Dnyanopasak Shikshan Mandal's

College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Lambade Snehal S **Department: Biotechnology**

Program: M.Sc F.Y **Subject**: Biotechnology **Course Code:** SBTTC-401

Paper Title: Cell and Developmental Biology

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	UNIT I	**Study of Cell & its architecture** Cell size and shape, History & Evolution, Cell as the basic unit of life, cell theory, Structural organization of prokaryotes and eukaryotes. Biogenesis of Mitochondria, Chloroplast. Structure of model membrane, lipid bilayer and membrane Protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. Structure and function of Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility	Understand cell organelles
II	UNIT II	**Cell-Cell interactions:** General principles of cell communication cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrin's. Neurotransmission and its regulation. Hormones and their receptors, cell surface receptor, signaling through G- protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways. Bacterial and plant two component	Understand cell-cell interaction

		systems, light signaling in plants, bacterial chemotaxis and quorum sensing. Regulation of hematopoiesis,	
III	UNIT III	**Cell division & Cancer genetics** Mechanism of cell division mitosis, meiosis and genetic recombination; regulation of cell cycle; factors and genes regulating cell cycle. Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, Virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth	Understand Cell Division
IV	UNIT IV	**Developmental Biology and Gene Patterning.** Gametogenesis, Fertilization, cleavage, blastulation, Gastrulation & formation of germ layers in animals, Concepts of competence, determination, commitment and differentiation (dedifferentiation, re-differentiation, trans differentiation) developmental plasticity in plant. Sex determination in plants & animals. Role of gene/s in patterning and development e.g. Arabidopsis thaliana (root, shoot, leaf & flower) & Drosophila melanogaster (maternal genes, bicoid, gap genes), Stem cells.	Understand Sex determination in plants & animals.

Specify Course Outcome:

1. Student will be able to understand about Cell Development
2. Student will understand structure, function and significance of various Cell Organel.

Specify Program Outcome:

- To develop understanding of Cell interaction.
- To develop understanding of structure and functions of Cell Organels.
- Understand significance of Cell Structure.

Signature of Teacher

Dnyanopasak Shikshan Mandal's

College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: M.D. Urooj **Department: Biotechnology**

Program: M.Sc F.Y **Subject:** Biotechnology **Course Code:** SBTTC-402

Paper Title: Microbiology and Virology

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	UNIT I	**The Beginning of Microbiology** Controversy over spontaneous generation, Development of pure culture methods. Bacteria: Purple and green bacteria, Cyanobacteria, Homoacetogenic bacteria. Budding and appendaged bacteria, Spirilla, Spirochetes, Gliding and sheathed bacteria, Pseudomonades; Lactic and propionic acid bacteria, Endospore forming rods and cocci, Mycobacterium, Rickettsia's, Chlamydia's and Mycoplasmas. Archaea: Archaea as earliest life forms, Halophiles, Methanogens, Hyperthermophilic archaea.	Understanding beginning of microbiology.
II	UNIT II	**Methods in Microbiology**: Theory and practice of sterilization, Principles of microbial Nutrition, Construction of culture media. Microbial Evolution, Systematics and Taxonomy Evolution of earth and earliest life forms: Primitive organisms and their metabolic strategies and approaches to bacterial taxonomy classification including Ribotyping; Ribosomal RNA sequencing; Characteristics of primary domains; Taxonomy, Nomenclature and Bergey's Manual.	Understand Methods in microbiology.

III	UNIT III	**Microbial Growth** The definition of growth, mathematical expression of growth, growth curve, measurement of Growth and growth yields; Synchronous growth; Continuous culture; Growth as affected by Environmental factors like temperature, acidity, alkalinity, water availability and oxygen.	Understand microbial growth.
IV	UNIT IV	**Virology** Discovery of viruses, Nomenclature, Classification, Structure of viruses, morphology and ultra structure. Virus receptors & entry into cell, Virus related agents Overview of viral replication; Assembly, Maturation & release from cell, Diagnostic Virology; Cultivation of viruses in embryonated eggs, animal cells and experimental animals, transgenic systems, Virus infectivity Assay (chemical and physical methods), PCR based diagnosis of viruses. Life cycle of – Bacterial viruses (Lambda, M13), Plant viruses (TMV, and CMV) Animal viruses (Herpes and Retro)	Understand virology and their types.

Specify Course Outcome:

1. Student will be able to understand the Microbiology and Virology.
2. Student will understand Microbial growth, methods in microbiology and virology.

Specify Program Outcome:

- To develop understanding Beginning of microbiology.
- To develop understanding of methods in microbiology.
- Understand the microbial growth.
- Understand virology.
- Understand the viruses and their cultivation.

