

Semester – I				
Course Code	Course Type	Course Title	Credits	Lectures/Week
USBT101	Core Subject	Basic Chemistry-I	2	3
USBT102	Core Subject	Basic Chemistry-II	2	3
USBT103	Core Subject	Basic Life Sciences-I : Biodiversity and Cell Biology	2	3
USBT104	Core Subject	Basic Life Sciences-II : Microbial Techniques	2	3
USBT105	Core Subject	Basic Biotechnology-I : Introduction to Biotechnology	2	3
USBT106	Core Subject	Basic Biotechnology-II : Molecular Biology	2	3
USBT107	Ability Enhancement Course 1 (FC I)	Societal Awareness	2	3
USBTP101, USBTP102, USBTP103	Core Subject Practicals	Practicals of USBT101, USBT102, USBT103, USBT104, USBT105 and USBT106	6	18
Semester – II				
Course Code	Course Type	Course Title	Credits	Lectures/Week
USBT201	Core Subject	Chemistry-I : Bioorganic Chemistry	2	3
USBT202	Core Subject	Chemistry-II : Physical Chemistry	2	3
USBT203	Core Subject	Life Sciences-I : Physiology and Ecology	2	3
USBT204	Core Subject	Life Sciences-II : Genetics	2	3
USBT205	Core Subject	Biotechnology-I : Tissue Culture & Scientific Writing and Communication Skills	2	3
USBT206	Core Subject	Biotechnology-II : Enzymology, Immunology and Biostatistics	2	3
USBT207	Ability Enhancement Course 2 (FC II)	Globalization, Ecology and Sustainable Development	2	3
USBTP201, USBTP202, USBTP203	Core Subject Practicals	Practicals of USBT201, USBT202, USBT203, USBT204, USBT205 and USBT206	6	18

SEMESTER – I
THEORY

SEMESTER I**Basic Chemistry-I**

COURSE CODE	TITLE	CREDITS	Notional Hours
USBT 101	Basic Chemistry I	2	
Course Objective : To acquaint the students with basic concepts of Chemistry like Classification and Nomenclature of Chemical compounds			
Learning Outcome : To impart hands-on skills in preparation of Buffers and Solutions			
Unit I Nomenclature and Classification	Nomenclature and Classification of Inorganic Compounds: Oxides, Salts, Acids, Bases, Ionic, Molecular and Coordination Compounds Nomenclature and Classification of Organic Compounds: Alkanes, Alkenes, Alkynes, Cyclic Hydrocarbons, Aromatic Compounds, Alcohols and Ethers, Aldehydes and Ketones, Carboxylic Acids and its derivatives, Amines, Amides, Alkyl Halides and Heterocyclic Compounds	15 Lectures	30 hrs
Unit II Chemical Bonds	Chemical Bonds: Ionic Bond: Nature of Ionic Bond, Structure of NaCl, KCl and CsCl, factors influencing the formation of Ionic Bond. Covalent Bond: Nature of Covalent Bond, Structure of CH ₄ , NH ₃ , H ₂ O, Shapes of BeCl ₂ , BF ₃ Coordinate Bond: Nature of Coordinate Bond Non Covalent Bonds: Van Der Waal's forces: dipole - dipole, dipole – induced dipole. Hydrogen Bond: Theory of Hydrogen Bonding and Types of Hydrogen Bonding (with examples of RCOOH, ROH, Salicylaldehyde, Amides and Polyamides).	15 Lectures	30 hrs
Unit III Water and Buffers	Chemistry of Water: Properties of Water, Interaction of Water with Solutes (Polar, Non-Polar, Charged), Non-Polar Compounds in Water – Change in its Structure and the Hydrophobic Effect, Role of Water in Biomolecular Structure and Function and Water as a Medium for Life	15 lectures	30 hrs

	<p>Solutions: Normality, Molarity, Molality, Mole fraction, Mole concept, Solubility, Weight ratio, Volume ratio, Weight to Volume ratio, ppb, ppm, millimoles, milliequivalents (Numericals expected).</p> <p>Primary and Secondary Standards: Preparation of Standard Solutions, Principle of Volumetric Analysis.</p> <p>Acids and Bases: Lowry-Bronsted and Lewis Concepts. Strong and Weak Acids and Bases - Ionic Product of Water - pH, pK_a, pK_b. Hydrolysis of Salts.</p> <p>Buffer solutions –Concept of Buffers, Types of Buffers, Derivation of Henderson equation for Acidic and Basic buffers, Buffer action, Buffer capacity (Numericals expected.) pH of Buffer Solution.</p>		
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SEMESTER I

Basic Chemistry-II

COURSE CODE	TITLE	CREDITS	Notional Hours
USBT 102	Basic Chemistry II	2	
<p>Course Objective : To acquaint students with Concepts of Stereochemistry</p> <p>Learning Outcome : To impart knowledge of Titrimetric and Volumetric Estimations and handling of basic Analytical Techniques like Chromatography and Colorimetry</p>			
Unit I Stereochemistry	<p>Isomerism – Types of Isomerism: Constitutional Isomerism (Chain, Position and Functional) and Stereoisomerism, Chirality.</p> <p>Geometric Isomerism and Optical Isomerism: Enantiomers, Diastereomers, and Racemic mixtures Cis-Trans, Threo, Erythro and Meso isomers. Diastereomerism (Cis-Trans Isomerism) in Alkenes and Cycloalkanes (3 and 4 membered ring)</p> <p>Conformation: Conformations of Ethane. Difference between Configuration and Conformation.</p> <p>Configuration, Asymmetric Carbon Atom, Stereogenic/ Chiral Centers, Chirality,</p>	15 Lectures	30 hrs

	<p>Representation of Configuration by “Flying Wedge Formula”</p> <p>Projection formulae – Fischer, Newman and Sawhorse. The Interconversion of the Formulae.</p>		
<p>Unit II Titrimetry and Gravimetry</p>	<p>Titrimetric Analysis: Titration, Titrant, Titrand, End Point, Equivalence Point, Titration Error, Indicator, Primary and Secondary Standards, Characteristics and examples</p> <p>Types of Titration –Acid –Base, Redox. Precipitation, Complexometric Titration. Acid – Base Titration.-Strong Acid Vs Strong Base -Theoretical aspects of Titration Curve and End Point Evaluation. Theory of Acid –Base Indicators, Choice and Suitability of Indicators.</p> <p>Gravimetric Analysis: Solubility and Precipitation, Factors affecting Solubility, Nucleation, Particle Size, Crystal Growth, Colloidal State, Ageing/Digestion of Precipitate. Co-Precipitation and Post-Precipitation. Washing, Drying and Ignition of Precipitate. (Numericals Expected).</p>	15 Lectures	30 hrs
<p>Unit III Analytical Techniques</p>	<p>Methods of Separation Precipitation, Filtration, Distillation and Solvent Extraction.</p> <p>Analytical Techniques Chromatography: Definition, Principles, Types Introduction to Paper Chromatography, Thin Layer Chromatography, Column Chromatography and its Applications.Colorimetry: Principle, Beer-Lambert’s Law, Measurement of Extinction, Derivation of $E = kcl$, Limitations of Beer-Lambert’s Law, Filter Selection</p>	15 Lectures	30 hrs

SEMESTER I

Basic Life Sciences-I : Biodiversity and Cell Biology

COURSE CODE	TITLE	CREDITS	Notional Hours
USBT 103	Biodiversity and Cell Biology	2	
Course Objectives : To acquaint students with concept of Biodiversity and Cell Biology Learning Outcome : To impart skill in handling and culture of Microorganisms			
Unit I Origin of Life and Biodiversity (Animal, Plant, Microorganisms)	Origin of Life, Chemical and Biological Evolution, Origin of Eukaryotic Cell. Concept of Biodiversity, Taxonomical, Ecological and Genetic Diversity & its Significance Introduction to Plant Diversity: Algae, Fungi, Bryophyta, Pteridophyta, Gymnosperms and Angiosperms (with one example each) Introduction to Animal Diversity: Non-Chordates and Chordates {with at least one representative example.) Introduction to Microbial Diversity Archaeobacteria, Eubacteria, Blue-green Algae, Actinomycetes, Eumycota- Habitats, Examples and Applications.	15 Lectures	30 hrs
Unit II Ultra Structure of Prokaryotic and Eukaryotic Cell.	Ultrastructure of Prokaryotic Cell: Concept of Cell Shape and Size. Detail Structure of Slime Layer, Capsule, Flagella, Pili, Cell Wall (Gram Positive and Negative), Cell Membrane, Cytoplasm and Genetic Material Storage Bodies and Spores Ultrastructure of Eukaryotic Cell: Plasma membrane, Cytoplasmic Matrix, Microfilaments, Intermediate Filaments, and Microtubules Organelles of the Biosynthetic- Endoplasmic Reticulum & Golgi Apparatus. Lysosome, Endocytosis, Phagocytosis, Autophagy, Proteasome Eucaryotic Ribosomes, Mitochondria and Chloroplasts	15 Lectures	30 hrs

	<p>Nucleus –Nuclear Structure, Nucleolus</p> <p>External Cell Coverings: Cilia And Flagella</p> <p>Comparison of Prokaryotic And Eukaryotic Cells</p>		
<p>Unit III</p> <p>Bacteria and Viruses</p>	<p>Bacteria : Classification, Types, Morphology (Size, Shape and Arrangement) Cultivation of Bacteria. Reproduction and Growth (Binary Fission, Conjugation and Endospore formation) Growth Kinetics, Isolation and Preservation. Significance of Bacteria</p> <p>Viruses :General Characters, Classification (Plant, Animal and Bacterial Viruses) Structure and Characterization of Viruses and Significance</p>	15Lectures	30 hrs

SEMESTER - I

Basic Life Sciences-II : Microbial Techniques

COURSE CODE	TITLE	CREDITS	Notional Hours
USBT 104	Microbial Techniques	2	
<p>Course Objectives : To acquaint students with basic techniques in Staining and Sterilization</p> <p>Learning Outcome : To impart the knowledge of growth of microorganisms</p>			
<p>Unit I</p> <p>Microscopy and Stains</p>	<p>Microscopy and Stains</p> <p>Microscope- Simple and Compound: Principle. Parts, Functions and Applications.</p> <p>Dark Field and Phase Contrast Microscope</p> <p>Stains and Staining Solutions- Definition of Dye and Chromogen. Structure of Dye and Chromophore. Functions of Mordant and Fixative. Natural and Synthetic Dyes. Simple Staining, Differential Staining and Acid Fast Staining with specific examples</p>	15 lectures	30 hrs
<p>Unit II</p> <p>Sterilization Techniques</p>	<p>Definition : Sterilization and Disinfection.</p> <p>Types and Applications</p> <p>Dry Heat, Steam under pressure,</p>	15 lectures	30 hrs

	<p>Gases, Radiation and Filtration</p> <p>Chemical Agents and their Mode of Action - Aldehydes, Halogens, Quaternary Ammonium Compounds, Phenol and Phenolic Compounds, Heavy Metals, Alcohol, Dyes, and Detergents</p> <p>Ideal Disinfectant. Examples of Disinfectants and Evaluation of Disinfectant</p>		
<p>Unit III</p> <p>Nutrition, Cultivation and Enumeration of Microorganisms</p>	<p>Nutrition and Cultivation of Microorganisms</p> <p>Nutritional Requirements : Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulphur and Growth Factors.</p> <p>Classification of Different Nutritional Types of Organisms.</p> <p>Design and Types of Culture Media.</p> <p>Simple Medium, Differential, Selective and Enrichment Media</p> <p>Concept of Isolation and Methods of Isolation. Pure Culture Techniques</p> <p>Growth and Enumeration</p> <p>Growth Phases, Growth Curve. Arithmetic Growth and Growth Yield. Measurement of Growth. Chemostat and Turbidostat</p> <p>Enumeration of Microorganisms- Direct and Indirect Methods</p> <p>Preservation of Cultures- Principle and Methods. Cryogenic Preservation</p> <p>Advantages and Limitations</p>	15 lectures	30 hrs

SEMESTER I

Basic Biotechnology-I : Introduction to Biotechnology

COURSE CODE	TITLE	CREDITS	Notional Hours
USBT 105	Introduction to Biotechnology	2	
<p>Course Objectives : To acquaint students with various fields of Biotechnology and their applications</p> <p>Learning Outcome : To impart the knowledge of Food Technology and Fermentation Techniques</p>			
<p>Unit I</p> <p>Scope and Introduction to Biotechnology</p>	<p>History & Introduction to Biotechnology</p> <p>What is Biotechnology?</p> <p>Definition of Biotechnology,</p> <p>Traditional and Modern Biotechnology,</p> <p>Branches of Biotechnology-</p>	15 lectures	30 hrs

	<p>Plant, Animal Biotechnology, Marine Biotechnology, Agriculture, Healthcare, Industrial Biotechnology, Pharmaceutical Biotechnology, Environmental Biotechnology.</p> <p>Biotechnology Research in India.</p> <p>Biotechnology Institutions in India (Public and Private Sector)</p> <p>Biotech Success Stories</p> <p>Biotech Policy Initiatives</p> <p>Biotechnology in context of Developing World</p> <p>Public Perception of Biotechnology</p>		
<p>Unit II Applications Biotechnology</p>	<p>Applications of Biotechnology in Agriculture : GM Food, GM Papaya, GM Tomato, Fungal and Insect Resistant Plants</p> <p>BT Crops, BT Cotton and BT Brinjal</p> <p>Pros and Cons</p> <p>Biotechnological applications in Crop and Livestock Improvements</p> <p>Modifications in Plant Quality</p> <p>Golden Rice,</p> <p>Molecular Pharming, Plant Based Vaccines</p> <p>Ethics in Biotechnology and IPR</p>	15 lectures	30 hrs
<p>Unit III Food and Fermentation Biotechnology</p>	<p>Food Biotechnology</p> <p>Biotechnological applications in enhancement of Food Quality</p> <p>Unit Operation in Food Processing</p> <p>Quality Factors in Preprocessed Food</p> <p>Food Deterioration and its Control</p> <p>Rheology of Food Products</p> <p>Microbial role in food products</p> <p>Yeast, Bacterial and other Microorganisms based process and products</p> <p>Modern Biotechnological Regulatory Aspects in Food Industries</p> <p>Biotechnology and Food - Social Appraisal</p> <p>Fermentation Technology</p> <p>Definition, Applications of Fermentation Technology</p> <p>Microbial Fermentations</p> <p>Overview of Industrial Production of Chemicals (Acetic Acid, Citric Acid and Ethanol), Antibiotics, Enzymes and Beverages</p>	15 lectures	30 hrs

