Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Miss. Nikita. S Ramawat **Department: Biotechnology**

Program: MSc/ FY **Subject**: **Biotechnology** **Course Code**: **BT-I**

Paper Title: Cell and Developmental Biology

Unit Number	**Unit Name**	**Topics**	**Unit-wise Outcome**
I	Study of Cell and its architecture	. f 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.	To study the structure and function of cell biology and its role in motality.
2	Cell-Cell Interaction	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 Gprotein coupled receptors, signal transduction pathways, second messengers,	To know Cell-Cell interaction through signalling pathways with bacterial and plant component system.

		regulation of signaling pathways, bacterial and plant two component systems, light signaling in plants, bacterial chemotaxis and quorum sensing. Regulation of hematopoiesis,	
3	Cell Division and 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.	To study the cell division and genetic recombination and fundamental of Cancer cells.
4	Developmental Biology	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.	To know fertilization of plant and animal cells and concept of competence.
5	Gene Pattering and Stem Cells	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.	To undustand the pattering and development of gene in plant.and stem cells

Specify Course Outcome: To understand the basics of Cell Biology and developmental Biology. To become aware about the stem cell technology.

Specify Program Outcome: To understand the basics of Cell Biology and developmental Biology and fundamentals of Cancer genetics. They will identify the characteristics and basic needs of living organisms and ecosystems.

Signature of Teacher

Miss. Nikita. S Ramawat

DnyanopasakShikshanMandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Miss. Nikita .S Ranawat **Department: Biotechnology**

Program: MSc /FY **Subject**: **Biotechnology** **Course Code**: **BT-II**

Paper Title: Microbiology and Virology

Unit Number	Unit Name	Topics	Unit-wise Outcome
1	The Begining of Microbiology	Controversy over spontaneous generation, Development of pure culture methods. **Bacteria:** Purple and green bacteria, Cyan bacteria, Homoacetogenic bacteria. Budding and append aged bacteria, Spirilla, Spirochetes, Gliding and sheathed bacteria, Pseudomonades; Lactic and prop ionic acid bacteria, Endospore forming rods and cocci, Mycobacterium, Rickettsia's, Chlamydia's and Mycoplasmas. **Archaea:** Archaea as earliest life forms, Halophiles, Methanogens, Hyper-thermophilic archaea.	To know the spontaneous generation and development of pure culture of different kinds of bacteria. To study the kinds of Archaea.
2	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 molecular coding; New approaches to bacterial taxonomy classification including Ribotyping; Ribosomal RNA sequencing;	To know the sterilization with the study of microbial evolution. To study of bacterial taxonomy.

		Characteristics of primary domains; Taxonomy, Nomenclature and Bergey's Manual.	
3	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.	To Learn the definition and steps of microbial growth and also learn environmental factors affected on growth of microbes.
4	General 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.	To know the discovery,nomenclature,structure , morphology and classification of Viruses. To know the Viral replication and cultivation by different ways.
5	Viruses	Life cycle of – Bacterial viruses (Lambda, M13), Plant viruses (TMV, and CMV) Animal viruses (Herpes and Retro)	To learn the life cycle of Plant,animal and bacterial viruses with examples.

Specify Course Outcome: To understand the basic principles of Microbiology and Virology. To learn the cultivation methods of Microorganisms.

Specify Program Outcome: To understand the development of Microbiology and Virology. Also will learn the growth pattern of Microorganisms.They will know the methods of cultivation of bacteria and Viruses for Industrial and Human use.

Signature of Teacher

Miss. Nikita .S Ranawat

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Farooqui Ayesha **Department: Biotechnology**

Program: MSc/ FY **Subject**: **Biotechnology** **Course Code**: **BT-III**

Paper Title: Biochemistry

Unit Number	**Unit Name**	**Topics**	**Unit-wise Outcome**
1	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.	To know the structure and properties of atoms of different molecules. To undustand the acid base concept and principle of thermodynamics.
2	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.	To study the Classification,occurrence,structure,function and properties of Carbohydreate and Lipid.
3	Amino acid	Classification and chemical reactions and physical properties. Peptide bond, peptide classification, biologically important peptides. **Proteins:** Properties and classification, primary, secondary, tertiary and quaternary	To study of Classification,properties and importance of peptide bonds.

		structure of proteins with example, structural comparison at secondary and tertiary levels. Ramachandran plot. **Enzymes:** Historical perspectives, general characteristics, nomenclature and classification. Methods of isolation, purification and characterization of enzymes. Concept of enzyme assay, enzyme activity, coenzymes and isoenzymes.	To learn structure,classification,properties of Protein. To know the History, characteristic, nomenclature and classification Enzyme.
4	Nucleic acid	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.	Structure, properties, types and significance of DNA and RNA.
5	Harmones	Structure and function; **Vitamins**: Types, structure and functions; Prostaglandins; Silk fibroin, coiled coils, collagen triple helix and hemoglobin.	Structure, function and types of Vitamines.

