M. Sc Biotechnology Course Structure (CBCS)

Semester-I							
S.No	Subject Code	Subject	Credits	Teaching Hours/Week	Marks		
					Internal Assessment	Semester Exam	Total
Theory							
1	BT 101T	Genetics	4	4	30	70	100
2	BT 102T	Cell Biology	4	4	30	70	100
3	BT 103T	Biochemistry	4	4	30	70	100
4	BT 104T	Microbiology	4	4	30	70	100
Practicals							
5	BT 101P	Genetics	2	4	-	50	50
6	BT 102P	Cell Biology	2	4	-	50	50
7	BT 103P	Biochemistry	2	4	-	50	50
8	BT 104P	Microbiology	2	4	-	50	50
Total			24	32	120	480	600

Semester-II							
S.No	Subject Code	Subject	Credits	Teaching Hours/Week	Marks		
					Internal Assessment	Semester Exam	Total
Theory							
1	BT 201T	Molecular Biology-I: Genome to Genes	4	4	30	70	100
2	BT 202T	Molecular Biology-II: Genes to Proteins	4	4	30	70	100
3	BT 203T	Immunology	4	4	30	70	100
4	BT 204T	Biostatistics, Laboratory Management and Biophysical Techniques	4	4	30	70	100
Practicals							
5	BT 201P	Molecular Biology-I: Genome to Genes	2	4	-	50	50
6	BT 202P	Molecular Biology-II: Genes to Proteins	2	4	-	50	50
7	BT 203P	Immunology	2	4	-	50	50
8	BT 204P	Biostatistics, Laboratory Management and Biophysical Techniques	2	4	-	50	50
Total			24	32	120	480	600

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Semester-III							
S.No	Subject Code	Subject	Credits	Teaching Hours/Week	Marks		
					Internal Assessment	Semester Exam	Total
Theory							
1	BT 301T	Genetic Engineering	4	4	30	70	100
2	BT 302T	Bioinformatics	4	4	30	70	100
3	BT 303T	Industrial Biotechnology	4	4	30	70	100
4	BT 304T	Bioprocess Engineering	4	4	30	70	100
Practicals							
5	BT 301P	Genetic Engineering	2	4	-	50	50
6	BT 302P	Bioinformatics	2	4	-	50	50
7	BT 303P	Industrial Biotechnology	2	4	-	50	50
8	BT 304P	Bioprocess Engineering	2	4	-	50	50
Total			24	32	120	480	600

Semester-IV							
S.No	Subject Code	Subject	Credits	Teaching Hours/Week	Marks		
					Internal Assessment	Semester Exam	Total
Theory							
1	BT 401T	Plant Biotechnology	4	4	30	70	100
2	BT 402T	Animal Biotechnology	4	4	30	70	100
3	BT 403T E1/E2 (Elective)	Environmental Biotechnology/ Medical Biotechnology	4	4	30	70	100
4	BT 404T	IPR, Entrepreneurship, Bioethics and Research Methodology	4	4	30	70	100
Practicals							
5	BT 401P	Plant Biotechnology	2	4	-	50	50
6	BT 402P	Animal Biotechnology	2	4	-	50	50
7	BT 403 P (E1/E2) (Elective)	Environmental Biotechnology/ Medical Biotechnology	2	4	-	50	50
8	BTPW	Project Work	2	4	-	50	50
Total			24	32	120	480	600
Grand Total			96	128	480	1920	2400

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M. Sc Biotechnology Programme Outcomes

Programme Outcomes:

1. Students can pursue Ph. D in Biotechnology or any allied subjects and are able to write research proposals and projects with critical thinking
2. Students can be employed in Biotech, Pharma Industries, Academia and Corporate sectors
3. Students can appear for National level examinations CSIR-UGC (JRF/NET), DBT-JRF, ICMR etc
4. Students can appear for National and State level Service Commission examinations
5. Students can become entrepreneurs with Start-ups in Biotechnology field with ethical and social responsibilities

Programme Specific Outcomes:

1. Students are able to culture and preserve microorganisms, animal cells and plant cells/tissues *in-vitro*
2. Students are able to develop improved breeding varieties of animals and plants
3. Students are able to develop Genetically Modified Organisms (GMOs) for human welfare with environmental safety
4. Students are able to develop recombinant DNA technology for the production recombinant therapeutic proteins and recombinant vaccines for medical sectors
5. Students are able to file patents for their innovations through interdisciplinary knowledge and advanced techniques

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M. Sc Biotechnology Syllabus (CBCS)

Semester: I

Subject: Genetics

Course Objectives:

1. To understand the concepts of heredity and variation
2. To learn the mechanism of sex determination and sex linkage
3. To know the concepts of genetic linkage and gene mapping
4. To introduce extrachromosomal inheritance and population genetics

Course Outcomes:

1. Understand the principles of Mendelian inheritance
2. Learn the mechanism of sex determination and inheritance of sex-linked traits
3. Acquire the knowledge to construct the genetic map of linked genes
4. Analyze the extrachromosomal inheritance and the concepts of population genetics

Credit-I: Mendelian Inheritance

1.1: Terms of Genetics: Gene, Alleles-Dominant Recessive and Lethal alleles, Phenotype, Genotypes-Homozygote and Heterozygote

1.2: Mendel's Laws: Law of Segregation and Law of Independent Assortment, Extension to Mendelian Genetics-Incomplete dominance, Codominance and Overdominance

1.3: The concept of Multiple Alleles: Coat colour in Rabbit, Blood groups in Humans

1.4: The concept of Pseudoalleles: Rh locus in Humans, Rh factor incompatibility-Erythroblastosis fetalis

1.5: Gene interactions, Epistasis and Modified Dihybrid Ratios

1.6: Penetrance and Expressivity, Pleiotropism, Phenocopies, Effect of environment on Phenotype

Credit-II: Polygenic Inheritance, Pedigree Analysis and Sex Determination

2.1: Quantitative traits and Polygenic Inheritance- Kernel colour in Wheat, Skin colour in Humans

2.2: Pedigree analysis in Humans-Autosomal dominant, Autosomal recessive, X-linked dominant, X-linked recessive and Y-linked inheritance

1.3: Chromosomal Theory of Inheritance, Autosomes and Sex chromosomes

1.4: Chromosomal sex determination systems- XX-XO, XX-XY, ZZ-ZW systems, Genic sex determination, Environmental sex determination

1.5: Sex determination in Humans: Mechanism, Role of Y chromosome, Lyon Hypothesis-Barr body formation, Sex chromosome abnormalities in Humans

1.6: Sex determination in Drosophila-Genic Balance Theory, Gynandromorphs, Sex linkage- Sex linked, Sex-influenced and Sex-limited traits

Credit-III: Linkage and Gene Mapping

3.1: Linkage, Recombination and Crossing over

3.2: Cytological evidence for crossing over: Creighton and McClintock experiment in Maize, Sturn's experiment in Drosophila

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3.3: Recombination frequency, Gene mapping by Two-point and Three-point test cross, Interference and Coefficient of Coincidence, Genetic map distance
3.4: Mitotic Crossover
3.5: Tetrad analysis in Neurospora
3.6: Linkage analysis in Humans- Sib Pair analysis, Lod Score Method

Credit- IV: Extranuclear Inheritance and Population Genetics

4.1: Extranuclear Inheritance- s Gene in Nicotiana
4.2: Cytoplasmic Inheritance-Leaf variegation in Mirabilis jalapa
4.3: Maternal Inheritance-The poky mutants of Neurospora
4.4: Cytoplasmic male sterility and hybrid seed production
4.5: Maternal Effect-Shell coiling in Snails, Mitochondrial DNA Inheritance
4.6: Population Genetics-Gene Pool and Gene Frequency, Hardy-Weinberg Law

Practicals:

Credit-I:

1.1: Problems on Monohybrid, Dihybrid and Trihybrid crosses, Genetics probability
1.2: Problems on Gene and Epistatic interactions
1.3: Problems on Multiple Alleles
1.4: Problems on Pedigree Analysis in Humans
1.5: Identification of Female and Male Drosophila, Mutant stocks of Drosophila

Credit-II:

2.1: Problems on sex determination
2.2: Problems on Gene Mapping by Two-point and Three-point test cross
2.3: Problems on Tetrad Analysis
2.4: Problems on Linkage Analysis in Humans
2.5: Problems on Population Genetics

Reference Books:

1. Principles of Genetics - D. Peter Snustad, Michael J. Simmons
2. Genetics: A molecular Approach - Peter J. Russell
3. Genetics: A conceptual Approach - Benjamin A. Pierce
4. Genetics: Principles and Analysis - Daniel L. Hartl, Elizabeth W. Jones
5. Principles of Genetics - Robert H. Tamarin
6. Genetics: From Genes to Genomes- Leland H. Hartwell, Michael L. Goldberg, Janice A. Fischer, Leroy Hood
7. Principles of Genetics: Eldon John Gardner, Michael J. Simmons. D. Peter Snustad Gardner
8. Genetics: Analysis and Principles - Robert J. Brooker
9. A Dictionary of Genetic - Robert C. King and William D. Stansfield
10. Population Genetics - V. Venugopal Rao Pratibha Nallari

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M. Sc Biotechnology Syllabus (CBCS)

Semester: I

Subject: Cell Biology

Course Objectives:

1. To understand the cellular architecture and intra and inter cellular transport mechanisms
2. To comprehend the cellular signalling and signal propagation for cell to cell communication
3. To understand the hall marks of cell cycle and cell division
4. To expose the cancer biology and cell death process

Course Outcomes:

1. Understand the intracellular organization and transport mechanisms
2. Comprehend the components, mechanism and pathways of cell signalling
3. Analyse the key events and regulation of cell cycle and cell division
4. Gain knowledge about the molecular mechanism involved in cancer development and Cell death

Credit I: Internal Organization and Transport of a Cell

1.1: Cell Membrane: Structure, Fluidity, Functions and Importance of Lipid bilayer, Composition: Membrane Lipids, Membrane Carbohydrates, Membrane Proteins-Integral, Peripheral and Lipid anchored Proteins

1.2: Structure and Functions of Semi-Autonomous Cell Organelles: Mitochondria and Chloroplast

1.3: Structure and Functions of Endomembrane System: Endoplasmic Reticulum and Golgi complex; Other Cell Organelles-Lysosomes (Endocytosis and Exocytosis), Peroxisomes and Glyoxysomes

1.4: Inter Cellular Transport: Passive Transport- Simple and Facilitated Diffusion, Three classes of transport membrane proteins-Uniporter, Symporter and Antiporter, Active Transport- Sodium Potassium Pump, ABC proteins, Multi Drug Resistant (MDR) Efflux, Diffusion of Ions through membranes: Ion Channels-Voltage gated, Ligand gated and Mechano-gated channels

1.5: Intra Cellular Transport: Transport of molecules between Nucleus and Cytosol, Nuclear pore complex, Selective transport of proteins and RNAs, Transport in Mitochondria and Chloroplast

1.6: Membrane Potential: Resting and Action potential, Propagation of action potential- Nerve impulse, Neurotransmission

Credit-II: Cell Communication and Interaction: Cell Signalling and Signal Transduction