SEMESTER - I**Basic Biotechnology-II : Molecular Biology**

COURSE CODE	TITLE	CREDITS	Notional Hours
USBT 106	Molecular Biology	2	
Corse Objectives : To acquaint students with DNA Replication, Repair and Genetic Engineering Learning Outcome : Impart the knowledge of molecular Biology Techniques			
Unit I Replication	DNA Replication in Prokaryotes and Eukaryotes- Semi-conservative DNA replication, DNA Polymerases and its role, E.coli Chromosome Replication, Bidirectional Replication of Circular DNA molecules. Rolling Circle Replication, DNA Replication in Eukaryotes DNA Recombination – Holliday Model for Recombination Transformation	15 lectures	30 hrs
Unit II Mutation and DNA Repair	Definition and Types of Mutations. Mutagenesis and Mutagens.(Examples of Physical, Chemical and Biological Mutagens) Types of Point Mutations, DNA REPAIR Photoreversal, Base Excision Repair, Nucleotide Excision Repair, Mismatch Repair, SOS Repair and Recombination Repair.	15 lectures	30 hrs
Unit III Genetic Engineering	Experimental evidences for DNA and RNA as Genetic Material. Genetic Engineering in Ecoli and other Prokaryotes, Yeast, Fungi and Mammalian Cells Cloning Vectors-Plasmids (pBR 322, pUC) Vectors for Plant and Animal Cells, Shuttle Vectors, YAC Vectors, Expression Vectors Enzymes- DNA Polymerases, Restriction Endonucleases, Ligases, Reverse Transcriptases, Nucleases, Terminal Transferases, Phosphatases Isolation and Purification of DNA (Genomic, Plasmid) and RNA,, Identification of Recombinant Clones	15 lectures	30 hrs

Semester – I

Practicals

SEMESTER – I
Practicals
Basic Chemistry

COURSE CODE	TITLE	CREDITS	Notional Hours
USBTP 101	Basic Chemistry	2	30 hrs
<ol style="list-style-type: none"> 1. Safety Measures and Practices in Chemistry Laboratory, Working and use of a Digital Balance, Functioning and Standardization of <i>pH</i> Meter, Optical Activity of a Chemical Compounds by Polarimeter 2. Preparation of Standard (Molar, Molal and Normal solutions) and Buffer Solutions Determination of strength of HCl in commercial sample 3. Qualitative Analysis of Inorganic Compounds - Three experiments 4. Characterization of Organic Compounds containing only C, H, O elements (no element test) - Compounds belonging to the following classes: Carboxylic Acid, Phenol, Aldehyde/Ketone, Ester, Alcohol, Hydrocarbon and Characterization of Organic Compounds containing C, H, O, N, S, Halogen Elements (element tests to be done) Compounds belonging to the following classes: Amine, Amide, Nitro Compounds, Thiamide, Haloalkane, Haloarene 5. To Standardize commercial sample of NaOH using KHP (Potassium hydrogen phthalate) and sample of HCl using borax. 6. Dissociation Constant of Weak Acids by Incomplete Titration Method using <i>pH</i> Meter and determination of Acetic acid in Vinegar by Titrimetric Method 7. Determination of the amount of Fe (II) present in the given solution Titrimetrically 8. Determination of amount of NaHCO₃ + Na₂CO₃ in the given solid mixture Titrimetrically 9. Determination of the amount of Mg (II) present in the given solution complexometrically 10. Determination of percent composition of BaSO₄ and NH₄Cl in the given mixture Gravimetrically 11. Separation of Cu, Ni and Fe using Paper Chromatography and amino acids - paper chromatography 12. Determination of fluoride ion using Colorimetry and Fe (III) by using Salicylic Acid by Colorimetric Titration 			

SEMESTER – I
Practicals
Basic Life Sciences

COURSE CODE	TITLE	CREDITS	Notional Hours
USBTP 102	Basic Life Science	2	30 hrs
<ol style="list-style-type: none"> 1. Components and working of Simple, Compound, Dark Field, Fluorescent and Phase Contrast Microscope 2. Staining of Plant and Animal Tissues using Single and Double Staining Techniques 3. Special Staining Technique for Cell Wall, Capsule and Endospores and Fungal Staining 4. Monochrome Staining, Differential Staining, Gram Staining, and Acid Fast Staining and Romanowsky Staining 5. Study of Plant, Animal and Microbial Groups with at least one examples from each x 3 6. Study of Photomicrographs of Cell Organelles 7. Sterilization of Laboratory Glassware and Media using Autoclave 8. Preparation of Media- Nutrient broth and Agar, MacConkey Agar, Sabourauds Agar 9. Isolation of Organisms : T-streak, Polygon method 10. Enumeration of microorganisms by Serial Dilution, Pour Plate, Spread Plate Method 11. Colony Characteristics of Microorganisms, Enumeration by Breed's count 12. Growth Curve of <u>E.Coli</u> 			

SEMESTER – I
Practicals
Basic Biotechnology

COURSE CODE	TITLE	CREDITS	Notional Hours
USBTP 103	Basic Biotechnology	2	30 hrs
<ol style="list-style-type: none">1. Assignment- Study of any branch of biotechnology and its applications2. Microbial examination of food and detection of Pathogenic Bacteria from Food Samples3. Isolation of organisms causing Food Spoilage4. Microscopic determination of Microbial flora from Yoghurt and Lactic Acid Determination5. Analysis of Milk- Methylene Blue, Resazurin Test, Phosphatase Test6. Extraction of Caesin from Milk7. Meat Tenderization using Papain8. Fermentative production of Alcohol9. Determination of Alcohol content10. Isolation and purification of DNA (genomic, plasmid)11. Restriction Digestion12. Agarose Gel Electrophoresis of the genomic and plasmid DNA			

SEMESTER – II
THEORY

SEMESTER II

Chemistry-I : Bioorganic Chemistry

COURSE CODE	TITLE	CREDITS	Notional Hours
USBT 201	Bioorganic Chemistry	2	
Course Objectives : To acquaint students with Bioorganic Molecules Learning Outcome : To impart the knowledge of Classification, Structure and Characterization of Biomolecules			
Unit I Biomolecules: Carbohydrates and Lipids	Carbohydrates: Structure, Function, Classification, Characteristic Reactions, Physical and Chemical Properties, D & L Glyceraldehydes, structure of Monosaccharide, Disaccharides, and Polysaccharides. Isomers of Monosaccharides, Chemical/Physical Properties of Carbohydrate, Chemical Reactions for Detection of Mono., Di and Polysaccharides, Lipids: Classification of Lipids, Properties of Saturated, Unsaturated Fatty Acids, Rancidity, and Hydrogenation of Oils Phospholipids: Lecithin Cephalin, Plasmalogen Triacylglycerol-Structure and Function Sterols: Cholesterol: Structure and Function, Lipoproteins: Structure and Function, Storage Lipids, Structural Lipids, Action of Phospholipases, Steroids	15 lectures	30 hrs
Unit II Biomolecules: Proteins and Amino Acids	Proteins and Amino Acids: Classification, Preparation and Properties, Isoelectric Point, Peptide Synthesis Proteins: Classification based on Structure and Functions, Primary Structure, N-terminal (Sanger and Edmans Method) and C-terminal Analysis (Enzyme) Reactions of Amino Acids, Sorenson's Titration, Ninhydrin Test. Denaturation of protein Structure of Peptides. Titration Curve of Amino Acids. Concept of Isoelectric pH, Zwitter ion. Glycoproteins	15 lectures	30 hrs
Unit III	Nucleic Acids: Structure, Function of Nucleic Acids, Properties and Types of	15 lectures	30 hrs

Biomolecules: Nucleic Acids	DNA, RNA. Structure of Purine and Pyrimidine Bases Hydrogen Bonding between Nitrogenous Bases in DNA Differences between DNA and RNA, Structure of Nucleosides, Nucleotides and Polynucleotides.		
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SEMESTER II

Chemistry-II : Physical Chemistry

COURSE CODE	TITLE	CREDITS	Notional Hours
USBT 202	Physical Chemistry	2	
Course Objectives : To acquaint students with concepts in Thermodynamics, Kinetics and Redox Reactions			
Learning Outcome : To impart skills in Kinetics and Chemical Reactions			
Unit I Thermodynamics	Thermodynamics: System, Surrounding, Boundaries Sign Conventions, State Functions, Internal Energy and Enthalpy: Significance, examples, (Numericals expected.) Laws of Thermodynamics and its Limitations, Mathematical expression. Qualitative discussion of Carnot Cycle for ideal Gas and Mechanical Efficiency. Laws of Thermodynamics as applied to Biochemical Systems. Concept of Entropy, Entropy for Isobaric, Isochoric and Isothermal Processes.	15 lectures	30 hrs
Unit II Chemical Kinetics	Reaction Kinetics: Rate of Reaction, Rate Constant, Measurement of Reaction Rates Order & Molecularity of Reaction, Integrated Rate Equation of First and Second order reactions (with equal initial concentration of reactants). (Numericals expected) Determination of Order of Reaction by a) Integration Method b) Graphical Method c) Ostwald's Isolation Method d) Half Time Method. (Numericals expected).	15 lectures	30 hrs
Unit III Oxidation Reduction reactions	Principals of Oxidation & Reduction Reactions– Oxidising and Reducing Agents, Oxidation Number, Rules to assign Oxidation Numbers with examples Ions like	15 lectures	30 hrs

	Oxalate, Permanganate and Dichromate. Balancing Redox Reactions by Ion Electron Method Oxidation, Reduction, Addition and Substitution & Elimination Reactions.		
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SEMESTER II

Life Sciences-I : Physiology and Ecology

COURSE CODE	TITLE	CREDITS	Notional Hours
USBT 203	Physiology and Ecology	2	
Course Objectives: To acquaint students with Physiological Processes in Plants and Animals Learning Objectives : To impart the knowledge of Physiology and Ecology			
Unit I Plant Physiology	Photosynthesis, Intracellular Organization of Photosynthetic System. Fundamental Reactions of Photosynthesis, Photosynthetic Pigments, Role of Light. Hill Reaction and its Significance, Light Reactions, Cyclic and Non-Cyclic Photo induced Electron Flow, Energetics of Photosynthesis, Photorespiration, Dark Phase of Photosynthesis, Calvin Cycle, C-3, C-4 pathways Plant hormones - Auxin, Gibberellins, Cytokinins, Ethylene, Abscissic acid Introduction to Secondary Metabolites	15 lectures	30 hrs
Unit II Animal Physiology	Physiology of Digestion Movement of Food and Absorption, Secretory functions of Alimentary Canal, Digestion and Absorption, assimilation in Gut of Mammals Anatomy of Mammalian Kidney, Structure of Nephron, Physiology of Urine Formation and Role of Kidney in Excretion and Osmoregulation Physiology of Respiration, Mechanism of Respiration Principles of Gaseous Exchange in the Blood and Body Fluids Blood and Circulation : Blood Composition, Structure and Function of its Constituents	15 lectures	30 hrs

	Blood Coagulation and Anti-Coagulants Hemoglobin and its Polymorphism Regulation of the Circulation Mechanism and working of Heart in Human.		
Unit III Ecosystem and Interactions	Ecology and Biogeography. Ecosystems, Definition and Components, Structure and Function of Ecosystems. Aquatic and Terrestrial Ecosystems, Biotic and Abiotic Factors, Trophic Levels, Food Chain and Food Web, Ecological Pyramids (Energy, Biomass and Number) Nutrient Cycle and Biogeochemical Cycles: Water, Carbon, Oxygen, Nitrogen and Sulphur. Interactions, Commensalism, Mutualism, Predation and Antibiosis, Parasitism.	15 lectures	30 hrs

SEMESTER – II
Life Sciences-II : Genetics

COURSE CODE	TITLE	CREDITS	Notional Hours
USBT 204	Genetics	2	
Course Objectives : To acquaint students with concepts in Genetics			
Learning Objectives : To impart skills in Techniques in Genetic Analysis and Population Genetics			
Unit I Genetics Fundamentals	Mendel's Laws of Heredity Monohybrid Cross: Principle of Dominance and Segregation. Dihybrid Cross: Principle of Independent Assortment. Application of Mendel's Principles Punnett Square. Mendel's Principle in Human Genetics. Incomplete Dominance and Co-dominance. Multiple Alleles. Allelic series. Variations among the effect of the Mutation. Genotype and Phenotype. Environmental effect on the expression of the Human Genes. Gene Interaction. Epistasis.	15 lectures	30 hrs