Signature of Teacher

Dnyanopasak Shikshan Mandal's

College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: M.D. Mujahed **Department: Biotechnology**

Program: M.Sc F.Y **Subject**: Biotechnology **Course Code**: SBTTC-403

Paper Title: Biochemistry

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	UNIT I	**Chemical foundations of Biology** Structure of atoms, molecules and chemical bonds; Ionization of water, properties of water The pH scale, concept of acids and bases, Henderson- Hasselbach equation, biological buffer systems. Thermodynamic principles in biology, Concept of free Energy and redox potential	Understanding Chemical foundations of Biology
II	UNIT II	**Biomolecules I:** Carbohydrates: Classification occurrence, structure, function and properties of monosaccharide, oligosaccharide and polysaccharides. Lipids: Classification, structure and functions of major lipids, Triglycerides, Phospholipids, Steroids and terpenes. Glycolipids and lipoproteins-structure and function. Role of lipids Hormones: Structure and function; Vitamins: Types, structure and functions; Prostaglandins; Silk fibroin, coiled coils, collagen triple helix and hemoglobin.	Understand Carbohydrates, Lipids and Vitamins.
III	UNIT III	**Biomolecules II** Amino acids: Classification and chemical reactions and physical properties. Peptide	Understand Amino acids, Proteins and Enzymes

		bond, peptide classification, biologically important peptides. 3.2 Proteins: Properties and classification, primary, secondary, tertiary and quaternary structure of proteins with example, structural comparison at secondary and tertiary levels. Ramachandran plot. Enzymes: Historical perspectives, generalcharacteristics, nomenclature and classification. Methods of isolation, purification and characterization of enzymes. Concept of enzyme assay, enzyme activity, coenzymes and isoenzymes	
IV	UNIT IV	**Biomolecules III** Nucleic acids: Primary, secondary and tertiary structure of nucleic acids, double stranded DNA and biological significance, forms of DNA, Physical properties of double stranded DNA, Types of RNAs and their biological significance. DNA Supercoiling	Understand Nucleic acids and their significance

Specify Course Outcome:

1. Student will be able to understand about Biomolecules.
2. Student will understand structure, function and significance of various Biomolecules.

Specify Program Outcome:

- To develop understanding of Biochemistry.
- To develop understanding of structure and functions of Biomolecules.
- Understand significance of Biomolecules.

M.dm

Signature of Teacher

Dnyanopasak Shikshan Mandal's

College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: M.D. Urooj **Department: Biotechnology**

Program: M.Sc F.Y **Subject**: Biotechnology **Course Code**: SBTTE-401

Paper Title: Techniques in Biotechnology

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	UNIT I	**Microscopy and Electrochemical techniques:** Light microscope, Fluorescence microscope, Phase contrast microscope, Electron microscope. Centrifugation: Principles, RCF and Types of centrifuges, types of rotors, preparative and analytical ultra-centrifuge. Principles of electrochemical techniques, redox reactions, the pH electrode, ionsensitive and gas-sensitive electrodes, The Clark oxygen electrode.	Understanding microscopy and electrochemical techniques.
II	UNIT II	**Chromatography and Electrophoresis:** Principles of chromatography, lon-exchange and affinity chromatography. High performance liquid chromatography (HPLC), Gas liquid chromatography (GLC), Thin layer chromatography (TLC), Paper chromatography, GC-MS, LC-MS, Maldi ToF. Electrophoresis: General principles, SDS-PAGE , Native gels, Gradient gel, Iso electricfocusing, 2-D gel electrophoresis (2-D PAGE), Detection, estimation and recovery of proteins, Western blotting. Electrophoresis of nucleic acids: agarose gel electrophoresis of DNA, DNA sequencing gels, Pulse field gel electrophoresis, Capillary	Understand chromatography and electrophoresis.

		electrophoresis.	
III	UNIT III	**Spectroscopic techniques**: Properties of electromagnetic radiation, interaction with matter. Gamma ray spectroscopy, Xray spectroscopy, UV and Visible spectroscopy, Infrared and Raman spectroscopy, Electron spin resonance spectroscopy, Nuclear magnetic resonance spectroscopy, Circular dichroism spectroscopy, Atomic spectroscopy, x-ray diffraction, xray crystallography. Spectrofluorimetry, turbidometry and nephelometry.	Understand spectroscopic techniques.
IV	UNIT IV	**Radio isotope techniques and Biosensor:** The nature of radioactivity, detection and measurement of radioactivity: detection based on gas ionization-Geiger Muller counter- principles and applications. Detection based on excitation- Liquid Scintillation counter-principle and applications. Supply, storage and purity of radiolabelled compounds, specific activity, inherent advantages and restrictions of radiotracer experiments, safety aspects, applications- of radio isotopes in biological sciences. Flowcytometry, ELISA, immunoblotting. Biosensors: Principle, construction, mechanism and applications of biosensor with one example. (Enzyme and cell based))	Understand radio isotope techniques and biosensor.

Specify Course Outcome:

1. Student will be able to understand the Techniques in biotechnology.

2. Student will understand chromatography, microscopy, electrophoresis and spectroscopy.

Specify Program Outcome:

- To understand the microscopic techniques.
- To understanding of chromatography techniques.
- Understand the spectroscopic techniques.
- Understand the Electrophoresis.

Signature of Teacher

Dnyanopasak Shikshan Mandal's

College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Lambade Snehal S **Department: Biotechnology**

Program: M.Sc F.Y **Subject**: Biotechnology **Course Code**: SVECR-401

Paper Title: Research and Methodology

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	UNIT I	**Introduction to Research** Introduction and definition of research. General characteristic and functions of research Objectives and types of research Scientific and reflective thinking	Understanding of Scientific and reflective thinking
II	UNIT II	**The Research Problem** Identification, source, and criteria for selection, characteristics of problem Hypothesis: meaning. nature, function, formulation, and testing Research proposal or synopsis Literature review: objectives, principles, procedure, and sources	Understand Hypothesis
III	UNIT III	**Collection and Analysis of Data** Data: methods of Collection and techniques Qualitative and d quantitative data analysis Experimental data and regression analysis	Understand Collection and Analysis of Data.
IV	UNIT IV	**The Research Report** Format, Process, Style, Form Contents of Research Paper, Reports, and Theses Ethics in publication and	Understand Contents of Research Paper

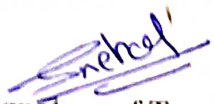
		plagiarism	

Specify Course Outcome:

1. Student will be able to understand Objectives and Types of Research
2. Student will understand Research proposal or synopsis.
3. Student will understand Reports and thesis.

