



SIES

**College of Arts,
Science &
Commerce**

**RISE WITH EDUCATION
Sion (West), Mumbai – 400022.
(Autonomous)**

Faculty: Science

Program: B.Sc.

Subject: BIOTECHNOLOGY

Academic Year: 2018 – 2019

F.Y.B.Sc

**Credit Based Semester and Grading Syllabi approved
by Board of Studies in Biotechnology to be brought into
effect from June 2018.**

PREAMBLE

Biotechnology, broadly defined, includes any technique that uses living organisms, or parts of such organisms, to make or modify products, to improve plants or animals, or to develop microorganisms for specific use. The interdisciplinary nature of biotechnology integrates living systems including animal, plant and microbes and their studies from molecular biology to cell biology, from biochemistry to biophysics, from genetic engineering to stem cell research, from bioinformatics to genomics-proteomics, from environmental biology to biodiversity, from microbiology to bioprocess engineering, from bioremediation to material transformation and so on.

Biotechnology is the science of today and tomorrow. It has applications in all major service sectors. i.e. health, agriculture, industry, environment etc. Biotechnology as an application science has taken firm footing in many countries, abroad where a number of transgenic crops, genetically modified food and recombinant therapeutic molecules for human and animal health are available in the market. Biotechnology as a science of service to human society is yet to make inroads in India

With the advent of World Wide Web in the early nineties and its subsequent growth, the latest research trends have become accessible from drawing rooms across the globe. This acted as a positive feedback mechanism in increasing the pace of research in all fields including Chemical Engineering and Bio-technology. This was the motivation for an in depth analysis of what is actually required for today's technology. It is also important to take advantage of the freely available software to enhance the quality and quantity of material that can be covered in the class room.

This restructured syllabus is therefore intended to combine the principles of physical, chemical and biological sciences along with developing advanced technology. The undergraduate curricula is prepared to impart primarily basic knowledge of the respective subject from all possible aspects. In addition, students will be trained to apply this knowledge particularly in day-to-day applications of biotechnology and hence get a flavor of research

Semester I

Course Code	Course Type	Course Title	Credits	Lectures/week
SIUSBT11	Core Subject	Basic Chemistry I	2	3
SIUSBT12	Core Subject	Bioorganic Chemistry	2	3
SIUSBT13	Core Subject	Biodiversity and Cell Biology	2	3
SIUSBT14	Core Subject	Microbial Techniques	2	3
SIUSBT15	Core Subject	Introduction to Biotechnology	2	3
SIUSBT16	Core Subject	Molecular Biology and Genetics	2	3
SIUSBT17	Ability Enhancement Course 1 (FC I)	Societal Awareness	2	3
SIUSBTP18 SIUSBTP19, SIUSBTP20	Core Subject Practicals	Practicals of SIUSBT11, SIUSBT12, SIUSBT13, SIUSBT14, SIUSBT15 and SIUSBT16	6	18

Semester II

Course Code	Course Type	Course Title	Credits	Lectures/week
SIUSBT21	Core Subject	Basic Chemistry II	2	3
SIUSBT22	Core Subject	Physical Chemistry	2	3
SIUSBT23	Core Subject	Physiology and Ecology	2	3
SIUSBT24	Core Subject	Genetics and rDNA Technology	2	3
SIUSBT25	Core Subject	Microbial Techniques and Tissue Culture	2	3
SIUSBT26	Core Subject	Enzymology, Immunology and Biostatistics	2	3
SIUSBT27	Ability Enhancement Course 1 (FC I)	Globalization, Ecology and Sustainable Development	2	3
SIUSBTP28, SIUSBTP29, SIUSBTP30	Core Subject Practicals	Practicals of SIUSBT21, SIUSBT22, SIUSBT23, SIUSBT24, SIUSBT25 and SIUSBT26	6	18

SEMESTER I

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT11	Basic Chemistry I		
Course Objectives	To acquaint the students with basic concepts of chemistry like nomenclature, chemical bonds and to familiarize them to the concepts stereochemistry		
Unit I Nomenclature and Classification	<p>Nomenclature and Classification of Inorganic Compounds: Oxides, Salts, Acids, Bases, Ionic, Molecular and Coordination Compounds</p> <p>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</p>	2	15
Unit II Chemical Bonds	<p>Ionic Bond: Nature of Ionic Bond, Structure of NaCl, KCl and CsCl, Factors influencing the formation of ionic bond</p> <p>Covalent Bond: Nature of covalent bond, Structure of CH₄, NH₃, H₂O, Shapes of BeCl₂, BF₃</p> <p>Coordinate Bond: Nature of Coordinate Bond</p> <p>Non Covalent Bonds: Van Der Waal's forces: dipole - dipole, dipole - induced dipole</p> <p>Hydrogen Bond: Theory of hydrogen bonding, Types of hydrogen bonding (with examples of RCOOH, ROH, Salicylaldehyde, Amides and Polyamides)</p>		15
Unit III 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, Representation of Configuration by “Flying Wedge Formula”</p> <p>Projection formulae – Fischer, Newman and Sawhorse, The Interconversion of the Formulae</p>		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT12	Bioorganic Chemistry		
Course Objectives	To acquaint the students with bioorganic molecules and to introduce them to the classification, structure and characterization of biomolecules		
Unit I Biomolecules: Carbohydrates and Lipids	<p>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</p> <p>Lipids: Classification of Lipids, Properties of Saturated, Unsaturated Fatty Acids, Rancidity, and Hydrogenation of Oils</p> <p><i>Phospholipids:</i> Lecithin Cephalin, Plasmalogen Triacylglycerol-Structure and Function</p> <p><i>Sterols:</i> Cholesterol- Structure and Function, Lipoproteins-Structure and Function, Storage Lipids, Structural Lipids, Action of Phospholipases, Steroids</p>	2	15
Unit II Biomolecules : Amino acids and Proteins	<p>Amino Acids: Classification, Preparation and Properties, Isoelectric Point, Titration Curve of Amino Acids, Concept of Isoelectric pH, Zwitter ion, Structure of Peptides, Peptide Synthesis</p> <p>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 Glycoproteins</p>		15
Unit III Biomolecules : Nucleic Acids	<p>Nucleic Acids: Structure of Purine and Pyrimidine Bases, Structure of Nucleosides, Nucleotides and Polynucleotides, Structure and Function of Nucleic Acids, Hydrogen Bonding between Nitrogeneous Bases in DNA, Properties and Types of DNA, RNA, Differences between DNA and RNA</p> <p>Denaturation, Annealing, Tm, Hypo & hyperchromic effect, cDNA</p>		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT13	Biodiversity and Cell Biology		
Course Objectives	To acquaint the students with concept of biodiversity and ultrastructure of prokaryotic and eukaryotic cell and its classification		
Unit I Origin of Life and Biodiversity (Plant, Animal & Microorganism s)	<p>Origin of Life, Chemical and Biological Evolution, Origin of Eukaryotic Cell</p> <p>Concept of Biodiversity, Taxonomical, Ecological and Genetic Diversity & its Significance</p> <p>Introduction to Plant Diversity: Algae, Fungi, Bryophyta, Pteridophyta, Gymnosperms and Angiosperms (with one example each)</p> <p>Introduction to Animal Diversity: Non-Chordates and Chordates {with at least one representative example.}</p> <p>Introduction to Microbial Diversity: Archaeobacteria, Eubacteria, Blue-green Algae, Actinomycetes, Eumycota-Habitats, Examples and Applications.</p>	2	15
Unit II Bacteria and Viruses	<p>Ultrastructure of Prokaryotic Cell: Concept of Cell Shape and Size, Detail Structure of Slime Layer, Capsule, Flagella, Pilli, Cell Wall (Gram Positive and Negative), Cell Membrane, Protoplast and Spheroplast, Cytoplasm and Genetic Material Storage Bodies and Spores</p> <p>Bacteria: Classification, Types, Morphology (Size, Shape and Arrangement) Modes of cell division, Significance of Bacteria</p> <p>Introduction to Viruses : General Characters, Classification (Plant, Animal and Bacterial Viruses)</p>		15
Unit III Ultrastructure of Eukaryotic Cell	<p>Ultrastructure of Eukaryotic Cell: Plasma membrane, Cytoplasmic Matrix, Microfilaments, Intermediate Filaments, and Microtubules, Organelles of the Biosynthesis-Endoplasmic Reticulum & Golgi Apparatus, Lysosome, Endocytosis, Phagocytosis, Autophagy, Proteasome Eukaryotic Ribosomes, Mitochondria and Chloroplasts, Nucleus –Nuclear Structure, Nucleolus, External Cell Coverings- Cilia And Flagella</p> <p>Comparison of Prokaryotic And Eukaryotic Cells</p>		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT14	Microbial Techniques		
Course Objectives	<p>To acquaint the students with basic staining techniques</p> <p>To introduce them to the concept of nutritional requirements for microbial growth</p> <p>To familiarize the students in with basic techniques used in microbiology</p>		
Unit I Basic Techniques in Microbiology	<p>Microscope : Simple and Compound – Principle, Parts and types, Aberration, Functions and Applications; Dark Field, Phase Contrast</p> <p>Colorimetry: Principle, Beer-Lambert’s Law, Measurement of Extinction, Derivation of $E = kcl$, Limitations of Beer-Lambert’s Law, instrumentation</p>	2	15
Unit II Stains	<p>Stains and Staining Solutions : Definition of Dye and Chromogen, Structure of Dye and Chromophore, Functions of Mordant and Fixative, Natural and Synthetic Dyes, Classification, Simple</p> <p>Chemistry of stains, Staining, Differential Staining (Gram staining , Romanowsky’s staining & Acid Fast Staining with specific examples)</p> <p>Fluorescent stains, Fluorescence and phosphorescence , Principles of metachromatic granules</p>		15
Unit III Nutrition and Cultivation of Microorganisms	<p>Nutrition and Cultivation of Microorganisms: Nutritional Requirements – Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulphur and Growth Factors.</p> <p>Classification of Different Nutritional types of Organisms, Design and Types of Culture Media: Simple Medium, Differential, Selective and Enriched Media</p> <p>Sterilization of media and glasswares</p> <p>Concept of Isolation and Methods of Isolation, Pure Culture Techniques</p>		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT15	Introduction to Biotechnology		
Course Objectives	To introduce the students with various fields of biotechnology and their applications To acquaint them with the knowledge of food technology and fermentation techniques		
Unit I Introduction and applications of Biotechnology	History & Introduction to Biotechnology What is Biotechnology? Definition of Biotechnology, Traditional and Modern Biotechnology, Branches of Biotechnology and applications- Plant, Animal, Marine, Agriculture, Healthcare, Industrial, Pharmaceutical and Environmental Biotechnology. Application of Enzymes in Biotechnology Ethics in Biotechnology	2	15
Unit II Food Biotechnology	Food Biotechnology : Scope of Food technology, Primary sources of microorganisms in food, Microbial role in food products: Bacteria, Molds and yeasts. Food Deterioration and its Control. Unit Operation in Food Processing, General principles of food preservation- asepsis, heat treatment, pasteurization, Irradiation, appertization. Modern Biotechnological Regulatory Aspects in Food Industries Biotechnology and Food - Social Appraisal Introduction to food packaging, food product labels and categories		15
Unit III Fermentation Biotechnology	Fermenters: Definition, Characteristics, Types of fermenters and basic structure of stirred tank fermenters Fermentation Technology: Definition, Applications of Fermentation Technology, Microbial Fermentations Overview of Industrial Production of Chemicals (Acetic Acid, Citric Acid and Ethanol), Antibiotics, Enzymes and Beverages (Beer, Wine) Prebiotics and probiotics		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT16	Molecular Biology & Genetics		
Course Objectives	To acquaint the students with DNA replication and repair mechanism To impart knowledge of horizontal gene transfer techniques and bacteriophage life cycle		
Unit I Replication	DNA Replication in Prokaryotes and Eukaryotes- Semi-conservative DNA replication, DNA Polymerases and its role, <i>E.coli</i> Chromosome Replication, Bidirectional Replication of Circular DNA molecules Rolling Circle Replication, DNA Replication in Eukaryotes, DNA Recombination –Holliday Model for Recombination	2	15
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, Ames test		15
Unit III Microbial Genetics	Genetic analysis in Bacteria- Prototrophs, Auxotrophs. Mechanism of Genetic Exchange in Bacteria- Conjugation; Transformation; Transduction (Generalized Transduction, Specialized Transduction); Introduction to Bacterial Transposable Elements Bacteriophages – Lytic and Lysogenic cycle		15