Unit II Microbial Genetics	Genetic analysis in Bacteria- Prototrophs, Auxotrophs. Bacteriophages: Lytic and Lysogenic Development of Phage. Mechanism of Genetic Exchange in Bacteria: Conjugation; Transformation; Transduction; (Generalized Transduction, Specialized Transduction) Bacterial Transposable Elements.	15 lectures	30 hrs
Unit III Population Genetics	Genetic Structure of Populations – Genotypic Frequencies and Allelic Frequencies, Hardy- Weinberg Law and its assumptions Genetic Variations in Populations- Measuring Genetic Variation at Protein Level and measuring Genetic Variations at DNA level Natural Selection. Genetic Drift Speciation Role of Population Genetics in Conservation Biology	15 lectures	30 hrs

SEMESTER II

Biotechnology-I : Tissue Culture & Scientific Writing and Communication Skills

COURSE CODE	TITLE	CREDITS	Notional Hours
USBT 205	Tissue Culture & Scientific Writing and Communication Skills	2	
Course Objectives : To acquaint students with Techniques of Plant and Animal Tissue Culture Learning Outcome : To impart the skills of PTC, ATC and Science Communication			
Unit I Plant Tissue Culture	Cell Theory, Concept of Cell Culture, Cellular Totipotency, Organization of Plant Tissue Culture Laboratory : Equipments and Instruments Aseptic Techniques: Washing of Glassware, Media Sterilization, Aseptic Workstation, Precautions to maintain Aseptic Conditions. Culture Medium: Nutritional requirements of the explants, PGR's and their <i>in-vitro</i> roles, Media Preparation Callus Culture Technique: Introduction, Principle and Protocols	15 lectures	30 hrs

<p align="center">Unit II Animal Tissue Culture</p>	<p>Basics of Animal Tissue Culture Introduction Cell Culture Techniques, Equipment and Sterilization Methodology. Introduction to Animal Cell Cultures: Nutritional and Physiological: Growth Factors and Growth Parameters. General Metabolism and Growth Kinetics Primary Cell Cultures : Establishment and Maintenance of Primary Cell Cultures of Adherent and Non-Adherent Cell Lines with examples. Application of Cell Cultures</p>	<p>15 lectures</p>	<p>30 hrs</p>
<p align="center">Unit III Scientific Writing and Communication Skills</p>	<p>Communication Skills Introduction to Communication -- Elements, Definitions, Scope of Communication and Communication as part of Science Communication Elements -- Verbal and Non-Verbal Communications. Principles of Effective Communication, Oral Presentations Scientific Reading, Writing & Presentation Scientific Writing Process of Scientific Writing: Thinking, Planning, Rough Drafts and Revising Contents. Introduction to Scientific Reports and Writings Compilation of Experimental Data, Communication Methods in Science, Examples of Scientific and Unscientific Writing. Writing Papers, Reviews, Bibliography Plagiarism--Introduction to Plagiarism , Examples of Plagiarism.</p>	<p>15 lectures</p>	<p>30 hrs</p>

SEMESTER - II

Biotechnology-II : Enzymology, Immunology and Biostatistics

COURSE CODE	TITLE	CREDITS	Notional Hours
USBT 206	Enzymology, Immunology and Biostatistics	2	
<p>Course Objectives : To acquaint students with concepts in Enzymology, Immunology and Biostatistics Learning Outcome : To impart the skills in Enzyme Kinetics, Immunological Techniques and Biostatistics</p>			

Unit I Enzymes	Definition, Classification, Nomenclature, Chemical Nature, Properties of Enzymes, Mechanism of Enzyme Action, Active Sites, Enzyme Specificity, Effect of pH, Temperature, Substrate Concentration on Enzyme Activity, Enzyme Kinetics, Michelis-Menten Equation, Types of Enzyme Inhibitions-Competitive, Uncompetitive, Non-Competitive Allosteric Modulators Co-Factors, Zymogens,	15 lectures	30 hrs
Unit II Immunology	Overview of Immune Systems, Cell and Organs involved, T and B cells. Innate Immunity, Acquired Immunity, Local and Herd Immunity, Humoral and Cellular Immunity - Factors Influencing and Mechanisms of each. Antigens and Antibodies: Types of Antigens, General Properties of Antigens, Haptens and Superantigens Discovery and Structure of Antibodies (Framework region) Classes of Immunoglobulins, Antigenic Determinants. Antigen-Antibody Interactions Monoclonal Antibodies, Vaccines (Live, Killed) and Toxoid. Problems with Traditional Vaccines, Impact of Biotechnology on Vaccine Development.	15 lectures	30 hrs
Unit III Biostatistics	Definition & Importance of Statistics in Biology Types of Data, Normal and Frequency Distribution Representation of Data and Graphs (Bar Diagrams, Pie Charts and Histogram, Polygon and Curve) Types of Population Sampling Measures of Central Tendency (For Raw, Ungroup & Group Data) Mean Median Mode Measures of Dispersion Range, Variance, Coefficient of Variance. Standard Deviation. Standard Error.	15 lectures	30 hrs

Semester – II
PRACTICALS

SEMESTER – II
Practicals
Chemistry

COURSE CODE	TITLE	CREDITS	Notional Hours
USBTP 201	Chemistry	2	30 hrs
<ol style="list-style-type: none"> 1. Spot test for Carbohydrates, Fats and Proteins and Amino Acids and Nucleic Acids 2. Standardization of Colorimeter and Estimation of Reducing sugar by DNSA method 3. Estimation of Protein by Biuret method and Lowry method 4. Saponification of Fats, Saponification Value of Oil or Fat, Iodine value of Oil and determine the rate constant for the saponification reaction between ethyl acetate and NaOH by back titration method 5. To determine enthalpy of dissolution of salt like KNO₃ 6. Determine the rate constant for hydrolysis of ester using HCl as a catalyst 7. Study the kinetics of reaction between Thiosulphate ion and HCl 8. Study reaction between potassium Persulphate and Potassium Iodide kinetically and hence to determine order of reaction 9. Study the reaction between NaHSO₃ and KMnO₄ and balancing the reaction in acidic, alkaline and neutral medium 10. Study transfer of electrons (Titration of sodium thiosulphate with potassium dichromate) 11. Determination of the volume strength of hydrogen peroxide solution by titration with standardised potassium permanganate solution 12. Determination of amount of K oxalate and oxalic acid in the given solution Titrimetrically 			

SEMESTER – II
Practicals
Life Sciences

COURSE CODE	TITLE	CREDITS	Notional Hours
USBTP 202	Life Sciences	2	30 hrs
<ol style="list-style-type: none"> 1. Study of Hill's reaction 2. Colorimetric study of Absorption Spectrum of Photosynthetic Pigments 3. Movement of Food in Paramecium 4. Activity of Salivary Amylase on Starch 5. Analysis of Urine 6. Study of Mammalian Blood, Blood count using Haemocytometer and estimation of Haemoglobin in Mammalian Blood 7. Study of Human Blood Groups 8. Study of Mammalian Kidney and Heart 9. Problems in Mendelian Genetics 10. Study of Mitosis and Meiosis 11. Study of Karyotypes – Normal Male and Normal Female 12. Study of Interactions Commensalism, Mutualism, Predation and Antibiosis, Parasitism. 			

SEMESTER – II
Practicals
Biotechnology

COURSE CODE	TITLE	CREDITS	Notional Hours
USBTP 203	Biotechnology	2	30 hrs
<ol style="list-style-type: none"> 1. Working and use of various Instruments used in Biotechnology Laboratory (Autoclave, Hot air Oven, Centrifuge, Incubator, Rotary Shaker, Filter Assembly, LAF, <i>pH</i> meter and Colorimeter) 2. Laboratory Organization and Layout for Plant and Animal Tissue Culture Laboratory 3. Preparation of Stock Solutions and Preparation of Media for PTC 4. Aseptic Transfer Technique, Surface Sterilization and Inoculation for Callus Culture 5. Media Preparation and Sterilization (ATC) 6. Trypsinization of Tissue and Viability Count 7. Qualitative Assay of Enzyme Amylase. Lipase, Protease, Urease, Catalase and Dehydrogenase 8. Enzyme Kinetics : Study of the effect of <i>pH</i>, Temperature on activity of Enzyme 9. Study of Effect of Substrate Concentration on enzyme activity and determination of V_{max} and K_m 10. Study of antigen antibody interaction by Ouchterlony method 11. Biometric Analysis for Mean, Median, Mode and Standard Deviation and Data representation using frequency Polygon, Histogram and Pie Diagram 12. Preparation of review reports of 5 Scientific Papers and Presentation (last 5 years) 			

Semester – I and II

Ability Enhancement Course 1 (FC I)

Ability Enhancement Course 2 (FC II)

SEMESTER I
Ability Enhancement Course 1 (FC I)
Societal Awareness

COURSE CODE	TITLE	CREDITS	Notional Hours
USBT 107	Societal Awareness	2	
Course Objective : To acquaint the students with concepts of Societal Awareness Learning Outcome : To impart knowledge of Society and make students aware about the Problems in Society			
Unit I Overview of Indian Society	Understand the multi-cultural diversity of Indian society through its demographic composition: population distribution according to religion, caste, and gender; Appreciate the concept of linguistic diversity in relation to the Indian situation; Understand regional variations according to rural, urban and tribal characteristics; Understanding the concept of diversity as difference	15 Lectures	30 hrs
Unit II Concept of Disparity	Concept of Disparity- I Understand the concept of disparity as arising out of stratification and inequality; Explore the disparities arising out of gender with special reference to violence against women, female foeticide (declining sex ratio), and portrayal of women in media; Appreciate the inequalities faced by people with disabilities and understand the issues of people with physical and mental disabilities Concept of Disparity-II Examine inequalities manifested due to the caste system and inter-group conflicts arising thereof; Understand inter-group conflicts arising out of communalism; Examine the causes and effects of conflicts arising out of regionalism and linguistic differences	15 Lectures	30 hrs
Unit III The Indian Constitution and Significant Aspects of Political Processes	The Indian Constitution Philosophy of the Constitution as set out in the Preamble; The structure of the Constitution-the Preamble, Main Body and Schedules; Fundamental Duties of the Indian Citizen; tolerance, peace and communal harmony as crucial values in strengthening the social fabric of Indian society; Basic features of the Constitution Significant Aspects of Political Processes The party system in Indian politics; Local self-government in urban and rural areas; the 73rd and 74th Amendments and their implications for inclusive politics; Role and significance of women in politics	15 lectures	30 hrs

Topics for Project Guidance: Growing Social Problems in India:

- Substance abuse- impact on youth & challenges for the future
- HIV/AIDS- awareness, prevention, treatment and services
- Problems of the elderly- causes, implications and response
- Issue of child labour- magnitude, causes, effects and response
- Child abuse- effects and ways to prevent
- Trafficking of women- causes, effects and response

SEMESTER II

Ability Enhancement Course 2 (FC II) Globalization, Ecology and Sustainable Development

COURSE CODE	TITLE	CREDITS	Notional Hours
USBT 207	Globalization, Ecology and Sustainable Development	2	
Course Objective : To acquaint the students with concepts of Globalization, Ecology and Environment Learning Outcome : To impart knowledge of Globalization make students aware about the Problems in Society			
Unit I Globalisation and Indian Society and Human Rights	Globalisation and Indian Society Understanding the concepts of liberalization, privatization and globalization; Growth of information technology and communication and its impact manifested in everyday life; Impact of globalization on industry: changes in employment and increasing migration; Changes in agrarian sector due to globalization; rise in corporate farming and increase in farmers' suicides. Human Rights Concept of Human Rights; origin and evolution of the concept; The Universal Declaration of Human Rights; Human Rights constituents with special reference to Fundamental Rights stated in the Constitution	15 Lectures	30 hrs
Unit II Ecology and Sustainable Development	Ecology and Sustainable Development Importance of Environment Studies in the current developmental context; Understanding concepts of Environment, Ecology and their interconnectedness; Environment as natural capital and connection to quality of human life; Environmental Degradation causes and impact on human life; Sustainable development, concept and components; poverty and environment	15 Lectures	30 hrs
Unit III Understanding and Managing Stress and Conflict in Contemporary Society	Understanding Stress and Conflict Causes of stress and conflict in individuals and society; Agents of socialization and the role played by them in developing the individual; Significance of values, ethics and prejudices in developing the individual; Stereotyping and prejudice as significant factors in causing conflicts in society. Aggression and violence as the public expression of conflict Managing Stress and Conflict in Society Types of conflicts and use of coping mechanisms for managing individual stress; Maslow's theory of self-actualisation; Different methods of responding to conflicts in society; Conflict-resolution and efforts towards building peace and harmony in society	15 lectures	30 hrs

Topics for Project Guidance: Growing Social Problems in India:

- Increasing urbanization, problems of housing, health and sanitation;
- Changing lifestyles and impact on culture.
- Farmers' suicides and agrarian distress.
- Debate regarding Genetically Modified Crops.
- Development projects and Human Rights violations.
- Increasing crime/suicides among youth.

