignment algorithms
11	• Multiple sequence alignment algorithms – progressive alignment algorithms, Iterative alignment algorithms
12	• Multiple sequence alignment based databases searching: Consensus sequence, patterns, profiles.
13	• PAM and BLOSUM matrices
14	• PAM and BLOSUM matrices
15	• PAM and BLOSUM matrices
	UNIT 3: GENOMIC AND PROTEOMIC APPLICATION OF BIOINFORMATICS
1	• Bioinformatics for genome sequencing

2	• EST Clustering and analyses
3	• EST Clustering and analyses
4	• Finding genes in prokaryotic and eukaryotic genomes: open reading frames, contents, signals.
5	• Finding genes in prokaryotic and eukaryotic genomes: open reading frames, contents, signals
6	• Finding genes in prokaryotic and eukaryotic genomes: open reading frames, contents, signals
7	• Bioinformatics for Genome maps and markers
8	• Bioinformatics for Genome maps and markers
9	• Bioinformatics for Genome maps and markers
10	• Bioinformatics for understanding Genome variation
11	• Bioinformatics for understanding Genome variation
12	• Bioinformatics for understanding Genome variation
13	• Protein structure prediction and classification
14	• Protein structure prediction and classification
15	• Protein structure prediction and classification
	UNIT - 4: APPLICATIONS OF BIOINFORMATICS
1	• Medical application of Bioinformatics – disease genes, drug targets, pharmacogenomics, drug designing
2	• Medical application of Bioinformatics – disease genes, drug targets, pharmacogenomics, drug designing
3	• Medical application of Bioinformatics – disease genes, drug targets, pharmacogenomics, drug designing
4	• Medical application of Bioinformatics – disease genes, drug targets, pharmacogenomics, drug designing
5	• Medical application of Bioinformatics – disease genes, drug targets, pharmacogenomics, drug designing
6	• Structural biology - Homology modeling
7	• Structural biology - Homology modeling
8	• Structural biology - Homology modeling
9	• Bioinformatics for micro array designing and transcriptional profiling
10	• Bioinformatics for micro array designing and transcriptional profiling
11	• Bioinformatics for micro array designing and transcriptional profiling
12	• Bioinformatics for micro array designing and transcriptional profiling
13	• Bioinformatics for phylogenetic analysis
14	• Bioinformatics for phylogenetic analysis
15	• Bioinformatics for phylogenetic analysis

BT 404 NANOBIOTECHNOLOGY

Class	Unit & Topic
	UNIT - I BASICS of BIONANOTECHNOLOGY
1	• Introduction to nanomaterials
2	• Structure and functional properties of Biomaterials
3	• Structure and functional properties of Biomaterials
4	• Role of size in nanomaterials, nanoparticles, semiconducting nanoparticles, nanowires, nanoclusters, quantum wells
5	• Role of size in nanomaterials, nanoparticles, semiconducting nanoparticles, nanowires, nanoclusters, quantum wells