2.1: Extracellular signaling: Autocrine, Paracrine and Endocrine signaling, Mechanism of action of Steroid, Protein and Amino acid derived hormones

2.2: Secondary Messengers and cascades: c-AMP, c-GMP, Inositol triphosphate, Diacyl glycerol, Calcium ions

2.3: Cell surface receptors structure and their role in Signal Transduction- G-Protein Coupled Receptors, Tyrosine Kinase Receptors, Insulin receptors

2.4: Interaction and regulation of Signal Transduction Pathways-Ras-MAP Kinase Pathway and Jak-Stat Pathway

2.5: Cytoskeleton Structure and Functions: Actin Filaments, Intermediate Filaments and Microtubules

2.6: Cell Junctions and Adhesions: Tight Junctions, Gap Junctions, Desmosomes, Cell Adhesion Molecules, Plasmodesmata

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Credit III: Cell Cycle and Cell Division

3.1: Cell cycle: Phases of Cell Cycle in Prokaryotes and Eukaryotes

3.2: Cell cycle regulation: Check Points and Cyclins, Role of Cyclin Dependent Kinases (CDKs), CDK phosphorylation and dephosphorylation, CDK inhibitors

3.3: Mitosis: Overview and Stages: Events occur during Prophase and Metaphase Mitosis: Formation of Mitotic Chromosomes, Centromeres and Kinetochores, Mitotic Spindle, Dissolution of nuclear envelope, Formation of Metaphase Plate, Metaphase-Movement of chromosomes to the Metaphase plate,

3.4: Mitosis: Events occur during Anaphase-Split of Sister chromatids, Telophase and Cytokinesis

3.5: Meiosis: Stages and Substages; Events of Prophase of Meiosis- Formation of Synaptonemal Complex, Role of Cohesins and Condensins in chromosome segregation

3.6: Non-disjunction of Mitosis and Meiosis

Credit-IV: Cancer Biology and Apoptosis

4.1: Cell Transformation and Cancer, Benign and Malignant cancers, Metastasis, Causes of Carcinogenesis, Characteristic features of Normal and Cancer Cells

4.2: Cellular and Molecular Genetics of Cancer-Oncogenes, Protooncogenes and Tumour Suppressor Genes, Tumour Suppressor Proteins-pRB, p53, pAPC, phMSH2, pBRCA1and pBRCA2

4.3: Cell Death: Apoptosis- Features and Importance, Necrosis and Autophagy

4.4: Mechanism of Apoptosis- Intrinsic and Extrinsic pathways

4.5: Apoptosis in Cancer

4.6: Apoptosis in Plants-Senescence: Apoptotic Like Programmed Cell Death (ALPCD), Defence against Pathogens

Practicals:

Credit-I:

1.1: Demonstration of Osmosis

1.2: Cell diffusion through Dialysis

1.3: Isolation of Mitochondria and Chloroplast by centrifugation

1.4: Isolation and observation of Protoplast

1.5: Activity of Na^+/H^+ antiporters in plants

Credit-II:

2.1: Identification of stages of Mitosis from Onion root tips

2.2: Identification of stages of Meiosis in Onion flower buds/Grasshopper Testis

2.3: Synchronization of Cell Cycle

2.4: Effect of colchicine in mitosis

2.4: Observation of Normal and Cancer Cells/Tissue

Reference Books:

1. Karp's Cell and Molecular Biology: Concepts and Experiments- Janet Iwasa and Wallace Marshall
2. Molecular Cell Biology - Harvey Lodish, Arnold Berk
3. Cell and Molecular Biology - E.D.P. De Robertis and E.M.F. De Robertis
4. The Cell: A Molecular Approach - Geoffrey M. Cooper and Robert E. Hausman

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5. Cell and Molecular Biology - David Baltimore
6. Essential Cell Biology - Bruce Albert

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M. Sc Biotechnology Syllabus (CBCS)

Semester: I

Subject: Biochemistry

Course Objectives:

1. To learn the classification, chemistry, sources and biological importance of carbohydrates and proteins
2. To impart the knowledge about significance, classification, chemistry and sources of lipids and nucleic acids
3. To understand the role and importance of enzymes in biochemical reactions
4. To comprehend and understand the metabolism of biomolecules

Course Outcomes:

1. Learn the classification, chemical structure, sources and biological importance of carbohydrates and proteins
2. Gain the knowledge about significance, classification, chemical structure and sources of lipids and nucleic acids
3. Understand the mechanism, kinetics and importance of enzymes in biochemical reactions
4. Critically analyze the Law's of Thermodynamics and bioenergetics of metabolic networks

Credit I: Carbohydrates and Proteins

1.1: Carbohydrates: Biological significance and Classification

1.2: Monosaccharides: Aldoses, Ketoses, Isomerism, Haworth and Fischer projections of Glucose, Fructose, Mannose and Galactose

1.3: Disaccharides: Structure and features of Maltose, Lactose, Sucrose and Trehalose

1.4: Homo polysaccharides: Structure and features of Cellulose, Chitin, Starch, Glycogen and Inulin, Heteropolysaccharides: Structure and features of Hyaluronic acid, Keratan sulphate, Chondroitin sulphate and Heparin

1.5: Proteins: Biological significance and Classification, Amino acids-Structures, Designation, Classification, Acid-base properties and Isomerism, Essential amino acids

1.6: Protein Conformation-Primary, Secondary, Tertiary and Quaternary structure, Ramachandran Plot

Credit-II: Lipids and Nucleic Acids

2.1: Lipids: Biological significance and Classification

2.2: Fatty Acids: Classification, Structures, Common and Systematic names, Sources, Essential fatty acids

2.3: Structures and importance of Triacylglycerols, Glycerophospholipids, Sphingolipids, Sterols and Waxes

2.4: History and discovery of DNA structure, Chargaff's rule

2.5: Chemical structure of DNA: Structure of Nitrogen bases and Sugars, Nucleosides and Nucleotides, Different forms of DNA, DNA Supercoiling and Topoisomerases

2.6: Types of RNA: m-RNA, t-RNA and r-RNA

Credit III: Biocatalysts

3.1: Enzymes: History, Nomenclature and Classification

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3.2: Properties of enzymes: Substrate specificity, Cofactors and Coenzymes, Active site
3.3: Enzyme kinetics: Derivation of Michaelis-Mention equation, Lineweaver-Burk plot, K_m, V_{max} and Turnover number
3.4: Enzyme Inhibition: Reversible Inhibition-Competitive, Non-competitive, Mixed and Uncompetitive; Irreversible inhibition
3.5: Isozymes, Zymogens, Multi enzymes, Ribozymes and Abzymes
3.6: Enzyme regulation: Allostery-Hemoglobin and Myoglobin, ATCase, Feedback inhibition

Credit-IV: Thermodynamics, Bioenergetics and Metabolism

4.1: Thermodynamics: Law's of thermodynamics, Entropy, Enthalpy, Gibb's free energy, Endergonic and Exergonic reactions, High energy biomolecules
4.2: Carbohydrate metabolism: Glycolysis and TCA cycle, Cori Cycle
4.3: Electron transport and Oxidative phosphorylation, Chemiosmotic theory of ATP synthesis
4.4: Fatty acid metabolism: β-oxidation of saturated and unsaturated fatty acids
4.5: Amino acid metabolism: Transamination, Deamination and Decarboxylation reactions, Urea Cycle
4.6: Photosynthesis: Light Dependent Reactions- Photo Systems, Cyclic and Non-cyclic Photophosphorylation; Light independent (Dark) reactions, C_3 and C_4 Cycle

Practicals:

Credit-I:

1.1: Preparation of Molar, Molal and Normal solutions, Buffers
1.2: Qualitative analysis of sugars
1.3: Quantitative estimation of sugars by Anthrone method
1.4: Qualitative analysis of amino acids
1.5: Quantitative estimation of proteins by Biuret method/ Lowry's method/ Folin's method

Credit-II:

2.1: Qualitative analysis of lipids
2.2: Determination of isoelectric point of Glycine
2.3: Extraction of amylase
2.4: Determination of Amylase activity
2.5: Extraction proteins from Milk/Egg

Reference Books:

1. Biochemistry - Donald Voet, Judith G. Voet
2. A Text Book of Biochemistry - Thomas M. Devlin
3. Lehninger's Principles of Biochemistry – David L. Nelson, Michael M. Cox
4. Harper's Illustrated Biochemistry - Victor W. Rodwell, David A. Bender, Kathleen M. Botham, Peter J. Kennely, P. Anthony Weil
5. Biochemistry - Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto.Jr and Lubert Stryer
6. Biochemistry - U. Satyanarayana, U. Chakrapani
7. Practical Biochemistry – Plummer
8. Biochemistry lab manual - Jayaraman

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M. Sc Biotechnology Syllabus (CBCS)

Semester: I

Subject: Microbiology

Course Objectives:

1. To introduce the origin, evolution, taxonomy, structure, classification and importance of diverse microorganisms
2. To learn the concepts of virology
3. To inculcate the skills required for microbial observation and culture
4. To know the role of microorganisms in causing infectious diseases of humans

Course Outcomes:

1. Gain the knowledge of diversity of microbial world and its significance
2. Understand the components, structure, taxonomy, life cycle and importance of viruses
3. Skilled to culture, stain and observe the microorganisms
4. Understand the transmission, pathogenesis, symptoms, diagnosis, treatment and prevention of infectious diseases caused by microbes

Credit I: Origin, Taxonomy, Diversity and Importance of Microorganisms

1.1: History, Scope and Future perspectives of Microbiology
1.2: Origin, Evolution, Diversity, Taxonomy of Microorganisms-Hackel's, Whittaker's and Carl Woese classification
1.3: Techniques to determine the Taxonomy and Phylogeny of Bacteria-16s r-RNA Typing, Multi Locus Sequence Typing (MLST), Bergey's Manual of Systemic Bacteriology
1.4: General and Structural characteristic features and Industrial importance of Bacteria
1.5: General characteristics, Classification and Economical importance of Algae and Cyanobacteria
1.6: General characteristics, Classification and Economical importance of Fungi

Credit-II: Concepts of Virology

2.1: Morphology and composition of Viruses: Host Range, Size and Shape, Components-Capsid and its symmetry, Envelope, Enzymes and Genomes
2.2: Principles of Viral Taxonomy: Baltimore System and ICTV Classification
2.3: Culturing, Enumeration, Purification and Assays of viruses
2.4: Viral Multiplication: Bacteriophages-Lytic and Lysogeny Cycle; Animal Viruses
2.5: Characteristic features and diseases caused by Viroids, Virusoids, Prions
2.6: Applications of Viruses in Biotechnology

Credit III: Microbial Observation, Growth, Culture and Control

3.1: Principle and instrumentation of microscopy: Light microscopy, Phase-contrast microscopy, Fluorescence microscopy Electron microscopy - TEM and SEM, Confocal microscopy
3.2: Preparation of specimen for microscopy: Light microscopy - Dyes, Staining Methods: Simple and Negative Staining, Differential and Structural Staining; Electron Microscopy- Sectioning of specimen, Chemical and Cryofixation, Shadow Casting, Freez Fracturing and Freez Etching
3.3: Control of Microorganisms: Disinfection, Sanitization, Antisepsis, Sterilization-Physical and Chemical Methods