Specify Program Outcome:

- To develop understanding of Characteristics and functions of research
- To develop understanding Qualitative and Data analysis



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Dnyanopasak Shikshan Mandal's

College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Lambade Snehal S **Department: Biotechnology**

Program: M.Sc F.Y **Subject**: Biotechnology **Course Code**: SBTTC-451

Paper Title: Molecular Genetics

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	UNIT I	**Fundamentals of genetics** Principles of Mendelian inheritance and Gene interactions: incomplete dominance, codominance, epistasis, complementary genes, duplicate genes, polymeric genes, modifying genes, lethal genes. Population and gene frequencies; The Hardy Weinberg Law. Genetic diseases due to defects in Autosome and Sex chromosomes. Gene transfer in Prokaryotes, Recombination.	Understand Gene interaction
II	UNIT II	**Genome organization** Genome organization of Prokaryotes-Bacteria and virus system. Genome organization of Eukaryotes-Structure and types of chromosome, heterochromatin, eu-chromatin, nucleosome. Variation in chromosome number, chromosome structure. Denaturation and Renaturation DNA, C-value paradox, Cot curve.	Understand Chromosome structure

III	UNIT III	**DNA and RNA** DNA as genetic material, Genome Replication in prokaryote & eukaryotes, enzymes involved, replication origin and replication fork, mechanism of replication, elongation and termination. DNA damage and repair mechanisms. Homologous and site-specific recombination, transposition. RNA synthesis and processing, transcription factors and machinery, RNA polymerases, co and post transcriptional RNA processing. RNA transport, RNA Stability and Half-life period.	Understand DNA and RNA
IV	UNIT IV	**RNA and Protein synthesis and Gene regulation.** Protein synthesis- Ribosome, Genetic code, t-RNA, initiation, elongation, termination of translation. Post translational modification of proteins. Gene regulation in prokaryotes- operon concept, Lactose, Tryptophan and Arabinose. Role of cAMP and CRP in lac operon, trp operon. Catabolite repression. Gene regulation in eukaryotes at transcription and translation level. Regulation of gene expression in phages, viruses, role of chromatin in gene expression and gene silencing.	Understand Gene regulation

Specify Course Outcome:

1. Student will be able to understand about Fundaments of Genetic.
2. Student will understand about Protin Synthesis.

Specify Program Outcome:

- To develop understanding Molecular Genetics.
- To develop understanding of Genome Replication.
- Understand significance of Protin Synthesis.

Signature of Teacher

Dnyanopasak Shikshan Mandal's

College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: M.D. Urooj **Department: Biotechnology**

Program: M.Sc F.Y **Subject**: Biotechnology **Course Code**: SBTTC-452

Paper Title: Immunotechnology

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	UNIT I	**Basic Concepts Basic concepts of Immune System** Cells and organs of immune system, Immunity Humoral and cell mediated, Hematopoiesis and differentiation. Antigens- General properties, types, epitope, hapten, adjuvant. Antibodies- Types, biological functions. Biology of Superantigen. BCR & TCR (structure & properties), MHC Antigen processing and presentation Maturation and Activation of B-cells Maturation and Activation of T-cells	Understanding immunity
II	UNIT II	**Complement system and Vaccine** Complement system; complement activation pathways, biological consequences of complement activation. Hypersensitivity: Components, Mechanisms of degranulation, Mediators, Consequences, Transfusion reactions, Localized reactions, generalized reactions, Delayed type hypersensitivity Vaccine technology and recombinant vaccines, Identifications of B and T epitopes for vaccine development. in situ characterization of cells in tissues. Hybridoma technology, monoclonal antibody production and applications. Catalytic antibodies, FACS	Understand complement system and vaccine.

III	UNIT III	**Autoimmunity:** Organ specific autoimmune diseases (Hashimoto's thyroiditis, Autoimmune anemia, Insulin dependent diabetes mellitus) 3.2 Systemic autoimmune diseases (SLE, Multiple sclerosis, Rheumatoid arthritis) Treatment of autoimmune diseases 3.3 Transplantation Immunology: Types of graft, Specificity and memory of rejection response, Mechanisms involved in graft rejection, Clinical manifestations of graft rejection Immunity to infectious diseases, Tumor Immunology	Understand concept of autoimmunity.
IV	UNIT IV	**Immunodeficiency:** Primary immunodeficiency (SCID, X-linked agammaglobulinemia, Defects in complement system), Secondary immunodeficiency (AIDS), Treatment of immunodeficiency diseases. Immunity to Infectious Agents Bacteria Viruses Malaria Anthrax and Helminthes. Immunological reactions: Precipitation. Agglutination, Radioimmunoassay, ELISA, Western Blotting, Flow cytometry and Fluorescence. Immunoelectron microscopy, RIA	Understand immunodeficiency.