Ability Enhancement Course I (FC I)

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT17	Societal Awareness		
Course Objectives	To acquaint the students with concepts of societal awareness and Indian society and to make students aware about the problems in society as well as about the Indian Constitution and Significance Aspects of Political Processes		
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	2	15
Unit II Concept of Disparity	<p>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</p> <p>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</p>		15
Unit III The Indian Constitution and Significance Aspects of Political Processes	<p>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</p> <p>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</p>		15

SEMESTER I (Practicals)

Basic Chemistry

COURSE CODE	TITLE	CREDITS	NOTIONAL HOURS
SIUSBTP18	Basic Chemistry	2	30 hrs
<ol style="list-style-type: none">1. Qualitative Analysis of Inorganic Compounds - Three experiments2. 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, Haloarene3. Verification of Beer Lamberts Law and determination of absorption maxima4. Spot test for Carbohydrates, Fats and Proteins and Amino Acids and Nucleic Acids5. Estimation of reducing sugar by DNSA method6. Estimation of Protein by Biuret method and Lowry method7. Estimation of Acid number and Iodine value of Oil			

Basic Life Sciences

COURSE CODE	TITLE	CREDITS	NOTIONAL HOURS
SIUSBTP19	Basic Life Sciences	2	30 hrs
<ol style="list-style-type: none">1. Introduction of laboratory instruments-Autoclave, Hot air Oven, Incubator, pH meter, Rotary Shaker and Centrifuge2. Components and working of Simple, Compound, Dark Field and Phase Contrast Microscope3. Staining and study of Plant and Animal Tissues4. Special Staining Technique for Cell Wall, Capsule, lipid granules and Endospores and Fungal Staining5. Monochrome Staining, Negative staining, Differential Staining, Gram Staining and Acid Fast Staining , Study of Motility6. Study of Permanent slides of Blue green Algae7. Sterilization of media and glasswares8. Aseptic transfer9. Preparation of Media- Nutrient broth and Agar, MacConkey Agar, Sabourauds Agar10. Isolation of Organisms : T-streak, Polygon method11. Colony Characteristics of Microorganisms (Bacteria, Molds and fungus)			

Basic Biotechnology

COURSE CODE	TITLE	CREDITS	NOTIONAL HOURS
SIUSBTP20	Basic Biotechnology	2	30 hrs
<ol style="list-style-type: none">1. Isolation of organisms causing Food Spoilage2. Microscopic determination of Microbial flora from Yoghurt and Lactic Acid Determination3. Analysis of Milk- Methylene Blue, Resazurin Test, Phosphatase Test4. Extraction of Caesin from Milk5. Meat Tenderization using Papain6. Isolation and purification of DNA (genomic) from plant source (Onion)7. Estimation of Alcohol by Dichromate method			

SEMESTER II

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT21	Basic Chemistry II		
Course Objectives	To acquaint the students with concept of titrimetric and volumetric estimation To impart skills in preparation of buffers and handling of basic analytical techniques like chromatography		
Unit I Water and buffers	<p>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, Water as a Medium for Life</p> <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. Applications of buffers in Biotechnology</p>	2	15
Unit II Titrimetry and Gravimetry	<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.</p> <p>Theory of Acid –Base Indicators, Choice and Suitability of Indicators.</p> <p>Gravimetric Analysis: Introduction, principle, 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. (Numerical Expected).</p>		15
Unit III Analytical Techniques	<p>Methods of Separation: Precipitation, Filtration, Zone refining, Distillation and Solvent Extraction.</p> <p>Analytical Techniques Chromatography: Definition, Principles, Types Introduction to Paper Chromatography, Thin Layer Chromatography, Introduction to Column Chromatography- Principle, and its Applications.</p>		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT22	Physical Chemistry		
Course Objective	To introduce the students with concepts in thermodynamics, kinetics and redox reactions		
Unit I Thermodynamics	<p>Thermodynamics: System, Surrounding, Boundaries Sign Conventions, State Functions, Internal Energy and Enthalpy: Significance, examples, (Numericals expected.)</p> <p>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.</p>	2	15
Unit II Chemical Kinetics	<p>Reaction Kinetics:</p> <p>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)</p> <p>Determination of Order of Reaction by a) Integration Method b) Graphical Method c) Ostwald's Isolation Method d) Half Time Method. (Numericals expected).</p>		15
Unit III Oxidation and Reduction Reactions	<p>Principles of Oxidation & Reduction Reactions :</p> <p>Oxidising and Reducing Agents, Oxidation Number, Rules to assign Oxidation Numbers with examples Ions like Oxalate, Permanganate and Dichromate.</p> <p>Balancing Redox Reactions by Ion Electron Method</p> <p>Oxidation, Reduction, Addition and Substitution & Elimination Reactions</p>		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT23	Physiology and Ecology		
Course Objective	To acquaint the students with physiological processes in plants and animals and to impart knowledge of physiology and ecology		
Unit I Plant Physiology	<p>Photosynthesis, Intracellular Organization of Photosynthetic System.</p> <p>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</p> <p>Plant hormones - Auxin, Gibbrellins, Cytokinins, Ethylene, Abscissic acid Introduction to Secondary Metabolites</p>	2	15
Unit II Animal Physiology	<p>Physiology of Digestion</p> <p>Movement of Food and Absorption, Secretary functions of Alimentary Canal, Digestion and Absorption, assimilation in Gut of Mammals</p> <p>Anatomy of Mammalian Kidney, Structure of Nephron, Physiology of Urine Formation and Role of Kidney in Excretion and Osmoregulation</p> <p>Physiology of Respiration, Mechanism of Respiration, Principles of Gaseous Exchange in the Blood and Body Fluids</p> <p>Blood and Circulation : Blood Composition, Structure and Function of its Constituents</p> <p>Blood Coagulation and Anti- Coagulants, Hemoglobin and its Polymorphism Regulation of the Circulation Mechanism and working of Heart in Human.</p>		15
Unit III Ecosystems and Interactions	<p>Ecology and Biogeography.</p> <p>Ecosystems, Definition and Components, Structure and Function of Ecosystems. Aquatic and Terrestrial Ecosystems,</p> <p>Biotic and Abiotic Factors, Trophic Levels, Food Chain and Food Web, Ecological Pyramids (Energy, Biomass and Number)</p> <p>Nutrient Cycle and Biogeochemical Cycles: Water, Carbon, Oxygen, Nitrogen and Sulphur.</p> <p>Interactions, Commensalism, Mutualism, Predation and Antibiosis, Parasitism.</p>		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT24	Genetics and rDNA Technology		
Course Objectives	To have a firm foundation in the concepts of genetics including genetic engineering techniques, genetic analysis and population genetics		
Unit I Fundamentals of Genetics	Genotype and Phenotype 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 & Co-dominance Multiple Alleles Variations among the effect of the mutation. Environmental effect on the expression of the Genes Gene Interaction- Epistasis	2	15
Unit II 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
Unit III Genetic Engineering	Experimental evidences for DNA and RNA as Genetic Material Genetic Engineering in <i>E.coli</i> and other Prokaryotes, Yeast, Fungi and Mammalian Cells Cloning Vectors-Plasmids (pBR 322, pUC) Enzymes- DNA Polymerases, Restriction Endonucleases, Ligases, Reverse Transcriptases, Nucleases, Terminal Transferases, Phosphatases		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT25	Microbial Techniques and Tissue Culture		
Course Objectives	To acquaint the students with concept of sterilization, enumeration techniques and tissue culturing techniques.		
Unit I Sterilization Techniques	<p>Definition: Sterilization and Disinfection</p> <p>Types and Applications : Dry Heat, Steam under pressure, 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 : Properties, Examples of Disinfectants and Evaluation of Disinfectant</p>	2	15
Unit II Growth and Enumeration of Microorganisms	<p>Growth: 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 Advantages and Limitations</p>		15
Unit III Plant and Animal Tissue Culture	<p>Basics of Plant Tissue Culture : Cell Theory, Concept of Cell Culture, Cellular Totipotency Organization of Plant Tissue Culture Laboratory - Equipments and Instruments Design of PTC and ATC lab with equipment</p> <p>Basics of Animal Tissue Culture : Introduction to Animal Cell Cultures, Equipments in ATC lab and Methodology, Culture vessels, Culture media and serum free media Introduction to Primary Cell Cultures, Cell line, Established cell line, Cell strain and Adherent and Non-adherent cells Applications of PTC and ATC</p>		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT26	Enzymology, Immunology and Biostatistics		
Course Objectives	To have a firm foundation in the concepts of enzymology, immunology and biostatistic		
Unit I Enzymes	<p>Definition, Classification, Nomenclature, Chemical Nature, Properties of Enzymes, Co-Factors, Co-enzymes, Zymogens, Active Sites, Enzyme Specificity.</p> <p>Mechanism of Enzyme Action, Effect of pH, Temperature and Substrate Concentration on Enzyme Activity, Enzyme Kinetics, Michelis-Menten Equation, Types of Enzyme Inhibitions-Competitive, Uncompetitive, Non-Competitive. Allosteric Modulators, Immobilization</p>	2	15
Unit II Immunology	<p>Overview of Immune Systems, Cell and Organs involved, Types of immunity: Innate Immunity, Acquired Immunity, Local and Herd Immunity, Humoral and Cellular Immunity - Factors Influencing and Mechanisms of each.</p> <p>Antigens and Antibodies: Types of Antigens, General Properties of Antigens, Haptens and Superantigens</p> <p>Discovery and Structure of Antibodies (Framework region)</p> <p>Classes of Immunoglobulins, Antigenic Determinants.</p> <p>Antigen-Antibody Interactions: Precipitation and Agglutination, Monoclonal Antibodies.</p> <p>Introduction to Vaccines</p>		15
Unit III Biostatistics	<p>Definition & Importance of Statistics in Biology, Types of Data, Normal and Frequency Distribution,</p> <p>Representation of Data and Graphs (Bar Diagrams, Pie Charts and Histogram, Polygon and Curve)</p> <p>Types of Population Sampling</p> <p>Measures of Central Tendency (For Raw, Ungroup & Group Data)</p> <p>Mean, Median, Mode, Measures of Dispersion, Range, Variance, Coefficient of Variance, Standard Derivation, Standard Error</p>		15