Specify Course Outcome: To learn structure, classification, properties, function and laboratory skills of Biomolecules.

Specify Program Outcome: To understand the Structure, classification and the properties of Biomolecules. They will acquire the basic laboratory skills for the isolation and separation of Biomolecules.

Signature of Teacher

Farooqui Ayesha

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Miss. Rumana.S. Khan **Department: Biotechnology**

Program: MSc/ FY **Subject**: **Biotechnology** **Course Code**: **BT-IV A**

Paper Title: Techniques in Biology

Unit Number	**Unit Name**	**Topics**	**Unit-wise Outcome**
1	Microscopy	Light microscope, Fluorescence microscope, Phase contrast microscope, Electron microscope. Centrifugation: Principles, RCF and Types of centrifuges, types of rotors, preparative and analytical ultra-centrifuge. **Electrochemical techniques**: Principles of electrochemical techniques, redox reactions, the pH electrode, ion-sensitive and gas-sensitive electrodes, The Clark oxygen electrode.	To know the types of Microscope with the principle of Electromagnetic techniques.
2	Chromatographic techniques	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 electrophoresis.	To study the Principle and types of Chromatography and its techniques. General principle of Electrophoresis.

3	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 dichorism spectroscopy, Atomic spectroscopy, x-ray diffraction, x-ray crystallography. Spectrofluorimetry, turbidometry and nephelometry.	To study the properties of Electromagnetic radiation and types of spectroscopy and its techniques.
4	Radio isotope techniques	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 biologicalsciences. Flowcytometry, ELISA, immunoblotting.	To learn the nature of radioactivity. To study the Principle and applications of Geiger Muller counter, radiolabelled compound and radio isotopes.
5	Biosensor	Principle, construction, mechanism and applications of biosensor with one example. (Enzyme and cell based)	To study the construction,mechanism, principle and application of Biosenser.

Specify Course Outcome: To know the basic principles, working and applications of biological techniques like Microscopy, electrophoresis, chromatography and spectroscopy.

Specify Program Outcome: Students will learn the working principles of biological techniques like microscopy, electrophoresis, chromatography and spectroscopy. They will use these biological techniques in research and development.

Signature of Teacher

Miss. Rumana.S. Khan

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Mr. Shaikh Irshad S.N **Department: Biotechnology**

Program: MSc/ FY **Subject**: **Biotechnology** **Course Code**: **BT-IV B**

Paper Title: Plant Metabolism and Development

Unit Number	Unit Name	Topics	Unit-wise Outcome
1	Plant water Relationship	Physical and chemical properties of water, diffusion, osmosis, plasmolysis, stress physiology, Whole Plants and Inorganic Nutrients, theories of absorption of mineral salt ions – contact exchange theory, carbonic acid exchange theory, mechanism of active absorption, Nutrient Uptake – Transport Systems - Translocation in the Phloem,	To learn physical and chemical properties of water. To study the absorption of mineral salt ions with study of different theories.
2	Photosynthesis and Respiration	The Light Reactions - Mode of Action of Some Herbicides - Dark Reactions – Oxidative Photosynthetic Carbon Cycle –C3, C4 and CAM pathway, Respiration: Mitochondrial electron transport; Glycolysis; synthesis of ATP, respiratory pathways- PPP; regulation of Respiration; Photorespiration: Glyoxylate pathway.	To study the photosynthetic reaction with pathways. To learn regulation of Respiration and photorespiration pathways.

3	Light and Harmonal control of plant growth	Photoperiodism - Phytochrome Regulation of Gene Expression - Blue-Light Responses - Guard Cell Osmoregulation – Auxin - Growth Hormone – Gibberellins - Regulators of Plant Height – Cytokinins - Regulators of Cell Division – Ethylene - Gaseous Hormone - Abscisic Acid - A Seed Maturation and Anti stress Signal - Circadian Rhythms.	To know light and Harmonal control of plant growth.
4	Plant Development	. Stamen and Androecium - Pollen Development - Carpel and Gynoecium - Ovule and Embryo Sac -Pollination and Pollen-Stigma Interaction – Pollen tube germination, growth and Fertilization - Endosperm- Embryo.	To study the plant development with the study of pollination, growth and fertilization.