6	• Role of size in nanomaterials, nanoparticles, semiconducting nanoparticles, nanowires, nanoclusters, quantum wells
7	• Role of size in nanomaterials, nanoparticles, semiconducting nanoparticles, nanowires, nanoclusters, quantum wells
8	• Water environment and their importance in bionanomachines
9	• Overview of natural Bionanomachines: Thymidylate Sythetase , ATP synthetase, Actin and myosin
10	• Overview of natural Bionanomachines: Thymidylate Sythetase , ATP synthetase, Actin and myosin
11	• Overview of natural Bionanomachines: Thymidylate Sythetase , ATP synthetase, Actin and myosin
12	• Overview of natural Bionanomachines: Thymidylate Sythetase , ATP synthetase, Actin and myosin
13	• Quantum Dot structures and their integration with biological structures
14	• Quantum Dot structures and their integration with biological structures
15	• Quantum Dot structures and their integration with biological structures
	UNIT 2 NANO-BIOSENSORS
1	• Biosensors
2	• Biosensors
3	• Biosensors
4	• Definition and classification – potential based sensors; electrochemical sensors; acoustic/mechanical sensors; thermal and phase transition sensors; sensors in modern medicine
5	
6	
7	
8	
9	
10	
11	
12	• Biomembrane based sensors. Diagnostic imaging techniques (digital imaging; molecular imaging).
13	• Biomembrane based sensors. Diagnostic imaging techniques (digital imaging; molecular imaging).
14	• Nanoengineered biosensors
15	• Nanoengineered biosensors
	UNIT 3 NANOMEDICINE AND NOVEL DRUG DELIVERY SYSTEMS
1	• Application of nano materials in medicine
2	• Nanoparticles as carrier for genetic material, neuroscience, cancer therapy, cardiovascular medical devices
3	• Nanoparticles as carrier for genetic material, neuroscience, cancer therapy, cardiovascular medical devices
4	• Tissue regeneration (tissue engineering)
5	• Tissue regeneration (tissue engineering)
6	• Tissue regeneration (tissue engineering)
7	• Dendrimers as nanoparticulate drug carriers
8	• Dendrimers as nanoparticulate drug carriers
9	• Dendrimers as nanoparticulate drug carriers
10	• Drug delivery systems –polymer drug conjugates; polymeric micelles; liposomes
11	• Drug delivery systems –polymer drug conjugates; polymeric micelles; liposomes
12	• Drug delivery systems –polymer drug conjugates; polymeric micelles; liposomes
13	• Nanoparticles for drug delivery
14	• Nanoparticles for drug delivery
15	• Nanoparticles for drug delivery
	UNIT 4 APPLICATIONS OF NANOBIOTECHNOLOGY

1	• Bio-Barcode

Teaching hours	**Intellectual property rights (IPR)**

2	• Assay Understanding of antibody based diagnostic techniques (immunoassay) - micro and nano immunosensors
3	• Assay Understanding of antibody based diagnostic techniques (immunoassay) - micro and nano immunosensors
5	•
6	
7	
8	• Nanotechnology in agriculture – Fertilizer and pesticides
9	
10	
11	
12	• Designer proteins, Peptide nucleic acids
13	• Designer proteins, Peptide nucleic acids
14	• Future of Bionanotechnology
15	• Future of Bionanotechnology

UNIT I	Intellectual property rights
Period 1	Classification and forms.
Period 2	Rationale for protection of IPRs
Period 3	Importance of IPRs in the fields of science and technology
Period 4	Patents – Concepts and principles of patenting – Patentable subject matter
Period 5	Procedure of obtaining patents
Period 6	Rights of patents
Period 7	Infringement of patent rights
Period 8	Remedies for infringement of patent rights
Period 9	Plant and Animal variety protection act
Period 10	The strategy of protecting plants and animals
Period 11	Recent Developments in Patent System
Period 12	Patentability of biotechnological inventions
Period 13	IPR issues in Indian Context Role of patent in pharmaceutical industry
Period 14	Case studies Rice, Haldi, neem, etc
Period 15	Patentability and emerging issues
UNIT II	**ETHICAL ISSUES**
Period 1	Introduction to Ethics
Period 2	Causes of unethical acts
Period 3	Causes of unethical acts Professional ethics
Period 4	Professional ethics professional conduct
Period 5	professional conduct
Period 6	Ethical decision making

Period 7	ethical dilemmas
Period 8	Teaching ethical values to scientists
Period 9	Good laboratory practices
Period 10	Good laboratory practices
Period 11	Good manufacturing practices
Period 12	Good manufacturing practices
UNIT III	**UNIT 3 QUALITY MANAGEMENT**
Period 1	**Introduction to QUALITY MANAGEMENT**
Period 2	Basic standards
Period 3	Need of standards
Period 4	Analytical standards
Period 5	Reference materials/controls (positive & negative
Period 6	matrix effect in standards
Period 7	Biological standards
Period 8	Microbial cell lines and standards
Period 9	Quality Management, Quality system
Period 10	Types of Quality systems ISI, ISO, HACCP
Period 11	HACCP , USFDA 21 CFR
Period 12	Inspection and testing
Period 13	Packaging, Preservation of the material
Period 14	Internal quality audits,
Period 15	Quality assurance. – Indian (NABL) & International systems
UNIT IV	**BIOSAFETY**
Period 1	Biosafety in the laboratory institution,
Period 2	Laboratory associated infections and other hazards
Period 3	assessment of biological hazards and levels of biosafety,
Period 4	prudent biosafety practices in the laboratory/ institution
Period 5	Biosafety regulations in the handling of recombinant DNA processes and products in institutions
Period 6	Biosafety regulations in the handling of recombinant DNA processes and products in