SEMESTER- III				
Course code	Course type	Course Title	Credits	Lectures/ Week
USBT301	Core Subject	Biophysics	2	3
USBT302	Core Subject	Applied Chemistry- I	2	3
USBT303	Core Subject	Immunology	2	3
USBT304	Core Subject	Cell Biology and Cytogenetics	2	3
USBT305	Core Subject	Molecular Biology	2	3
USBT306	Skill Enhancement Elective	Bioprocess Technology	2	3
USBT307	General Elective	Research Methodology	2	3
USBTP301	Core Subject Practicals	Practicals of USBT_301 and USBT_302	2	6
USBTP302	Core Subject Practicals	Practicals of USBT_303 and USBT_304	2	6
USBTP303	Core Subject and Skill Enhancement Elective Practical	Practicals of USBT_305 and USBT_306	2	6
SEMESTER-IV				
Course code	Course type	Course Title	Credits	Lectures/ Week
USBT401	Core Subject	Biochemistry	2	3
USBT402	Core Subject	Applied Chemistry- II	2	3
USBT403	Core Subject	Medical Microbiology	2	3
USBT404	Core Subject	Environmental Biotechnology	2	3
USBT405	Core Subject	Biostatistics and Bioinformatics	2	3
USBT406	Skill Enhancement Elective	Molecular Diagnostics	2	3
USBT407	General Elective	Entrepreneurship Development	2	3
USBTP401	Core Subject Practicals	Practicals of USBT_401 and USBT_402	2	6
USBTP402	Core Subject Practicals	Practicals of USBT_403 and USBT_404	2	6
USBTP403	Core Subject and Skill Enhancement Elective Practical	Practicals of USBT_405 and USBT_406	2	6

SEMESTER III

Course Code	Title	Credits	No. of Lectures	Notional hours
USBT301	BIOPHYSICS	2		
Course objectives:- The objective of this course is to have a firm foundation of the fundamentals and applications of current biophysical theories. Learning outcomes:- By the end of the course the student will: <ul style="list-style-type: none"> Develop an understanding of the different aspects of classical Physics. Be able to relate principles of Physics to applications and techniques in the field of Biology such as Microscopy, Spectroscopy and Electrophoresis. 				
UNIT I Optics and Electromagnetic Radiations	Introduction to Optics and Lasers: Optics : Properties of Light - Reflection, Refraction, Dispersion, Interference. Lasers : Properties of Lasers, Stimulated Emissions, Laser Action; Applications of Laser. Electromagnetic Radiations: Introduction to Electromagnetic Radiation. Spectroscopy : Types and Properties of Spectra; Basic Laws of Light Absorption. Spectrophotometer:-Principle, Instrumentation and Applications; UV-Vis Spectrophotometer, Single and Dual Beam Spectrophotometer. Microscopy: Types of Microscopy; Electron Optics; Electron Microscopy- Preparation of Specimen, SEM, TEM and Immuno-Electron Microscopy. Fluorescence Microscopy.		15	
UNIT II Heat, Sound, Magnetism and Fluid Dynamics	Heat: Concept of Temperature; Modes of Heat Transfer; Measuring Temperature; Platinum Resistance Thermometer; Thermocouple and Thermistors. Sound: Types of Sound Waves - Audible, Ultrasonic and Infrasonic Waves; Doppler Effect; Applications of Ultrasonic Waves. Magnetism: Magnetic Field; Magnetism of Earth; Paramagnetism, Diamagnetism, Ferromagnetism. Nuclear Magnetism and Biomagnetism.		15	

	Fluid Dynamics : Viscosity: Definition Flow of Liquids through Capillaries; Stokes' Law; Terminal Velocity. Determination of ' η ' by Falling Sphere Method; Viscosity Estimation by Oswald's Viscometer. Surface Tension: Definition - Surface Tension and Surface Energy; Capillary Action; Angle of Contact; Wettability; Temperature Dependence of Surface Tension. Applications in Biology.			
UNIT III Electrophoretic Techniques	Electrophoresis: Migration of Ions in an applied electric field; Factors affecting Electrophoretic Mobility; Moving Boundary Electrophoresis; Principle of Electrophoresis; Supporting Matrix; Paper Electrophoresis; AGE; Native and SDS PAGE (reducing and non-reducing, continuous and discontinuous); IEF and 2D PAGE. Staining and Detection Methods; Gel-Documentation. Applications in Biology.		15	

Course Code	Title	Credits	No. of Lectures	Notional hours
USBT302	APPLIED CHEMISTRY –I	2		
Course objectives:- The objective of this course is to have a firm foundation of the fundamentals and applications of Organic and Green Chemistry. Learning outcomes:- By the end of the course the student will be able to: <ul style="list-style-type: none"> • Develop an understanding of the different aspects of Organic and Green Chemistry. • Discuss role of Organic Compounds in Biology and Synthesis of Organic Compounds. • Discuss role of Green Chemistry and its application in Industry. 				
UNIT I Organic Chemistry	Introduction to Types of Organic Reactions : Addition, Elimination and Substitution Reactions. Essential and Non-essential Elements in Biological Systems. Role of Metal Ions in Biological Systems. Metal Coordination in Biological Systems : Enzymes, Apoenzymes and Coenzymes. Biological Role of Metalloenzymes <i>wrt</i> Myoglobins, Haemoglobin. Biological Role of Carboxypeptidases, Catalases and Peroxidases.		15	

	Structure and Function : Dioxygen Binding, Transfer and Utilization; Metal Complexes in Medicines.			
UNIT II Synthesis of Organic Compounds	Synthesis of Organic Compounds : Criteria for Ideal Synthesis; Selectivity and Yield. Linear and Convergent Synthesis and Multicomponent Reactions. Microwave Assisted Organic Synthesis, Ultrasound in Synthesis and Polymer supported Synthesis. Retrosynthesis.		15	
UNIT III Green Chemistry and Synthesis	Green Chemistry and Synthesis: Introduction to Green Chemistry; Need and Relevance of Green Chemistry; Principles of Green Chemistry. Green Synthesis in Industry: Green Materials, Green Reagents, Green Solvents and Green Catalysts.		15	

Course Code	Title	Credits	No. of lectures	Notional hours
USBT303	IMMUNOLOGY	2		
Course objectives:- The objective of this course is to familiarize students with the Immune Effector Mechanisms and various Immunotechniques. Learning outcomes:- By the end of the course the student will be able to: <ul style="list-style-type: none"> Understand the role of different types of Cells, Effector Molecules and Effector Mechanisms in Immunology. Understand the principles underlying various Immunotechniques. 				
UNIT I Effectors of Immune Response	Haematopoiesis; Cells of the Immune System; Primary and Secondary Lymphoid Organs. Complement System- Classical, Alternate and Lectin; Regulation and Biological Effects of Complement System; Deficiencies of Complement System		15	
UNIT II Cell Receptors	T-cell Receptor Complex : Structure and Activation. MHC Classes - General Organization and Inheritance; Structures and Peptide Interactions; Class I and II Diversity and Polymorphism; Antigen Presentation - Endocytic and Exocytic Pathways; MHC Restriction. B-cell Receptor : Structure, Maturation and Activation B-T Cell Interaction (B-T cell Cooperation).		15	

UNIT III Immuno-Techniques	Precipitation Reactions : Immunoprecipitation, Immunoelectrophoresis, CIEP, Rocket Electrophoresis and 2-D Immunoelectrophoresis. Agglutination Reactions : Passive, Reverse Passive, Agglutination Inhibition. Coomb's Test; Complement Fixation Tests, RIA, ELISA, ELISPOT, Chemiluminescence, Western Blot, Immunofluorescence, Flow Cytometry. Alternatives to Antigen-Antibody Reactions.		15	
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Course Code	Title	Credits	No. of lectures	Notional hours
USBT304	CELL BIOLOGY AND CYTOGENETICS	2		
Course objectives:- The objective of this course is to have a firm foundation in the fundamentals of Cell Biology and Cytogenetics. Learning outcomes:- By the end of the course the student will be able to: <ul style="list-style-type: none"> • Develop an understanding of the Cytoskeleton and Cell Membrane. • Discuss the structure of Chromosomes and types of Chromosomal Aberrations. • Discuss the principles underlying Sex Determination, Linkage and Mapping. 				
UNIT I Cytoskeleton	Cytoskeleton : Overview of the Major Functions of Cytoskeleton. Microtubules: Structure and Composition. MAPs: Functions- Role in Mitosis, Structural Support and Cytoskeleton Intracellular Motility. Motor Proteins: Kinesins, Dynein; MTOCs. Dynamic Properties of Microtubules. Microtubules in Cilia and Flagella. Microfilaments: Structure, Composition, Assembly and Disassembly. Motor Protein: Myosin. Muscle Contractility: Sliding Filament Model. Actin Binding Proteins : Examples of Non-Muscle Motility. Intermediate Filaments :Structure and Composition; Assembly and Disassembly; Types and Functions.		15	
UNIT II Cell Membrane	Cell Membrane : Uptake of Nutrients by Prokaryotic Cells; Cell Permeability. Principles of Membrane Transport-Transporters and Channels; Active Transport,		15	

	Passive Transport; Types of Transporters; Types of ATP Driven Pumps - Na ⁺ K ⁺ Pump. Cell Junctions; Cell Adhesion and Extracellular Material Microvilli; Tight Junctions, Gap Junctions; Cell Coat and Cell Recognition. Cellular Interactions.			
UNIT III Cytogenetics	Cytogenetics : Structure of Chromosome - Heterochromatin, Euchromatin, Polytene Chromosomes. Variation in Chromosomal Structure and Number : Deletion, Duplication, Inversion, Translocation, Aneuploidy, Euploidy and Polyploidy and Syndromes- Klinefelter, Turner, Cri-du-Chat, Trisomy -21, Trisomy 18 and Trisomy 13. Sex Determination and Sex Linkage : Mechanisms of Sex Determination (XX-XY, ZZ-ZW, XX-XO) Dosage Compensation and Barr Body. Genetic Linkage, Crossing Over and Chromosomal Mapping : Tetrad Analysis; Two-point Cross; Three-point Cross; Pedigree Analysis.		15	

Course Code	Title	Credits	No. of Lectures	Notional hours
USBT305	MOLECULAR BIOLOGY	2		
Course objectives:- The objective of this course is to have an insight into mechanism of Gene Expression and Regulation. Learning outcomes:- By the end of the course the student will be able to: <ul style="list-style-type: none"> • Discuss the mechanisms associated with Gene Expression at the level of Transcription and Translation. • Discuss the mechanisms associated with Regulation of Gene Expression in Prokaryotes and Eukaryotes 				
UNIT I Gene Expression- Transcription	Gene Expression- an Overview. Transcription Process in Prokaryotes : RNA Synthesis; Promoters and Enhancers; Initiation of Transcription at Promoters; Elongation and Termination of an RNA Chain. Transcription in Eukaryotes : Eukaryotic RNA Polymerases; Eukaryotic Promoters; Transcription of Protein Coding Genes by RNA Polymerase; Eukaryotic mRNA's; Transcription of other genes;		15	

	Spliceosomes; RNA editing.			
UNIT II Gene Expression-Translation	Nature of Genetic Code. Wobble Hypothesis. Translation : Process of Protein Synthesis (Initiation, Elongation, Translocation, Termination); Post Translation Modifications. Protein sorting.		15	
UNIT III Regulation of Gene Expression	In Prokaryotes: In Bacteria : <i>lac</i> Operon of <i>E.coli</i> ; <i>trp</i> Operon of <i>E.coli</i> . In Viruses : Lytic / Lysogenic Regulation In Eukaryotes : Operons in Eukaryotes; Control of Transcriptional Initiation; Gene Silencing and Genomic Imprinting; Post-Transcriptional Control; RNA Interference.		15	

Course Code	Title	Credits	No. of Lectures	Notional hours
USBT306	BIOPROCESS TECHNOLOGY	2		
Course objectives:- The objective of this course is to understand the basics skills applied in Fermentation Technology and build a foundation for more advanced studies in Bioprocess Technology. Learning outcomes:- By the end of the course the student will be able to: <ul style="list-style-type: none"> • Develop an understanding of the various aspects of Bioprocess Technology. • Develop skills associated with screening of Industrially Important Strains. • Understand principles underlying design of Fermentor and Fermentation Process. 				
UNIT I Microorganisms in Industrial Processes	Types of Microorganisms used in Industrial Processes : Bacteria, Actinomycetes, Fungi and Algae. Screening and Maintenance of Strains: Primary Screening and Secondary Screening; Cultivation; Preservation of Industrially Important Microbial Strains.		15	
UNIT II Fermentor and Fermentation Processes	Design of a fermentor : Stirred Tank Fermentor- Basic Design; Parts of a Typical Industrial Fermentor. Fermentation Media : Components; Design and Optimization. Sterilization : Sterilization of Fermentor and Fermentation Media.		15	

	Process Parameters : <i>pH</i> , Temperature, Aeration, Agitation, Foam, etc. Types of Fermentation : Surface and Submerged; Batch and Continuous, Aerobic and Anaerobic. Product Isolation and Purification. Study of Representative Fermentation Processes : Outline of Penicillin and Ethanol Production by Fermentation along with a <i>flow-diagram</i> .			
UNIT III <i>In-vivo and In-vitro</i> Assay of Industrial Products	Assay of Industrial Products: Chemical and Biological; Types and Subtypes; Kinetics. Advantages and Disadvantages. Half-Life Determination of Pharmacological Products. Bioavailability and Bioequivalence Studies		15	

Course Code	Title	Credits	No. of Lectures	Notional hours
USBT307	RESEARCH METHODOLOGY	2		
Course objectives:- The objective of this course is to develop Research Aptitude, Logical Thinking and Reasoning. Learning outcomes:- By the end of the course the student will be able to: <ul style="list-style-type: none"> Understand basic principles of Research Methodology and identify a Research Problem. Understand a general definition of Research Design. Identify the overall Process of Designing a Research Study from its inception to its Report. 				
UNIT I Introduction to Research Methodology and Research Problem	Meaning of Research; Objectives of Research; Motivation in Research; Types of Research; Research Approaches; Significance of Research; Research Methods versus Methodology; Research Process; Criteria of Good Research; Problems Encountered by Researchers in India; What is a Research Problem? Selecting the Problem; Necessity of Defining the Problem; Technique Involved in Defining a Problem		15	
UNIT II Research Design and Data Collection	Meaning of Research Design; Need for Research Design; Features of a Good Design; Important Concepts Relating to Research Design; Different Research Designs; Basic Principles of Experimental Designs; Developing a Research Plan- Collection of Primary Data; Observation Method; Interview Method; Collection of Data		15	

	through Questionnaires; Collection of Data through Schedules; Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method			
UNIT III Interpretation and Report Writing	Meaning of Interpretation, Why Interpretation?, Technique of Interpretation, Precautions in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.		15	
Internal Evaluation	Submission of Research Report/ Project/ Case Study/ Assignment			