Specify Course Outcome: To learn the fundamental process in plant system. To understand the basic aspects of plant physiology.

Specify Program Outcome: To learn the plant water relationship, mechanism of photosynthesis and respiration also able to explain the mechanism of plant reproduction.

Signature of Teacher

Mr. Shaikh Irshad S.N

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Miss. Nikita Ramawat **Department: Biotechnology**

Program: MSc /FY **Subject**: **Biotechnology** **Course Code**: **BT-V**

Paper Title: Molecular Genetics

Unit Number	Unit Name	Topics	Unit-wise Outcome
1	**Molecular Genetics**	Principles of Mendelian inheritance and Gene interactions: incomplete dominance, co dominance, 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.	To know the principle of Mendelian inheritance. To study the Recombination and genetic diseases.
2	**Molecular Genetics**	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.	To learn genomic organisation of Prokaryotes and Eukaryotes. To know the structure and types of Chromosome.
3	**Molecular Genetics**	DNA as genetic material, Genome Replication in prokaryote & eukaryotes, enzymes involved, replication origin and replication fork, mechanism of replication, elongation and termination.	To learn DNA as a genetic material. To study the Prokaryote and eukaryotes.

		DNA damage and repair mechanisms. Homologous and site-specific recombination, transposition.	To know the DNA damage and repair mechanism.
4	**Molecular Genetics**	RNA synthesis and processing, transcription factors and machinery, RNA polymerases, co and post transcriptional RNA processing. RNA transport, RNA Stability and Half-life period. Protein synthesis- Ribosome, Genetic code, t-RNA, initiation, elongation, termination of translation. Post translational modification of proteins.	To study the RNA synthesis with the help of enzyme. To know the synthesis and modification of Protein.
5	**Molecular Genetics**	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.	To study the gene regulation in Prokaryotes and eukaryotes. To learn gene regulation in phages and viruses.

Specify Course Outcome: To learn the Principles of Mendelian inheritance with the study of the Genome organization and gene regulation of Prokaryotes and eukaryotes.

Specify Program Outcome: Students will acquire the laboratory skills for the isolation if genetic material. They will learn the biochemistry of DNA and RNA. Students will analyze the gene interactions.

Signature of Teacher

Miss. Nikita Ramawat

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Miss. Farooqui Ayesha **Department: Biotechnology**
Program: MSc /FY **Subject**: **Biotechnology** **Course Code**: **BT-VI**

Paper Title: Immuno-technology

Unit Number	Unit Name	Topics	Unit-wise Outcome
1	**Immuno-technology**	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.	To learn the basic concept of Immune system and types of Immunity. To study the properties, types and function of Antigen and Antibodies. To know the Maturation and activation of B.cell and T-cell.
2	**Immuno-technology**	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.	To learn Complement system. To study types and mechanism of Hypersensitivity. To know the different Hypersensitivity reaction.
3	**Immuno-technology**	Autoimmunity: Organ specific autoimmune diseases (Hashimoto's thyroiditis, Autoimmune anemia, Insulin dependent diabetes mellitus) Systemic	To know the Autoimmunity.

		autoimmune diseases (SLE, Multiple sclerosis, Rheumatoid arthritis) Treatment of autoimmune diseases 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.	To study the Specific Autoimmune diseases To learn the Tranplantation Immunology.
4	**Immuno-technology**	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.	To know the Immunodeficiency its types. To learn Immunodeficiency diseases. To study the Radioimmunoassay and Immunoelectron microscopy.
5	**Immuno-technology**	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.	To study the Vaccine technology. To know the Vaccine development in situ.

Specify Course Outcome: To understand the basic concepts of Immune System Cells and organs of immune system with the vaccines and development in vaccine technology.

Specify Program Outcome: Students will learn the various components and working of immune system. They will acquire the techniques for the development of vaccines.