Specify Course Outcome:

1. Student will be able to understand the immunology
2. Student will understand immunity, autoimmunity and immunodeficiency,

Specify Program Outcome:

- To develop understanding immunity
- To develop understanding of immune cells.
- Understand the autoimmunity.
- Understand immunodeficiency.
- Understand the immunological techniques.

Signature of Teacher

Dnyanopasak Shikshan Mandal's

College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: M.D. Urooj **Department: Biotechnology**

Program: M.Sc F.Y **Subject**: Biotechnology **Course Code**: SBTTC-453

Paper Title: Process Biotechnoogy

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	UNIT I	**Inoculum development and Media** Isolation, Screening, Preservations and maintenance of Microorganisms, Strain improvement, Mutagenesis, Genetic Engineering for Strain Improvement. Selection of Mutants producing improved level of Primary Metabolites with suitable Example. Isolation of mutants which do not produce feedback inhibitors or repressors. Isolation of mutants which do not recognize presence of inhibitors or repressors. Modification of Permeability. Media formulation & optimization its need and significance, Sterilization of media and air, exhaust air, Batch sterilization; Del factor D and Z value, Continuous Sterilization: Design and Methods, sterilization kinetics, inoculum development.	Understanding inoculum development and media preparation.
II	UNIT II	**Bioreactor** Basic aspect of Bioreactor Designing, Types of Bioreactors, Ideal Properties of Bioreactor, Body Construction, Agitator, Impeller, Baffles, etc. Packed-bed reactor, Air –lift, Trickle bed, Photo bioreactors, Rotating Biological Reactors	Understand bioreactor and their types.
III	UNIT III	**Instrumentation and Control** : Fluid flow and mixing, Classification	Understand instrumentation and their

		of fluids, concept of Reynolds's number, Rheological properties of fermentation process (Viscosity, cell concentration, product concentration etc.) Mass transfer in bioreactors (Oxygen and heat transfer). Measurement and control of Bioprocess parameters, Automation for monitoring and Control (online and offline sensors, Biosensors) Use of Computers: Data logging, data analysis, and process control, Process scale up: factors involved, steps involved, Immobilization techniques for cell and enzyme	control.
IV	UNIT IV	**Microbial Growth Kinetics** Microbial growth and its kinetics (Batch & Continuous) Types of ProcessesBatch, fed batch, continuous, Concept of scale up of fermentation. Comparative account of batch and continuous sterilization. Types of fermentation processes, Comparison between SSC and SLC, Factors affecting solid-state fermentations, Economic Applications.	Understand microbial growth and their kinetics.

Specify Course Outcome:

1. Student will be able to understand process biotechnology.
2. Student will understand Microbial growth, instrumental control and bioreactor.

Specify Program Outcome:

- To develop understanding inoculum preparation and media preparation.
- To develop understanding of bioreactor.
- Understand the microbial growth kinetics.
- Understand instrument control.
- Understand the computer used in bioreactor.

Signature of Teacher

Dnyanopasak Shikshan Mandal's

College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: M.D. Mujahed *Department: Biotechnology*

Program: M.Sc F.Y **Subject:** Biotechnology *Course Code: SBTTE-401*

Paper Title: ENZYMOLOGY

Unit Number	Unit Name	Topics	*Unit-wise Outcome*
I	UNIT I	**Basic Concepts:** Enzyme Classification, Characteristics of enzymes, enzyme substrate complex. Concept of active centre, binding sites, stereo specificity. Effect of temperature, pH and substrate concentration on reaction rate. Activation energy. Transition state theory. Enzyme catalysis. Factors affecting catalytic efficiency proximity and orientation	*Understanding Enzyme classification and characteristics*
II	UNIT II	**Enzyme kinetics** Enzyme kinetics: Michaelis – Menten Equation – form and derivation, steady state enzyme kinetics. Significance of Vmax and Km. Bisubstrate reactions. Allosteric Reactions and regulation: Protein ligand binding including measurements, analysis of binding isotherms, Cooperativity, Hill and Scatchard plots and kinetics of allosteric enzymes. Enzyme regulation: Product inhibition, feedback control, enzyme induction and repression and covalent modification.	Understand enzyme kinetics.
III	UNIT III	**Enzyme Interactions** Enzyme inhibition – types of inhibitors – competitive, non-competitive and	Understand Enzyme interactions

		uncompetitive, their mode of action and experimental determination. Enzyme activity, international units, specific activity, turnover number, end point kinetic assay. Multi-enzyme system: Occurrence, isolation and their properties: Mechanism of action and regulation of pyruvate dehydrogenase complex. Enzyme-enzyme interaction, multiple forms of enzymes with special reference to lactate dehydrogenase	
IV	UNIT IV	**Enzymes Immobilization** Immobilized Enzymes: Relative practical and economic advantage for industrial use, effect of partition on kinetics and performance with particular emphasis on charge and hydrophobicity (pH, temperature and Km). Various methods of immobilization ionic bonding, adsorption, covalent bonding (based on R groups of amino acids), microencapsulation and gel entrapment	Understand immobilization methods

Specify Course Outcome:

1. Student will be able to understand about Enzyme classification, properties and their regulation.
2. Student will understand about immobilization.

Specify Program Outcome:

- To develop understanding of Enzymology.
- To develop understanding of functions of enzymes.
- Understand significance of immobilized enzymes.