Ability Enhancement Course 2 (FC II)

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT27	Globalization, Ecology and Sustainable Development		
Course Objectives	To acquaint the students with concepts of globalization, ecology and environment as well as to make them aware about the problems in society		
Unit I Globalization and Indian Society and Human Rights	<p>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.</p> <p>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</p>	2	15
Unit II Ecology and Sustainable Development	<p>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</p>		15
Unit III Understanding and Managing Stress and Conflict in Contemporary Society	<p>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</p> <p>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</p>		15

Sem II 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*

Sem II 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 II (Practicals)

Chemistry

COURSE CODE	TITLE	CREDITS	NOTIONAL HOURS
SIUSBTP28	Chemistry	2	30 hrs
<ol style="list-style-type: none">1. Preparation of Standard (Molar, Molal and Normal solutions) and Buffer Solutions2. To determine enthalpy of dissolution of salt like KNO_33. Determine the rate constant for hydrolysis of ester using HCl as a catalyst4. Study the kinetics of reaction between thiosulphate ion and HCl5. Determination of the volume strength of hydrogen peroxide solution by titration with standardized potassium permanganate solution6. Determination of amount of K oxalate and oxalic acid in the given solution titrimetrically7. Determination of strength of HCl in commercial sample8. To Standardize commercial sample of NaOH using KHP (Potassium hydrogen phthalate)9. Determination of Acetic acid in Vinegar by Titrimetric Method10. Determination of the amount of Fe (II) present in the given solution Titrimetrically11. Determination of amount of $\text{NaHCO}_3 + \text{Na}_2\text{CO}_3$ in the given solid mixture Titrimetrically12. Determination of the amount of Mg (II) present in the given solution complexometrically13. Determination of percent composition of BaSO_4 and NH_4Cl in the given mixture Gravimetrically14. Separation of amino acids by paper chromatography			

Life Sciences

COURSE CODE	TITLE	CREDITS	NOTIONAL HOURS
SIUSBTP29	Life Sciences	2	30 hrs
<ol style="list-style-type: none">1. Study of Hill's reaction2. Colorimetric study of Absorption Spectrum of Photosynthetic Pigments3. Movement of Food in Paramecium4. Activity of Salivary Amylase on Starch5. Study of Mammalian Blood, Blood count using Haemocytometer and estimation of Haemoglobin in Mammalian Blood6. Study of Human Blood Groups7. Study of Mammalian Kidney and Heart8. Differential staining of Blood cells9. Problems in Mendelian Genetics10. Study of Mitosis and Meiosis11. Study of Interactions Commensalism, Mutualism, Predation and Antibiosis, Parasitism			

Biotechnology

COURSE CODE	TITLE	CREDITS	NOTIONAL HOURS
SIUSBTP30	Biotechnology	2	30 hrs
<ol style="list-style-type: none">1. Preparation of Stock Solutions and Preparation of Media for PTC2. Aseptic Transfer Technique, Surface Sterilization and Inoculation for Callus Culture3. Trypsinization of Tissue and Viability Count4. Qualitative Assay of Enzyme Amylase, Urease, Lipase, Catalase and Dehydrogenase5. Enzyme Kinetics : Study of the effect of pH, Temperature on activity of Enzyme6. Study of Effect of Substrate Concentration on enzyme activity and determination of Vmax and Km7. Enumeration of microorganism by pour plate and spread plate method8. Enumeration by Breed's count9. Growth curve of <i>E. coli</i>10. Biometric Analysis for Mean, Median, Mode and Standard Deviation and Data representation using frequency Polygon, Histogram and Pie Diagram			

References

1. Applegate, E. (2014). Study guide for the anatomy and physiology learning system-e-book. Elsevier Health Sciences.
2. Arora, P. N., & Malhan, P. K. (2010). Biostatistics. Himalaya Publishing House.
3. Bahl, B.S., Tuli, G.D. & Bahl, A. (2000). Essentials of physical chemistry, 24th edn. S. Chand & Company Limited.
4. Baker, T. A., Watson, J. D., Bell, S. P., Gann, A., Losick, M. A., & Levine, R. (2003). Molecular biology of the gene. Benjamin-Cummings Publishing Company.
5. Banerjee, P. K. (2011). Introduction to Bio-Statistics. S. Chand & Company Limited.
6. Chang, R. (2005). Physical chemistry for the biosciences, 1st edn. University Science Books.
7. Chaudhuri, S. K. (1997). Concise medical physiology. New Central Book Agency.
8. Conn, E., & Stumpf, P. (2009). Outlines of biochemistry. John Wiley & Sons.
9. Cooper, G. M., & Hausman, R. E. (2004). The cell: molecular approach. Medicinska naklada.
10. De, K. K. (1997). Plant tissue culture. New Central Book Agency.
11. Dubey, R.C. (2014). Advanced Biotechnology. S. Chand & Company Limited.
12. Frazier, W. C., & Westhoff, D. C. (1988). Food microbiology, 4th edn. McGraw-Hill.
13. Freshney, R. I. (2015). Culture of animal cells: a manual of basic technique and specialized applications. John Wiley & Sons.
14. Frobisher, M., Hinsdill, R., Crabtree, K.T. & Goodheart, C.R. (1968). Fundamentals of microbiology, 8th edn. W.B. Saunders Co.
15. Gangal, S. (2007). Principles and practice of animal tissue culture. Universities Press.
16. Guyton, A. C. (1979). Physiology of the human body. Saunders Limited.
17. Hall, J. E. (2015). Guyton and Hall textbook of medical physiology. Elsevier Health Sciences.
18. Jain, J.L., Jain, S. & Jain, N. (2016). Fundamentals of Biochemistry, 7th edn. S. Chand & Company Limited.
19. Jordan, E.L. and Verma, P. S. (1978). Chordate zoology. S. Chand & Company Limited.
20. Jordan, E.L. and Verma, P. S. (1978). Invertebrate Zoology. S. Chand & Company Limited.
21. Karp, G. (2009). Cell and molecular biology: concepts and experiments. John Wiley & Sons.
22. Kindt, T. J., Goldsby, R. A., Osborne, B. A., & Kubly, J. (2007). Kubly immunology, 6th edn. Macmillan.
23. Kotpal, R. L. (2012). Modern text book of zoology: invertebrates. Rastogi Publications.
24. Lee, J.D. (2008). Concise inorganic chemistry, 5th edn. John Wiley & Sons.
25. Mahajan, B. K. (2002). Methods in biostatistics. Jaypee Brothers Publishers.
26. Marieb, E. N., & Hoehn, K. (2007). Human anatomy & physiology. Pearson Education.
27. Mendham, J. (2006). Vogel's textbook of quantitative chemical analysis. Pearson Education India.
28. Mitra, S. (1996). Genetic engineering: principles and practice. McGraw-Hill Education.
29. Morrison, R.T. & Boyd, R.N. (1992). Organic chemistry. Pearson Education Inc.
30. Mu, P., & Plummer, D. T. (1988). Introduction to practical biochemistry. Tata McGraw-Hill Education.
31. Murphy, K.M. & Weaver, C. (2017). Janeway's immunology, 9th edn. W.W. Norton and Company.
32. Narayan, A., Paniker. (2009). Text Book of Microbiology. Universities Press.

33. Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008). *Lehninger principles of biochemistry*. Macmillan.
34. Patel, A.H. (2015). *Industrial microbiology*, 2nd edn. Laxmi Publications.
35. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (2001). *Microbiology*, 5th edn. Tata McGraw-Hill publications.
36. Rao, C. V. (2002). *An introduction to immunology*. CRC Press.
37. Rao, C.N.R. (2000). *University general chemistry*, 1st edn. Macmillan India Ltd.
38. Razdan, M. K. (2003). *Introduction to plant tissue culture*. Science Publishers.
39. Russel, P. J. (2000). *Fundamentals of genetics*. Benjamin Cummings
40. Russell, P. J., & Gordey, K. (2002). *IGenetics*, 3rd edn. San Francisco: Benjamin Cummings.
41. Salle, A. J. (1973). *Fundamental principles of bacteriology* (Vol. 7). McGraw-Hill.
42. Satyanarayan, U., & Chakrapani, U. (1999). *Textbook of Biochemistry*. Books and Allied Pvt Ltd.
43. Sharma, B. K. (2000). *Instrumental methods of chemical analysis*. Krishna Prakashan Media.
44. Singh, B. D. (2015). *Fundamentals of Genetics*. Kalyani Publishers.
45. Singh, B. K. (2004). *Biodiversity: Conservation and Management*. Mangal Deep Publications.
46. Singh, B.D. (2017). *Biotechnology*. Kalyani Publishers.
47. Singh, P. (2010). *An introduction to biodiversity*. Ane Books Pvt. Ltd.
48. Skoog, D. A., West, D. M., Holler, F. J., & Crouch, S. (2013). *Fundamentals of analytical chemistry*. Nelson Education.
49. Stanbury, P. F., Whitaker, A., & Hall, S. J. (2013). *Principles of fermentation technology*. Elsevier.
50. Verma, P. S., Agarwal, V. K., & Verma, P. S. (2007). *Cell biology, genetics, molecular biology, evolution and ecology*. S. Chand & Company Limited.
51. Verma, V. (2011). *Textbook of plant physiology*. Ane Books Pvt Ltd.
52. West, E. S., Todd, W. R., Mascon, H. S., & Van Bruggen, J. T. (1974). *Textbook of biochemistry*. Oxford and IBH Publishing.
53. Willey, J.M., Sherwood, L., Woolverton, C.J. (2008). *Prescott, Harley and Klein's Microbiology*. McGraw-Hill.