Signature of Teacher

Farooqui Ayesha

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Miss. Nikita Ramawat **Department: Biotechnology**

Program: MSc/ FY **Subject**: **Biotechnology** **Course Code**: **BT-VII**

Paper Title: Process Biotechnology

Unit Number	Unit Name	Topics	Unit-wise Outcome
1	**Process Biotechnology**	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.	To study the strain development of microorganism. To learn the genetic engineering for strain development and selection of mutant.
2	**Process Biotechnology**	Basic aspect of Bioreactor Designing, Types of Bioreactors, Ideal Properties of Bioreactor, Body Construction, Agitator, Impeller, Baffles, etc. Types of Bioreactor: Packed-bed reactor, Air –lift, Trickle bed, Photo bioreactors, Rotating Biological Reactors.	To learn the basic concept of Bioreactor. To study the Designing, types and properties of Bioreactors.
3	**Process Biotechnology**	Fluid flow and mixing, Classification 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	To know the classification of Fluid. To study the Reynolds's Number. To know the measurement and control of Bioprocess

		involved, Immobilization techniques for cell and enzyme.	Parameter with uses of computer. To know the concept of Immobilization techniques.
4	**Process Biotechnology**	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.	To study the concept of media formulation and significance. To know the Sterlization methods with its factors and types. To learn inoculums development.
5	**Process Biotechnology**	Microbial growth and its kinetics (Batch & Continuous) Types of Processes-Batch, 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.	To know the microbial growth and its kinetics. To study the concept and types of fermentation. To know the application

Specify Course Outcome: To learn the microbial techniques for the Isolation, Screening, Preservations and maintenance of Microorganisms. To become aware about the designs and types of bioreactors.

Specify Program Outcome: To understand the various laboratory methods for the isolation and preservation of Microorganisms. They will learn the Industrial use of bioreactor and also become aware about the media optimization.

Signature of Teacher

Miss. Nikita Ramawat

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Miss. Farooqui Ayesha **Department: Biotechnology**

Program: MSc/ FY **Subject**: **Biotechnology** **Course Code**: **BT-VIII A**

Paper Title: Enzymology

Unit Number	Unit Name	Topics	Unit-wise Outcome
1	**Enzymology**	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.	To know the classification, characteristic, and types of Enzyme. To know the factors affecting on Enzyme catalysis
2	**Enzymology**	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.	To study the Enzyme kinetics and its significance. To learn the Enzyme regulation.
3	**Enzymology**	Enzyme inhibition – types of inhibitors – competitive, non-competitive and uncompetitive, their mode of action and experimental determination. Enzyme	To study the Enzyme inhibiton and types of enzyme activity.

		activity, international units, specific activity, turnover number, end point kinetic assay.	
4	**Enzymology**	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.	To study the Immobilized enzymes and its various methods and economic advantage for industrial uses.
5	**Enzymology**	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.	To know the occurrence,isolation properties of Multi-enzyme system. To study the enzyme – enzyme interaction.

Specify Course Outcome: To know the fundamental details of Enzymes. To learn the various methods of enzyme immobilization and enzyme kinetics.

Specify Program Outcome: To learn the role of enzyme in human health and their industrial applications and the laboratory knowledge for the industrial enzyme products.

Signature of Teacher

Miss. Farooqui Ayesha

DnyanopasakShikshanMandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Miss. Nikita Ramawat **Department: Biotechnology**

Program: MSc/ FY **Subject**: **Biotechnology** **Course Code**: **BT-VIII B**

Paper Title: Nano-Biotechnology

Unit Number	Unit Name	Topics	Unit-wise Outcome
1	Nano-Biotechnology	Introduction, The nanoscale dimension and paradigm. Types of nanomaterials and their classifications. D, 2D and 3D etc. Nanocrystal, Nanoparticle, Quantum dot, Quantum Wire and Quantum Well etc. Polymer, Carbon, Inorganic, Organic and Biomaterials – Structures and characteristics. Physical and Chemical Fundamentals of Nanomaterial.	To study the introduction,types structure and characteristic of Nanomaterials.
2	Nano-Biotechnology Application	Proteins - Lipids - RNA and DNA Protein Targeting - Small molecule/Nanomaterial – Protein Interactions Nanomaterial-Cell interactions-Manifestations of Surface Modification (Polyvalency) MRI, Imaging Surface Modified Nanoparticles	To know the biotechnological application of Nanomaterial with genetic material

		MEMS/NEMS based on Nanomaterials.	
3	Bological Nanoparticles	Lipid Nanoparticles for Drug Delivery. Peptide/DNA Coupled Nanoparticles. Inorganic Nanoparticles for Drug Delivery Metal/Metal Oxide Nanoparticles (antibacterial/anti fungal/anti viral) Anisotropic and Magnetic Particles (Hyperthermia).	To know the Lipid nanoparticles for Drug delivery.
4		Applications of Nanotechnology/ Nano-biotechnology in various areas like agriculture, medicine, cosmetics and environment. Intellectual Property Rights:- Concept of IPR, Patents, Trademarks, Copyrights, Secrets. Patenting of biological materials.	To learn the application of Nanotechnology. To undustand the Intellactual property rights.