PRACTICALS

	SEMESTER III	
Course code	Title	Credits
USBTP301 (PRACTICALS based on USBT301 and USBT302)	<ol style="list-style-type: none"> 1. Study of Absorption Spectra of Coloured Compounds (CuSO_4, CoCl_2, KMnO_4). 2. Verification of Beer-Lambert's Law. 3. Extraction of Plasmid DNA and Separation by Agarose Gel Electrophoresis. 4. Determination of Purity of Plasmid DNA using UV Spectrophotometry. 5. Study of the Structure and Function of an Electron Microscope (Visit / Video Demonstration - including Sample Preparation and Staining). 6. Demonstration of Structure and Working of a Fluorescence Microscope (Stained Preparation). 7. Electrophoresis of Proteins by PAGE and SDS-PAGE. 8. Purification of any TWO Organic Compounds by Recrystallization Selecting Suitable Solvent. 9. Organic Estimations: Acetone, Amide, Benzoic Acid. 10. Organic Preparations : <ol style="list-style-type: none"> a) Acetylation of Primary Amine (Preparation of Acetanilide). b) Base Catalysed Aldol Condensation (Synthesis of Dibenzalpropanone). 	2
Course code	Title	Credits
USBTP302 (PRACTICALS based on USBT303 and USBT304)	<ol style="list-style-type: none"> 1. Complement Fixation Test (CFT). 2. Passive Agglutination- RA Factor Test. 3. Immunoelectrophoresis. 4. ELISA (Kit-based) - HEPALISA. 5. DOT-ELISA. 6. Western Blotting - Demonstration. 7. Flow Cytometry - Lab Visit. 8. Study of Chromosomal Aberrations- Deletion, Duplication, Inversion, 	2

	<p>Translocation and Syndromes- Trisomy 21 Trisomy 13 Trisomy 18, Klinefelter, Turner and Cri-du-Chat.</p> <p>9. Induction of Polyploidy by PDB Treatment using Suitable Plant Material.</p> <p>10. Study of Polytene Chromosomes.</p> <p>11. Mapping based on Tetrad Analysis and Three Point Cross.</p> <p>12. Pedigree Analysis- Autosomal and Sex-Linked.</p>	
Course code	Title	Credits
<p>USBTP303 (PRACTICALS based on USBT305 and USBT306)</p>	<ol style="list-style-type: none"> 1. Study of <i>E.coli</i> Diauxic Growth Curve- (Lactose and Glucose). 2. Study of <i>lac</i> Gene Expression using Blue-White Selection. 3. Expression of β-galactosidase and Measurement of Activity. 4. Screening for an Antibiotic Producing Strain of Microorganism. 5. Screening for an Alcohol Producing Strain of Microorganism. 6. Lab Scale Production of Penicillin (Static and Shaker). 7. Purification of <i>Penicillin</i> from Broth Culture of <i>Penicillium spp.</i> by Solvent Extraction. 8. Lab Scale Production of Ethanol. 9. Purification of Ethanol from Broth Culture of <i>Saccharomyces spp.</i> by Distillation. 10. Estimation of <i>Penicillin</i> from Recovered Broth by Chemical (Iodometric) Method. 11. Estimation of <i>Penicillin</i> from Recovered Broth by Biological (Bioassay) Method. 12. Estimation of Alcohol from Recovered Broth by Dichromate Method. 	2

SEMESTER-IV

Course Code	Title	Credits	No. of Lectures	Notional hours
USBT401	BIOCHEMISTRY	2		
Course objectives:- The objective of this course is to gain an insight into the Metabolic Processes associated with Catabolism of Carbohydrates, Amino Acids, Lipids and Nucleotides. Learning outcomes:- By the end of the course the student will be able to <ul style="list-style-type: none"> Discuss the Metabolic Pathways of Carbohydrates, Amino Acids, Lipids and Nucleotides. Explain the Role of Energy Rich Molecules in Metabolism. 				
UNIT I Carbohydrate Metabolism, ETS and Energy Rich Compounds	Carbohydrate Metabolism : Glycolytic Pathway and its Regulation, Homolactic Fermentation; Alcoholic Fermentation; Energetics of Fermentation; Citric Acid Cycle and its Regulation; Gluconeogenesis; Pentose Phosphate Pathway; Glyoxalate Pathway; Reductive TCA . (Sequence of Reactions, Regulation, Energy Yield and Metabolic Disorders of the above Pathways) Electron Transport System : Electron Transport and Oxidative Phosphorylation. Inhibitors of ETS. Energy Rich Compounds : ATP as Energy Currency, Structure of ATP, Hydrolysis, Other Energy Rich Compounds other than ATP like PEP, Creatine Phosphate, etc.	15	15	
UNIT II Amino Acid Metabolism	Amino Acid Breakdown : Deamination, Transamination, Urea Cycle, Breakdown of Glucogenic and Ketogenic Amino Acids. Amino Acids as Biosynthetic Precursors : Biosynthesis of Epinephrine, Dopamine, Serotonin, GABA, Histamine, Glutathione. (Sequence of Reactions, Regulation and Metabolic Disorders of the above Pathways)	15	15	
UNIT III Lipid and Nucleotide Metabolism	Lipid Metabolism : Mobilization, Transport of Fatty Acids. Beta, Alpha and Omega Oxidation of Saturated Fatty Acids; Oxidation of Unsaturated Fatty Acids; Oxidation of Odd Chain Fatty Acids. Energy Yield, Ketone Body Breakdown to Yield Energy. (Sequence of Reactions, Regulation, Energy Yield and Metabolic Disorders of the above Pathways)	15	15	

	Nucleotide Metabolism : Degradation of Purines and Pyrimidines.			
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Course Code	Title	Credits	No. of Lectures	Notional hours
USBT402	APPLIED CHEMISTRY –II	2		

Course objectives:-

The objective of this course is to have a firm foundation of the fundamentals and applications of current Chemical Theories for the Physical World.

Learning outcomes:- By the end of the course the student will:

- Develop an understanding of the different aspects of Analytical Chemistry.
- Gain knowledge of Natural Product Chemistry and related acquired skills.
- Gain an understanding of basic concepts in Polymer Chemistry and Nanomaterials.

UNIT I Sampling and Separation Techniques	Sampling : Importance of Sampling and Sampling Techniques Types of Sampling - Random and Non-Random Sampling of Solids, Liquids and Gases. Separation Techniques : Types of Separation Techniques - Filtration, Zone Refining, Distillation, Vacuum Distillation. Solvent Extraction - Partition Coefficient and Distribution Ratio, Extraction Efficiency, Separation Factor, Role of Complexing Agents, Chelation, Ion Pair Formation, Solvation, and Soxhlation. Centrifugation - Basic Principles of Sedimentation.	15	15	
UNIT II Natural Product Chemistry	Natural Product Chemistry : Primary and Secondary Metabolites. Classification of Natural Products based on Bio-Synthesis. Classification of Natural Products based on Structure- Alkaloids, Phenolics, Essential Oils and Steroids. Structure Determination of Natural Products. Commercial Synthesis of Natural Products. Chromatographic Separation of Natural Products : Gas Chromatography and its Applications. Liquid Chromatography : HPLC and its Applications. HPTLC for Separation and Analysis of Natural Products.	15	15	

UNIT III Polymers and Nanomaterials	Polymers : Introduction to Polymers. Types of Polymers - Monomer, Polymer, Homopolymer, Copolymer, Thermoplastics and Thermosets, Addition and Condensation Polymers (Examples and Uses) Stereochemistry of Polymers. Biodegradable Polymers. Nanomaterials : Introduction to Nanomaterials. Forms of Nanomaterials : Nanoparticles, Nanofilms and Nanotubes Synthesis and Characterization of Nanomaterials. Applications of Nanomaterials.	15	15	
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Course Code	Title	Credits	No. of lectures	Notional hours
USBT403	MEDICAL MICROBIOLOGY	2		
Course objectives:- The objective of this course is to gain insight into Disease Factors and Processes and Diseases Caused by Microorganisms. Learning outcomes:- By the end of the course the student will be able to: <ul style="list-style-type: none"> List the factors playing a role in causing a disease. Discuss the various aspects of Systemic Infections including Causative Agents, Symptoms and Prophylaxis. Gain the technical capability of handling, isolating and identifying various Bacteria. 				
UNIT I Infectious Diseases	Host Parasite Relationship: Normal Flora; Factors Affecting the Course of Infection and Disease; Mechanisms of Infection and Virulence Factors. Infection: Patterns of Infection; Types of Infections; Signs and Symptoms; Epidemiology and Epidemiological Markers. Diseases: Origin of Pathogens; Vectors; Acquisition of Infection; Koch's Postulates.		15	
UNIT II Medical Microbiology- Causative Organisms- I	Skin : <i>S. aureus, S. pyogenes.</i> Respiratory Tract Infections : <i>M. tuberculosis, S. pneumoniae</i> (Characteristics Transmission, Course of Infection, Lab Diagnosis, Management of TB, Prevention and Control, Immuno and Chemoprophylaxis, DOTS and MDR).		15	

	Urinary Tract Infections : <i>E.coli</i> : Characteristics, Virulence, Clinical disease, and <i>E.coli</i> Infections. <i>Proteus</i> .			
UNIT III Medical Microbiology - Causative Organisms- II	GI Tract Infections : <i>Salmonella and Shigella spp.</i> (Characteristics, Virulence- Pathogenesis and Immunity, Clinical Disease, Carriers Lab Diagnosis, Phage Typing Prophylaxis and Treatment). Sexually Transmitted Diseases : Syphilis and Gonorrhoea. Nosocomial Infections : <i>Ps. aeruginosa</i>		15	

Course Code	Title	Credits	No. of Lectures	Notional hours
USBT404	ENVIRONMENTAL BIOTECHNOLOGY	2		
Course objectives:- The objective of this course is to gain awareness about different Types of Environmental Pollution and Related Issues. Learning outcomes:- By the end of the course the student will be able to: <ul style="list-style-type: none"> Gain an understanding of the causes, types and control methods for Environmental Pollution. Application of different life forms in Environmental Remediation. 				
UNIT I Environmental Pollution	Sources of Pollution. Air Pollution : Types; Sources; Classification of Air Pollutants; Air Pollution Monitoring and Control. Water Pollution : Causes, Types and Classification; Eutrophication; Assessment of Water Quality- Pollutant Monitoring and Control; Soil and Solid Waste Pollution : Characteristics of Wastes, Impacts of Solid Waste on Health, Occupational Hazards and Control. Soil Erosion : Concept, Causes and Effects.		15	
UNIT II Global Environmental Problems and Issues	Green House Effect : Factors Responsible for Green House Effect; Green House Gases. Global Warming; Ozone Depletion; Kyoto Protocol; UV Radiation; Acid Rain.		15	

UNIT III Bioremediation	Concept of Bioremediation. Microorganisms in Bioremediation, Myco-remediation and Phytoremediation. Bioremediation Technologies. Measuring Bioremediation in the Field. Bioaugmentation and Biostimulation. Monitoring the Efficacy of Bioremediation.		15	
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Course Code	Title	Credits	No. of Lectures	Notional hours
USBT405	BIOINFORMATICS and BIOSTATISTICS	2		

Course objectives:-

The objective of this course is learning and understanding basic concepts of Bioinformatics and Biostatistics.

Learning outcomes:- By the end of the course the student will be able to:

- Gain an understanding of the basic concepts of Bioinformatics and Biostatistics.
- Understand the tools used in Bioinformatics.
- Apply the various Statistical Tools for Analysis of Biological Data.

UNIT I Introduction to Computers and Biological Databases	Computer Basics : Organization of a Computer; I/O Units; Computer Memory; Processor; Binary Arithmetic; Logic Circuit; Architecture; Operating System. Internet Basics : Connecting to the Internet, E-mail, FTP, www, Difference between www and Internet. Biological Databases : Classification of Databases - Raw and Processed Databases; Primary (NCBI), Secondary (PIR) and Tertiary or Composite (KEGG) Databases; Structure and Sequence Databases. Specialized Databases - Protein Pattern Databases; Protein Structure and Classification Databases (CATH/SCOP). Genome Information Resources: DNA Sequence Databases Specialized Genomic Resources. Protein Databases based on Composition, Motifs and Patterns. Protein Structure Visualization Software.		15	
UNIT II BLAST and Sequence Alignment	BLAST and Sequence Alignment : BLAST and its Types; Retrieving Sequence using BLAST. Pairwise Alignment : Identity and Similarity; Global and Local Alignment; Pairwise Database Searching.		15	

	Multiple Sequence Alignment: Goal of Multiple Sequence Alignment; Computational Complexity; Manual Methods; Simultaneous Methods; Progressive Methods; Databases of Multiple Alignment; Secondary Database Searching; Analysis Packages; MSA and Phylogenetic Trees.			
UNIT III Biostatistics	Theory and Problems based on- Coefficient of Correlation and Regression Analysis; Steps in Testing Statistical Hypothesis; Parametric Tests:- Z Test – Single Mean and Two Means, t-Test – Single Mean, Paired and Unpaired; Chi-Square Test.		15	