EVALUATION SCHEME

The performance of the learner shall be evaluated into TWO Parts.

The learner's performance shall be assessed by Internal Assessment of **40 Marks** and Semester End Examination (theory) of **60 Marks for each term**.

Practical examination will be conducted at end of each semester for **300 Marks**.

The allocation of marks for the Internal Assessment and Semester End Examinations are as follows:-

Internal Assessment – 40 Marks

There will be **two** internal assessment tests:

S. No.	Particulars	Marks
1.	Internal Assessment 1	20 Marks
2.	Internal Assessment 2	15 Marks
3.	Active participation	05 Marks

Semester End Examination – 60 Marks

S. No.	Particulars	Marks
All questions are compulsory Number of questions – 4 (Four) Each question carries 15 Marks		
1.	Q1 – Unit I a. Answer in one sentence (any three out of five) b. Short notes (any three out of five)	3 Marks 12 Marks
2.	Q2 – Unit II a. Answer in one sentence (any three out of five) b. Short notes (any two out of three)	3 Marks 12 Marks
3.	Q3 – Unit III a. Answer in one sentence (any three out of five) b. Short notes (any three out of five)	3 Marks 12 Marks
4.	Q4 – Short notes based on Unit I, II and III (any three out of five)	15 Marks
	TOTAL	60 Marks



SIES

**College of Arts,
Science &
Commerce**

**RISE WITH EDUCATION
Sion (West), Mumbai – 400022.
(Autonomous)**

Faculty: Science

Program: B.Sc.

Subject: BIOTECHNOLOGY

Academic Year: 2018 – 2019

S.Y.B.Sc.

**Credit Based Semester and Grading Syllabi approved
by Board of Studies in Biotechnology to be brought into
effect from June 2018.**

PREAMBLE

Biotechnology, broadly defined, includes any technique that uses living organisms, or parts of such organisms, to make or modify products, to improve plants or animals, or to develop microorganisms for specific use. The interdisciplinary nature of biotechnology integrates living systems including animal, plant and microbes and their studies from molecular biology to cell biology, from biochemistry to biophysics, from genetic engineering to stem cell research, from bioinformatics to genomics-proteomics, from environmental biology to biodiversity, from microbiology to bioprocess engineering, from bioremediation to material transformation and so on.

Biotechnology is the science of today and tomorrow. It has applications in all major service sectors. i.e. health, agriculture, industry, environment etc. Biotechnology as an application science has taken firm footing in many countries, abroad where a number of transgenic crops, genetically modified food and recombinant therapeutic molecules for human and animal health are available in the market. Biotechnology as a science of service to human society is yet to make inroads in India

With the advent of World Wide Web in the early nineties and its subsequent growth, the latest research trends have become accessible from drawing rooms across the globe. This acted as a positive feedback mechanism in increasing the pace of research in all fields including Chemical Engineering and Bio-technology. This was the motivation for an in depth analysis of what is actually required for today's technology. It is also important to take advantage of the freely available software to enhance the quality and quantity of material that can be covered in the class room.

This restructured syllabus is therefore intended to combine the principles of physical, chemical and biological sciences along with developing advanced technology. The undergraduate curricula is prepared to impart primarily basic knowledge of the respective subject from all possible aspects. In addition, students will be trained to apply this knowledge particularly in day-to-day applications of biotechnology and hence get a flavor of research

Semester I				
Course Code	Course Type	Course Title	Credits	Lectures/week
SIUSBT31	Core Subject	Biophysics	2	3
SIUSBT32	Core Subject	Applied Chemistry-I	2	3
SIUSBT33	Core Subject	Immunology	2	3
SIUSBT34	Core Subject	Cell biology and Cytogenetics	2	3
SIUSBT35	Core Subject	Molecular Biology	2	3
SIUSBT36	Core Subject	Bioprocess Technology	2	3
SIUSBT37	General Elective	Research Methodology	2	3
SIUSBTP38, SIUSBTP39, SIUSBTP40	Core subject Practical	Practical of SIUSBT31, SIUSBT32, SIUSBT33, SIUSBT34, SIUSBT35 and SIUSBT36	6	18
Semester II				
Course Code	Course Type	Course Title	Credits	Lectures/week
SIUSBT41	Core Subject	Biochemistry	2	3
SIUSBT42	Core Subject	Applied Chemistry-II	2	3
SIUSBT43	Core Subject	Medical Microbiology	2	3
SIUSBT44	Core Subject	Environmental Biotechnology	2	3
SIUSBT45	Core Subject	Biostatistics and Bioinformatics	2	3
SIUSBT46	Core Subject	Molecular Diagnostics	2	3
SIUSBT47	General Elective	Entrepreneurship Development	2	3
SIUSBTP48, SIUSBTP49, SIUSBTP50	Core subject Practical	Practical of SIUSBT41, SIUSBT42, SIUSBT43, SIUSBT44, SIUSBT45 and SIUSBT46	6	18

SEMESTER III

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT31	Biophysics		
Course Objective	To have a firm foundation in the fundamentals and applications of current biophysical theories and to develop an understanding of the different aspects of classical physics and its applications in the field of biology.		
Unit I Optics and Electromagnetic Radiations	Introduction to Optics and Lasers: Optics: Properties of light: Reflection, Refraction, Dispersion and Interference; Lasers: Properties of lasers, Stimulated Emissions, Laser Action, Applications of Laser; Electromagnetic Radiation: 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 Specimens, SEM TEM, Immuno-electron Microscopy, Fluorescence Microscopy and Confocal Microscopy	2	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 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.		15
Unit III 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	LECTURES
SIUSBT32	Applied Chemistry-I		
Course Objectives	To acquaint the students with fundamentals and applications of organic compounds and understand the role of green chemistry and its application in industry.		
Unit I Organic Chemistry	<p>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.</p> <p>Metal Coordination in Biological Systems: Enzymes, Apoenzymes and Coenzymes. Biological Role of Metalloenzymes wrt Myoglobins, Haemoglobin. Biological Role of Carboxypeptidases, Catalases and Peroxidases.</p> <p>Structure and Function: Dioxygen Binding, Transfer and Utilization; Metal Complexes in Medicines.</p>	2	15
Unit II Synthesis of Organic Compounds	<p>Synthesis of Organic Compounds: Criteria for Ideal Synthesis; Selectivity and Yield. Linear and Convergent Synthesis and Multicomponent Reactions. Microwave Assisted Organic Ultrasound in Synthesis and Polymer supported Synthesis. Retrosynthesis.</p>		15
Unit III Green Chemistry and Synthesis	<p>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.</p>		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT33	Immunology		
Course Objectives	<p>To understand the role of complements in immune response and different immune cell receptors involved in immune reaction</p> <p>To introduce them to the principles underlying various immune-techniques</p>		
Unit I Effectors of Immune Response	<p>Complement System- Classical, Alternate and Lectin; Regulation and Biological Effects of Complement System; Deficiencies of Complement System</p> <p>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.</p>	2	15
Unit II Cell Receptors	<p>T-cell Receptor Complex: Structure, mechanism, T cell co-receptor complex</p> <p>B-cell Receptor: Structure, mechanism, B cell co-receptor complex</p> <p>Toll-like receptors (TLRs)</p> <p>B-T cell interaction (B-T cell cooperation).</p> <p>Introduce cell cytotoxic responses as the effector mechanism</p>		15
Unit III Immuno-Techniques	<p>Precipitation Reactions: Immunoprecipitation, Immunoelectrophoresis, CIEP, Rocket Electrophoresis and 2-D Immunoelectrophoresis.</p> <p>Agglutination Reactions: Passive, Reverse Passive, Agglutination Inhibition. Coomb's Test; Complement Fixation Tests, RIA, ELISA, ELISPOT, Chemiluminescence, Western Blot, Immunofluorescence, Flow Cytometry.</p> <p>Alternatives to Antigen-Antibody Reactions.</p>		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT34	Cell Biology and Cytogenetics		
Course Objectives	To develop an understanding of the cytoskeleton and cell membrane To familiarize the students with structure of chromosomes, types of chromosomal aberrations as well as sex determination and sex linkage		
Unit I Cytoskeleton	<p>Cytoskeleton: Overview of the Major Cytoskeleton.</p> <p>Microtubules: Structure and Composition.</p> <p>MAPs: Functions- Role in Mitosis, Structural Support and Cytoskeleton Intracellular Motility.</p> <p>Motor Proteins: Kinesins, Dynein; MTOCs.</p> <p>Dynamic Properties of Microtubules. Microtubules in Cilia and Flagella.</p> <p>Microfilaments: Structure, Composition Assembly and Disassembly.</p> <p>Motor Protein: Myosin. Muscle Contractility: Sliding Filament Model. Actin Binding Proteins: Examples of Non-Muscle Motility.</p> <p>Intermediate Filaments: Structure, Composition; Assembly and Disassembly, Types and Functions.</p>	2	15
Unit II Cell Membrane	<p>Cell Membrane: Uptake of Nutrients by Prokaryotic Cells; Cell Permeability. Principles of Membrane Transport-Transporters and Channels; Active Transport, Passive transport; Types of Transporters, Types of ATP Driven Pumps - Na⁺ K⁺ Pump.</p> <p>Cell Junctions; Cell Adhesion and Extracellular Material; Microvilli; Tight Junctions, Gap Junctions; Cell Coat and Cell Recognition. Cellular Interactions.</p>		15
Unit III Cytogenetics	<p>Cytogenetics: Structure of Chromosome - Heterochromatin, Euchromatin, Polytene Chromosomes, Cytogenetic staining</p> <p>Variation in Chromosomal Structure and Number: Deletion, Duplication, Inversion, Translocation, Euploidy, Aneuploidy, Polyploidy and Syndromes-Klinefelter, Turner, Cri-du-Chat, Trisomy -21, Trisomy-18 and Trisomy-13.</p> <p>Sex Determination and Sex Linkage: Mechanisms of Sex Determination (XX-XY, ZZ-ZW, XX-XO), Dosage Compensation and Barr Body.</p> <p>Genetic Linkage, Crossing Over and Chromosomal Mapping: Tetrad Analysis; Two-point Cross; Three- point Cross; Pedigree Analysis.</p>		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT35	Molecular Biology		
Course Objectives	To have an insight into mechanism of gene expression and regulation at the level of transcription and translation 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 mRNAs; Transcription of other Spliceosomes; RNA editing.	2	15
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 Bacteria: <i>lac</i> Operon of E. coli; <i>trp</i> Operon of E. coli. 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	LECTURES
SIUSBT36	Bioprocess Technology		
Course Objectives	<p>To understand the basics skills applied in fermentation technology and build a foundation for more advanced studies in bioprocess technology.</p> <p>To develop skills associated with screening of industrially important strains.</p> <p>To understand principles underlying design of fermenter and fermentation process.</p>		
Unit I Microorganisms in Industrial Processes	<p>Types of Microorganisms used in Industrial Processes: Bacteria, Actinomycetes, Fungi and Algae.</p> <p>Screening and maintenance of strains: Primary Screening and Secondary Screening; Cultivation; Preservation of Industrially Important Microbial Strains.</p>	2	15
Unit II Fermenters	<p>Design of a fermenter: Stirred Tank Fermenter- Basic Design; Parts of a Typical Industrial Fermentor.</p> <p>Fermentation Media: Components; Design and Optimization.</p> <p>Sterilization: Sterilization of Fermenter and Fermentation Media.</p> <p>Process Parameters: pH, Temperature, Aeration, Agitation, Foam, etc.</p> <p>Types of Fermentation: Surface and Submerged; Batch and Continuous, Aerobic and Anaerobic. Product Isolation and Purification.</p>		15
Unit III Fermentation Processes	<p>Study of representative fermentation processes: Penicillin, Ethanol, Beer, Wine, Vinegar</p> <p>Assay of Industrial Products: Chemical and Biological; Types and Subtypes Advantages and Disadvantages.</p>		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT37	Research Methodology		
Course Objectives	To develop research aptitude, logical thinking and reasoning by understanding basic principles of research methodology and identify a research problem. To 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.	2	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 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		15
Unit III Scientific Communication and Report Writing	Scientific Communication: Communication elements - verbal and non-verbal communications, principles of effective communications, oral presentations, Scientific writing, Introduction to scientific reports and writing, egg: writing reviews, papers and bibliography. Report Writing: Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. Introduction to Plagiarism		15
Internal Evaluation	Submission of Research Report/ Project/ Case Study/ Assignment		