Specify Course Outcome: To know the use of Biotechnology at nanoscale and learn the various methods for the development of nanoparticles and IPR.

Specify Program Outcome: To understand the use of Nano-biotechnology in various areas like agriculture, medicine, cosmetics and environment and learn the rights of Intellectual properties.

Signature of Teacher

Miss. Nikita Ramawat

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Nikita .S. Ramawat **Department: Biotechnology**

Program: MSc/SY **Subject**: **Biotechnology** **Course Code**: **BT-XI**

Paper Title: Genetic Engineering

Unit Number	Unit Name	Topics	Unit-wise Outcome
1	Molecular tool in genetic Engineering	Restriction Endonucleases, Modification methylases and other enzymes needed in genetic 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.	To know the concept of genetic engineering with enzyme needed in genetic engineering. To studythe Plasmid and its Vectors and its types.
2	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.	To know the construction of genomic DNA. To study the concept of situ Hybridization of DNA.

3	Techniques in Molecular	Chemical synthesis and Sequencing of DNA. Polymerase chain reaction and its applications Protein Engineering and Applications: Site-directed mutagenesis, PCR based methods of mutagenesis, DNA Shuffling. Strategies for production and purification of recombinant proteins.	To learn the chemical synthesis and DNA sequencing. To study the protein engineering and application. To know strategies of recombinant protein.
4	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.	To know the Physical method of gene transfer. To study the strategies of gene expression in prokaryotes and plant and animal cells.
5	Application 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.	To study the genetic engineering application

Specify Course Outcome: To learn molecular cloning and tools and strategies of gene expression.

Specify Program Outcome: To aware the study of genetic engineering and its application that inhance the recombinant concept to plant and animal.

Signature of Teacher

Nikita .S. Ramawat

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Miss. Nikita .S. Ramawat **Department: Biotechnology**

Program: MSc/SY **Subject**: **Biotechnology** **Course Code**: **BT-XII**

Paper Title: Industrial Biotechnology

Unit Number	Unit Name	Topics	Unit-wise Outcome
1	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.	To know the removal and recovery of cell mass by physical and chemical process. To learn purification of liquid product by chromatographic and membrane process techniques.
2	Microbial Production	Microbial production of Organic Acids and Solvents, alcohol by fermentation Production, recovery and applications: Glycerol, Acetone, Citric acid, Lactic acid Microbial Production of Amino Acids and Vitamins: Vitamin-B12 and Riboflavin Production, recovery and applications of amino acids: L-Glutamic acid, L-Tryptophan Production, recovery and applications of antibiotics: Penicillin, Erythromycin,	To study the microbial production of organic acid and solvents. To learn application of amino acid and antibiotics.

3	Microbial Productions	Production, recovery and applications of polysaccharides: Xanthan, Dextran and Alginate Polyhydroxyalkanoates: Chemistry and properties, Polyhydroxybutyrate (PHB), biodegradable plastic. Microbial recovery of petroleum. Production and applications of: Proteases, Pectinases, Cellulase.	To study the production, recovery and application of polysaccharides,PHB, petroleum and proteases.
4	Microbial transformations	Basic concept involved, Types of bioconversion reactions: Oxidation, Reduction, Hydrolytic reactions, Condensations. Transformation of steroids and sterols. Transformation of nonsteroid compounds: L-Ascorbic acid, Prostaglandins, Antibiotics.	To know the bioconversion and hydrolytic reaction.
5	QC QA and GLP	Concept of QC, QA, Good Laboratory Practices, cGMP QC testing of products: Purity, Sterility, Toxicity, Carcinogenicity, Pyrogen testing. Fermentation Economics: Cost Estimates, Process Design, Capital Cost Estimates, Operating Cost Estimates.	To learn concept of QC,QA and GLP also Good lab practices

Specify Course Outcome: To undustand microbial production by downstream processes and microbial transformation.

Specify Program Outcome: To learn microbial production and their recovery in industries and also aquire QC, QA, and GLP .