Signature of Teacher

Dnyanopasak Shikshan Mandal's

College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Lambade Snehal S **Department: Biotechnology**

Program: M.Sc S.Y **Subject:** Biotechnology **Course Code:** BT-IX

Paper Title: Genetic Engineering

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	UNIT I	**Molecular Tools in Genetic Engineering.** engineering. Cloning vectors: Plasmids and plasmid vectors, Phages and Phage derived Vectors, Phagemids, Cosmids, artificial chromosome vectors (YAC, BAG). Animal virus derived vectors -SV40 and retroviral vectors. Ti, Ri plasmid vectors.	Understanding Molecular tools in Genetic Engineering
II	UNIT II	**Molecular cloning** Construction of Genomic DNA and cDNA libraries, screening of recombinants. DNA analysis: labeling of DNA and RNA probes. Southern and fluorescence in situ hybridization, DNA fingerprinting, chromosome walking. Techniques for gene expression: Northern and Western blotting, gel retardation technique, DNA foot printing. SI mapping, Reporter assays.	Understand the molecular cloning
III	UNIT III	**Techniques in Molecular cloning** Chemical synthesis and Sequencing of DNA. Polymerase chain reaction and its applications Protein Engineering and Applications: Site-	Understand the PCR Technique

		directed mutagenesis, PCR based methods of mutagenesis, DNA Shuffling. Strategies for production and purification of recombinant proteins	
IV	UNIT IV	**Strategies of Gene Expression** Strategies of Gene Expression Physical methods of Gene transfer: Gene gun, Microinjection, Electroporation, Liposomes. Expression strategies for heterogonous genes: in prokaryotes, plant, animal cells. Genetic and Physical Mapping of genome. Use of transposons in genetic analysis: Transposon tagging and its use in identification and isolation of genes.	Understand gene expression
V	UNIT V	**Applications of Genetic Engineering** Transgenic Animals, Plants, production of recombinant proteins, recombinant vaccines and pharmaceuticals, concept of Bio-pharming. Gene Therapy: Gene replacement, gene augment. Bio safety regulation: Physical and Biological containments.	Understand Gene Therapy.

Specify Course Outcome:

1. Student will be able to understand the plasmids and plasmid vectors.
2. Student will understand techniques for gene expression

Specify Program Outcome:

- To develop understand northern blotting.
- To develop understanding of Gene replacement
- Understand of Transposons in genetic analysis

Signature of Teacher

Dnyanopasak Shikshan Mandal's

College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: M.D. Urooj

Department: Biotechnology

Program: M.Sc S.Y

Subject: Biotechnology

Course Code: BT-X

Paper Title: Industrial Biotechnology

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	UNIT I	**Down Stream Processing:** Removal and Recovery of cell mass: Precipitation, Filtration and Centrifugation Cell disruption - Physical and Chemical methods. Purification of Product Liquid-liquid extraction: Solvent Recovery. Chromatography: Adsorption, Ion-exchange, HPLC, GC-MS Membrane processes: Ultrafiltration and Reverse Osmosis. Drying and Crystallization	Understanding different techniques.
II	UNIT II	**Microbial production:** Microbial production of Organic Acids and Solvents, alcohol by fermentation Production, recovery and applications: Glycerol, Acetone, Citric acid Production, recovery and applications of amino acids: L-Glutamic acid, L-Tryptophan Production, recovery and applications of antibioties: Penicillin	Understand microbial fermentation.
III	UNIT III	**Production, recovery and applications of polysaccharides:** Xanthan, Dextran and Alginate Polyhydroxyalkanoates: Chemistry and properties, Polyhydroxybutyrate (PHB), biodegradable plastic. Microbial recovery of petroleum.	Production, recovery and application of polysaccharides.

		Production and applications of: Proteases, Pectinases, Cellulase	
IV	UNIT IV	**Microbial transformations**: Basic concept involved, Types of bioconversion reactions: Oxidation, Reduction, Hydrolytic reactions, Condensations. Transformation of steroids and sterols. Transformation of non-steroid compounds: L-Ascorbic acid, Prostaglandins, Antibiotics	Understand the microbial transformation and their types.
V	UNIT V	**Concept of QC and QA:** Introduction and overview of QC and QA QC testing of products: Purity, Sterility, Toxicity, Carcinogenicity, Pyrogen testing. Fermentation Economics: Cost Estimates, Process Design, Capital Cost Estimates, Operating Cost Estimates.	Understand the concept of QC and QA.

Specify Course Outcome:

1. Student will be able to understand the industrial important techniques.
2. Student will understand product recovery, production and application of microbial fermented products.

Specify Program Outcome:

- To develop understanding downstream processing.
- To develop understanding of microbial fermented products.
- Develop skills in production.
- Understand production, recovery and application of fermented product.
- Learn concept of QC and QA.