Course Code	Title	Credits	No. of Lectures	Notional hours
USBT406	MOLECULAR DIAGNOSTICS	2		
Course objectives:- The objective of this course is learning and understanding Molecular Techniques and utilizing these techniques in Diagnosis. Learning outcomes:- By the end of the course the student will be able to: <ul style="list-style-type: none"> • Gain an understanding of the basic Principles used in Molecular Diagnosis. • Gain critical thinking and analytical skills to understand new Diagnostic Methods. • Apply the knowledge and skills gained in the course should be useful in developing new Diagnostic Kits. 				
UNIT I Basics of Molecular Diagnostics	Introduction to Molecular Diagnostics : Overview of Molecular Diagnostics; History of Molecular Diagnostics; Molecular Diagnostics in Post Genomic Era; Areas used in Molecular Diagnostics; Future Prospects - Commercialising Molecular Diagnostics, Personalized Medicine, Theranostics. Characterisation and analysis of Nucleic – Acids and Proteins : Extraction, Isolation and Detection of DNA, RNA and Proteins; Restriction Endonucleases and Restriction Enzyme Mapping. Hybridisation Techniques : Southern, Northern, Western and FISH; Markers, Probes and its Clinical Applications.		15	
UNIT II Nucleic Acid Amplification Methods	Target amplification : PCR - General Principle; Components of a Typical PCR Reaction; Experimental Design; Primer Designing; Control of PCR Contamination and Mispriming; PCR Product Clean-up and Detection. PCR Types : Reverse Transcriptase and Real Time PCR.		15	

	Probe amplification : Ligase Chain Reaction			
UNIT III Molecular Biology based Diagnostics	DNA Polymorphism and Identification: RFLP and Parentage Testing; RFLP and Sickle-Cell Anaemia. Molecular Diagnostics for Infectious Diseases Molecular Testing for <i>Neisseria</i> , Molecular Diagnosis for HIV-1; Genetic Counselling and Molecular Diagnosis Genetic Testing- Need and Uses; genetic Counselling. Case Studies- Diagnostic Testing for Cystic Fibrosis; Fragile X Diagnostic and Carrier Testing. Ethical, Social and Legal Issues to Molecular - Genetic Testing		15	

Course Code	Title	Credits	No. of Lectures	Notional hours
USBT407	ENTERPRENEURSHIP DEVELOPMENT	2		
Objective: To develop and systematically apply an Entrepreneurial way of thinking that will allow identification and creation of Business Opportunities. Learning Outcome: By the end of the course the student will be able to: <ul style="list-style-type: none"> Develop an understanding of the systematic process and to select and screen a Business Idea. Design strategies for successful implementation of ideas. Write a Business Plan. 				
UNIT I Introduction to Entrepreneurship Development	Concept of Entrepreneur; Entrepreneurship; Need and Importance; Factors Influencing Entrepreneurship; Essentials of a Successful Entrepreneur		15	
UNIT II Setting-up of an Enterprise and Planning	Location of Enterprise; Real Estate and Human Resource Planning, Financial Planning; Role of Government and Financial Institutions in Entrepreneurship Development; Raising Money from Venture Capitalists, Government Grants, Product Selection and Ideas; Project Planning and Formulation; Project Feasibility Assessment; Regulatory Affairs, Corporate Laws, Innovation, IPR generation and Protection, Preparation of a Business Plan, Characteristics and Importance of Planning;		15	

UNIT III Marketing, Sales, Advertising and International Market research	Marketing Plan for an Entrepreneur; Strategic Alliances, Advertising and Sales Promotion; Market Assessment, Need for International Market Research, Domestic vs. International Market Research, Cost and Methodology of Market Research, Desk and Field Research		15	
Internal Evaluation	Submission and Presentation of Business Proposal for any Biotechnological Product/Enterprise			

	SEMESTER IV	
Course code	Title	Credits
USBTP401 (PRACTICALS based on USBT401 and USBT402)	<ol style="list-style-type: none"> 1. Determination of Lactate Dehydrogenase (LDH) Activity in Blood Serum. 2. Determination of Total, LDL and HDL Cholesterol in Serum. 3. Organ Function Tests: Liver (SGPT, SGOT); Kidney (Urea from Serum). 4. Estimation of Uric Acid and Creatinine in Urine. 5. Qualitative Detection of Ketone Body in Urine. 6. Isolation of Mitochondria and Demonstration of ETC using a Marker Enzyme. 7. Separation of Binary (Solid-Solid) Mixture (Min 4 Compounds). 8. Identification of Organic Compound of Known Chemical Type (Min 4 Compounds). 9. HPLC analysis and Interpretation of any one Secondary Metabolite from Plants 10. Analysis of Essential Oils from any Plant Source using GC. 11. HPTLC fingerprint analysis of any one Medicinally Important Plant. 12. Chemical and Biological Synthesis of Silver Nanoparticles and its Characterisation by UV- VIS Spectrophotometer. 	2
Course code	Title	Credits
USBTP402 (PRACTICALS based on USBT403 and USBT404)	<ol style="list-style-type: none"> 1. Identification of <i>S.aureus</i>-Isolation, Catalase, Coagulase Test. 2. Identification of <i>E.coli</i>-Isolation, Sugar Fermentations, IMViC. 3. Identification of <i>Salmonella</i>- Isolation, Sugar Fermentations, TSI Slant. 4. Identification of <i>Shigella</i>- Isolation, Sugar Fermentations, TSI Slant. 5. Identification of <i>Proteus</i>- Isolation, Sugar Fermentations, IMViC. 6. Identification of <i>Pseudomonas</i> - Isolation, Urease test, Oxidase Test, TSI Slant. 7. RPR Test (Kit Based). 8. Permanent Slide- <i>Mycobacterium</i>. 9. Biological Oxygen Demand (BOD). 10. Chemical Oxygen Demand (COD). 11. Isolation of Bacteria from Air by Gravity Sedimentation Method. 12. Most Probable Number (MPN) – Presumptive, Confirmed and Completed Tests. 	2

	13. Bioremediation of Metal. 14. Visit to STP / CETP	
Course code	Title	Credits
USBTP403 (PRACTICALS based on USBT405 and USBT406)	1. Familiarization with NCBI, EMBL, DDBJ, PIR, KEGG Databases. 2. Use of NCBI BLAST Tool. 3. Pairwise and Multiple Sequence Alignment and Phylogeny. 4. Classification of Proteins using CATH/SCOP. 5. Visualization PDB Molecules using Rasmol/Raswin. 6. Handling and Calibration of Micropipette. 7. Isolation, Quantitative Analysis and AGE of Genomic DNA from Bacteria and Yeast. 8. Isolation and Detection of RNA from Bacteria and Yeast. 9. Restriction Enzyme Digestion. 10. RFLP- Kit Based. 11. Primer Designing through Open Online Source NCBI- BLAST. 12. DNA Amplification – PCR.	2

Summer Training:

1. This should be taken up in the summer over a period of one month preferably in an Immunology / Veterinary / Virology Institute or a laboratory using Recombinant DNA Methods.
2. The students could also be assigned to assist a Clinic (in a hospital), a Fermentation Plant, Brewery or Bakery and watch the various stages in Brewing and Baking and Post-Fermentation Processing. Prior arrangement must be made on the mode of interaction of the educational institute with the Clinic and the Industry.

TYBSC Biotechnology Course Structure

Semester V

Course code USBT	Title	Theory /Practical	Marks	Credits	Nos of Lectures & Practical
501	Cell biology	Theory	100	2.5	60
502	Medical Microbiology & Instrumentation	Theory	100	2.5	60
503	Genomes and Molecular Biology	Theory	100	2.5	60
504	Marine Biotechnology	Theory	100	2.5	60
P501+502	Cell biology+ Medical Microbiology & Instrumentation	Practical	100	3.0	72
P503+504	Genomes and Molecular Biology+ Marine Biotechnology	Practical	100	3.0	72
Applied Component	Biosafety	Theory	100	2.0	48
	Biosafety	Practical	100	2.0	48
	TOTAL		800	20	480

Semester VI

Course code USBT	Title	Theory/ Practical	Marks	Credits	Nos of Lectures & Practical
601	Biochemistry	Theory	100	2.5	60
602	Industrial Microbiology	Theory	100	2.5	60
603	Pharmacology and Neurochemistry	Theory	100	2.5	60
604	Environmental Biotechnology	Theory	100	2.5	60
P 601-P 602	Biochemistry& Industrial Microbiology	Practical	100	3	72
P 603-P 604	Pharmacology - Neurochemistry and Environmental Biotechnology (50M)+ Project work (50M)	Practical	100	3	72
Applied component	Agribiotechnology	Theory	100	2.0	48
Applied component	Agribiotechnology	Practical	100	2.0	48
	TOTAL		800	20	480

Teaching pattern:

One (01) Credit would be of thirty- forty (30-40) learning hours; of this more than fifty percent of the time will be spent on class room instructions including practical as prescribed by the University. Rest of the time spent invested for assignments, projects, journal writing, case studies, library work, industrial visits, attending seminars / workshops, preparations for examinations etc. would be considered as notional hours. The present syllabus considers (60L as class room teaching and 15 lectures as Notional hours/ paper). Each lecture duration would be for 48 min

The names of the reference books provided in the syllabus are for guidance purpose only. Students and faculty are encouraged to explore additional reference books, online lectures, videos, science journals for latest/ additional information.

Examination pattern for:

Theory:

- The question paper for the Term End Exam would be of **100 marks** consisting of 5 Questions (20M each), of which one question would be common for all units in the syllabus.
- The question paper would be set for 150 marks including internal options.
- There shall be no internal exam for any paper.

Practical:

- Would be conducted over a period of 3 days; 50M each paper.
- Each student to perform 2 major and 2 minor practical for Sem V and 2 major and project presentation for Sem VI ,
- Viva would be conducted during the practical during Sem V; Sem VI would have ONLY project presentation
- Journals would be uniform throughout all the centres; matter would be communicated to all the centres by the syllabus committee.
- Distribution of marks for the experiments carried out during the examination:

Sem V (50M/ paper): Major: 20M; Minor: 10M; Viva: 10M; Journal 10M.

Sem VI (50M/paper): Major (x2): 40M; Journal: 10M; Project 50M

The report could be around 25-30 pages with appropriate referencing and formatting.

Marks distribution for the project would be as follows:

25M documentation, 15M presentation, 10 M viva and interactions;

- Students would undertake a project for 1-2 months during the last semester for 50 M. The project **should** include **either** of the following:
 1. One/ more major instrumentation OR
 2. One / more major technique/s required in the field of interest OR
 3. Bioinformatics OR
 4. Biostatistics

Semester V

Course code USBT	Title	Unit	Topics	Credit	No of Lectures
501	Cell Biology	I: Cell cycle	Cell cycle Introduction: Prokaryotic and Eukaryotic- 3 Lectures ; The Early Embryonic Cell Cycle and the Role of MPF- 4 Lectures ; Yeasts and the Molecular Genetics of Cell-Cycle Control – 4 Lectures ; Apoptosis, Cell-Division Controls in Multicellular Animals- 4 Lectures	2.5	15
		II: Cell Signalling	Cell signalling and signal transduction:Introduction General Principles of Cell Signaling - 3 Lectures ; Signaling via G-Protein-linked Cell-Surface Receptors - 3 Lectures ; Signaling via Enzyme-linked Cell-Surface Receptors - 3 Lectures ; Target-Cell Adaptation, The Logic of Intracellular - 3 Lectures ; Signaling: Lessons from Computer-based "Neural Networks"- 3 Lectures		15
		III: Developmental Biology	Overview of how the modern era of developmental biology emerged through multidisciplinary approaches - 5 Lectures ; Stages of development- zygote, blastula, gastrula, neurula cell fate & commitment – potency- concept of embryonic stem cells, differential gene expression, terminal differentiation ,lineages of three germ layers, fate map - 6 Lectures ; Mechanisms of differentiation- cytoplasmic determinants, embryonic induction, concept of morphogen, mosaic and regulative development Pattern formation-- axis specification, positional identification (regional specification), Morphogenetic movements, Model organisms in Developmental biology - 4 Lectures		15
		IV: Cancer Biology	Cancer: Introduction, Cancer as a Microevolutionary Process - 4 Lectures ; The Molecular Genetics of Cancer - 6 Lectures ; Cancer and Virus Cancer diagnosis and chemotherapy - 5 Lectures		15
		Total			60

References:

1. Molecular Cell Biology. 7th Edition, (2012) Lodish H., Berk A, Kaiser C., K Reiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., W.H. Freeman and Co., USA
2. Molecular Biology of the Cell, 5th Edition (2007) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Garland Science, USA
3. Cell Biology, 6th edition, (2010) Gerald Karp. John Wiley & Sons., USA
4. The Cell: A Molecular Approach, 6th edition (2013), Geoffrey M. Cooper, Robert E. Hausman, Sinauer Associates, Inc. USA
5. Developmental Biology; Scott Gilbert; 9th Edition

Course code USBT	Title	Unit	Topics	Credit	No of Lectures
502	Medical Microbiology and Instrumentation	I: Virology	Introduction to viruses-Position in biological spectrum; Virus properties - 2 Lectures ; General structure of viruses Baltimore Classification and Taxonomy(ICTV) - 2 Lectures ; Cultivation of viruses - 2 Lectures ; Reproduction of ds DNA phages Hepatitis /ss RNA (influenza), animal viruses and plant (TMV)virus - 4 Lectures ; Virus purification and assays - 2 Lectures ; Cytocidal infections and cell damage - 2 Lectures ; Viroids and Prions - 1 Lecture	2.5	15
		II: Chemotherapeutic drugs	Discovery and Design of antimicrobial agents - 1 Lecture ; Classification of Antibacterial agents, Selective toxicity, MIC, MLC - 2 Lectures Inhibition of cell wall synthesis (Mode of action for): Beta lactam antibiotics: Penicillin, Cephalosporins; Glycopeptides: Vancomycin; Polypeptides: Bacitracin - 2 Lectures Injury to Plasma membrane: Polymyxin – 1 Lecture ; Inhibition of protein synthesis Aminoglycosides, Tetracyclines Chloramphenicol, Macrolides-Erythromycin- 2 Lectures ; Inhibition of Nucleic acid synthesis: Quinolones, Rifampicin, Metronidazole - 2 lectures ; Antimetabolites: Sulphonamides, Trimethoprim - 1 lecture ; Drug Resistance: Mechanism, Origin and transmission of drug resistance - 1 lecture ; Use and misuse of antimicrobial agents - 1 lecture ; Antifungal drugs, Antiviral drugs - 2 lectures		15