Signature of Teacher

Miss. Nikita .S. Ramawat

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Miss Nikita .S. Ramawat **Department: Biotechnology**

Program: MSc/SY **Subject**: **Biotechnology** **Course Code: BT-XIII**

Paper Title: Animal Biotechnology

Unit Number	Unit Name	Topics	Unit-wise Outcome
1	Animal Cell Culture	Structure and organization of Animal cells - Culture media; Balanced salt solutions and simple growth medium, Physical, chemical and metabolic functions of different constituents of culture medium; Role of carbon dioxide, serum, growth factors, glutamine in cell culture; Serum and protein free defined media and their applications.	To know the structure and function of Animal cells and its culture media. To studythe physical,chemical and metabolic function of different constituents of culture media.
2	Animal Cell Culture	Types of cell culture: primary and established culture; organ culture; tissue culture; three dimensional culture and tissue engineering; feeder layers; disaggregation of tissue and primary cell culture; cell separation; cell synchronization. Cryopreservation. Biology and characterization of cultured cells: tissue typing; cell-cell interaction; measuring parameters of growth; measurement of cell death; Apoptosis and its determination; cytotoxicity assays -	To study the types of Animal cell culture. To know the biology and characterization of culture cell. To learn parameters of growth of cells.
3	Molecular techniques in cell culture	Cell transformation; physical, chemical and biological methods; Viral gene delivery systems: Adenoviruses, ALVs,	To know the types of cell transformation.

		Bacculoviruses; manipulation of genes; cell cloning and micro manipulation; hybridoma technology and its applications; cell fusion methods; gene mapping; vaccine production; gene therapy, targeting, silencing and knockout. Selectable markers like pSV and pRSV plasmids -reporter genes. Application of animal cell culture - Engineered cell culture as source of valuable products and protein production.	To learn the Viral gene delivery system. To know the hybridoma technology and its application. To study the application of animal cell.
4	Embryology	Collection and preservation of embryos; culturing of embryos; Gametogenesis and fertilization in animals; types of cleavage pattern; role of maternal contributions in early embryonic development; genetic regulation of embryonic development in Drosophila; homeotic genes in development; stem cell culture, embryonic stem cell and their applications.	To know the concept of embryology. To learn types of cleavage pattern. To undustand the concept of embryonic development and their applications.
5	Transgenics	Transgenic animal: production and application; transgenic animals as models for humandiseases; transgenic animals in live-stock improvement; expression of the bovine growth hormone; transgenics in industry; chimera production; Ethical issues in animal biotechnology.	To study the Transgenic animals ..its production and application in industry.

Specify Course Outcome: To know the molecular techniques in animal cell culture, embryonic development and transgenic animal.

Specify Program Outcome: To undustand the transgenic animal production and its application in industry.

Signature of Teacher

Miss Nikita .S. Ramawat

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Miss. Farooqui Ayesha **Department: Biotechnology**

Program: MSc/SY **Subject**: **Biotechnology** **Course Code: BT-XIV**

Paper Title: Plant and Agriculture Biotechnology

Unit Number	Unit Name	Topics	Unit-wise Outcome
1	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 and homozygous lines. Cryopreservation, slow growth and DNA banking for germ plasm conservation Commercial application of tissue culture technology, examples: banana and Sugarcane.	To study the structure types and organization of plant tissue culture. To know the commercial application of tissue culture technology.
2	Transgenic Crop	Crops with resistance to biotic stresses, viruses, fungal and bacterial diseases: strategy and examples Crops with resistance to abiotic stresses (Herbicides and drought conditions): strategy and examples. Terminator technology. Ecological risk assessment of genetically modified crops.	To know the crops with biotic and abiotic stresses with strategy and examples. To undustand the Terminator technology and genetically modified crops.

3	Microbes for Sustainable Agriculture	N2 fixing bacteria as microbial biofertilizers: Symbiotic and non symbiotic 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. Plant hormones by bacteria.	To know the microbial biofertilizer with symbiotic and non symbiotic bacteria. To learn the physiology and production technology of different microbes.
4	Plant Pathology	Concept of Plant Pathology. Host Pathogen Relationship. Pathogenesis mechanism- Enzymes, Toxins, Nutrition etc. Mechanism of Plant defense, resistance to disease. Classification of Plant Diseases based on Symptoms. Plant Diseases: Causative agent, Symptoms, Mechanism of Action and Control Measures against plant diseases (Chemical and Biological)	To know the concept and mechanism of plant pathology. To learn the classification,symptoms and mechanism of plant diseases.
5	Biopesticides and Integrated past Managment	Biological control, Plant biopesticides and botanicals and microorganisms pest control Biopesticides v/s chemical pesticides: advantages and disadvantages. Examples of biopesticides: Bt-based biopesticides, Baculoviruses, Trichoderma Integrated Pest Management (IPM): Use of insect resistant crops, Refugia and Ecological approach of IPM. Present status and future needs for making biopesticides and IPM popular.	To study the biological and chemical types of biopesticides. To know the advantages and disadvantages of biopesticides.