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3.4: Factors effecting Bacterial growth: Temperature, P^H, Osmotic pressure and Oxygen, Nutritional groups of microorganisms
3.5: Bacteriological culture media: Defined Vs Undefined/Complex media, Enriched and Enrichment media, Differential and Selective media, Indicator media, Sugar media, Transport media
3.6: Bacterial culture and growth: Isolation of pure culture methods, Enrichment and Anaerobic culture, Bacterial Growth-Binary Fission, Growth Kinetics, Measurement of Bacterial Growth, Bacterial population growth curve

Credit-IV: Epidemiology and Infectious Diseases:

4.1: Terms of Epidemiology- Endemic, Epidemic, Sporadic, Pandemic, Source, Reservoir, Carrier
4.2: Infectious disease cycle, Mode of transmission of Infectious Diseases, Nosocomial Infections, Control of Epidemics and Pandemics
4.3: Bacterial Infections: Air born-Tuberculosis, Water borne-Typhoid
4.4: Viral infections: Airborn-SARS-Covid-19, Water and Food born-Polio
4.5: Zoonotic Infections-Rabies, Wound infections-Streptococcal infections
4.6: Sexually Transmitted Diseases-Gonorrhoea, Syphilis and HIV
4.6: Microbiome and its role in Human health, Role of Probiotics and Prebiotics in gut health

Practicals:

Credit-I:

1.1: Sterilization techniques- Autoclave, Hot Air Oven, Filtration, Laminar Air Flow
1.2: Preparation of bacteriological media
1.3: Dilution plating by serial dilution
1.4: Isolation of pure cultures of Bacteria- Spread plate, Streak plate and Pour plate methods
1.5: Plotting of Bacterial population growth curve
1.6: Isolation of Fungi

Credit-II:

2.1: Observation of Bacterial smear by Simple staining
2.2: Differential staining of Bacteria-Gram's staining
2.3: Endospore staining
2.4: Identification of Bacteria by IMVIC Tests
2.5: Fungal mounting by Lactophenol Cotton Blue
2.6. Cultivation of Bacteriophages from sewage sample

Reference Books:

1. Microbiology: An Introduction - Gerard J. Tortora, Berdell Ra. Funke and Christine Case
2. Prescott's Principles of Microbiology - Willey, Sherwood, Woolverton
3. Brock Biology of Microorganisms - Madigan, Martinko, Stahl, Clark
4. Microbiology: Principles and Explorations - Jacquelyn G. Black, Laura J. Black
5. Microbiology - M.J. Pelzar, E.S.N. Cfan and N.R. Kreig, McGraw Hill Publ
6. General Microbiology - Stanier, R.Y, J.L. Ingrahm, M.L. Wheel is & P.R. Painter
7. Text book of Microbiology - M. Burrows
8. Laboratory Experiments in Microbiology - Gopal Reddy

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M. Sc Biotechnology Syllabus (CBCS)

Semester: II

Subject: Molecular Biology-I: Genomes to Genes

Course Objectives:

1. To enable the architecture of chromosomes and its abnormalities
2. To learn the organization of genome and genes
3. To know the discovery and the mechanism of DNA replication
4. To elaborate the molecular mechanism of DNA damage, repair and recombination

Course Outcomes:

1. Able to understand the ultrastructure of chromosomes and its chromosomal abnormalities
2. Critically analyse the packaging of genome and organization of genes
3. Gain the knowledge of the experiments designed to prove the DNA as genetic material and the mechanism and regulation of DNA replication
4. Comprehend the molecular mechanism involved in DNA damage, repair and recombination

Credit-I: Chromosome Organization and Chromosomal Aberrations

1.1: Chromosome theory of inheritance, Structure of chromosomes-Centromere and Telomere, Telomere length and aging in Humans, Chromosome number, Chromosome Staining and Painting

1.2: Euchromatin and Heterochromatin

1.3: Human Karyotype and Classification of Human chromosomes

1.4: Specialized chromosomes- Polytene and Lamp brush chromosomes

1.5: Structural chromosomal abnormalities- Deletions, Duplications, Inversions and Translocation, Genetic disorders associated with chromosomal structural abnormalities in Humans

1.6: Variations in chromosome number-Aneuploidy, Euploidy and Polyploidy

Credit-II: Genome and Gene Organization

2.1: Genome organization in Prokaryotes

2.2: Genome organization in Eukaryotes, Nucleosome formation and role histone proteins

2.3: Mitochondrial and Chloroplast genome organization

2.4: Genome size, C-value and C-value paradox, Reassociation kinetics of DNA, Cot curves, Melting Points; Nucleotide sequence composition of Eukaryotic genomes-Unique, Moderately repetitive and Highly repetitive sequences; Satellite DNA

2.5: Gene organization-Cistron, Muton and Recon, Split and Overlapping genes

2.6: Gene families: Origin and evolution, Pseudogenes, Types- Tandem array and Clustered gene families

Credit III: History and Replication of Genetic Material

3.1: DNA as genetic material-Griffith's, Avery and Mac Leod, Hershey and Chase Experiments

3.2: RNA as genetic material-TMV

3.3: Models of DNA replication- Conservative, Semi-conservative and Dispersive model, Stahl and Meselson Experiment

3.4: DNA replication in Prokaryotes: Enzymes and proteins involved in replication, Stages of replication-Initiation, Elongation and Termination, Replisome, Fidelity of DNA Replication

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3.5: Models of Circular DNA replication: Theta model-Plasmid DNA, Rolling Circle model-Bacteriophage DNA

3.6: Nuclear DNA replication in Eukaryotes: Mechanism of linear DNA Replication, Enzymes and proteins involved replication, Replication of telomeres

Credit IV: DNA Damage, Repair, Recombination and Transposable Elements

4.1: Mutations: Somatic or Germinal, Spontaneous and Induced, Point mutations, Missense and Nonsense mutations, Frame shift mutations, Reversion of mutations, Phenotypic effects of mutations-Deleterious and Recessive, Conditional lethal mutations

4.2: Molecular basis of mutations: Tautomeric shift, Transitions and Transversions, Mutagenesis by Chemical and Physical agents, Ame's test for mutagenicity

4.3: DNA Repair: Direct repair, Excision repair, Mismatch repair, Homologous recombination repair and SOS Repair

4.4: Recombination in Bacteria: Conjugation, Transduction and Transformation

4.5: Models of Recombination, Homologous and Site-specific recombination

4.6: Transposable elements: IS elements, Composite transposons and TN3 elements; Simple, Replicative and Retrotransposons, DNA sequence pattern of transposable elements

Practicals:

Credit-I:

1.1: Isolation DNA from E. coli

1.2: Isolation of Plant genomic DNA

1.3: Isolation of DNA from blood

1.4: Separation of DNA by agarose gel electrophoresis

1.5: Chromosomal ploidy study in Plants

Credit-II:

2.1: Preparation of polytene chromosomes

2.2: Karyotyping

2.3: Determination of melting temperature of DNA

2.4: Problems on reassociation kinetics

2.5: Induction of mutations by chemical agents in Plants

Reference Books:

1. Molecular Cell Biology - Harvey Lodish, Arnold Berk
2. Karp's Cell and Molecular Biology: Concepts and Experiments - Janet Iwasa, Wallace Marshall
3. Molecular Biology - Robert Weaver
4. Genes - Benjamin Lewin
5. Molecular Biology of Gene - James D. Watson, Stephen P.Bell, Alexander Gann, Michael Levine, Richard Losick
6. Molecular Biology -David and Freifelder
7. Molecular Biotechnology - Primrose
8. Genetics: Analysis and Principles - Robert J. Brooker
9. Principles of Genetics – D. Peter Snustad, Michael J. Simmons
10. Genetics: A molecular Approach- Peter J. Russel

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M. Sc Biotechnology Syllabus (CBCS)

Semester: II

Subject: Molecular Biology-II: Genes to Proteins

Course Objectives:

1. To describe the mechanism of transcription in prokaryotes and eukaryotes
2. To brief the components required and their role in translation
3. To critically summarize the regulation of gene expression at various levels
4. To explain the importance of protein folding, targeting and degradation

Course Outcomes:

1. Able to understand the process of transcription
2. Learn the mechanism of translation of genetic information
3. Comprehend various molecular mechanisms involved regulation of gene expression
4. Understand the role of molecular chaperones in protein folding, trafficking and degradation

Credit I: Transcription

1.1: Transfer of genetic information- The Central Dogma, Protein synthesis machinery

1.2: Transcription in prokaryotes: General features of RNA synthesis, Polycistronic m-RNA, RNA polymerase and its Inhibitor-Actinomycin D, Viral RNA polymerase inhibitors-Nucleoside analogue inhibitors and Non-nucleoside inhibitors, Stages of transcription-Initiation, Elongation and Termination

1.3: Transcription in eukaryotes: Monocistronic m-RNA, RNA polymerases, RNA polymerase-II inhibitor-α-Amanitin, Stages of Transcription: Initiation, Elongation and Termination

1.5: m-RNA processing in Eukaryotes-Capping, Tailing, Splicing of Group-I and II Introns, Alternate splicing and Editing

1.6: Synthesis and processing of eukaryotic ribosomal and transfer RNAs

Credit-II: Translation

2.1: Overview of protein synthesis, Components of translation

2.2: Deciphering the genetic code and features of genetic code

2.3: Recognition of codons by t-RNA and Wobble hypothesis

2.4: Translation-Initiation, Elongation and Termination of Polypeptide synthesis in prokaryotes and eukaryotes

2.5: Post-translational modifications: Glycosylation, Lipidation, Acetylation

2.6: Peptide antibiotics, Inhibitors of prokaryotic protein synthesis-Aminoglycosides, Tetracyclines, Macrolides

Credit III: Regulation of Gene Expression

3.1: Gene expression in prokaryotes: Constitutive, Positive and Negative control of gene expression in prokaryotes, Concept of operon, Inducible Operon-Lac Operon, Repressible Operon-Tryptophan Operon

3.2: Levels of control of gene expression in eukaryotes; Spatial, Temporal and Tissue specific gene expression in eukaryotes

3.3: Eukaryotic gene regulation of at chromatin level: Gene amplification- r-RNA genes in Xenopus laevis oocytes; Chromatin remodelling and epigenetic regulation-Histone modification, DNA methylation and CpG Islands, Genomic Imprinting

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3.4: Regulation at transcription level: Response elements, Regulatory transcription factors-Activators and Co-activators, Repressors and Co-repressors; Structural domains of regulatory transcription factors-Helix-turn-helix, Leucine zipper, Zinc finger and Helix-loop-helix motifs; Modulation of function of regulatory transcription factors; eg; Galactose utilization in Yeast, Mating types in Yeast and Steroid hormone expression in Animals

3.5: Post-transcriptional regulation of gene expression: RNA Interference-Micro RNAs, RNAi Pathway, m-RNA stability

3.6: Regulation at translational level: Phosphorylation of ribosomal factors, eg; Regulation of iron assimilation in Mammals

Credit-IV: Protein Folding, Trafficking and Degradation

4.1: Dynamics of protein folding: Two families of Chaperones-Molecular chaperones and Chaperonins, Protein folding Pathways