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Signature of Teacher

Dnyanopasak Shikshan Mandal's

College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: M.D. Mujahed **Department: Biotechnology**

Program: M.Sc S.Y **Subject:** Biotechnology **Course Code:** BT-XI

Paper Title: PLANT BIOTECHNOLOGY

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	UNIT I	**Plant Tissue Culture.** Structure and organization of Plant tissue culture laboratory. Tissue culture media: Types, Composition and preparation. Initiation and maintenance of callus and suspension culture. Somatic embryogenesis, Shoot tip culture, Protoplast culture. Embryo culture and embryo rescue. Anther, Pollen and Ovary culture for production of haploid plants. Cryopreservation, slow growth and DNA banking for germ plasm conservation Commercial application of tissue culture technology, examples: banana and Sugarcane	Understanding of PTC Media Preparation and various plant parts cultivation and their conservation
II	UNIT II	**Transgenic Crops:** Crops with resistance to abiotic stresses (Herbicides and drought conditions): Crops with resistance to biotic stresses, viruses, fungal and bacterial diseases: strategy and examples strategy and examples. Terminator technology. Ecological risk assessment of genetically modified crops	Understand Transgenic crops with resistance to biotic and abiotic stresses
III	UNIT III	**Microbes and Sustainable Agriculture:** N2 fixing bacteria as microbial bio fertilizers: Symbiotic	Understand Biofertilizer Production and their advantages for

		and nonsymbiotic bacteria. Microbial inoculants for sustainable agriculture: Microorganisms, Physiology and Production technology of (i) Cyanobacteria (ii) Plant growth promoting rhizobacteria (iii) Phosphate solubilizing microorganisms (iv) Mycorrhizae. Classification of Plant Diseases based on Symptoms. Plant Diseases: Causative agent, Symptoms, Mechanism of Action and Control Measures against plant diseases (Chemical and Biological	Sustainable Agriculture.
IV	UNIT IV	**Bio pesticides and Integrated Pest Management** Microbial growth and its kinetics (Batch & Continuous) Types of ProcessesBatch, fed batch, continuous, Concept of scale up of fermentation. Comparative account of batch and continuous sterilization. Types of fermentation processes, Comparison between SSC and SLC, Factors affecting solid-state fermentations, Economic Applications.	Understand about Biopesticides and IPM.
V	UNIT V	**Molecular Markers and Plant Pathology:** Molecular marker aided breeding: RFLP, RAPD, Microsatellites, AFLP etc. Plant diseases, causative agent, Symptoms, Mechanism of action and control measures against plant diseases (Chemical and Biological)	Understand about Molecular markers and Plant diseases and their Management

Specify Course Outcome:

1. Student will be able to understand Plant Tissue Culture.
2. Student will understand Media Preparation and various plant parts cultivation In vitro.
3. Student will understand production of Biofertilizers and Biopesticides.

Specify Program Outcome:

- To develop understanding of Plant Tissue Culture
- To acquire comprehensive knowledge on GM technology for quality characteristics and their role in crop improvement.
- Acquire knowledge in metabolic engineering and industrial products.
- Develop skills in molecular markers studies and their use in plant breeding.
- Develop scientific skills to work in Plant tissue culture and Research laboratories.

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Signature of Teacher

Dnyanopasak Shikshan Mandal's

College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Lambade Snehal S **Department: Biotechnology**

Program: M.Sc S.Y **Subject**: Biotechnology **Course Code**: BT-XII

Paper Title: English and Science Communication Skill

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	UNIT I	**Essentials of Communication:** Meaning, Definition, process, feedback, emergence of communication as a key concept in the corporate and global world, impact of technological advancements on communication. Channels of Communication: Formal and Informal: Vertical, horizontal, diagonal, and grapevine.	Understand Essential of Communication
II	UNIT II	**Methods and Modes of Communication:** Verbal and nonverbal, Verbal Communication: Characteristics of verbal communication, Non-verbal Communication: Characteristics of non-verbal communication, kinesics, proxemics and chronemics.	Understand Verbal and Non Verbal Communication.
III	UNIT III	**Soft Skills** a) Importance of listening skills, cultivating good listening skills b) Interpersonal skills. c) Negotiation skills. d) Time management skills.	Understand Soft Skills.

		e) Stress management skills.	
IV	UNIT IV	**Written Communication:** Business letters, memos, minutes of meeting, notices, e- mails, agendas and circulars. **Technical Report Writing:** Types of Reports, contents of reports. Formatting, writing styles and documentation.	Understand Written Communication

Specify Course Outcome:

1. Student will be able to understand Channels of communication
2. Student will understand Modes of Communication

Specify Program Outcome:

- To develop understanding Good Listening skill.
- To develop understanding of time management Skill.
- To develop Stress Management Skill.
- Understand the Characteristics of Non verbal Communication

Signature of Teacher

Dnyanopasak Shikshan Mandal's

College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: M.D. Urooj **Department: Biotechnology**

Program: M.Sc S.Y **Subject**: Biotechnology **Course Code**: BT-XIII B

Paper Title: Intellectual Property Right (IPR)

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	UNIT I	**Research**: Definition, Importance and Meaning of Research, Objectives of research, Characteristics of Research, Types of Research. Steps in Research; Identification, Selection and Formulation of Research Problem, Research Design, Formulation of Hypothesis, Review of Literature. Sampling Techniques: Sampling theory, Types of Sampling, Steps in Sampling, Sample Size, Advantages and limitations.	Understanding basic concept of research.
II	UNIT II	**Thesis and Manuscript writing:** Abstract, Introduction, Materials and Methods, Results and Discussion, Summary and Conclusion, References (IMRAD). Preparation of Manuscript; Author instructions, modes of paper communication, criteria for publication. Presentation of a scientific Paper.	Understand concept of manuscript writing.
III	UNIT III	**Introduction to IPR and Patents:** Intellectual property, Protection of Intellectual property, World organizations, forms of protection-patent, copyright, trademark, geographical indications, trade secrets. Criteria and procedure of	Understand the concept of IPR and patents.

		patenting.	
IV	UNIT IV	**Patenting biological material**. Patent procedure in India. Types of patenting, Patenting of biological materials with examples. Patent infringement- meaning, scope, litigation and examples.	Understand the concept patenting
V	UNIT V	**Plant breeder's right:** concept of UPOV, Breeders exemption, Plant variety protection in India. Farmer's right, advantages and disadvantages of PBR. Technology transferIntroduction, types of technology transfer and Indian scenario..	Understand plant breeder's right.