Specify Course Outcome: To learn the Transgenic crops with the study of plant tissue culture.To study plant pathology and its pest control management.

Specify Program Outcome: To acquire the knowledge of transgenic plant concept and apply in agriculture development .

Signature of Teacher

Miss. Farooqui Ayesha

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Miss. Farooqui Ayesha **Department: Biotechnology**

Program: MSc/SY **Subject**: **Biotechnology** **Course Code**:BT-XVI

Paper Title: Computational Biology and Biostatics

Unit Number	Unit Name	Topics	Unit-wise Outcome
1	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.	To know the computation in biology as a study of bioinformatics. To undustand the introduction and concept of biological data bases.
2	Application of Bioinformatics	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.	To learn the bioinformatics applications. To know the computational biology and computational methods.

3	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, identification and characterization of novel proteins. Protein-Ligand Docking: Introduction; Docking problems, methods for protein- ligand docking, validation studies and applications.	To know the concept ,strategies and applications of Proteomics.... To study the characterization of novel protein . To learn the Docking problems, methods and applications.
4	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, Toxicogenomics, Pharmacogenomics, Metagenomics. Metabolic engineering.	To learn the concept of genomics and gene analysis. To know the functional genomics. To study of microarray...its types and applications
5	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 . Idea of two types of errors and level of significance. Tests of significance- F-Test and chi-square test. Linear regression and correlation.	To study the concept biostatics in biological data in the form of tabulation and graphical representation.

Specify Course Outcome: To learn the computational biology as a study of Bioinformatics.

Specify Program Outcome: To learn the concept of biostatics in biological data in the form of tabulation and graphical representation as genomics and proteomics.

Signature of Teacher

Miss. Farooqui Ayesha

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College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Miss Rumana. S. khan **Department: Biotechnology**

Program: MSc/SY **Subject**: **Biotechnology** **Course Code**: **BT-XVII**

Paper Title: Pharmaceutical Biotechnology

Unit Number	Unit Name	Topics	Unit-wise Outcome
1	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 an Secondary Metabolites: Types and Medicinal Applications.	To know the types and mechanism of antimicrobial agents. To learn types of antibiotics. To study the types of secondary metabolites and their application.
2	Chemotherapeutic agent	Structure, Mechanism of Action and Applications of Antibacterial drug: Sulfonamides, Quinolones. Antiviral drug: Amantadine, Azidothymidine. Antifungal drug: Nystatin, Griseofulvin.Mechanism of action of Anticancer drugs, Drugs acting on CNS, Insulin, Blood factor VIII.	To study the structure,mechanism and application of Antibacterial drug and Anticancer drug.
3	Protein Engineering	Methods of protein sequencing: mass spectrometry, Edman degradation, Tryptic and/or Chymotryptic Peptide 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,	To know the methods of protein. To study the different methods for protein engineering.

		and direct evolution. Mapping of protein interactions: Two hybrid, phage display etc.	
4	Discovery and Development	History, drug targeting, Molecular Biology and Combinatorial drug discovery, Rational Drug designing. Computer Aided Drug Discovery, Concept of Chemoinformatics, Pharmacokinetics, Pharmacodynamics. Drug delivery systems, Liposomes.	To know the History of Drug discovery. To learn development of drug with the help of computer...as a computer aided drug.
5	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 teratogenecity and mutagenecity. Introduction to Indian, International Pharmacopoeia and global regulatory guidelines.	To study the phases of clinical trial of drug. Toxicity test in animals.

Specify Course Outcome: To the study the mechanism of action of antimicrobial drug and types and classification of antibiotics also learn drug development its clinical trials.

Specify Program Outcome: To understand the drug development and protein engineering techniques.