SEMESTER III (PRACTICAL)

COURSE CODE	TITLE	CREDITS	NOTIONAL HOURS
SIUSBTP38	PRACTICALS based on SIUSBT31 and SIUSBT32	2	30 Hrs
<ol style="list-style-type: none"> 1. Extraction of Plasmid DNA and Separation by Agarose Gel Electrophoresis. 2. Determination of Purity of Plasmid DNA using UV Spectrophotometry. 3. Study of the Structure and Function of an Electron Microscope 4. Demonstration of Structure and Working of a Fluorescence Microscope (Stained Preparation). 5. Electrophoresis of Proteins by PAGE and SDS-PAGE (Demonstration) 6. Purification of any TWO Organic Compounds by Recrystallization Selecting Suitable Solvent. 7. Organic Estimations: Acetone, Amide, Benzoic Acid. 8. Organic Preparations: <ol style="list-style-type: none"> a) Acetylation of Primary Amine (Preparation of Acetanilide). b) Base Catalysed Aldol Condensation (Synthesis of Dibenzalpropanone). 			

COURSE CODE	TITLE	CREDITS	NOTIONAL HOURS
SIUSBTP39	PRACTICALS based on SIUSBT33 and SIUSBT34	2	30 hrs.
<ol style="list-style-type: none"> 1. Complement Fixation Test (CFT)- Demonstration 2. Passive Agglutination- RA Factor Test. 3. Immunoelectrophoresis. 4. Double immunodiffusion (Ouchterlony method) 5. SRID 6. ELISA (Kit-based) - HEPALISA. 7. DOT-BLOT 8. Western Blotting - Demonstration. 9. Flow Cytometry – Lab Visit/Demonstration. 10. Study of Chromosomal Aberrations-Normal male and female and Syndromes- Trisomy 21 Trisomy 13 Trisomy 18, Klinefelter and Turner, Cri-du-Chat and Philadelphia chromosome 11. Induction of Polyploidy by PDB Treatment using Suitable Plant Material. 12. Study of Polytene Chromosomes. 13. Mapping based on Tetrad Analysis and Three Point Cross. 14. Pedigree Analysis- Autosomal and Sex-Linked. 			

COURSE CODE	TITLE	CREDITS	NOTIONAL HOURS
SIUSBTP40	PRACTICALS based on SIUSBT35 and SIUSBT36	2	30 hrs.
<ol style="list-style-type: none">1. Study of <i>E.coli</i> Diauxic Growth Curve- (Lactose and Glucose).2. Comparison of Growth curve and selection of industrially important strains3. Study of <i>lac</i> Gene Expression using Blue-White Selection.4. Induction and screening of β-galactosidase activity5. Screening for an Antibiotic Producing Strain of Microorganism.6. Estimation of Penicillin by Chemical (Iodometric) Method.7. Estimation of Penicillin by Biological (Bioassay) Method.8. Lab Scale Production of Ethanol.9. Purification of Ethanol from Broth Culture of <i>Saccharomyces spp.</i> By distillation10. Estimation of Alcohol from Recovered Broth by Dichromate Method.			

SEMESTER IV

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT41	Biochemistry		
Course Objectives	To gain an insight into the metabolic processes associated with catabolism of carbohydrates, amino acids, lipids and nucleotides and explain the role of energy rich molecules in metabolism.		
Unit I Carbohydrate Metabolism, ETS and Energy Rich Compounds	<p>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)</p> <p>Electron Transport System: Electron Transport and Oxidative Phosphorylation. Inhibitors of ETS</p> <p>Energy Rich Compounds: ATP as Energy Currency, Structure of ATP, Hydrolysis, Other Energy Rich Compounds other than ATP like PEP, Creatine Phosphate, etc.</p>	2	15
Unit II Amino Acid Metabolism	<p>Amino Acid Breakdown: Deamination, Transamination, Urea Cycle, Breakdown of Glucogenic and Ketogenic Amino Acids.</p> <p>Amino Acids as Biosynthetic Precursors: Biosynthesis of Epinephrine, Dopamine, Serotonin, GABA, Histamine, Glutathione. (Sequence of Reactions, Regulation and Metabolic Disorders of the above pathways)</p>		15
Unit III Lipid and Nucleotide Metabolism	<p>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)</p> <p>Nucleotide Metabolism: Degradation of Purines and Pyrimidines</p>		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT42	Applied Chemistry-II		
Course Objectives	To develop an understanding of the different aspects of analytical chemistry. To gain knowledge of natural product chemistry and related acquired skills. To 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: 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. Preparative: differential and density gradient, isopycnic and rate zonal gradient materials, preparation, sample application, recovery, choice of rotors. Analytical centrifuge	2	15
Unit II Chromatographic Techniques	Column chromatography and its types: Column chromatography: Principle, packing of column, matrix used, parts of column chromatography. Principle, working and application of Adsorption chromatography, partition chromatography, Affinity, Gel Permeation and Ion-Exchange chromatography, Applications		15
Unit III Polymers and Nanomaterials	Polymers: Introduction to Polymers, Types of Polymers: Monomers, Polymer, Homopolymer, Copolymer, Thermoplastics and thermosets, Addition and Condensation Polymers (Examples and Uses) Stereochemistry of Polymers Biodegradable Polymers Nanomaterials: Introduction to nanomaterials, Types of nanomaterials, Forms of Nanomaterials: Nanoparticles, Nanofilms, Nanotubes and Quantum Dots, Synthesis and characterization of Nanomaterials, Applications of Nanomaterials.		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT43	Medical Microbiology		
Course Objectives	To gain insight into host parasite relationship and virulence factors To study the pathogenesis and epidemiology of various diseases caused by microorganisms and its prophylaxis.		
Unit I Infectious Diseases	<p>Host Parasite Relationship: Normal Flora; Factors Affecting the Course of Infection and Disease; Mechanisms of Infection and Virulence Factors.</p> <p>Infection: Patterns of Infection; Types of Infections; Signs and Symptoms; Epidemiology and Epidemiological Markers.</p> <p>Diseases: Origin of Pathogens; Vectors; Acquisition of Infection; Koch's Postulates.</p>	2	15
Unit II Medical Microbiology-Causative Organisms-I	<p>Skin: <i>S. aureus</i>, <i>S. pyogenes</i></p> <p>Respiratory Tract Infections: <i>M. tuberculosis</i>, <i>S. pneumoniae</i> (Characteristics, Transmission, Course of Infection, Lab Diagnosis, Management of TB, Prevention and Control, Immuno and Chemoprophylaxis, DOTS and MDR).</p> <p>Urinary Tract Infections: <i>E.coli</i>: Characteristics, Virulence, Clinical disease, and <i>E.coli</i> Infections.</p> <p><i>Proteus</i></p>		15
Unit III Medical Microbiology-Causative Organisms-II	<p>GI Tract Infections:</p> <p><i>Salmonella</i> and <i>Shigella</i> spp. (Characteristics, Virulence - Pathogenesis and Immunity, Clinical Disease, Carriers Lab Diagnosis, Typing Prophylaxis and Treatment).</p> <p>Sexually Transmitted Diseases: <i>Syphilis</i> and <i>Gonorrhea</i>.</p> <p>Nosocomial Infections: <i>Ps. aeruginosa</i></p>		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT44	Environmental Biotechnology		
Course Objectives	To gain insight on the causes, types and control methods for environmental pollutions and bioremediation		
Unit I Water and Soil Pollution	<p>Types of Pollution</p> <p>Water Pollution: Causes, Types and Classification; Eutrophication; Assessment of Water Quality- Pollutant Monitoring and Control;</p> <p>Soil and Solid Waste Pollution: Characteristics of Wastes, Impacts of Solid waste on Health, Occupational Hazards and Control.</p> <p>Soil Erosion: Concept, Causes and Effects.</p>	2	15
Unit II Air Pollution and Monitoring	<p>Air Pollution: Types; Sources; Classification of Air Pollutants; Air Pollution Monitoring and Control</p> <p>Green House Effect: Factors Responsible for Green House Effect; Green House Gases. Global Warming; Ozone Depletion; Kyoto Protocol; UV Radiation; Acid Rain.</p>		15
UNIT III Bioremediation	<p>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</p>		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT45	Bioinformatics and Biostatistics		
Course Objectives	To develop an understanding in basic concepts of bioinformatics and its use in sequence alignment To apply the various statistical tools for analysis of biological data.		
Unit I Introduction to Computers and Biological Databases	<p>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.</p> <p>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).</p> <p>Genome Information Resources: DNA Sequence Databases specialized Genomic Resources. Protein Databases based on Composition, Motifs and Patterns. Protein Str. Visualization Software.</p>	2	15
Unit II BLAST and Sequence Alignment	<p>Pairwise Alignment: Identity and Similarity; Global and Local Alignment; Pairwise Database Searching. FASTA</p> <p>BLAST and Sequence Alignment: BLAST and its Types; Retrieving Sequence using BLAST</p> <p>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.</p>		15
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	LECTURES
SIUSBT46	Molecular Diagnostics		
Course Objectives	To develop a learning and understanding of the basic principles used in molecular diagnosis and gain critical thinking and analytical skills to understand new diagnostic methods.		
Unit I Basics of Molecular Diagnostics	<p>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- Commercializing Molecular Diagnostics, Personalized medicine, Theranostic.</p> <p>Characterization and analysis of Nucleic-acids and Proteins: Extraction, Isolation and Detection of DNA, RNA and Proteins; Restriction Endonucleases and restriction enzyme mapping</p> <p>Hybridization techniques: Southern, Northern, Western Blotting technique and FISH; Markers, probes and its Clinical applications.</p>	2	15
Unit II Nucleic Acid Amplification Methods	<p>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.</p> <p>PCR Types: Reverse Transcriptase and Real Time PCR</p> <p>Probe amplification: Ligase Chain Reaction</p>		15
Unit III Molecular Biology based Diagnostics	<p>DNA Polymorphism and Identification: RFLP and Parentage Testing; RFLP and Sickle-Cell Anemia.</p> <p>Molecular Diagnostics for infectious diseases: Molecular testing for Neisseria, Molecular diagnosis for HIV-1;</p> <p>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, CML and Down Syndrome</p> <p>Ethical, Social and legal issues to molecular genetic testing</p>		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT47	Entrepreneurship Development		
Course Objectives	<p>To develop and systematically apply an entrepreneurial way of thinking that will allow identification and creation of business opportunities.</p> <p>To help design strategies for successful implementation of ideas and write a business plan.</p>		
Unit I Introduction to Entrepreneurship Development and IPR	Entrepreneurship: Concept of Entrepreneur; Entrepreneurship; Need and Importance; Factors Influencing Entrepreneurship; Essentials of a Successful Entrepreneur Intellectual Property Rights (IPR): Introduction, Types and Management of IPR.	2	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 Planning 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, Domestic vs. International Market research 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 (Practical)