		III: Spectroscopy	Principle, instrumentation, working and applications of: Fluorescence Spectroscopy - 3 Lectures Luminometry - 3 Lectures Light scattering spectroscopy - 3 Lectures Infrared Spectroscopy - 3 Lectures Atomic absorption Spectroscopy - 3 Lectures		15
		IV: Bio-analytical techniques	Principle, working and applications of: Affinity chromatography - 2 Lectures Ion-exchange chromatography - 2 Lectures Molecular (size) exclusion chromatography - 2 Lectures ; HPLC - Method development and validation- 3 Lectures ; Isotopes in Biology: Nature of radioactivity - 1 Lecture ; Detection Techniques using GM counter, Scintillation counter, autoradiography - 4 Lectures ; Applications of Tracer techniques in Biology - 1 Lecture		15
		Total			60

References:

1. Principles and techniques in biochemistry and molecular biology (2010), Keith Wilson and John Walker, 7th edition, Cambridge University Press
2. Biophysics (2002) Vasantha Pattabhi and N. Gautham, Kluwer Academic Publishers
3. Physical Biochemistry: principles and applications, 2nd edition (2009), David Sheehan, John Wiley & Sons Ltd
4. HPLC method validation for pharmaceuticals: a review (2013), Harshad V. Paithankar, International Journal of Universal Pharmacy and Bio Sciences 2(4): July-August.
5. Mim's Medical Microbiology 5th edition
6. Microbiology by Prescott Harley and Klein 5th edition Mc Graw Hill
7. Medical Microbiology Jawetz, E., Brooks, G.E, Melnick, J.L., Butel, J.S Adelberg E. A 18th edition
8. Medical Microbiology by Patrick Murray 5th edition
9. Foundations In Microbiology by Talaro and Talaro Third edition W.C Brown
10. Understanding Viruses by Teri Shors

PRACTICALS

USBT P 501-502

3 credits

72hrs

1. Separation of components from a mixture using Affinity chromatography
(Kit may be used)
2. Separation of components from a mixture using ion exchange chromatography
(Kit may be used)
3. Separation of components from a mixture using Size exclusion chromatography
(Kit may be used)
4. HPLC method validation.
5. MIC and MLC of any one antibiotic
6. Antibiotic sensitivity test using agar cup method
7. Antibiotic sensitivity test using paper disc method
8. Antibiotic sensitivity test using ditch method.
9. Cancer Biology: (Field visit and 2 page report in the journal)
10. Chick embryo candling and inoculation methods Demonstration experiment
11. Book review (Emperor of all Maladies)

Course Code USBT	Title	Unit	Topics	Credit	No of Lectures
503	Genomics and Molecular Biology	I: Genetic engineering of plants	Genetic engineering of plants; Methodology. Plant transformation with the Ti plasmid of <i>A.tumefaciens</i> , Ti plasmid derived vector system - 4 Lectures ; Transgenic plants: Physical methods of transferring genes to plants : electroporation, microprojectile bombardment, liposome mediated, protoplast fusion- 5 Lectures ; Vectors for plant cells - 4 Lectures ; Improvement of seed quality protein - 2 Lectures	2.5	15
		II: Transgenic Animals	Transgenic mice- methodology-retroviral method, DNA microinjection, ES method - 5 Lectures ; genetic manipulation with cre-loxP - 2 Lectures ; Vectors for animal cells - 2 Lectures ; Transgenic animals recombination system - 2 Lectures ; Cloning live stock by nuclear transfer - 2 Lectures ; Green Fluorescent Protein - 1 Lectures ; Transgenic fish – 1 Lectures		15
		III: Tools in Molecular Biology	Cloning vectors-Plasmids (pUC series), Cosmids, phagemids M13, shuttle vectors, YAC vectors, expression vectors pET - 4 Lectures ; Gene cloning-Isolation and purification of DNA; Isolation of gene of interest: Restriction digestion, electrophoresis, blotting, cutting, and joining DNA, methods of gene transfer in prokaryotes and eukaryotes - 3 Lectures ; Recombinant selection and screening methods: genetic, immunochemical, Southern and Western analysis, nucleic acid hybridization, HART,HRT- 2 Lectures ; Expression of cloned DNA molecules and maximization of expression - 2 Lectures ; Cloning strategies-genomic DNA libraries, cDNA libraries, chromosome walking and jumping - 4 Lectures		15
		IV: Gene sequencing and editing	Maxam Gilbert's method, Sanger's dideoxy method, Automated DNA sequencing, Pyrosequencing - 6 Lectures ; Human genome mapping and it's implications in health and disease - 3 Lectures ; RNAi, ZNF(Zinc finger nucleases), TALENS(Transcription Activator Like Effector Nucleases), CRISPER/Cas system(Clustered Regularly Interspersed Repeats) - 6 Lectures		15
		Total			60

References:

1. iGenetics A Molecular Approach 3rd Edition Peter J. Russell.
2. Molecular Biotechnology-Principles and Applications of Recombinant DNA Technology 3rd Edition Glick B.R., Pasternak J.J., Patten C.L.
3. Principles of Gene Manipulation 7th Edition Primrose S.B., Twyman R.M.
4. Biotechnology 3rd Edition S.S. Purohit.
5. Genomes 3rd Edition T.A. Brown.
6. Biotechnology B.D. Singh.
7. Gene Cloning and DNA Analysis 6th Edition T.A. Brown.
8. Genomics Cantor C.R., and Smith C.L. John Wiley & Sons. (1999)

Course Code USBT	Title	Unit	Topics	Credit	No. of Lectures
504	Marine Biotechnology	I: Marine Biotechnology-Introduction & Bioprospecting	Introduction to Marine Biotechnology- 1 lecture; The marine ecosystem and its functioning: intertidal, estuarine, salt marsh, mangrove, coral reef, coastal & deep sea ecosystems. Hydrothermal vents- 4 lectures; Bioprospecting, Marine Microbial Habitats and Their Biotechnologically relevant Microorganisms- 2 lectures; Methods for Microbial Bioprospecting in Marine Environments - 2 lectures; Biotechnological Potential of Marine Microbes - 1 lecture; Bioactive compounds from other Marine Organisms: fungi, Microalgae, Seaweeds, Actinomycetes, sponges - 5 lectures	2.5	15
		II: Marine Drugs and Enzymes	Drugs from Marine organisms: Pharmaceutical compounds from marine flora and fauna - marine toxins, antiviral and antimicrobial agents - 4 lectures; Approved Marine Drugs as Pharmaceuticals - 2 lecture; Marine Natural products and its Challenges - 2 lectures; Marine Microbial Enzymes- Marine Extremozymes and Their Significance, Current Use of Marine Microbial Enzymes - 7 lectures.		15
		III: Marine Functional foods and Nutraceuticals	Marine Functional Foods: Marine Sources as Healthy Foods or Reservoirs of Functional Ingredients - 3 lectures; Marine-Derived Ingredients with Biological Properties- 3 lectures; Functional Foods Incorporating Marine-Derived Ingredients - 2 lectures; Marine Nutraceuticals : Marine Bioactives as Potential Nutraceuticals, Functional Carbohydrates, Polyunsaturated Fatty Acids- 3 lectures; Carotenoids, Soluble Calcium, Fish Collagen and Gelatin, Marine Probiotics - 4 lectures.		15
		IV: Marine Bioresources and	Marine Bioresources, Marine Secondary Metabolites, Marine Proteins, Marine Lipids- 4 lectures; Cosmetics from Marine Sources: Scenario of Marine Sources in the Cosmetic Industry, Cosmetics: Definition and Regulations,		15

		Cosmetics	Cosmeceuticals , Target Organs and Cosmetics Delivery Systems , Components of Cosmetics, Major Functions of Some Marine Components in Cosmetics and Cosmeceuticals , Treatments Based on Marine Resources , Products Based on Marine Resources - 11 lectures.		
		Total			60

References:

1. Kim, S.K. Springer Handbook of Marine Biotechnology; Springer: Berlin, Germany; Heidelberg, Germany, 2015.
2. Nollet, Leo M. L- Marine microorganisms- extraction and analysis of bioactive compounds-CRC Press_Taylor& Francis (2017)
3. R. S. K. Barnes, R. N. Hughes(auth.)-An Introduction to Marine Ecology, Third Edition-Wiley-Blackwell (1999)
4. Blanca Hernández-Ledesma, Miguel Herrero-Bioactive Compounds from Marine Foods-Plant and Animal Sources-Wiley-Blackwell (2013)
5. Fabio Rindi, Anna Soler-Vila, Michael D. Guiry (auth.), Maria Hayes (eds.)-Marine Bioactive Compounds_ Sources, Characterization and Applications-Springer US (2012)
6. W. Evans-Trease and Evans Pharmacognosy 15 th ed.-Saunders (2010)

PRACTICALS

USBT P 503-504

3 credits

72hrs

1. Transformation in *E.coli*.
2. Genomic DNA Extraction: Animal cells.
3. Restriction enzyme digestion and ligation (Kit may be used).
4. Phage titration: *Demonstration*
5. Polymerase chain reaction. *Demonstration*
6. Gradient plate technique
7. Bacterial gene expression (Kit may be used).
8. Study of any 5 marine bacteria and algae (Macro and micro)
9. DPPH assay for antioxidant extracted from marine algae
10. Extraction of carotenoids from marine algae/Bacteria/Fungi
11. Extraction and estimation of Gelatin / Collagen.
12. Extraction of alkaloids from marine organisms and their separation by TLC.

Course	Title	Unit	Topics	Credits	Lectures
Applied component	Biosafety	I: Introduction to biosafety	Introduction - 1 lecture Biological Risk Assessment, Hazardous Characteristics of an Agent- 2 lectures ; Genetically modified agent hazards - 1 lecture ; Cell cultures - 1 lecture ; Hazardous Characteristics of Laboratory Procedures - 1 lecture ; Potential Hazards Associated with Work Practices – 2 lectures ; Safety Equipment and Facility Safeguards - 2 lectures ; Pathogenic risk and management - 2 lectures	2.0	15
		II: GLP	Concept of GLP- 1 lectures ; Practicing GLP- 1 lecture ; Guidelines to GLP - 2 lectures ; Documentation of Laboratory work - 1 lectures ; Preparation of SOPs - 2 lectures ; Calibration records - 1 lectures ; Validation of methods - 1 lectures ; Documentation of results - 1 lecture ; Audits & Audit reports - 1 lecture.		12
		III: Detection and testing of contaminants	Microbial Contamination in food and pharma product - 3 lectures ; Some common microbial contaminants - 3 lectures ; Microbiological Assays for pharmaceutical products - 4 lectures ; Regulatory Microbiological testing in pharmaceuticals - 3 lectures.		12
		IV: Biosafety in Biotechnology	Concepts on biosafety in Biotechnology - 2 lectures ; Regulating rDNA technology - 2 lectures ; Regulating food and food ingredients - 3 lectures ; Genetically engineered crops, livestock Bioethics - 3 lectures ; Contemporary issues in Bioethics - 2 lectures.		12
		Total			48

References:

1. Pharmaceutical Microbiology - Hugo, W.B, Russell, A.D 6th edition Oxford Black Scientific Publishers.
2. Biosafety in Microbiological and Biomedical Laboratories - 5th Edition, L. Casey Chosewood Deborah E. Wilson U.S. Department of Health and Human Services Centers for Disease Control and Prevention National Institutes of Health.
3. Molecular Biotechnology –Principles and Applications of Recombinant DNA Glick, B.R, Pasternak, J.J Patten, C.L 3rd edition ASM press

PRACTICALS**Applied Component- Biosafety****2 Credits****48hours**

1. Validation of micropipette, measuring cylinders, colorimeters
2. Calibration of pH meter and weighing balance
3. Vitamin B12 bioassay
4. Testing for adulterants in food; ex. Starch in milk
5. Making SOP for any 2 major laboratory instruments
6. Sterility of injectables

Semester VI

Course Code USBT	Title	Unit	Topics	Credits	Lectures
601	Biochemistry	I: Protein Biochemistry	Protein structure: Protein Tertiary and Quaternary Structures - 2 Lectures ; Protein Denaturation and Folding – 3 Lectures ; Protein Function: Reversible Binding of a Protein to a Ligand: Oxygen-Binding Proteins – 2 Lectures ; Complementary Interactions between Proteins and Ligands: Immunoglobulins – 1 Lecture ; Protein Interactions Modulated by Chemical Energy: Actin, Myosin, and Molecular Motors - 3 Lectures ; Protein purification – 4 Lectures .	2.5	15
		II: Metabolism	Carbohydrate biosynthesis and its regulation: Peptidoglycan in Bacteria - 2 Lectures ; Starch and sucrose in Plants - 4 Lectures ; Glycogen in Animals - 4 Lectures ; Biosynthesis and regulation of Cholesterol, Atherosclerosis – 5 Lectures .		15
		III: Endocrinology	Mechanism of action of group I and II hormones- 1 Lecture ; Structure, storage, release, transport, biochemical functions and disorders associated with hormones secreted by Hypothalamus - 1 Lecture ; Anterior Pituitary gland - GH, stimulating hormones) - 1 Lecture ; Posterior Pituitary gland – oxytocin and vasopressin - 1 Lecture ; Thyroid gland – Thyroxine, calcitonin - 2 Lectures ; Parathyroid gland – PTH - 1 Lecture ; Adrenal medulla – epinephrine and norepinephrine - 1 Lecture ; Adrenal cortex – Glucocorticoids - 1 Lecture ; Pancreas – insulin and glucagon - 2 Lectures ; Female Gonads – estrogen and progesterone - 2 Lectures ; Male gonads – testosterone- 1 Lecture ; Placenta – hCG - 1 Lecture .		15
		IV:	Minerals and Vitamins;		

		Nutrition	Dietary sources, bioactive form, functions and disorders associated with fat soluble (A D E K) and water soluble vitamins- 7 Lectures; Minerals - physiological and biochemical functions of principal and trace elements. - 7 Lectures; Malnutrition – Over nutrition (obesity) and PEM (Kwashiorkor and Marasmus)- 1 Lecture.		15
		Total			60

References:

1. Lehninger, principles of biochemistry, 4th edition (2005), David Nelson and Michael Cox *W.H. Freeman* and Company, New York.
2. Biochemistry , 4th edition (2010), Voet and Voet, John Wiley and sons, USA
3. Harper's Illustrated Biochemistry, 27th edition, RK Murray, DK Granner, PA Mayes and VW Rodwell, McGraw Hills publication.
4. Biochemistry, 4nd edition (2017), Satyanarayana and Chakrapani, Books & Allied (P) Ltd
5. Nutrition Science, 6th edition (2017), Srilakshmi, new age international publishers.