	industries
Period 7	biosafety assessment procedures in India and abroad
Period 8	Biotechnology and food safety, The GM-food debate and biosafety assessment procedures for biotech foods
Period 9	related products, including transgenic food crops
Period 10	Ecological safety assessment of recombinant organisms and transgenic crops,
Period 11	Biosafety assessment of biotech pharmaceutical products such as drugs
Period 12	Biosafety assessment of biotech pharmaceutical products Vaccines
Period 13	International dimensions in biosafety
Period 14	Catagena protocol on biosafety
Period 15	Bioterrorism, convention on biological weapons

Teaching hours	**PAPER – II : BT 202 r-DNA TECHNOLOGY**	
UNIT I	**ENZYMES AND VECTORS USED IN MOLECULAR CLONING.**	
Period 1	Introduction rDNA technology	Creation of recombinant DNA molecules DNA sequencing, amplification of DNA, expression of genes, Transgenic crops and animals, vaccines, therapeutic proteins.
Period 2	Discovery of restriction enzymes	Contribution of Luria, Human and Weigle in 1950 Werner Arber and Linn in 1960 and 1968 Meselson and Yuan, Smith and Kent Wilcox Restriction and Modification system
Period 3	Restriction endonucleases, classification	Type-I,II,III, subunits, cofactors, cutting Pattern
Period 4	Properties of Type II Enzymes	Nomenclature,restriction site nature, length, Sticky end and blunt ends, Isoschizomers, Neoschizomers, star activity, Unit definition, Deactivation, sequential and double digestion and applications
Period 5	methylases, polymerases	DAM and DCM Methyl ases, examples and application DNA Polymearase I, Klenow fragment, T7 DNA and RNA Polymerases, Thermostable Polymerases Taq , Pfu, Pow
Period 6	ligases, kinases,	Ligases and operation steps, T4 DNA &E.coli DNA ligases, cofactor requirement, Weiss units Kinases: T4 Poly nucleotide kinase properties
Period 7	phosphatases Nucleases,	E.coli, Shrimp and calf Intestine Phosphotase, Antarctic phosphotase, heat inactivation DNase I, Exonuclease III, Exonulease VIII, S1 nuclease, Mung bean nuclease
Period 8	RNA dependent DNA polymerase Terminal Deoxynucleotidyltransferase	Discovery, AMV/MAVRT, MULVRT, RNase H activity, cDNA Synthesis

		TDT Homopolymers at 3' end
Period 9	E.Coli plasmid vectors – pBR322	Cloning, purpose of cloning, Copy number, plasmid incompatability,Properties of cloning vectors, Construction of pBR322 series and properties, Insertional Inactivation
Period 10	pUC18, pET21	pUC18 features, MCS, Bi directional cloning, Lac promoter, B galctosidase, IPTG, Xgal, Blue white screening , Alpha complementation. pET21- properties of expression vectors, promoters, RBS, His tag, BL21 (DE3) pLys host
Period 11	Bacterio-phage vectors – λ	ʎ genome features, Insertion and replacement vectors
Period 12	M13,Cosmids,	M13- life cycle, Single strand DNA, M13mp1, M13mp2, M13mp7 Cosmids: cos site, larger insert pJB8
Period 13	Phasmids, phagemids	Phasmids -pBluescript-SK, , phagemids -pEMBL8
Period 14	Shuttle vectors Yeast vectors	Feasture of Shuttle vectors – Ecoli and yeast hosts Auxotrophic markers, p416GPD
Period 15	Baculo virus vector	Nucleopolyhedroviruses (NPV) , Granuloviruses , cell lines are sf9 & sf21, polyhedrin promoter of Autographacalifornicapolyhedrosis virus, pfastBac, (bacmid)
UNIT II	**CONSTRUCTION OF GENOMIC AND CDNA LIBRARIES**	
Period 1	DNA cloning.	Generation of DNA fragments by different methods: restriction digestion, mechanical shearing, duplex cDNA synthesis, chemical synthesis, PCR and selection of vector
Period 2	DNA cloning.	Joining to vector: Homo polymer tailing Ligation cohesive termini Blunt end ligation Linkers molecules T/A cloning