Specify Course Outcome:

1. Student will be able to understand the basic concept of research.
2. Student will understand research, IPR, patent and PBR.

Specify Program Outcome:

- To develop understanding Research.
- To develop understanding of manuscript writing.
- Understand the concept of Patent.
- Understand the criteria of IPR
- Understand PBR.

Signature of Teacher

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College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: M.D. Urooj **Department: Biotechnology**

Program: M.Sc S.Y **Subject**: Biotechnology **Course Code**: BT-XIV

Paper Title: Computational Biotechnology

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	UNIT I	**Biological Data Bases** The need for computation in Biology: An introduction to Bioinformatics, Historical overview, the principles involved, development of tools, internet based access. Introduction to Biological Databases, Database Browsing and Data Retrieval - Sequence databases, Structural databases, Literature and other databases	Understanding Biological data bases
II	UNIT II	**Application of Bioinformatics** Approaches for analysis and interpretation of Sequence Data and using: Homology Searches, Sequence Alignments, Pattern Searching. Application of Bioinformatics Approaches for analysis and interpretation of Genome data such as – Gene prediction, Full Genome comparison etc. Introduction to computational structural biology: Protein structure prediction using computational methods, Structure analysis, Classification of Proteins etc.	Understand application of bioinformatics.
III	UNIT III	**Proteomics Strategies in Proteomics:** 2 D PAGE, Mass spectrometry. Databases and search engines in proteomics. Proteomics applications: Understanding the mechanism of pathogenesis, Drug discovery, Disease diagnosis,	Understand the proteomics.

		identification and characterization of novel proteins. Protein-Ligand Docking: Introduction; Docking problems, methods for protein- ligand docking, validation studies and applications	
IV	UNIT IV	**Genomics** Introduction sequencing strategies for whole genome analysis, sequence data analysis. Comparative Genomics: Protein evolution from exon shuffling, Protein structural genomics, Gene function by sequence comparison Global expression profiling: whole genome analysis of mRNA and protein expression, microarray analysis, types of microarrays and their applications Functional genomics, Toxic genomics, Pharmacogenomics, Metagenomics. Metabolic engineering	Understand Genomics
V	UNIT V	**Biostatistics** Brief description and tabulation of data and its graphical representation Measurement of central tendency and dispersion- mean, mode, median, range Mean deviation, standard deviation, variance	Understand Biostatistics.

Specify Course Outcome:

1. Student will be able to understand the Computational biotechnology.
2. Student will understand application of bioinformatics, genomics, proteomics and biostatistics.

Specify Program Outcome:

- To develop understanding Computational Biotechnology.
- To develop understanding application of bioinformatics.
- To understand the proteomics.
- Understand Genomics.
- Understand the Biostatistics concept.

Signature of Teacher

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Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Lambade Snehal S **Department:** Biotechnology

Program: M.Sc S.Y **Subject:** Biotechnology **Course Code:** BT-XV

Paper Title: Pharmaceutical Biotechnology

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	UNIT I	**Chemotherapy** Antimicrobial Drug. Mechanism of action of antimicrobial agents. Microbial Resistance to antibiotics and antimicrobial agents (Types and Mechanism). Types of Antibiotics: Classification of antibiotics with example. General characteristics of a Secondary Metabolites: Types and Medicinal Applications	Understanding of anti microbial drug
II	UNIT II	**Chemotherapeutics Agents** Structure, Mechanism of Action and Applications of Antibacterial drug: Sulfonamides, Quinolones. Antiviral drug: Amantadine, Azido thymidine. Antifungal drug: Nystatin, Griseofulvin. Mechanism of action of Anticancer drugs, Drugs acting on CNS, Insulin, Blood factor VIII. Detailed account on Corona and Ebola viruses. Detailed account on nCOVID-2019	Understand chemotherapeutics agent
III	UNIT III	**Protein Engineering** Methods of protein sequencing: mass spectrometry, Edman degradation, Tryptic and/or Chymotryptic Peptide	Understand methods of protein sequencing

		Mapping. Isolation and purification of proteins. Stability and activity based approaches of protein engineering. Chemical and Physical Considerations in Protein and Peptide Stability. Different methods for protein engineering. Site-directed mutagenesis, gene shuffling, and direct evolution. Mapping of protein interactions: Two hybrid, phage display etc.	
IV	UNIT IV	**Computer aided drug design** Overview of computer assisted drug discovery (CADD). Concept and steps involved in pharmacophore modeling. Molecular modeling functions, types of molecular modeling. limitations of CADD	Understand computer aided drug design
V	UNIT V	**Clinical Trials** Phases of Clinical trials of drugs, Preclinical drug evaluation of its biological activity, potency and Toxicity-Toxicity test in animals including acute, sub-acute and chronic toxicity, ED50 and LD50 determination, special toxicity test like teratogenicity and mutagenicity. Introduction to Indian, International Pharmacopoeia and global regulatory guidelines.	Understand Clinical trials.