Signature of Teacher

Miss Rumana. S. khan

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Mr. Shaikh Irshad S.N **Department: Biotechnology**

Program: MSc/SY **Subject**: **Biotechnology** **Course Code**: **BT-XVIII**

Paper Title: Environmental Biotechnology

Unit Number	Unit Name	Topics	Unit-wise Outcome
1	Ecology and Environment	Interactions between environment and biota; Concept of habitat and ecological niches; Limiting factor; Energy flow, food chain, food web and tropic levels; Ecological pyramids and recycling, biotic community-concept, structure, dominance, fluctuation and succession; N.P.C and S cycles in nature. Concepts and theories of evolution - Population ecology - community structure.	To know the concept of habitat, food web and food chain . To learn the ecological pyramids ..structure and concept. To learn the concept and theories of evolution.
2	Ecology and Environment	Ecosystem dynamics and management: Stability and complexity of ecosystems; Speciation and extinctions; environmental impact assessment; Principles of conservation; Conservation strategies; sustainable development. Global environmental problems: ozone depletion, UV-B green house effect and acid rain, their impact in biotechnological approaches for management.	To learn the ecosystem and its principles. To studythe different types of environment problem.
3	Environment Pollution	Types of pollutions, Methods for the measurement of pollution. Methodology of environmental management - the problem solving approach, its limitations. Air pollution and its control through	To learn the types and methodology of pollutions.

		Biotechnology. Water Pollution and control: Need for water management, Measurement and sources water pollution. 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.	
4	Waste water treatment	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. Management of estuarine, coastal water systems and man-made reservoirs; Biology and ecology of reservoirs.	To undustand the physical , biological and chemical treatment of waste water.
5	Xenobiotics	Ecological considerations, decay behaviour and degradative plasmids; hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides. Biopesticides in integrated pest management. Bioremediation of contaminated soils and wastelands. Solid waste: Sources and management, Municipal waste management (composting, vermiculture andmethane production). Environmental mutagenesis and toxicity testing.	To know the concept of decay and degradation To study the concept of Bioremediation.

Specify Course Outcome: To learn the ecology and environment with the study of types of envioment and their pollution.

Specify Program Outcome: To acquire the knowledge of different types of environment and pollution control aspects in waste water and Xenobiotics.

Signature of Teacher

Mr. Shaikh Irshad S.N

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Miss. Nikita Ramawat **Department: Biotechnology**

Program: MSc/SY **Subject**: **Biotechnology** **Course Code: BT-XIV**

Paper Title: Applied Biotechnology

Unit Number	Unit Name	Topics	Unit-wise Outcome
1	Food biotechnology 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. Natural Colors: Types, Applications, Advantages of natural colors over Artificial Sweeteners. Sweeteners: Types and Applications. Causes of food spoilage, processing and packaging for food preservation.	To study the concept of HACCP and foodsafety. To learn types function, definition and characterization of food additives and natural food colors. To know the causes of food spoilage.
2	Food biotechnology II	Genetic engineering of bakers 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 soruce. Functional foods: Concept of Prebiotics, Probiotics and Neutraceuticals.	To know the concept of biotechnology in food and mechanisms. To undustand the concept of biosensors in food quality assessment. To know the biotransformation in food industry.
3	Nano biotechnology	Introduction, The nanoscale dimension and paradigm. Types of nanomaterials and their	To study the introduction, types and

		classifications. D, 2D and 3D etc. Nanocrystal, Nanoparticle, Quantum dot, Quantum Wire and Quantum Well etc. Polymer, Carbon, Inorganic, Organic and Biomaterials –Structures and characteristics. Physical and Chemical Fundamentals of Nanomaterial.	classification of Nanomaterials.
4	Nano biotechnology application	Proteins - Lipids - RNA and DNA Protein Targeting - Small molecule/Nanomaterial – Protein Interactions Nanomaterial-Cell interactions-Manifestations of Surface Modification (Polyvalency) MRI, Imaging Surface Modified Nanoparticles MEMS/NEMS based on Nanomaterials Peptide/DNA Coupled Nanoparticles. Lipid Nanoparticles for Drug Delivery Inorganic Nanoparticles for Drug Delivery Metal/Metal Oxide Nanoparticles (antibacterial/anti fungal/anti viral) Anisotropic and Magnetic Particles (Hyperthermia)	To know the application of nanomaterial in different ways.
5	Intellactual property rights	IPR, Patents, Trademarks, Copyrights, Secrets. Patentingof biological materials. International cooperation, obligations with patent applications. Current issues, hybridoma technology etc. Patenting of higher plants, animals, transgenic organisms and isolated genes. Patenting of genes and DNA sequences. Right of plant breeders and farmers.	To know the property rights on higher plant and genetic materials like gene patening.

Specify Course Outcome: To know the food safety measurement, causes of food spoilage and quality improvement. Also study of Nanomaterials and its application in industry.

Specify Program Outcome: Student will undustand concept of HCCEP and applications of Nanomaterials in industry and also will get knowledge about Intellactual property rights on higher plants and genetic materials.

Signature of Teacher

Miss. Nikita Ramawat