COURSE CODE	TITLE	CREDITS	NOTIONAL HOURS
SIUSBTP48	Practical based on SIUSBT41 and SIUSBT42	2	30 hrs.
<ol style="list-style-type: none">1. Gradient Plate technique2. Determination of 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 by differential centrifugation and Demonstration of ETC using a Marker Enzyme.7. Separation of Chloroplast using Sucrose Density Gradient8. Separation of Binary (Solid-Solid) Mixture (Min 4 Compounds).9. Identification of Organic Compound of Known Chemical Type (Min 4 Compounds).10. Separation of components from a mixture using Affinity chromatography (Kit may be used)11. Separation of components from a mixture using ion exchange chromatography (Kit may be used)12. Separation of components from a mixture using Size exclusion chromatography (Kit may be used)13. Chemical and Biological Synthesis of Silver Nanoparticles and its characterization by UV-Vis Spectrophotometer.			

COURSE CODE	TITLE	CREDITS	NOTIONAL HOURS
SIUSBTP49	Practical based on SIUSBT43 and SIUSBT44	2	30 hrs.
<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. Study of rhizospheric organism by Contact slide method 12. Study pond ecosystem using Winogradsky's Column 13. Isolation of Bacteria from Air by Gravity Sedimentation Method. 14. Most Probable Number (MPN) – Presumptive, Confirmed and Completed tests. 			

COURSE CODE	TITLE	CREDITS	NOTIONAL HOURS
SIUSBTP50	Practical based on SIUSBT45 and SIUSBT46	2	30 hrs.
<ol style="list-style-type: none">1. Familiarization with NCBI, EMBL, DDBJ, PIR, KEGG Databases.2. Basic formatting using MS word3. Use of MS Excel4. Preparation of graph using MS excel5. Use of powerpoint6. Use of Coral draw for posters7. Use of NCBI BLAST Tool.8. Pairwise and Multiple Sequence Alignment and Phylogeny.9. Classification of Proteins using CATH/SCOP.10. Visualization PDB Molecules using Rasmol/Raswin.11. Handling and Calibration of Micropipette.12. Isolation and visualization of Genomic DNA by AGE (Bacteria and Yeast).13. Quantitative estimation of DNA by DPA method14. Quantitative estimation of RNA by Orcinol method15. Problems on Restriction Enzyme Digestion16. Problems on PCR17. RFLP- Kit Based.18. Primer Designing through Open Online Source NCBI- BLAST.			

References

1. Ahluwalia, V. K. (2009). Green chemistry: environmentally benign reaction. Ane Books Pvt. Ltd.
2. Ahluwalia, V. K., & Aggarwal, R. (2001). Organic synthesis: special techniques. CRC Press.
3. Alberts B, Johnson A, Lewis J, et al. Molecular Biology of the Cell. 4th edition. New York: Garland Science; 2002.
4. Ananthanarayan, R. (2013). Textbook of microbiology. University Press (India).
5. Ananthanarayan, R., & Paniker, C. K. Jayaram.(2009). Textbook of Microbiology. Universities Press (India) Pvt. Ltd. Hyderabad, India. ISBN, 978(81), 7371.
6. Arora, P. N., & Malhan, P. K. (2010). Biostatistics (2010 Edition). Himalaya Publishing House.
7. Atkins, R. C., & Carey, F. A. (1997). Organic chemistry: a brief course (p. 362). New York: McGraw-Hill.
8. Attwood, T. K., & Parry-Smith, D. J. (2003). Introduction to bioinformatics. Prentice Hall.
9. Baliga, K., et. al. College Analytical Chemistry, T.Y.B.Sc (Mumbai University). Himalaya Publishing House.
10. Baliga, K., et. al. College Analytical Chemistry, T.Y.B.Sc (Mumbai University). Himalaya Publishing House.
11. Basotia, G. R., & Sharma, K. K. (1999). Handbook of Entrepreneurship Development: an Entrepreneur's Guide to Planning Starting Developing and Managing a New Enterprise. Mangal Deep Publications.
12. Beat, J., Elliott, E., Baur, L., & Keena, V. (2002). Scientific Writing-Easy when you know how. The BMJ Publishing Group.
13. Beiser, A. (2003). Concepts of modern physics. Tata McGraw-Hill Education.
14. Bruckner, R. (2001). Advanced organic chemistry: reaction mechanisms. Elsevier.
15. Buckingham, L. (2007). Flaws. Molecular Diagnostics (Fundamentals, Methods, Clinical Applications), FA Davis Company.
16. Carruthers, W., & Coldham, I. (2015). Modern Methods of Organic Synthesis South Asia Edition. Cambridge University Press.
17. Casida, L. E., & Casida, L. E. (2005). Industrial microbiology. New Age International (P) Limited Publishers.
18. Coleman, W. B., & Tsongalis, G. J. (Eds.). (2006). Molecular diagnostics: for the clinical laboratorian. Springer Science & Business Media.
19. Conn, E., & Stumpf, P. (2009). Outlines of biochemistry. John Wiley & Sons.
20. Corey, E. J. (1991). The logic of chemical synthesis. John Wiley & Sons.
21. Delves, P. J., Martin, S. J., Burton, D. R., & Roitt, I. M. (2017). Essential immunology. John Wiley & Sons.
22. Dewick, P. M. (2006). Essentials of organic chemistry: for students of pharmacy, medicinal chemistry and biological chemistry. John Wiley & Sons.
23. Dey, S. (2000). Business Communication. Reliable Publications, Mumbai.
24. Frobisher Jr, M. (1953). Fundamentals of microbiology. (Edn 5). W. B. Saunders Co.

25. Goldsby, R. A., Kindt, T. J., Osborne, B. A., & Kuby, J. (2003). Immunology. 5th. New York: WH Freeman, 23(551), 70.
26. Gowariker, V. R., Viswanathan, N. V., & Sreedhar, J. (1986). Polymer science. New Age International.
27. Habraken, J. W. (2003). Absolute beginner's guide to networking. Que Publishing.
28. Jain, J. L. (2004). Fundamentals of biochemistry. S. Chand.
29. Karp, G. (2009). Cell and molecular biology: concepts and experiments. John Wiley & Sons.
30. Khopkar, S. M. (1998). Basic concepts of analytical chemistry. New Age International.
31. Kobe, K. A. (1957). Unit operations of chemical engineering (McCabe, WL, and Smith, JL). ACS Publications.
32. Kothari, C. R. (2004). Research methodology: Methods and techniques. New Age International.
33. Kulkarni, S. K. (2015). Nanotechnology: principles and practices (p. 403). Berlin, Germany:Springer.
34. Kurup, M.R. (1990). Towards Entrepreneurship. Bombay Kelkar Edu. Trust.
35. Lehninger, A. L. (2005). Lehninger Principles of Biochemistry: David L. Nelson, Michael M. Cox. W. H. Freeman.
36. Mahajan, B. K. (2002). Methods in biostatistics. Jaypee Brothers Publishers.
37. Mendham, J. (2006). Vogel's textbook of quantitative chemical analysis. Pearson Education India.
38. Mittal, P., Anand. J. (2007). A Textbook of Sounds. Har Anand Publications.
39. Modi, H.A. (2009). Fermentation Technology, Volume-II. Pointer, Jaipur.
40. Morisson, R. N., & Boyd, R. N. (1973). Organic Chemistry, Vol. 2. Allyn and Bacon, Inc. Boston, Massachusetts, 73.
41. Murray, P. R., Rosenthal, K. S., & Pfaller, M. A. (2015). Medical microbiology. Elsevier Health Sciences.
42. NCERT Physics Textbook, Class XII.
43. Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008). Lehninger principles of biochemistry. Macmillan.
44. Owen, J. A., Punt, J., & Stranford, S. A. (2013). Kuby immunology (p. 692). New York: WH Freeman.
45. Park, T. K., & Talaro, A. (1999). Foundations in Microbiology. McGraw-Hill.
46. Patel, A. H. (2007). Industrial microbiology. Macmillan Publishers India
47. Patrinos, G., & Ansorge, W. (2009) Molecular Diagnostics. Academic Press.
48. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (2001). Text book of microbiology. MC Graw-Hill publications, 5th edn, New York, 1193, 504-508.
49. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (2001). Text book of microbiology. MC Graw-Hill publications, 5th edn, New York, 1193, 504-508.
50. Pierce, B. A. (2012). Genetics: A conceptual approach. Macmillan.
51. Pillai, S. O. (1994). Solid State Physics: Structure and Electron Related Properties. Wiley Eastern Limited.
52. Prieve, D. (2000). Unit Operation of Chemical Engineering. Notes.
53. Raghuraman, K., Prabhu, D.V., & Sathe, P.A. Basic Principles in Analytical Chemistry Sem-III & IV(Mumbai University), Sheth Publishers.