Course Code USBT	Title	Unit	Topics	Credit	No. of Lectures
602	Industrial Microbiology	I: Dairy technology	Milk: Normal flora, changes in raw milk - 2 lectures ; Enumeration - 1 lecture ; Factors affecting bacteriological quality - 1 lecture ; Dairy technology Preservation methods - 2 lectures ; Pasteurization- 1 lecture ; Starter Cultures - 2 lectures ; Fermented products-Production process and spoilage of Cheese: Swiss and Cheddar - 2 lectures ; Butter - 2 lectures ; Yogurt - 1 lectures and Buttermilk - 1 lecture .	2.5	15
		II: Down-stream Processing (DSP)	Introduction of DSP - 2 lectures ; Foam separation - 1 lecture ; Types of Precipitation - 1 lecture ; Filtration 2 lectures , Centrifugation - 1 lecture ; Chromatography in DSP - 2 lectures ; Cell disruption- physical and chemical methods - 2 lectures ; Solvent recovery, Membrane processes - 1 lecture ; Drying - 1 lecture ; Crystallization and Whole broth processing - 2 lectures .		15
		III: Fermentation process	Introduction to Inoculum development - 2 lectures ; Bacterial and fungal inoculum development with one example each - 3 lectures , scale up, scale down - 2 lectures ; Production of: Streptomycin - 1 lecture ; Protease - 1 lecture ; Mushroom - 1 lecture ; Glutamic acid - 1 lecture ; Lysine - 1 lecture , ethanol production 1 lecture Semi-synthetic Penicillin 1 lecture , Biotransformation - 1 lecture .		15
		IV: QA-QC	Concept of GMP- 1 Lectures ; Requirements of GMP implementation - 2 Lectures ; Documentation of GMP practices - 2 Lectures ; Regulatory certification of GMP - 2 Lectures ; Quality Control (QC): Concept of QC - 2 Lectures ; Requirements for implementing QC -		15

			2 Lectures; QA concepts: Concept of QA - 2 Lectures; Requirements for implementing - 2 Lectures.		
		Total			60

References:

1. Applied Dairy Microbiology Elmer H Marth and James L Steele Mercel Dekker Inc
New York, 2nd edition
2. Microbial Technology Peppler,H.J and Perlman,D 2nd Academic Press Practicals
3. Industrial Microbiology Prescott and Dunn CBS publishers
4. Dairy technology by Yadav and Grower
5. Fermentation technology by Stanbury and Whittkar
6. Pharmaceutical Microbiology by Russel and Hugo

PRACTICALS

USBT P 601-602

3 credits

72hrs

1. Estimation of Milk protein-Pynes method
2. Microbial analysis of Milk by MBRT and RRT
3. Phosphatase test in Milk
4. DMC of milk sample
5. Isolation of Normal flora from Milk and curd
6. Determination of blood glucose levels for detection of diabetes mellitus.
7. Determination of serum cholesterol (total, HDL and LDL ratio)
8. Estimation vitamin C by DCPIP method from food samples.

Course Code USBT	Title	Unit	Topics	Credits	No of Lectures
603	Basic pharmacology and Neurochemistry	I: General principles of Pharmacology	Mechanism of drug action - 2 Lectures ; drug receptors and biological responses - 2 Lectures ; second-messenger systems, the chemistry of drug–receptor binding - 2 Lectures ; dose–response relationship: therapeutic index - 3 Lectures ; ED, LD, - 2 Lectures ; Potency and Intrinsic Activity - 2 Lectures ; Drug antagonism - 2 Lectures .	2.5	15
		II: Drug Absorption and Distribution	Absorption of drugs from the alimentary tract - 2 Lectures ; factors affecting rate of gastrointestinal absorption - 2 Lectures ; absorption of drugs from lungs - 1 Lecture ; skin - 1 Lecture ; absorption of drugs after parenteral administration factors influencing drug distribution - 2 Lectures ; binding of drugs to plasma proteins - 2 Lectures ; Physiological barriers to drug distribution - 3 Lectures .		15
		III: Basic Toxicology and Regulatory Toxicology	Background Definitions - 1 Lectures ; Causation: degrees of certainty Classification - 1 Lectures ; Causes Allergy in response to drugs Effects of prolonged administration: chronic organ toxicity - 2 Lectures ; Adverse effects on reproduction - 1 Lecture ; <u>Poisons</u> : Deliberate and accidental self-poisoning Principles of treatment Poison-specific measures General measures - 2 Lectures ; Specific poisonings: cyanide, methanol, ethylene glycol, hydrocarbons, volatile solvents, heavy metals, - 3 Lectures ; herbicides and pesticides, - 2 Lectures ; biological substances (overdose of medicinal drugs is dealt with under individual agents) - 1 Lecture ; Incapacitating agents: drugs used for torture - 1 Lecture ; Nonmedical use of drugs - 1 Lecture .		15
		IV: Neurochemistry	Anatomy and functioning of the brain - 2 Lectures ; Neuronal pathways - 2 Lectures ;		15

			Propagation of nerve impulses - 2 Lectures ; Neuronal excitation and inhibition - 3 Lectures ; Synapses and gap junctions - 3 Lectures ; Action of Neuro toxins and neurotransmitters - 3 Lectures .		
		Total			60

References:

1. Textbook of Medical Physiology Guyton, A.C and Hall 11th edition J.E Saunders
2. Modern Pharmacology with clinical Applications Craig,C.R, Stitzel,R.E 5th edition
3. Clinical Pharmacology Bennet,PN,Brown,M.J, Sharma,P 11th edition Elsevier
4. Biochemistry Metzler, D.E Elsevier

Course Code USBT	Title	Unit	Topics	Credits	No of Lectures
604	Environmental Biotechnology	I: Renewable sources of energy	Energy sources renewable – solar energy, wind power, geothermal energy and hydropower, biomass energy - 5 Lectures ; Biogas technology- biogas plant & types, biodigester. Biogas- composition, production and factors affecting production, uses - 5 Lectures ; Biofuels – ethanol production. Microbial hydrogen production Biodiesel, Petrocrops - 5 Lectures ;	2.5	15
		II Industrial effluent treatment	Biological processes for industrial effluent treatment, aerobic biological treatment- activated sludge process, CASP, advanced activated sludge processes (any two) Biological filters, RBC, FBR - 5 Lectures ; Anaerobic biological treatment- contact digesters, packed bed reactors, anaerobic baffled digesters, UASB - 3 Lectures ; Solid waste treatment - 2 Lectures ; pollution indicators & biosensors - 2 Lectures ; biodegradation of xenobiotics- persistent compounds, chemical properties influencing biodegradability, microorganisms in biodegradation - 2 Lectures ; Use of immobilized enzymes or microbial cells for treatment - 1 Lecture .		15
		III Wastewater treatment	Wastewater treatment- introduction, biological treatment, impact of pollutants on biotreatment, use of packaged organisms and genetically engineered organisms in waste treatment - 5 Lectures ; Heavy metal pollution – sources, microbial systems for heavy metal accumulation, techniques used for heavy metal removal - 5 Lectures ; biosorption by bacteria, fungi and algae, factors affecting biosorption limitations of biosorption - 5 Lectures .		15
		IV Hazardous waste management	Biodegradation of waste from tanning industry - 2 Lectures ; petroleum industry - 2 Lectures ; paper & pulp industry - 2 Lectures ; Dairy - 2 Lectures ; Distillery - 2 Lectures ; Dye - 1 Lecture ; Antibiotic industry - 2 Lectures ; Removal of oil spillage & grease deposits - 2 Lectures .		15
		Total			60

References:

1. Environmental Biotechnology Allan Scragg Oxford University press
2. Environmental Biotechnology (Basic concepts and applications) Indu Shekar Thakur
IK International
3. Environmental Biotechnology (Industrial pollution management) S.D. Jogdand
Himalaya Publishing House

PRACTICALS

USBT P 603-604

3 credits

72hrs

1. LD 50, ED 50 evaluation using suitable models e.x daphnia
2. Study the effect of heavy metals on the growth of bacteria.
3. Determination of Total Solids from an effluent sample.
4. Study of physico-chemical (pH, color, turbidity, BOD, COD) parameters of any one industrial effluent sample
5. Estimation of chromium from Effluents (Demonstration)
6. Visit to ETP/ CETP

Course	Title	Unit	Topics	Credit	No. of Lectures
Applied component	Agri Biotechnology	I: Precision Agriculture and Agriculture systems	Introduction to Agriculture and Agriculture systems- 1 Lecture ; Green house Technology-- Types of green house, importance, functions and features of green house, Design criteria and calculation - 2 Lectures ; Construction material, covering material and its characteristics, growing media, green house irrigation system. nutrient management - 3 Lectures ; Greenhouse heating, cooling and shedding and ventilation system, Computer controlled environment - 3 Lectures ;; Phytotrons, fertigation and roof system - 1 Lecture ; Precision Cultivation- tools, sensors for information acquisition - 2 Lectures .	2	12
		II: Plant stress biology	Abiotic stress –Physiological and molecular responses of plants to water stress, salinity stress, temperature stress – heat and cold, Photooxidative stress, stress perception and stress signaling pathways, Ionic and osmotic homeostasis, reactive oxygen species scavenging- 4 Lectures ; Biotic stress - plant interaction with bacterial, viral and fungal pathogens, plant responses to pathogen– biochemical and molecular basis of host-plant resistance , toxins of fungi and bacteria , systemic and induced resistance –pathogen derived resistance, signalling - 8 Lectures .		12
		III: Molecular Markers in Plant Breeding	Genetic markers in plant breeding-- Classical markers, DNA markers (RFLP, RAPD, AFLP, SSR, SNP)- 4 Lectures ; Application of Molecular Markers to Plant Breeding [quantitative trait locus (QTL) mapping] - 4 Lectures ; Plant DNA Barcoding- Barcoding Markers (matK, rbcL, ITS, tmH-psbA), steps, recent advances, Benefits, Limitations - 4 Lectures .		12

		IV: Biofertilizers and Biopesticides	Biofertilizer: Nitrogen-fixing Rhizobacteria - Symbiotic Nitrogen Fixers -2 Lectures; Nonsymbiotic Nitrogen Fixers Plant Growth Promoting Microorganisms-Phosphate-Solubilizing Microbes (PSM), Phytohormones and Cytokinins, Induced Systemic Resistance- 2 Lectures; Plant Growth Promotion by Fungi-- Mycorrhizae Arbuscular Mycorrhizae Ectomycorrhizae -2 Lectures; Microbial Inoculants -- Inocula, Carriers, and Applications, Monoculture and Co-culture Inoculant Formulations Biocontrol, Polymicrobial Inoculant Formulations- 3 Lectures; Biopesticides – types, Bacillus thuringiensis, insect viruses and entomopathogenic fungi (characteristics, physiology, mechanism of action and application) -3 Lectures.		12
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References:

1. M. Ajmal Ali, G. Gyulai, F. Al-Hemaid -Plant DNA Barcoding and Phylogenetics, LAP Lambert Academic Publishing (2015)
2. P. Parvatha Reddy (auth.)-Sustainable Crop Protection under Protected Cultivation- Springer Singapore (2016)
3. S.B. Anderson (ed.), Plant Breeding from Laboratories to Fields, InTech,2013
4. Henry Leung, Subhas Chandra Mukhopadhyay (eds.) - Intelligent Environmental Sensing (2015, Springer International Publishing)
5. Travis R. Glare, Maria E. Moran-Diez - Microbial-Based Biopesticides_ Methods and Protocols (2016, Humana Press)
6. Altieri, Miguel A.Farrell, John G-Agroecology- The Science Of Sustainable Agriculture, Second Edition-CRC Press (2018)
7. Arie Altman, Paul Michael Hasegawa-Plant Biotechnology and Agriculture_ Prospects for the 21st Century-Academic Press (2011)

PRACTICALS

Applied component-Agri-Biotechnology

USBT P 603-604

2 credits

48 hrs

1. RAPD analysis demonstration experiment
2. Isolation of Rhizobium
3. Isolation of Azotobacter
4. Isolation of Phosphate solubilising bacteria
5. Study of effect of abiotic stress on plants.
6. Rapid screening tests for abiotic stress tolerance (drought, - PEG, Mannitol & salinity NaCl)
7. Estimation of antioxidants and antioxidant enzymes - Ascorbate, Catalase, and Peroxidase
8. Visit to green house facility and submission of field visit report.