4.2: Protein folding promoted by proline isomerases-Modification of amino acids

4.3: Protein Sorting: Overview of protein sorting pathways-Signal based targeting and Vesicle based trafficking (Secretory Pathway)

4.4: Protein targeting into and across ER

4.5: Protein targeting in Mitochondria and Chloroplast

4.6: Protein degradation: Ubiquitin-Proteasome mediated proteolysis, Regulation of protein function- Ca^{+2}-Calmodulin mediated switching, Phosphorylation and dephosphorylation, Ubiquitinylation and deubiquitylation

Practicals:

Credit-I:

1.1: Extraction of RNA from Yeast

1.2: Extraction of RNA from Plants

1.3: Extraction of RNA from blood

1.4: Estimation of RNA by Orcinol method

1.5: Purification of m-RNA

Credit-II

2.1: Determination of concentration and purity of RNA

2.2: c-DNA synthesis

2.3: Gene expression analysis by qRT-PCR

2.4: Induction of Lac operon

2.5: Characterization of transcription factor using Electrophoretic Mobility Shift Assay

Reference Books:

1. Molecular Cell Biology- Harvey Lodish, Arnold Berk
2. Karp's Cell and Molecular Biology: Concepts and Experiments - Janet Iwasa, Wallace Marshall
3. Molecular Biology- Robert Weaver
4. Genes- Benjamin Lewin
5. Molecular Biology of Gene- James D. Watson, Stephen P.Bell, Alexander Gann, Michael Levine
6. Genetics: Analysis and Principles- Robert J. Brooker
7. Principles of Genetics- D. Peter Snustad, Michael J. Simmons
8. Genetics: A molecular Approach- Peter J. Russell

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M. Sc Biotechnology Syllabus (CBCS)

Semester: II

Subject: Immunology

Course Objectives:

1. To provide an overview of immune system and its components
2. To discuss the role of MHC in immune response and its importance in organ transplantation
3. To provide the insights of specific immune response
4. To brief the immune reactions in diagnostics, allergy, autoimmune disorders and cancer

Course Outcomes:

1. Understand the structure and functions of various organs, cells and other components of immune system
2. Learn the structure, functions, inheritance and role of MHC in immune response
3. Explores the mechanism involved in triggering the activation, proliferation and differentiation of lymphocytes
4. Understand about antigen- antibody reactions and the mechanism involved in immune response of allergic reactions, autoimmune disorders and cancer

Credit I: Immunity and Immune System

1.1: History and Development of Immunology, Classification of immunity: Innate Immunity- Anatomical, Physiological, Inflammatory and Phagocytic barriers- Toll-like receptors; Acquired Immunity-Active and Passive

1.2: Organs of the Immune System: Primary, Secondary and Tertiary lymphoid organs, Lymphatic system

1.3: Cells of the immune system: Hematopoiesis, Granulocytes, Agranulocytes and Lymphocytes

1.4: Antigens: Properties, Epitopes, Haptens, Adjuvants, Super Antigens

1.5: Immunoglobulins: Discovery, General structure, Classes of immunoglobulins and their biological features, Monoclonal Antibodies: Hybridoma technology, Applications of monoclonal antibodies

1.6: Organization of immunoglobulin genes, Generation of antibody diversity

Credit-II: Major Histocompatibility Complex

2.1: General organization, inheritance and classes of MHC

2.2: Structure and genes of MHC Class-I and Class-II molecules

2.3: Interaction of MHC Class-I and Class-II with peptides

2.4: Genetic map of MHC genes, HLA typing

2.5: Cellular expression of MHC Molecules, Regulation of MHC expression

2.6: Role of MHC in antigen processing and presentation, Antigen processing and presentation pathways- Cytosolic and Endocytic pathways

Credit III: Cell and Humoral Mediated Immunity

3.1: Cytokines- Features and biological functions, Cytokines in Hematopoiesis, Cytokine related diseases and Cytokine based therapies

3.2: Structure and role of T-cell receptor, T-cell receptor complex-CD3, T-cell accessory membrane molecules CD_4 and CD_8

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3.3: T-Cell Maturation, Activation and Differentiation
3.4: B-Cell Maturation, Activation and Differentiation
3.5: Cell mediated immunity: Cytotoxic responses by Helper and Cytotoxic T Cells, Natural Killer Cells
3.6: Humoral mediated immunity, Primary and Secondary immune response, Class Switching

Credit-IV: Immune Reactions, Immune Response in Allergy, Organ Transplantation and Cancer

4.1: Complement System: Activation of Complement Pathway- Classical, Lectin and Alternative Pathways, Functions of Complement
4.2: Antigen-antibody reactions: Kinetics, Types- Agglutination, Precipitation, Neutralization, ELISA and RIA, Complement Fixation Test
4.3: Hypersensitivity: Allergy, Coomb's Classification, Hypersensitivity Reactions-Type-I, II, III and IV
4.4: Autoimmunity: Causes, Organ specific autoimmune diseases-Hashimoto's thyroiditis, Autoimmune anaemias, Insulin dependent diabetes mellitus, Goodpasture's syndrome, Graves's disease, Myasthenia gravis; Systemic autoimmune diseases-Systemic Lupus Erythematosus, Multiple sclerosis and Rheumatoid arthritis
4.5: Immune response in Transplantation: Immunological basis and stages of graft rejection, Immune response in graft rejection, Immunosuppressive therapy
4.6: Immunology of Cancer: Tumour Antigens, Immune response to Cancer, Cancer Immunotherapy

Practicals:

Credit-I:

1.1: Differential Leucocyte count
1.2: RBC counting
1.3: WBC counting
1.4: Separation of plasma from blood
1.5: Isolation of serum

Credit-II

2.1: Blood grouping by Hemagglutination test
2.2: Widal test for Typhoid infection
2.3: VDRL test for Syphilis
2.4: Radial Immuno Diffusion test/ Ouchterlony's Double Diffusion test
2.5: C-Reactive Protein Test and Rheumatoid Arthritis Test

Reference Books:

1. Kuby Immunology - Richard A Goldsby, Thomas J Kindt and Barbara A Osborne
2. Roitt's Essential Immunology - Peter J. Delvis, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt
3. Text Book of Immunology- Baruj Benacerraf
4. Textbook of Immunology: An Introduction to Immunochemistry and Immunobiology – J. T. Barret
5. Immunology: An Introduction - Ian. R. Tizard
6. Fundamental Immunology - Willaim E. Paul
7. Immunology, Immunopathology and Immunity - Stewart Sell, Edward E. Max
8. The Elements of Immunology - Fahim Halim Khan

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M. Sc Biotechnology Syllabus (CBCS)

Semester: II

Subject: Biostatistics, Laboratory Management and Biophysical Techniques

Course Objectives:

1. To know the basic concepts of statistics and its importance in biological sciences
2. To learn the statistical tools, tests and their applications in biological research
3. To inculcate the skills required to design and analyse the results of research experiments and good laboratory practices
4. To explain the principles, instrumentation and applications of various biophysical techniques

Course Outcomes:

1. Acquire the skills to present and infer the results of biological research experiments
2. Able to apply the statistical tools and tests in biological research
3. Enable to design and analyse research experiments and laboratory management skills
4. Learn the art of skills of various biophysical techniques used in biological sciences

Credit I: Introduction to Biostatistics

1.1: History and terminology of Biostatistics - Variable, Data, Sample and Population
1.2: Sampling techniques: Methods of Sampling, Choice of sampling methods, Sampling and Non-sampling errors
1.3: Frequency distributions, Diagrammatic and Graphical representation of data
1.4: Measures of central tendency: Arithmetic Mean, Median, Mode, Geometric Mean and Harmonic Mean
1.5: Measures of dispersion: Range, Mean Deviation, Variance and Standard Deviation, Representation of dispersion - Skewness and Kurtosis
1.6: Probability and distributions: Laws and Theorems of probability, Binomial, Poison and Normal Distribution

Credit-II: Inferential Statistics

2.1: Test of significance: Null and Alternate hypothesis, Types of errors and level of Significance
2.2: Comparison of means of two small samples: t- Test and Paired t-Test
2.3: Comparison of means of two large samples: Z test
2.4: Analysis of variance: One-way and Two-way ANOVA
2.5: Correlation and regression: Types, Methods of studying correlation, Analysis of regression
2.6: Chi-square test: Degrees of freedom, Characteristics of Chi-square test and applications

Credit-III: Experimental Design and Laboratory Management

3.1: Experimental design: Introduction, Concepts and Principles, Types
3.2: Types of experimental design: Completely randomized design, Randomized complete block design, Latin square design, Factorial experiments, Confounding-Principles and Experiments,
3.3: Administration of laboratory: Laboratory design Security measures, Laboratory Information Management System (LIMS), Good Laboratory Practices, Good Manufacturing Practices, Laboratory accreditation
3.4: Laboratory safety: General safety measures, Chemical, Physical and Biological Hazards, Disposal of Laboratory waste, First Aid

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3.5: Biosafety of GMOs: GMOs and LMOs, Applications of GMOs in food and agriculture, Environmental release of GMOs, Risk analysis, Assessment, Management and Communication
3.6: Biosafety guidelines and management system of Government of India- RCGM, GEAC; National regulations and International agreements on biosafety-Cartagena protocol

Credit IV: Biophysical Techniques

4.1: Centrifugation: Principle, Instrumentation, Types of Centrifuges, Methods of Centrifugation- Differential and Density gradient centrifugation
4.2: Electrophoresis: Principle and Instrumentation, Agarose Gel Electrophoresis, PAGE and SDS-PAGE, ,2-D Gel and Pulse Field electrophoresis, Isoelectric focusing
4.3: Spectroscopy: Principle, Instrumentation and Applications of Colorimetry and Spectroscopy
4.4: Principle, Instrumentation and applications of FRET, FTIR, NMR, ESR, Mass, Fluorescence, Emission/Absorption Spectroscopy
4.5: Optical rotation and Circular dichroism, X-ray Diffraction and X-ray Crystallography
4.6: Radioisotopes used in Biology, Scintillation Counter, Autoradiography

Practicals:

Credit-I:

1.1: Diagrammatic and graphical representation of data
1.2: Problems on measures of central tendency
1.3: Problems on measures of dispersion
1.4: Problems on probability
1.5: Fitting Binomial, Poisson and Normal Distribution

Credit-II

2.1: Problems on Chi-square test
2.2: Problems on t-Test, ANOVA
2.3: Problems on correlation and regression
2.4 Separation of proteins by SDS-PAGE
2.5 Measurement of absorbance using spectrophotometer

Reference Books:

1. Biostatistics - Khan and Khanum
2. Biostatistical Methods in Agriculture Biology and Medicine - Khan and Khanum
3. Fundamentals of Biostatistics - P.H. Rao and Janardhan
4. Population Genetics - V. Venugopal and Pratibha Nallari
5. Biostatistics - Vishweswara Rao
6. Principles and Techniques of Biochemistry and Molecular Biology - Keith Wilson and Jhon Walker
7. Biophysical Chemistry: Principles and Techniques - Upadhyay and Upadhyay
8. Biophysical Techniques - Iain D. Campbell
9. CRC Handbook of Laboratory Safety - A. Keith Furr
10. Biological Safety: Principles and Practices - Diane O. Fleming, Debra L. Hunt
11. Practical Biochemistry - Plummer
12. Biochemistry Lab Manual - Jayaraman