54. Rajaraman, V., & ADABALA, N. (2014). Fundamentals of computers. PHI Learning Pvt. Ltd.
55. Rangan, C. S., Sarma, G. R., & Mani, V. S. V. (1983). Instrumentation: devices and systems. Tata McGraw-Hill.
56. Rao, C. V. (2005). Immunology: A textbook. Alpha Science Int'l Ltd.
57. Rao, R., et. al. College Organic Chemistry, T.Y.B.Sc (Mumbai University), Himalaya Publishing House.
58. Rao, R., et. al. College Organic Chemistry, T.Y.B.Sc (Mumbai University). Himalaya Publishing House.
59. Rastogi, S. C., Rastogi, P., & Mendiratta, N. (2008). Bioinformatics Methods and Applications: Genomics Proteomics and Drug Discovery 3Rd Ed. PHI Learning Pvt. Ltd.
60. Robertis, D. (1987). Cell and molecular biology. 8th edition. B.I. Waverly, 1995.
61. Russell, P. J. (2009). IGenetics-A Molecular Approach. Pearson Education India.
62. Russell, P. J., & Gordey, K. (2002). IGenetics (No. QH430 R87). San Francisco: Benjamin Cummings.
63. Salle, A. J. (1973). Fundamental principles of bacteriology (Vol. 7). New York: McGraw-Hill.
64. Satyanarayan, U., & Chakrapani, U. (2013). Textbook of Biochemistry. Elsevier Health Sciences.
65. Satyanarayan, U., & Chakrapani, U. (2013). Textbook of Biochemistry. Elsevier Health Sciences.
66. Scragg, A. H. (2005). Environmental biotechnology. New York: OXFORD university press.
67. Singh, V. (2011). Handbook of Science Communication. ABD Publishers.
68. Skoog, D. A., Holler, F. J., & Crouch, S. R. (2017). Principles of instrumental analysis. Cengage learning.
69. Smith, M. B. (2008). Reagents for Organic Synthesis: Collective Index for (Vol. 1). John Wiley & Sons.
70. Smith, M. B., & March, J. (2007). March's advanced organic chemistry: reactions, mechanisms, and structure. John Wiley & Sons.
71. Srivastava, M.L. (2007). Bioanalytical techniques. Alpha Science International Ltd.
72. Stanbury, P. F., Whitaker, A., & Hall, S. J. (2013). Principles of fermentation technology. Elsevier.
73. Stanier, Y., Adelberg, E. A., & Ingraham, J. L. (1977). General microbiology. Macmillan India.
74. Subrahmanyam, N., Lal, B., & Avadhanulu, M. N. (2015). A Text Book of Optics (me). S. Chand.
75. Thakur, I. S. (2011). Environmental biotechnology: basic concepts and applications. New Delhi: IK International.
76. Tortora, G. J., Funke, B. R., Case, C. L., & Johnson, T. R. (2007). Microbiology: an introduction (Vol. 9). San Francisco, CA: Benjamin Cummings.
77. Upadhyay, A. (2009). Biophysical chemistry. Himalaya Publishing House.
78. Upadhyay, A. (2009). Biophysical chemistry. Himalaya Publishing House.
79. Verma, H. C. (1992). Concepts of Physics, Vol. I. Bharati Bhawan.

80. Verma, H. C. (1999). Concept of physics part 2. Bharati Bhawan.
81. Viswanathan, B. (2009). Nano Materials. Alpha Science.
82. Voet, D., & Voet, J. G. (2004). Biochemistry. John Wiley & Sons.
83. White, A., Handler, P., Smith, E. L., Hill, R. L., & Lehman, I. R. (1978). Principles of Biochemistry. McGraw-Hill Publications.
84. Willey, J. M., Sherwood, L., & Woolverton, C. J. (2008). Prescott, Harley, and Klein's microbiology. New York: McGraw-Hill Higher Education.
85. Willey, J. M., Sherwood, L., & Woolverton, C. J. (2008). Prescott, Harley, and Klein's Microbiology. New York: McGraw-Hill Higher Education.
86. Wilson, K., & Walker, J. (Eds.). (2000). Principles and techniques of practical biochemistry. Cambridge University Press.

EVALUATION SCHEME

The performance of the learner shall be evaluated into TWO Parts.

The learner's performance shall be assessed by Internal Assessment of **40 Marks** and Semester End Examination (theory) of **60 Marks for each term**.

Practical examination will be conducted at end of each semester for **300 Marks**.

The allocation of marks for the Internal Assessment and Semester End Examinations are as follows:-

Internal Assessment – 40 Marks

There will be **two** internal assessment tests:

Sr. No.	Particulars	Marks
1.	Internal Assessment 1	20 Marks
2.	Internal Assessment 2	15 Marks
3.	Active participation	05 Marks

Semester End Examination – 60 Marks

Sr. No.	Particulars	Marks
All questions are compulsory Number of questions – 4 (Four) Each question carries 15 Marks		
1.	Q1 – Unit I a. Answer in one sentence (any three out of five) b. Short notes (any three out of five)	3 Marks 12 Marks
2.	Q2 – Unit II a. Answer in one sentence (any three out of five) b. Short notes (any two out of three)	3 Marks 12 Marks
3.	Q3 – Unit III a. Answer in one sentence (any three out of five) b. Short notes (any three out of five)	3 Marks 12 Marks
4.	Q4 – Short notes based on Unit I, II and III (any three out of five)	15 Marks
	TOTAL	60 Marks



SIES

**College of Arts,
Science &
Commerce**

**RISE WITH EDUCATION
Sion (West), Mumbai – 400022.
(Autonomous)**

Faculty: Science

Program: B.Sc.

Subject: BIOTECHNOLOGY

Academic Year: 2018 – 2019

T.Y.B.Sc.

**Credit Based Semester and Grading Syllabi approved
by Board of Studies in Biotechnology to be brought into
effect from June 2018.**

PREAMBLE

Biotechnology, broadly defined, includes any technique that uses living organisms, or parts of such organisms, to make or modify products, to improve plants or animals, or to develop microorganisms for specific use. The interdisciplinary nature of biotechnology integrates living systems including animal, plant and microbes and their studies from molecular biology to cell biology, from biochemistry to biophysics, from genetic engineering to stem cell research, from bioinformatics to genomics-proteomics, from environmental biology to biodiversity, from microbiology to bioprocess engineering, from bioremediation to material transformation and so on.

Biotechnology is the science of today and tomorrow. It has applications in all major service sectors. i.e. health, agriculture, industry, environment etc. Biotechnology as an application science has taken firm footing in many countries, abroad where a number of transgenic crops, genetically modified food and recombinant therapeutic molecules for human and animal health are available in the market. Biotechnology as a science of service to human society is yet to make inroads in India

With the advent of World Wide Web in the early nineties and its subsequent growth, the latest research trends have become accessible from drawing rooms across the globe. This acted as a positive feedback mechanism in increasing the pace of research in all fields including Chemical Engineering and Bio-technology. This was the motivation for an in depth analysis of what is actually required for today's technology. It is also important to take advantage of the freely available software to enhance the quality and quantity of material that can be covered in the class room.

This restructured syllabus is therefore intended to combine the principles of physical, chemical and biological sciences along with developing advanced technology. The undergraduate curricula is prepared to impart primarily basic knowledge of the respective subject from all possible aspects. In addition, students will be trained to apply this knowledge particularly in day-to-day applications of biotechnology and hence get a flavor of research

SEMESTER V				
Course Code	Course Title	Theory/Practical	Credits	Lectures/week
SIUSBT51	Cell Biology	Theory	2.5	4
SIUSBT52	Medical Microbiology & Instrumentation	Theory	2.5	4
SIUSBT53	Genomes and Molecular Biology	Theory	2.5	4
SIUSBT54	Marine Biotechnology	Theory	2.5	4
SIUSBTP56	Cell biology+ Medical Microbiology & Instrumentation	Practical	3.0	8
SIUSBTP57	Genomes and Molecular Biology+ Marine Biotechnology	Practical	3.0	8
SIUSBT55	Biosafety	Theory	2.0	4
SIUSBTP58	Biosafety	Practical	2.0	4
	Total		20	36
SEMESTER VI				
Course Code	Course Title	Theory/Practical	Credits	No. of Lectures and Practicals
SIUSBT61	Biochemistry	Theory	2.5	4
SIUSBT62	Industrial Microbiology	Theory	2.5	4
SIUSBT63	Pharmacology and Neurochemistry	Theory	2.5	4
SIUSBT64	Environmental Biotechnology	Theory	2.5	4
SIUSBTP66	Biochemistry & Industrial Microbiology	Practical	3.0	8
SIUSBTP67	Pharmacology - Neurochemistry and Environmental Biotechnology (50M)+ Project work (50M)	Practical	3.0	8
SIUSBT65	Agribiotechnology	Theory	2.0	4
SIUSBTP68	Agribiotechnology	Practical	2.0	4
	Total		20	36

SEMESTER V

COURSE CODE	TITLE	CREDIT S	LECTURES
SIUSBT51	Cell Biology		
Course Objectives	To familiarize the students with basic concepts cell cycle, cell signaling, apoptosis and cancer. To introduce them to the stages involved in developmental biology		
I Cell cycle	Cell cycle Introduction: Prokaryotic and Eukaryotic; The Early Embryonic Cell Cycle and the Role of MPF; Yeasts and the Molecular Genetics of Cell- Cycle Control; Apoptosis, Cell-Division Controls in Multicellular Animals.	2.5	15
II Cell Signalling	Cell signalling and signal transduction: Introduction General Principles of Cell Signaling; Signaling via G-Protein-linked Cell-Surface Receptors; Signaling via Enzyme-linked Cell-Surface Receptors; Target-Cell Adaptation, The Logic of Intracellular; Signaling: Lessons from Computer-based "Neural Networks"		15
III Developmental Biology	Overview of how the modern era of developmental biology emerged through multidisciplinary approaches; 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; 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		15
IV Cancer Biology	Cancer: Introduction, Cancer as a Micro-evolutionary Process; The Molecular Genetics of Cancer; Cancer and Virus Cancer diagnosis and chemotherapy		15
Total			60