Specify Course Outcome:

1. Student will be able to understand application of anti microbial drugs.
2. Student will understand classification of antibiotic

Specify Program Outcome:

- To develop understanding computer aided drug design.
- To develop understanding of protein engineering.
- Develop phases of clinical trial.
- Understand functions and types molecular modeling

Dnyanopasak Shikshan Mandal's

College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: M.D. Mujahed **Department:** Biotechnology

Program: M.Sc S.Y **Subject:** Biotechnology **Course Code:** BT-XVI

Paper Title: ENVIRONMENTAL BIOTECHNOLOGY

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	UNIT I	**Ecology & Environment:** Interactions between environment and biota; Concept of habitat and ecological niches; Energy flow, food chain, food web and tropic levels; Ecological pyramids and recycling, N.P.C and S cycles in nature. Concepts and theories of evolution -Population ecology - community structure. Global environmental problems: ozone depletion, UV-B greenhouse effect and acid rain, their impact in biotechnological approaches for management.	Understanding of Ecology & Environment
II	UNIT II	**Biofuels:** Environmental Biotechnology and biofuels: biogas; bioethanol; biodiesel; bio hydrogen; Description of the industrial processes involved microorganisms and biotechnological interventions for optimization of production; Microbiologically enhanced oil recovery (MEOR); Bioleaching of metals; Production of bioplastics; Production of bio surfactants: bio emulsifiers.	Understand Biofuels and their production
III	UNIT III	**Environmental pollution:** Types of pollution, Methods for the measurement of pollution. Methodology of environmental	Understand Pollution

		management - the problem-solving approach, its limitations. Air pollution and its control through biotechnology. Bioremediation of contaminated soils and wastelands.	
IV	UNIT IV	**Waste water treatment:** Water Pollution and control: Need for water management, Measurement and sources water pollution. Waste water collection, Physico-chemical properties of water, physical, chemical and biological treatment processes. Activated sludge, oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds. Anaerobic digestion, anaerobic filters, up flow anaerobic sludge blanket reactors. Treatment schemes for waste waters of dairy, distillery, tannery, sugar, antibiotic industries. Kind of aquatic habitats, (fresh and marine), distribution and impact of environmental factors on the aquatic biota, productivity, mineral cycles and biodegradation different aquatic ecosystems. Management of estuarine, coastal water systems and man-made reservoirs; Biology and ecology of reservoirs	Understand Waste wate treatment.
V	UNIT V	**Xenobiotics:** Ecological considerations, decay behavior and degradative plasmids; hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides. Bioremediation of contaminated soils and wastelands. Solid waste: Sources and management, Municipal waste management (composting, vermiculture and methane production). Environmental mutagenesis and toxicity testing.	Understanding of Xenobiotics degradation and Solid waste Management

Specify Course Outcome:

1. Student will be able to understand about Environmental problems and their Management.
2. Student will understand Bofuels
3: Student will understand about Waste Water Management

Specify Program Outcome:

- To develop understanding of Environmental problems
- Acquire knowledge about biofuels and their production.
- Understand about Waste Water Management process

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Dnyanopasak Shikshan Mandal's

College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: M.D. Urooj

Department: Biotechnology

Program: M.Sc S.Y

Subject: Biotechnology

Course Code: BT-XVII B

Paper Title: Food Biotechnology

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	UNIT I	**Biotechnology of microbial polysaccharides, flavors in food.** Food safety: HACCP System to food protection, Responsibility for food safety. Food Additives: Definition, Types and Functional characteristics	Understanding food biotechnology.
II	UNIT II	**Natural Colors:** Types, Applications, Advantages of natural colors over Artificial Colors. Sweeteners: Types and Applications and Advantages. Causes of food spoilage, processing and packaging for food preservation.	Understand Natural colors.
III	UNIT III	**Genetic engineering** of baker's yeast. wine yeast. Diagnostics methods in food biotechnology, Genetic mechanisms involved in regulation of mycotoxin biosynthesis. Biosensors for food quality assessment. Biotransformation applicable to food industries. SCP, Spirulina and Chlorella as food source. Functional foods: Concept of Prebiotics, Probiotics and Nutraceuticals	Understand the genetic engineering.
IV	UNIT IV	**Fermented dairy products:** Cheese and yoghurt, Spoilage of fermented dairy products and their control,	Understand fermented dairy products.

		Production of Baker's yeast, Food enzymes and food additives. Biotechnological approaches to improve nutritional quality and shelf life of fruits and vegetables	
V	UNIT V	**Food safety Laws and Standards:** Food quality & analysis: Pre and Post-harvest factors in food quality, Physical, Chemical and Microbiological factors of quality, proximate analysis of foods, Sample and sample preparation in foods. Food laws: Voluntary and Mandatory food laws in India. Food Certification Agencies.	Understand food safety laws and standards.

Specify Course Outcome:

1. Student will be able to understand the food biotechnology.
2. Student will understand fermented products, genetic engineering and food safety laws and standards.

Specify Program Outcome:

- To develop understanding Food Biotechnology.
- To develop understanding of natural colors.
- Develop skills in production.
- Understand food safety and standards.
- Understand the fermented dairy produts.

Signature of Teacher