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M. Sc Biotechnology Syllabus (CBCS)

Semester: III

Subject: Genetic Engineering

Course Objectives:

1. To describe the requirements of gene cloning
2. To learn the strategies involved in gene cloning
3. To inculcate the skills required for screening of desired recombinant clones
4. To understand the applications of r-DNA technology

Course Outcomes:

1. Learn the techniques required for construction of r-DNA molecules
2. Learn the strategies of gene cloning
3. Able to identify and screen the desired recombinant clones
4. Able to apply the r-DNA technology for the human welfare

Credit I: Enzymes and Vectors used in Gene Cloning

1.1: Enzymes used in gene cloning: Nucleases- Exonuclease-III, S1 Nuclease; Polymerases- E. coli DNA polymerase I, Klenow, Terminal transferase; DNA Modifying Enzymes: Kinases – Bacteriophage T_4 Polynucleotide Kinase; Phosphatases- Alkaline Phosphatase; Ligases- Bacteriophage T_4 DNA Ligase and Bacteriophage T_4 RNA Ligase

1.2: Restriction Endonucleases: History, Types: Type-I and Type-II, Features of Type-II, Modification of restriction ends-Linkers and Adaptors

1.3: Features of vectors, Cloning and Expression vectors, Plasmids- Classification and features, Plasmid Vectors-p^{BR322}, p^{BR327}, p^{UC}, $p^{Bluescript}$, p^{GEM}, p^{ET}

1.4: Phage vectors: Insertional Vectors- λgt-10 and λgt-11, Replacement Vectors- EMBL, M13 vectors

1.5: Hybrid vectors: Cosmids- p^{JB}, C2XB, Phasmids, Phagemids

1.6: Yeast Vectors-YACs, BACs

Credit-II: Construction of Genomic and c-DNA Libraries

2.1: Steps involved in gene cloning, Construction of genomic libraries

2.2: Positional cloning-Contig, Chromosome walking, Chromosome jumping

2.3: c-DNA synthesis, Construction of c-DNA libraries

2.4: Model organisms: Bacteriophages, E.coli, Agrobacterium, Yeast, Chlamydomonas, Caenorhabditis elegans, Drosophila, Zebra Fish, Mice, Arabidopsis thaliana, Tobacco

2.5: Gene amplification by PCR- Mechanism and Steps, Thermocycler, Primer designing, Applications of PCR

2.6: Variations in PCR- ARMS PCR, RT-PCR, q-PCR, Multiplex PCR

Credit-III: Screening of Desired Recombinant Clones

3.1: Screening of Libraries: Genetic Selection- Insertional Inactivation, Alpha Complementation; Screening by Immunological Assays

3.2: Synthesis of probes- Nick translation, Random primer labelling, End labelling; Selection of recombinant clones by colony hybridization, FISH

3.3: Detection of genes and gene products: Blotting techniques- Southern blotting, Northern blotting and Western blotting; Reporter Genes

3.4: DNA Sequencing: Maxam Gilbert and Sanger method, Automated Sequencing, Next generation

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sequencing

3.6: Hybrid Released Translation (HRT) and Hybrid Arrested Released Translation (HART)

Credit-IV: Applications of Genetic Engineering

4.1: Site Directed Mutagenesis

4.2: Organellar transformation: Chloroplast and Mitochondria

4.3: CRISPR-Cas technology: TALENS, Zinc-Finger Nucleases, Base and Prime editing

4.4: Micro array chip technology and its applications

4.5: DNA Fingerprinting and its applications

4.6: Applications of r-DNA technology in agriculture, medicine and pharmacy

Practicals:

Credit-I:

1.1: Isolation of Plasmid DNA

1.2: Restriction digestion and Problems on restriction mapping

1.3: Restriction digestion of lambda DNA

1.4: Primer designing

1.5: Preparation of competent cells by $CaCl_2$ and transformation

Credit-II:

2.1: Cloning of a gene

2.2: Construction of c-DNA libraries

2.3: Blue-white screening of non-recombinant and recombinant clones

2.4: PCR reaction

2.5: GUS staining technique/Ruby to evaluate putative transformants

Reference Books:

1. Principles of Gene Manipulation - S. B. Primrose, R. M Twyman and R.W. Old
2. Gene Cloning and DNA Analysis: An Introduction - T.A. Brown
3. From Genes to Clones: An Introduction to Gene Technology - Ernst L. Winnacker
4. Lewin's Genes - Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick
5. Molecular Cloning: A Laboratory Manual - Sambrook and Russell Vol-I, II and III
6. Molecular Biotechnology: Principles and Applications of Recombinant DNA Technology- Bernard R. Glick. Jack J. Pasternak. Cheryl L. Patten
7. An Introduction to Genetic Engineering - Desmond S. T Nicholl
8. Genetic Engineering - Smita Rastogi and Neelam Pathak
9. Genetic Engineering - Verma P. S and Agarwal V.K
10. Introduction to Genetic Engineering - Ranjan Kumar Sahoo

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M. Sc Biotechnology Syllabus (CBCS)

Semester: III

Subject: Bioinformatics

Course Objectives:

1. To explores the resources and tools for retrieving, storing and processing bioinformatics data
2. To use the tools and algorithms for sequence alignment
3. To apply *in-silico* tools for gene annotation and genome sequencing
4. To predict the protein structure and design, study the drugs *in-silico*

Course Outcomes:

1. Explores the use of resources and tools of bioinformatics
2. Able to compare the sequences to predict the origin, evolution and function of sequences
3. Enable the use of *in-silico* tools for prediction of genes and their regulatory elements
4. Develop the skills required for prediction of protein structure, drug designing and docking

Credit-I: Resources and Tools of Bioinformatics

1.1: Introduction, History, Scope, Applications and Limitations of Bioinformatics

1.2: Bioinformatics data: Nucleic acid sequence, Protein sequence and Single letter designations of amino acids, Protein structure, Terminology of Genomics, Proteomics and Metabolomics

1.2: Classification of databases-Primary, Secondary and Special Databases

1.3: Nucleotide databases: NCBI-Genbank, EMBL and DDBJ; Gene expression databases: GEO, Expression Atlas, GTEx; Protein Databases: Uniprot, PDB, Swiss Prot; Metabolic databases: KEGG, MetaCyc

1.5: File formats of databases, Database search engines - Entrez and SRS

1.6: Internet and its role in Bioinformatics: Web Portals, Software Packages, Online Tools

Credit-II: Sequence Alignment

2.1: Sequence alignment- Local and Global, Pairwise and Multiple alignment, Scoring of alignment- Match, Mismatch, Gap, Gap penalties

2.2: Relationship between sequences- Homologs, Paralogs and Orthologs; Vertical and Horizontal Gene Transfer

2.3: Sequence similarity search tools - BLAST and FASTA

2.4: Sequence alignment scoring matrices - PAM and BLOSSUM

2.5: Pairwise alignment: Dot matrix comparison; Dynamic programming: Global-Needleman and Wunsch algorithm and Local- Smith and Waterman algorithm

2.6: Multiple sequence alignment: Heuristic algorithms - Progressive and Iterative method algorithms: CLUSTALW, CLUSTAL Omega and PILEUP

Credit-III: Genomics

3.1: Bioinformatics for genome sequencing: Reads, Contigs, Scaffold

3.2: Bioinformatics tools and resources for genomic sequencing technologies

3.3: Tools for gene prediction in prokaryotes - Finding Genes, Open Reading Frames (ORFs), Promoters, Regulatory Elements, Repeats, Expressed Sequence Tags (ESTs)

3.4: Tools for gene prediction in Eukaryotes - Ab-initio, Homology and Consensus based programmes; Human Genome Project

3.5: Phylogenetic analysis of sequences: Evolutionary trees - Rooted and Unrooted, Methods of

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phylogenetic trees construction and evaluation

3.6: Transcript profiling: Micro Arrays, Transcriptome sequencing, RNA Seq analysis

Credit-IV: Protein Modeling and Molecular Docking

4.1: Classes of protein structure, Protein structure classification databases- SCOP, CATH, FSSP, MMDB and SARF, Visualization and Comparison of proteins

4.2: Prediction of protein structure: Homology based modelling- steps involved and resources available, Significance of protein prediction

4.3: Bioinformatics for metabolic networks: Pathways and reconstruction

4.4: Computer aided drug design: Structure based drug design, Ligand based drug design

4.5: Molecular databases, Prediction of ADMET properties

4.6: Molecular docking: Types, Scoring and interpretation of docked models, Significance, Web resources for molecular docking

Practicals:

Credit-I:

1.1: File formats of Nucleic acid databases

1.2: Downloading DNA sequence data (Genbank/DDBJ/EBI)

1.3: Downloading protein sequence data (UniProt/PDB)

1.3: Sequence search tools- BLAST and FASTA

1.4: Pairwise sequence alignment

1.5: Multiple sequence alignments

1.6: Construction of phylogenetic trees by Mega software

Credit-II

2.1: Downloading protein structure data (PDB/MMDB) and visualisation

2.2: Prediction of ORFs, Promoters and Regulatory Elements

2.3: Prediction of protein structure- Homology modeling

2.4: Chemoffice for generation of molecular database

2.5: Prediction of ADMET properties

2.6: Molecular docking

Reference Books:

1. Bioinformatics: Sequence and Genome Analysis - David W. Mount
2. Bioinformatics Technologies - Yi-Ping Phoebe Chen (Ed.)
3. Essential Bioinformatics - Jin Xiong
4. Bioinformatics: An Introduction - Jeremy Ramsden
5. Bioinformatics - An Introductory Text Book - Thomas Dandekar, Meik Kunz
6. Bioinformatics for Beginners: Genes, Genomes, Molecular Evolution, Data Bases and Analytical Tools - Supratim Choudhury
7. Bioinformatics: Concepts, Skills and Applications – R. S. Rastogi
8. Cheminformatics: A Text Book – Johann Gasteiger

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M. Sc Biotechnology Syllabus (CBCS)
Semester: III
Subject: Industrial Biotechnology

Course Objectives:

1. To enable the use of strategies involved in screening and development of industrially useful microbial strains
2. To develop the fermentation technology for industrial production of microbial products
3. To produce various industrially important microbial products
4. To produce fermentative dairy and food products

Course Outcomes:

1. Able to screen and develop the microbial strain for the production of useful products
2. Learn the fermentation technology required for the microbial product production
3. Enable the fermentative production of economically important products
4. Able to produce fermentative dairy and food products

Credit I: Screening and Selection of Industrially Useful Microorganisms

1.1: Introduction to fermentation technology, Industrially useful microorganisms- Bacteria, Algae, Fungi and Actinomycetes
1.2: Microbial fermentation products: Microbial Biomass, Microbial Enzymes and Recombinant products
1.3: Industrially useful metabolites-Primary and Secondary metabolites
1.4: Screening of industrially useful microorganisms- Primary and Secondary Screening
1.5: Strain improvement of industrial microorganisms- Mutagenesis, Recombination, Protoplast Fusion and Gene Technology
1.6: Long-term and short-term preservation methods of economically important microbial strains, Centralized culture collection centers for valuable culture deposition