Period 3	DNA cloning.	Introduction into host: Transfection with recombinant phage DNA, Transformation of recombinant plasmid, Invitro packing into phage coat
Period 4	DNA cloning.	Selection: Hybridization, PCR, Functional complementation
Period 5	Strategies for construction of genomic libraries	Maniatisstratagey, using phage Lambda vector EMBL3A
Period 6	Screening of genomic libraries	Colony hybribidization and plaque hybridizaation
Period 7	chromosome walking.	Restriction mapping, probe preparation, hybridization, fragment 1
Period 8	Strategies for construction of cDNA libraries	Hair pin loop based, oligo d(T) Primer Okayama and berg method, Heidecker& Messing method
Period 9	Subtraction libraries	Driver cDNA,Tester cDNA
Period 10	normalized libraries	Genome based, denaturation –hybridization method, hydroxyapatite column chromatography
UNIT III	**TECHNIQUES EMPLOYED IN MOLECULAR CLONING**	
Period 1	Labeling of Nucleic acids	End Labelling, Nick translation, random labeling Radio active and non radio active
Period 2	Labeling of proteins	Biotin labeling, enzyme labeling, fluorescent probes
Period 3	Southern blot	DNA isolation, digestion, electrophoresis, transfer to membrane, crosslinking , probing and detection
Period 4	Northern ,Western,	mRNA isolation, Agarose electrophoresis, transfer to membrane, crosslinking , probing and detection Protein isolation, SDS PAGE, protein transfer, Primary antibody, secondary antibody and washes Substrate addition and
Period 5	North- Western,Zoo blots	Both DNA and protein interaction sites DNA from animals, digestion, agarose electrophoresis and detection
Period 6	Colony	Microbial colonies transferred to nitrocellulose membrane, alkali treatment, cross linking and

	hybridization	detection by using probe
Period 7	DNA sequencing – Maxam and Gilbert method	Obtain single strand DNA, Labeling , cleavage by chemicals, high resolution PAGE electrophoresis Detection of sequences
Period 8	Sanger's method,	Chain termination and fluorescent labeled dyes Single strand DNA, Labelled primer, dideoxy nucleotides
Period 9	PCR technology	Taq polymerase, primers, template, dNTPS, Mg. Primer design, Denaturation, annealing, Extension
Period 10	PCR Technology	Types Reverse, real time, nested, multiplex, Arbitaryand Applications
Period 11	Cloned gene expression.	Codon optimization Transcription termination Secondary structure mRNA
Period 12	Factors influencing cloned gene expression	Ribosome binding site Promoter strength
Period 13	Factors influencing cloned gene expression	Plasmid copy number Plasmid stability N terminal or c terminal fusions Host cell physiology Post translations modifications, glycosyslation
Period 14	siRNA	DICER, RISC
Period 15	Gene Silencing	Applications, cancer, Infectious diseases, vaccines
UNIT IV	**SELECTION AND ANALYSIS OF RECOMBINANT CLONES**	
Period 1	Genetic selection – alpha complementation,	B-galactosidase, x-gal , IPTG, Lac promoter, blue white screening
Period 2	Insertional inactivation	Plasmids with two antibiotic resistance makers Transformed, transformed with no recombinant