Credit-II: Microbial Fermentation Process

2.1: Fermentation Process: Inoculum Preservation, Growth of the Inoculum, Fermenter Preculture, Production Fermentation
2.2: Culture systems of fermentation: Batch Culture, Fed-batch Culture, Continuous Culture-Chemostat and Turbidostat, Dual or Multiple Fermentations, Aerobic and Anaerobic Fermentation
2.3: Types of fermentation process: Surface, Submerged and Solid-state fermentation
2.4: Scale-up of Fermentation: Significance, Scale up with constant power consumption and Constant oxygen transfer rate
2.5: Enhancing the fermentation product yield
2.6: Raw materials for industrial fermentation: Substrates used as Carbon and Nitrogen sources

Credit III: Fermentative Productions

3.1: Fermentative production of alcoholic beverages: Wine and Beer
3.2: Industrial production of antibiotics: Penicillin and Streptomycin- Biosynthesis, Strain development, Production and Product recovery
3.3: Production of organic acids and organic solvents: Citric Acid and Butanol- Acetone - Biosynthesis, Strains used, Production, Extraction and Recovery

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3.4: Enzymes as fermentation products: Amylase and Proteolytic enzymes
3.5: Production of Vitamins: Cyanocobalamin and Riboflavin, Production of Amino acids- Glutamate
3.6: Production of recombinant vaccines - Hepatitis-B and HPV

Credit-IV: Dairy and Food Technology

4.1: Microbiology of milk: Microorganisms present in milk, Spoilage and Preservation of Milk
4.2: Fermentative production of dairy products: Cheese, Butter, Yoghurt and Butter Milk
4.3: Microbiology of food: Microorganisms and Food spoilage, Food intoxication, Assessment of Food quality, Food preservatives and flavouring agents
4.4: Fermented and oriental foods: Bread, Sauerkraut, Soy sauce, Soy products-Tofu
4.5: Microbial cells as food: Single Cell Proteins and Mushrooms
4.6: Probiotics and Prebiotics: Properties and Applications

Practicals:

Credit-I:

1.1: Screening of amylase producing microorganisms
1.2: Screening of organic acid producing microorganisms
1.3: Screening of antibiotic producing microorganisms
1.4: Antibiotic sensitivity test- Disc diffusion test
1.5: Glycerol stocks and slant/stab culture preparation for microbial preservation and maintenance

Credit-II:

2.1: Production of Wine
2.2: Fermentative production of citric acid and its estimation
2.3: Microbiological quality testing of Milk
2.4: Isolation of Lactobacilli from curd
2.5: Mushroom cultivation

Reference Books:

1. Industrial Microbiology - Prescott and Dunn
2. Biotechnology: A Text Book of Industrial Microbiology - W. Cruger and A. Cruger
3. Industrial Microbiology - L.E. Casida
4. Industrial Microbiology - A.H. Patel
5. Microbial Technology: Fermentation Technology - H.J Peppler and D. Perlman
6. Microbial Biotechnology: Principles and Applications - Lee Yuan Kun
7. Principles of Fermentation Technology - P.F Stanbury, A. Whitaker and S. J. Hall
8. Industrial Microbiology - David B. Wilson, Hermann Sah
9. Industrial Microbiology - Miller, BM and Litsky
10. Microbial Technology - Peppler, JH and Perlman, D.

H.O.D 11/25
Dept. of Biotechnology
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R V Ramalakshmi

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M. Sc Biotechnology Syllabus (CBCS)

Semester: III

Subject: Bioprocess Engineering

Course Objectives:

1. To give the outline of a bioprocess for industrial production
2. To design a bioreactor, media and sterilization for a specific bioprocess
3. To design the strategy for extraction and purification of a product of a bioprocess
4. To measure and control the variables of a bioprocess and use of computers in control

Course Outcomes:

1. Enables the kinetic modelling and improvement of a bioprocess
2. Gain the skills to design different bioreactors, sterilization process and formulation of media
3. Able to recover and purify the product of a bioprocess
4. Enables the control of variables and use of computers in fermentation technology

Credit I: Fundamentals of Bioprocess Engineering

1.1: Introduction to bioprocess engineering- Upstream and Downstream process

1.2: Bioprocess kinetics: Quantitative description of bioprocess, Malthusian growth model, Monad Model

1.3: Mass balances for ideal bioreactors, Material and Energy balances

1.4: Mass transfer in bioprocess systems: Molecular diffusion, Theory of diffusion, Fick's Law, Mass transfer between Liquid-solid, Liquid-liquid and Gas-liquid

1.5: Oxygen transfer in bioreactor; Heat transfer - Modes and Principle of heat transfer, Generation, exchange and removal of heat

1.6: Principle and methods of immobilization: Adsorption, Covalent binding, Cross linking and Entrapment

Credit-II: Upstream Processing

2.1: Design of bioreactor: Body construction, Agitator, Baffles, Valves and Steam Traps, Pressure control valves

2.2: Bioreactors based on design: Continuous stirred, Airlift, Bubble column, Fluidized-bed and Packed bed bioreactors, Photobioreactor, Membrane bioreactor

2.3: Bioreactors based on mode of mixing: Mechanically agitated, Pneumatically agitated and Jet-agitated bioreactors

2.4: Batch and Continuous sterilization of fermentation media

2.5: Filter sterilization of fermentation media, Fermentor air and Exhaust air

2.6: Design of media: Media formulation- Water, Carbon sources, Nitrogen sources, Minerals, Chelators, Growth factors

Credit III: Downstream Processing

3.1: Downstream processing: A multistage process

3.2: Solid-liquid separation: Filtration-Theory, Types of Filters, Filter Aids; Centrifugation-Theory, Types of Centrifuges; Flocculation; Foam Separation

3.3: Recovery of intracellular components: Physico-mechanical methods of cell disruption: Liquid shear, Solid shear, Agitation with abrasives, Freez thawing, Ultrasonication; Chemical Methods of cell disruption - Detergents, Osmotic shock, Alkali treatment, Enzyme treatment

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3.4: Concentration and extraction of biological products: Evaporation and Solvent recovery, Pervaporation, Perstraction, Liqui-liquid extraction, Two-phase aqueous extraction, Precipitation, Adsorption

3.5: Extraction and Purification of products: Chromatographic techniques- Adsorption, Ion exchange, Gel filtration and Affinity chromatography, HPLC, Crystallization

3.6: Product formulation: Drying and Types of driers, Lyophilization

Credit-IV: Instrumentation and Control

4.1: Fundamentals of process control: Classes of sensors- In-line, On-line, Offline sensors; Physical and Chemical sensors

4.2: Measurement and control of physical variables - Temperature, Flow, Pressure

4.3: Measurement and control of chemical variables - Foam, Dissolved oxygen, Carbon dioxide, P^H, Microbial mass

4.4: Control systems: Components of control loops, Types of control: Manual control, Automatic control-Two-position controllers, Proportional control, Integral control and Derivative control

4.5: Combinations of methods of control, Complex control systems-Cascade, Feed forward, Feedback, Adaptive control

4.6: Computer applications in fermentation technology

Practicals:

Credit-I:

1.1: Designing of a Bioreactor

1.2: Study of microbial growth kinetics

1.3: Immobilization of Yeast cells by entrapment method

1.4: Production and recovery of alcohol produced by immobilized Yeast cells

1.5: Industrial visit to Biotechnology companies

Credit-II:

2.1: Extraction of proteins by ATPS

2.2: Separation and identification of compounds by TLC

2.3: Separation of plant leaf pigments by column chromatography

2.4: Separation of proteins by gel filtration chromatography

2.5: Concentration of proteins by Sephadex G-25

Reference Books:

1. Principles of Fermentation Technology - P.F Stanbury, A. Whitaker and S. J. Hall
2. Bioprocess Engineering Principles - P. M. Doran
2. Bioprocess Engineering Basic Concepts - Kargi and Shuler
3. Fundamentals of Biochemical Engineering - Bailey and Ollis
4. Introduction to Biochemical Engineering Principles - D. G. Rao
5. Bioreaction Engineering Principles - Jens Hoiriis Nielsen, John Villadsen, Gunnar Lidén
7. Basic Biotechnology - C. Ratledge and Bjorn Kristiansen
8. Bioprocess Engineering - Bjorn K, Lydersen, Nacy, D'Elia, Nelson

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M. Sc Biotechnology Syllabus (CBCS)

Semester: IV

Subject: Plant Biotechnology

Course Objectives:

1. To introduce the concepts and principles of plant tissue culture and cellular totipotency
2. To enable the strategies involved in commercial production of useful products from plant cell culture
3. To inculcate skills required for development of transgenic/genome edited plants
4. To acquire the knowledge and use of advanced techniques for crop improvement and sustainability

Course Outcomes:

1. Learn *in-vitro* plant tissue culture techniques and mass propagation of elite genotypes
2. Acquire the knowledge required for the commercial production of useful products from Plant cell cultures and preservation of germ plasm
3. Critically understand the highlights of the transgenic/genome edited technology for the improvement of various traits of plants
4. Understand the insights of advanced molecular techniques for crop improvement

Credit I: Clonal Propagation of Plants

1.1 Plant tissue culture: History, Concept of cellular totipotency, Sterilization techniques, Media preparation, Role of nutrients and plant growth regulators

1.2 Establishment of *in vitro* cultures: Meristem culture (Shoot tip and Nodal culture), Direct and Indirect Organogenesis, Somatic embryogenesis

1.3 Micropropagation in elite plant species: Stages and Applications, Somaclonal variations and clonal fidelity

1.4 Production of Haploids: Anther, Pollen, Ovule, Embryo culture, Rescue and their applications

1.5 Protoplast isolation, Culture, Fusion, Selection of somatic hybrids, Cybrids and its applications

1.6 Technology of Cryopreservation: Plant *in-vitro* conservation, Exchange of germplasm and its applications, Synthetic seeds

Credit II: Commercial Production of Secondary Metabolites by Cell Cultures

2.1: Callus and cell suspension cultures: Cell line selection

2.2 Introduction, Types and Industrial importance of plant secondary metabolites,

2.3 Production of commercially useful compounds by plant cell culture and its advantages

2.4 Induction of hairy and adventitious root cultures and their applications

2.5 Physical and Chemical factors (Permeabilization, Elicitation and precursor feeding) that influence the production of secondary metabolites through cell culture *invitro*

2.6: Metabolic engineering and Omic techniques in secondary metabolite production

Credit III: Transgenic Technology

3.1: Vector mediated gene transfer in plants: *Agrobacterium* mediated gene transfer-Ti plasmid derived vectors

3.2: Direct gene transfer in plants: PEG, Particle bombardment mediated transformation, Nano particle mediated gene transfer

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3.3: Engineering Plants to overcome biotic stress: Herbicide resistance, Insect resistance (Bt-toxin, Protease inhibitor), Disease resistance (Bacterial, Fungal, Viral)
3.4: Engineering Plants to overcome abiotic stress: Salt stress, Drought stress, Flooding stress, Temperature stress, Photooxidative stress and Metal Stress, Nutritional Stress-Nitrogen, Phosphorous and Potassium deficiency
3.5: Screening and selection of putatively transformed plants
3.6: Genetically modified value-added crops and social issues

Credit IV: Applications of Plant Biotechnology

4.1 Molecular markers: RFLP, RAPD, AFLP & SSR and their applications in crop improvement, Marker assisted selection (MAS)- Strategies for introducing genes of agronomic importance
4.2: Molecular Pharming: Production of Edible vaccines, Biopharmaceuticals and Plantibodies
4.3: Engineering for nutritional quality: Improved seed storage proteins, Improving and altering the composition of starch and Plant oils, Enhancement of micro nutrients- Beta carotene and Iron, Improving nutritional deficiency
4.4: Chloroplast transformation, advantages and applications
4.5: RNAi technology/Gene silencing and overexpression of candidate genes for crop improvement
4.6: Genome editing technology for crop improvements

Practicals:

Credit-I:

1.1: Preparation of MS and WPM media for plant tissue culture
1.2: Surface sterilization of explants and their inoculation
1.3: Establishment of Callus culture, Micropropagation of elite plant species
1.4: Embryo culture of Maize/ Crotolaria
1.5: Suspension cultures and elicitation for secondary metabolite production

Credit-II:

2.1: Induction of somatic embryos and preparation of synthetic seeds
2.2: Induction of hairy root cultures by Agrobacterium rhizogenes / Adventitious rooting
2.3: Estimation of Reactive Oxygen Species generated by biotic/abiotic stress in Plants
2.4: Genetic transformation of plants using *Agrobacterium tumefaciens*/ gene gun method
2.5: Synthesis and application of nanoparticles/CQDs in crop improvement

Reference Books:

1.Introduction to Plant Biotechnology - H. S. Chawla
2. Plant Tissue Culture: Theory and Practice - S.S. Bhojwani and A. Razdan
3. Plant Cell and Organ Culture: Applied and Fundamental Aspects - Y.P.S. Bajaj and Reinhard
4. Frontiers of Plant Tissue Culture - Akio Fujiwara
5. Plant Tissue Culture and Its Biotechnological Applications - W. Barz, E. Reinhard, M.H. Zenk
6. Plant Physiology - Lincoln Taiz
7. Concepts in Biotechnology - Balasubramaniyan
8. CRISPR and RNAi Systems: Nanobiotechnology Approaches to Plant Breeding and Protection- Kamel A. Abd-elsalam and Ki-taek Lim
9. Basics of CRISPR/Cas Mediated Plant Genome Editing - Anshu Alok, Jitesh Kumar and Mahipal S.
10. Recent Trends and Techniques: Plant Metabolic Engineering - Sudesh Kumar Yadav, Vinay Kumar and Sudhir P. Singh

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M. Sc Biotechnology Syllabus (CBCS)

Semester: IV

Subject: Animal Biotechnology

Course Objectives:

1. To introduce the concepts of animal cell culture
2. To illustrate the applications of animal cell culture
3. To explain the breeding methods and Assisted Reproductive Technology for improvement of Animals
4. To highlight the transgenic technology for introducing new traits and gene targeting for development of animal models

Course Outcomes:

1. Comprehend basic concepts of animal cell culture
2. Understand the importance and applications of animal cell culture
3. Critically understand various strategies involved in animal improvement
4. Gain the knowledge of transgenic technology for animals

Credit I: Animal Cell Culture

1.1: History, Scope, Applications and Limitations of animal cell culture, Requirements of animal cell culture-Laboratory layout, Biosafety Cabinets and Equipment, Culture vessels and Substrates

1.2: Animal cell culture media: Components and Physical properties, Serum and Supplements, Different types of media, Sterilization and storage of media

1.3: Primary cell culture, Detection of contamination in cell culture, Preservation of cell cultures, Cell Banks, Subculture of monolayer and suspension cells, Cell synchronization

1.4: Cell Lines: Characterization, Naming and Development-Immortalization

1.5: Isolation of Stem Cells and their applications

1.6: Cell separation - Fluorescent Activated Cell Sorting; Cell viability and Cytotoxicity assays

Credit-II: Scale-up and Production of Therapeutics from Animal Cell Culture

2.1: Scale-up in suspension cultures

2.2: Bioreactors for scale-up of cell culture

2.3: Tissue Engineering: Principles, Scaffolds, Methods of scaffolds synthesis, Biomaterials, 2-D and 3-D Cultures

2.4: Tissue engineering of Skin, Pancreas and Liver

2.5: Production of therapeutic proteins from CHO cell lines-Monoclonal antibodies, Interferons and Erythropoietin

2.6: Production of fertility hormones-Follicular Stimulating hormone, Leutinizing Hormone; Production of recombinant vaccines from Vero cell lines

Credit-III: Breeding and Assisted Reproductive Technology in Animals

3.1: Animal Husbandry: Types and its economical importance

3.2: Improvement of livestock: Principles and strategies of animal breeding

3.3: Animal breeding methods: Inbreeding, Linebreeding and Crossbreeding

3.4: Artificial Insemination (AI): Collection, evaluation and preservation of semen, AI centers, Different Methods of AI, Detection and synchronization of oestrous cycle

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3.5: In-vitro Fertilization (IVF): Gametogenesis, Collection of oocytes and spermatozoa, IVF and ICSI, Embryo Transfer, Embryo splitting

3.6: Animal cloning: Somatic nuclear transfer, Dolly technology and its limitations

Credit IV: Animal Transgenics

4.1: Gene transfer methods for transgenesis: Microinjection, Electroporation, Lipofection, Particle Bombardment and Vector mediated method

4.2: Transgenic Mice Technology: DNA Microinjection and Embryonic Stem Cell Technology

4.3: Development of transgenic Animals: Goats, Sheep, Cattle, Pig, Poultry and Fish

4.4: Molecular Pharming: Strategy, Advantages and Limitations, Transgenic pioneers by Molecular Pharming-Nancy, Ethel and Hermann; Therapeutic products produced by Molecular Pharming

4.5: Development of Animal models: Gene Targeting, Knock-out and Knock-in Mice

4.6: Animal disease models: Alzheimer's, Cancer

Practicals:

Credit-I:

1.1: Requirement of animal cell culture lab, sterilization and maintenance

1.2: Preparation of Balanced Salt Solution (BSS), Phosphate-Buffered Saline (PBS)

1.3: Preparation and sterilization of Animal cell culture media and supplements

1.4: Primary culture- Isolation of blood Lymphocytes

1.5: Thawing, passaging and cryopreservation of cell lines

Credit-II:

2.1: Cell Counting and Seeding

2.2: Cell viability assay-MTT assay

2.3: Wound healing assay

2.4: Extraction of DNA/RNA/Protein from treated animal cells

2.5: Study of apoptosis by Propidium Iodide staining

Reference Books:

1. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications-R. Ian Freshney
2. Animal Biotechnology: Cell & Tissue Culture- Dr. R. N. Shukla
3. Animal Cell Culture - Jhon R. W. Masters
4. Animal Cell Culture Technology: Principles and Applications - Rajasekhar Pinnamaneni, Praveen Kumar Vemuri
4. Understanding Animal Breeding - Richard M. Bourdon
5. Molecular Biotechnology: Principles and Applications of Recombinant DNA Technology - Bernard R. Glick. Jack J. Pasternak. Cheryl L. Patten
6. Human Molecular Genetics - Tom Strachan and Andrew Read
7. Biotechnology - H. K Das
8. Biotechnology - H.D Kumar
9. Practical Animal Breeding - Blackwell Science
10. Cytogenetics in Animal Reproduction - W.C.D. Hare and Elizabeth L. Singh

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M. Sc Biotechnology Syllabus (CBCS)

Semester: IV

Subject: Environmental Biotechnology

Course Objectives:

1. To give an overview of types, sources, causes and measurement of environmental pollution
2. To highlight the need, importance and production of biofuels
3. To explain the use of microorganisms as biofertilizers and biopesticides for enhancing crop yield
4. To introduce the concepts of biodegradation, biomining and biodiversity

Course Outcomes:

1. Gain the information about environmental pollution
2. Learn the strategies for the production of biofuels
3. Understand the need of using biofertilizers and biopesticides to subside the environmental pollution
4. Understand the importance of waste management and biodiversity

Credit I: Environmental Pollution

1.1: Environment: Atmosphere, Lithosphere, Hydrosphere, Concept of ecosystems, Biosphere-Biotic and Abiotic interactions

1.2: Environmental Pollution: Pollution disasters, Environmental Pollution- Air, Water and Soil Pollution

1.3: Sources of Pollution: Domestic and Municipal waste, Agriculture waste, Industrial effluents, Algal blooms

1.4: Sources of energy and their impact on environment: Non-renewable and Renewable energy sources

1.5: Global environmental problems: Climate change, Global warming, Greenhouse effect, Ozone depletion

1.6: Assessment of pollution-Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), Bioindicators

Credit-II: Biomass and Biofuels

2.1: Biomass as renewable sources of energy: First, Second and Third and Fourth generation biomass

2.2: Biomass production and its applications

2.3: Production of Bioethanol from plant biomass

2.4: Production of Biodiesel from plants and algae

2.5: Production of Biogas and its applications

2.6: Production of Biohydrogen and Biomethane

Credit III: Biofertilizers and Biopesticides

3.1: Biogeochemical Cycles: Carbon, Nitrogen, Sulphur and Phosphorous cycle

3.2: Microbial Interactions, Plant growth promoting microorganisms (PGPRs)- Nitrogen fixing microorganisms, Phosphate solubilizing microorganisms

3.3: Nitrogen fixation: Mechanism, nif genes and nod genes

3.4: Biofertilizers: Bacterial- Rhizobium, Azotobacter, Azospirillum; Algal- Anabaena, Nostoc, Azolla; Fungal- Mycorrhizal fungi; Vermicomposting

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3.5: Microbial pesticides: Bacterial-Bacillus, Clostridium and Pseudomonas; Fungal- Trichoderma, Viral- Baculovirus and NPV; Plant based biopesticides- Neem
3.6: Integrated Pest Management (IPM) and Integrated Nutrient Management (INM) for sustainable agriculture

Credit-IV: Bioremediation, Bioleaching and Biodiversity

4.1: Bioremediation: *In-situ* and *Ex-situ* bioremediation, Advantages and Applications; Phytoremediation, Bioaugmentation, Biostimulation, Biosorption, Biofilms
4.2: Biodegradation of Xenobiotics, Hydrocarbons and Heavy metals
4.3: Waste management: Primary, Secondary and Tertiary treatments; Treatment of Waste water, Municipal sewage, Industrial effluents and Medical waste
4.4: Bioleaching: *In-situ* and *Ex-situ* bioleaching; Biosurfactants, Oil recovery
4.5: Genetically engineered organisms for the protection of environment-Superbug
4.6: Biodiversity: Concept, Classification, Importance, National Biosphere Reserves-Hot spots, Conservation of Biodiversity- *In-situ* and *Ex-situ* conservation, Current Indian Wild life conservation projects, Indian Biodiversity Acts, Legislation and Policies

Practicals:

Credit-I:

1.1: Estimation of BOD in different samples
1.2: Estimation of COD in different samples
1.3: Estimation of total dissolved oxygen in different samples
1.4: Estimation of total dissolved solids
1.5: Production of Biogas
1.6: Biodiesel production from Jatropha plant biomass