		Transformed with insert
Period 3	Screening of libraries using labeled probes	Colony hybridization , plaque hybridization, antibody Probe
Period 4	Restriction mapping of cloned fragments	Restriction digestion and agarose gel electrophoresis , probing and detection
Period 5	S1 Nuclease Mapping	Mapping of transcription start site termination site, mapping of introns site, quantitative estimation of particular mRNA
Period 6	Hybrid arrest	Cloned DNA,
Period 7	hybrid released translation	
Period 8	Site directed mutagenesis	Principles and various methods of SDM
Period 9	Site directed mutagenesis applications	Functional and structural protein studies and protein engineering , predicting the ligand binding sites. Increased expression of proteins, Addition of motifs to enhance the protein purification.
Period 10	Applications of rDNA technology	
Period 11	**In Agriculture/ Animal**	Abiotic and biotic stress tolerant transgenic plants Phytofortification, biopharming
Period 12	**Medicine and Health care**	Vaccines , therapeutics, Enzymes, Disease models Gene therapy
Period 13	**Environment**	Bioremediation by Genetically Modified organisms
Period 14	**Diagnosis**	DNA Finger printing ,PCR
Period 15		

Teaching hours	**BT 303 PLANT BIOTECHNOLOGY**	
UNIT I	**UNIT -I CLONAL PROPAGATION OF PLANTS**	
Period 1	Introduction to Plant Biotechnology	
Period 2	Introduction to totipotency of Plant cells	
Period 3	Types of media	
Period 4	Types of media	
Period 5	Initiation of Callus	
Period 6	suspension cultures	
Period 7	Micropropogation	
Period 8	Protoplast culture and fusion	
Period 9	Development of somatic hybrids	
Period 10	organogenesis	
Period 11	embryogenesis.	
Period 12	Encapsulation and production of synthetics seeds	
Period 13	Production of haploids through Anther	
Period 14	Production of haploids through pollen culture	
Period 15	Technology of freeze preservations and crop improvement	
UNIT II	**PRODUCTION OF COMMERCIALLY USEFUL COMPOUNDS BY CELL CULTURES**	
Period 1	Advantages of cultured plant cells and tissues	
Period 2	Cell line selection	
Period 3	commercial production	

Period 4	permeabilisation	
Period 5	elicitation	
Period 6	immobilisation	
Period 7	Induction of hairy root cultures	
Period 8	Hairy root culture uses	
Period 9	Biotransformations	
Period 10	Application of Biotransformations	
UNIT III	**MOLECULAR MECHANISMS OF ABIOTIC STRESS TOLERANCE IN CROP PLANTS**	
Period 1	**Introduction to ABIOTIC STRESS**	
Period 2	Drought stress tolerance	
Period 3	Drought stress tolerance	
Period 4	Flooding stress tolerance	
Period 5	Flooding stress tolerance	
Period 6	Salt stress tolerance.	
Period 7	Salt stress tolerance.	
Period 8	High temperature stress tolerance	Chain termination and fluorescent labeled dyes
Period 9	**Low** temperature stress tolerance	Components, Methodlogy, Primer design
Period 10	Photooxidative (light) stress tolerance	Types and Applications
Period 11	Photooxidative (light) stress tolerance	
Period 12	Metal stress tolerance	
Period 13	Metal stress tolerance	
Period 14		
Period 15		
UNIT IV	**MOLECULAR MECHANISMS OF BIOTIC STRESS TOLERANCE IN CROP PLANTS**	
Period 1	**Introduction to BIOTIC STRESS**	
Period 2	Biotic stress tolerance mechanisms	

Period 3	Bacterial resistance	
Period 4	Bacterial resistance	
Period 5	Fungal resistance	
Period 6	Fungal resistance	
Period 7	Viral resistance	
Period 8	Viral resistance	
Period 9	Molecular markers a	
Period 10	Molecular markers a	
Period 11	Molecular markers a	
Period 12	crop improvement	
Period 13	crop improvement	
Period 14		
Period 15		