Credit-II:

2.1: Isolation of Rhizobium from root nodules of Legume Plants
2.2: Isolation and production of Azolla
2.3: Formulation of biopesticides using phytoextracts
2.4: Vermicomposting
2.5: Field survey and molecular identification of regional of ecofriendly flora/fauna
2.6: Visit to National Biosphere Reserves/ Sanctuaries/Park

Reference Books:

1. Molecular Biotechnology- Glick and Pasternak
2. Environmental Biotechnology- S.V.S Rana
3. Environmental Biotechnology: Theory and Applications- Gareth M. Evans and Judith C. Furlong
4. Environmental Biotechnology: Principles and Applications- Bruce E. Rittmann and Perry L. McCarty
5. Environmental Microbiology- W.D Grant, P.E. Long
6. Comprehensive Biotechnology: Vol-III- Murray Moo Young
7. Environmental Biotechnology-M. H. Fulekar
8. Text Book of Biotechnology- H. K Das
9. Biotechnology- H.D Kumar
10. Biotechnology, IPR and Biodiversity- M. B. Rao and Manjula Guru

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M. Sc Biotechnology Syllabus (CBCS)

Semester: IV

Subject: Medical Biotechnology

Course Objectives:

1. To explain the hall marks of human genetic disorders
2. To comprehend different prenatal and neonatal diagnostic methods
3. To critically analyze various therapeutic strategies
4. To understand the importance of regenerative and nanomedicine, medical implants

Course Outcomes:

1. Understand the molecular basis of genetic disorders
2. Comprehend and understand the importance of diagnostic approaches
3. Gain knowledge on insights of therapeutic approaches
4. Critically understand the concepts of regenerative medicine, nanotechnology and medical implants in therapy

Credit I: Genetic Disorders

1.1: Introduction to genetic disorders and Classification
1.2: Single Gene Disorders: Cystic Fibrosis, Marfan Syndrome, Duchene Muscular Dystrophy, Huntington Disease, Hemoglobinopathies: Sickle cell anaemia, Thalassemia
1.3: Metabolic Disorders: Phenyl ketonuria, Familial Hypercholesterolemia, Gaucher's Syndrome, ADA deficiency
1.4: Multifactorial Disorders: Diabetes, Hypertension, PCOD, Alzheimer's disease
1.5: Mitochondrial Disorders: Mitochondrial encephalomyopathy (MELAS), Laber's Hereditary Optic Neuropathy (LHON), Myoclonic epilepsy (MERRF)
1.6: Genomic Imprinting Disorders: Prader Willi and Angelman Syndromes

Credit-II: Prenatal and Neonatal Diagnostics

2.1: Prenatal Diagnosis: Invasive and Non-invasive methods
2.2: Prenatal Screening for Neural tube defects and Down syndrome, Neonatal and Carrier Screening
2.3: Newborn screening: Diagnosis using enzymes-Guthrie test for PKU, Creatine kinase test for Dystrophy; Diagnosis using Monoclonal antibodies for hormonal and infectious diseases
2.4: Molecular diagnosis (DNA/RNA based): BCR-ABL1 Test for Chronic Myeloid Lukemia (CML)
2.5: Global Gene Expression Analysis/ Profiling or Microarray technology for diagnosis of diseases,
2.6: Genetic counselling: Risk calculation and Discussion of options

Credit III: Therapeutics

3.1: Gene Therapy: Strategies of gene therapy- Gene augumentation, Targeted killing of specific cells, Targeted mutation correction, Targeted inhibition of gene expression; Gene transfer methods for gene therapy
3.2: Approaches for Gene Therapy: Ex-vivo gene therapy for ADA deficiency and Familial Hypercholesterolemia; In-vivo gene therapy for Cystic fibrosis and Duchenne Muscular Dystrophy
3.3: RNA Interference in prevention and treatment of Cancer
3.4: Therapeutic genome editing technology for HIV and Leukemia

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3.5: Recombinant therapeutics: Enzyme replacement therapy- Gaucher's disease; Thrombolytic therapy-Streptokinase and Urokinase for Thrombosis; Hormone replacement therapy- Diabetes and Growth hormone deficiency

3.6: Immuno therapeutics: Live attenuated vaccines, Killed vaccines, Toxoid vaccines, Subunit vaccines, Conjugated vaccines, Nucleic acid vaccines, Recombinant vector vaccines

Credit-IV: Regenerative Medicine, Nanotechnology and Medical Implants

4.1: Cellular Therapy: Cells used in Regenerative Medicine, CAR-T Technology

4.2: Encapsulation technology for engineered cells and bioactive materials for Diabetes and Hypothyroidism

4.3: Nanotechnology: Nanomaterials- Quantum dots, Dendrimers, Peptide nanotubes, Nanopore sensors

4.4: Nano Devices: Nano robots- Microbivores and Respirocytes, DNA based nano devices; Nanomedicine: Smart drugs, Nanomedicine for cancer therapy

4.5: Targeted drug delivery and mechanism of drug release by Nanomaterials

4.6: Medical Implants: Implantable Materials- Biopolymers, Bioceramics and Bioglasses; Biodegradable polymers for Orthopedic Implants and Cardiovascular stents

Practicals:

Credit-I:

1.1: Molecular diagnosis of genetic disorder Sickle Cell Anaemia by PCR

1.2: Detection of genetic diseases by RT-PCR

1.3: Screening of mutations by ARMS-PCR

1.4: Estimation of maternal serum α-fetoprotein

1.5: Simulation of prenatal diagnostic sampling and DNA analysis

Credit-II:

2.1: Case study analysis on prenatal diagnostic ethics/amniocentesis genetic counselling

2.2: Study of triple and quadruple marker tests

2.3: Synthesis of Metal nanoparticles

2.4: Synthesis of Nanoliposomes

2.5: Synthesis of Polymers

Reference Books:

1. Human Molecular Genetics- Tom Strachan and Andrew Read
2. Human Genetics: The Molecular Revolution-Edwin H. Mc Conckey
3. Emery's Elements of Medical Genetics and Genomics- Peter Turnpenny, Sian Ellard, Ruth Cleaver
4. An Introduction to Human Molecular Genetics: Mechanisms of Inherited Diseases- Jack J. Pasternak
5. Medical Biotechnology- Pratibha Nallari and V. Venugopal Rao
6. Medical Biotechnology- Bernard R. Glick, Cheryl L. Patten, Terry L. Delovitch
7. Medical Biotechnology- Mary Keen and Judit Pongracz
8. Nanobiotechnology-David Goodsell. John Wiley
9. Nanobiotechnology-Niemeyer CM & Mirkin CA 2005
10. Medical Biotechnology- Jogdand S. N.,

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M. Sc Biotechnology Syllabus (CBCS)

Semester: IV

Subject: Intellectual Property Rights, Bioethics, Entrepreneurship and Research Methodology

Course Objectives:

1.To bring awareness on importance of Intellectual Property Right
2. To inculcate ethics in scientific research and academic code of conduct
3. To inculcate entrepreneur skills for establishing Start-ups
4. To develop skills for research innovations and for sciatic development

Course Outcomes:

1. Enable knowledge on Intellectual Property Rights
2. Inculcate ethics in biological research
3. Develops entrepreneur skills a
4. Enables planning and execution of research projects on local and need based problems

Credit I: Intellectual Property Rights

1.1: Intellectual property rights: Patents, Trademarks, Copyrights, Industrial designs, Traditional knowledge, Geographical indications
1.2: IPs relevant to biotechnology and case studies, Rationale of IPRs in science and technology, Protection of GMOs
1.3: Agreements and Treaties related to IPRs: GATT, WTO, TRIPS, WIPO, PCT and Budapest Treaty
1.4: Patent Databases, National and International patent searches-USPTO, EPO, IPO
1.5: Patents: Concepts and Principles, Patentable subject matter, Patent filing -Types of applications, National and International filing, Precautions before patenting-disclosure/non-disclosure, Rights of patents and Infringement
1.6: Indian Patent Acts and Amendments, Indian patent publication-Gazette of India

Credit II: Bioethics

2.1: Ethics: Causes of unethical acts, Professional ethics, Ethical decision making and dilemmas
2.2: Bioethics: Concepts and Terms, Principles and Theories, Law Issues
2.3: Bioethics in Biotechnology: GMOs and LMOs, Cloning, Medical Techniques, Bioweapons
2.4: Bioethics in Animal research: Animal Rights, Human Cloning, Stem Cell Research
2.5: Emerging issues in Biotechnology: Biotechnology impact on society, DNA on the witness stand, Use of genetic evidence in civil and criminal court cases
2.6: Challenges to public policy, Awareness of Biotechnology products to public

Credit III: Entrepreneurship

3.1: Entrepreneurship: Concept, Definition, Structure, Types and Theories
3.2: Fundamentals of marketing, Start-ups: Setting of a small industry, Location of an enterprise, Steps, Incentives & Subsidies
3.3: Entrepreneurial development: Training, Institution in aid of entrepreneur, Entrepreneurial culture, Entrepreneurial leadership, Problems of entrepreneurship, Risk and benefits, The art of negotiation, Workable market and the strength of distribution
3.4: Project management: Concept of projects, Project identification, Formulation, Design and Network analysis, Project report and Project appraisal
3.5: Product planning and development: Identification of market needs and opportunities, Development of product road map, Ideation and concept, Design, Testing and Validation

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Market analysis, Risk management, Launch and post-launch evaluation

3.6: Establishment and marketing of biotechnology company, Commercialization of a biotechnological product, Effective advertising, Case studies

Credit IV: Research Methodology

4.1: Basic, Applied, Need based research and its significance

4.2: Research Project Planning: Identification and defining the research problem at national and international level, Designing objectives and hypothesis, Research planning

4.3: Literature Search: Sources- Library, Internet, Use of AI in research and publication writing

4.4: Research design: Variables in the experiments, Sample- Biological and Technical replicates

4.5: Progress of research: Evaluation of results, Statistical approach, Comparison with existing methodologies, Validation of findings, Scientific publication -Predatory and Peer reviewed journals, Impact factor-H index

4.6: Publication Ethics: Plagiarism, Mentor-Mentee relationship, Authorship and Conflict of interest

Reference Books:

1. IPR, Biosafety and Bioethics- Deepa Goel and Shomini Parashar
2. Intellectual Property Rights, Bioethics, Biosafety and Entrepreneurship in Biotechnology- Sibi. G
3. Comprehensive Guide to Intellectual Property Rights- Dr. Chennupathi V. Suresh, Dr. K.N.V. Rao and Dr. Muralidhar
4. Intellectual Property Rights, Biosafety and Bioethics: Ethical Frontiers- Dr. Alok Kumar Shrivastav
5. Bioethics: An Introduction - Marrianne Talbot
6. Guides to entrepreneurship in biotechnology by P. Ponnumurugan, J Robinson and B. Kalpana
7. Guidelines for entrepreneurship development program for biotechnology graduates by P. Ponnu Murugan and Nithya. B
8. Research Methods: A Practical Guide for Students and Researchers- Willie Chee Keong Tan
9. Research Methodology- R. C. Kothari
10. Practical Research: Planning and Design - Paul D. Leedy and Jeanne Ellis Ormrod

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