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT52	Medical Microbiology and Instrumentation		
Course Objectives	<p>To introduce the students to viruses, its classification and replication. They will also be familiarized to vaccines against various diseases</p> <p>To acquaint the students with various antimicrobial agents, its mode of action and development of resistance</p> <p>To have a firm foundation in various bioanalytical techniques including chromatography and radioactivity</p>		
I Virology	<p>Introduction to viruses-Position in biological spectrum; Virus properties;</p> <p>General structure of viruses Baltimore Classification and Taxonomy(ICTV);</p> <p>Cultivation of viruses; Reproduction of ds DNA phages Hepatitis /ss RNA (influenza), animal viruses and plant (TMV)virus; Virus purification and assays; Cytocidal infections and cell damage; Viroids and Prions</p>	2.5	15
II Chemotherapeutic drugs	<p>Discovery and Design of antimicrobial agents; Classification of Antibacterial agents, Selective toxicity, MIC, MLC; Inhibition of cell wall synthesis (Mode of action for): Beta lactam antibiotics: Penicillin, Cephalosporins; Glycopeptides: Vancomycin; Polypeptides: Bacitracin; Injury to Plasma membrane: Polymyxin; Inhibition of protein synthesis Aminoglycosides, Tetracyclines Chloramphenicol, Macrolides-Erythromycin;</p> <p>Inhibition of Nucleic acid synthesis: Quinolones, Rifampicin, Metronidazole; Antimetabolites: Sulphonamides, Trimethoprim; Drug Resistance: Mechanism, Origin and transmission of drug resistance; Use and misuse of antimicrobial agents; Antifungal drugs, Antiviral drugs</p>		15
III Vaccines	<p>Immunization, immunization schedule, Vaccines- Live and Attenuated Vaccines, Inactivated and killed vaccines, subunit vaccines-HSV, cholera, HPV, Peptide vaccines-Foot and mouth disease, Malaria; Attenuated vaccines – cholera, HSV, Edible vaccines; Gene therapy, Human gene therapy- in vitro & in vivo</p>		15
IV Bioanalytical techniques	<p>Principle, working and applications of: Affinity chromatography; Ion-exchange chromatography; Molecular (size) exclusion chromatography; HPLC - Method development and validation; Isotopes in Biology: Nature of radioactivity; Detection Techniques using GM counter, Scintillation counter, autoradiography; Applications of Tracer techniques in Biology</p>		15

PRACTICALS

SIUSBTP57

3 credits

72hrs

(Practicals of SIUSBTP53 & SIUSBTP54)

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	TITLE	CREDITS	LECTURES
SIUSBT53	Genomics and Molecular Biology		
Course Objectives	To have a strong foundation in tools used in molecular biology and its application in genetic engineering of plants and animals. They will also be acquainted with genome sequencing techniques and human genome mapping		
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; Transgenic plants: Physical methods of transferring genes to plants: electroporation, microprojectile bombardment, liposome mediated, protoplast fusion; Vectors for plant cells; Improvement of seed quality protein	2.5	15
II Transgenic Animals	Transgenic mice-methodology-retroviral method, DNA microinjection, ES method; genetic manipulation with cre-loxP; Vectors for animal cells; Transgenic animals recombination system; Cloning live stock by nuclear transfer; Green Fluorescent Protein; Transgenic fish		15
III Tools in Molecular Biology	Cloning vectors-Plasmids (pUC series), Cosmids, phagemids M13, shuttle vectors, YAC vectors, expression vectors pET; 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; Recombinant selection and screening methods: genetic, immunochemical, Southern and Western analysis, nucleic acid hybridization, HART, HRT; Expression of cloned DNA molecules and maximization of expression; Cloning strategies-genomic DNA libraries, cDNA libraries, chromosome walking and jumping		15
IV Gene sequencing and editing	Maxam Gilbert's method, Sanger's dideoxy method, Automated DNA sequencing, Pyrosequencing; Human genome mapping and it's implications in health and disease; RNAi, ZNF Zinc finger nucleases), TALENS (Transcription Activator Like Effector Nucleases), CRISPER/Cas system (Clustered Regularly Interspersed Repeats)		15
Total			60

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT54	Marine Biotechnology		
Course Objectives	To introduce the students to marine ecosystem and its potential as the treasure for novel bioactive compounds, cosmeceuticals, drugs, antimicrobial agents, functional foods and nutraceuticals		
I Marine Biotechnology- Introduction & Bioprospecting	Introduction to Marine Biotechnology; The marine ecosystem and its functioning: intertidal, estuarine, salt marsh, mangrove, coral reef, coastal & deep sea ecosystems. Hydrothermal vents; Bioprospecting, Marine Microbial Habitats and Their Biotechnologically relevant Microorganisms; Methods for Microbial Bioprospecting in Marine Environments; Biotechnological Potential of Marine Microbes; Bioactive compounds from other Marine Organisms: fungi, Microalgae, Macroalgae, Actinomycetes, sponges	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; Approved Marine Drugs as Pharmaceuticals; Marine Natural products and its Challenges; Marine Microbial Enzymes - Marine Extremozymes and Their Significance, Current Use of Marine Microbial Enzymes		15
III Marine Functional foods and Nutraceuticals	Marine Functional Foods: Marine Sources as Healthy Foods or Reservoirs of Functional Ingredients; Marine-Derived Ingredients with Biological Properties; Functional Foods Incorporating Marine-Derived Ingredients; Marine Nutraceuticals: Marine Bioactives as Potential Nutraceuticals, Functional Carbohydrates, Polyunsaturated Fatty Acids; Carotenoids, Soluble Calcium, Fish Collagen and Gelatin, Marine Probiotics		15
IV Marine Bioresources and Cosmetics	Marine Bioresources, Marine Secondary Metabolites, Marine Proteins, Marine Lipids; Cosmetics from Marine Sources: Scenario of Marine Sources in the Cosmetic Industry, Cosmetics: Definition and Regulations, 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		15
Total			

PRACTICALS

SIUSBTP57

3 credits
(Practicals of SIUSBTP53 & SIUSBTP 54)

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. Replica 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.

APPLIED COMPONENT

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT55	Biosafety		
Course Objectives	This course has been introduced to stress upon the importance of biosafety and good laboratory practices in Biotechnology		
I Introduction to biosafety	Introduction; Biological Risk Assessment, Hazardous Characteristics of an Agent; Genetically modified agent hazards; Cell cultures; Hazardous Characteristics of Laboratory Procedures; Potential Hazards Associated with Work Practices; Safety Equipment and Facility Safeguards; Pathogenic risk and management	2	12
II GLP	Concept of GLP; Practicing GLP; Guidelines to GLP; Documentation of Laboratory work; Preparation of SOPs; Calibration records; Validation of methods; Documentation of results; Audits & Audit reports		12
III Detection and testing of contaminants	Microbial Contamination in food and pharma product; Some common microbial contaminants; Microbiological Assays for pharmaceutical products; Regulatory Microbiological testing in pharmaceuticals		12
IV Biosafety in Biotechnology	Concepts on biosafety in Biotechnology; Regulating rDNA technology; Regulating food and food ingredients; Genetically engineered crops, livestock Bioethics; Contemporary issues in Bioethics		12
Total			48

PRACTICALS

SIUSBTP58

2 Credits

48 hours

(Practicals of Applied Component)

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 testing of injectables
7. Effect of UV as a method of microbial control
8. Determination of Phenol coefficient of disinfectant
9. Detection of adulterants in food products like tea, coffee, milk, oil etc
10. Decontamination and biomedical waste segregation

SEMESTER VI

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT61	Biochemistry		
Course Objectives	This topic has been introduced to acquaint the students with the concepts of biochemistry such as metabolism, bioenergetics, nutrition and endocrinology		
I Bioenergetics	Laws of thermodynamics, Concept of enthalpy, Entropy, Free energy with relation to living system, Standard free energy change and equilibrium constant, Energy rich compound-ATP as energy currency, Structure of ATP hydrolysis, other energy rich compounds, Phosphoryl group transfers, ATP and muscle contraction, ATP and active transport, Transphosphorylation reaction, Biological oxidation-reduction reaction, Flavin nucleotides, NAD, NADP	2.5	15
II Metabolism	Carbohydrate biosynthesis and its regulation: Peptidoglycan in Bacteria; Starch and sucrose in Plants; Glycogen in Animals; Biosynthesis and regulation of Cholesterol, Atherosclerosis.		15
III Endocrinology	Mechanism of action of group I and II hormones; Structure, storage, release, transport, biochemical functions and disorders associated with hormones secreted by Hypothalamus; Anterior Pituitary gland - GH, stimulating hormones); Posterior Pituitary gland – oxytocin and vasopressin; Thyroid gland – Thyroxine, calcitonin; Parathyroid gland – PTH; Adrenal medulla – epinephrine and norepinephrine; Adrenal cortex – Glucocorticoids; Pancreas – insulin and glucagon; Female Gonads – estrogen and progesterone; Male gonads – testosterone; Placenta – hCG		15
IV Nutrition	Minerals and Vitamins; Dietary sources, bioactive form, functions and disorders associated with fat soluble (A D E K) and water soluble vitamins; Minerals - physiological and biochemical functions of principle and trace elements.; Malnutrition – Over nutrition (obesity) and PEM (Kwashiorkor and Marasmus)		15
Total			

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT62	Industrial Microbiology		
Course Objectives	<p>To familiarize students with the various processes in fermentation technology such as upstream, downstream.</p> <p>To introduce students to various applications involved in dairy technology. They will be also taught the importance of quality control and quality assurance</p>		
I Dairy technology	Milk: Normal flora, changes in raw milk; Enumeration; Factors affecting bacteriological quality; Dairy technology Preservation methods; Pasteurization; Starter Cultures; Fermented products-Production process and spoilage of Cheese: Swiss and Cheddar; Butter; Yogurt and Buttermilk	2.5	15
II Down-stream Processing (DSP)	Introduction of DSP; Foam separation; Types of Precipitation; Filtration , Centrifugation; Chromatography in DSP; Cell disruption- physical and chemical methods; Solvent recovery, Membrane processes; Drying; Crystallization and Whole broth processing.		15
III Fermentation process	Introduction to Inoculum development; Bacterial and fungal inoculum development with one example each, scale up, scale down; Production of: Streptomycin; Protease; Mushroom; Glutamic acid; Lysine, ethanol production Semi-synthetic Penicillin, Biotransformation.		15
IV QA-QC	Concept of GMP; Requirements of GMP implementation; Documentation of GMP practices; Regulatory certification of GMP; Quality Control (QC): Concept of QC; Requirements for implementing QC; QA concepts: Concept of QA; Requirements for implementing.		15
Total			60

PRACTICALS

SIUSBTP66

3 credits

72hrs

(Practicals based on SIUSBTP61& SIUSBTP 62)

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.
9. Estimation of Vitamin B12 using chemical method and biological method.
10. Estimation of Fe and Ca titrimetrically
11. Estimation of phosphorus using Fiske and Subbarow method

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT63	Basic pharmacology and Neurochemistry		
Course Objectives	The students will be exposed to the various concept in pharmacology such as absorption, distribution, metabolism and excretion They would also be introduced to the field of neurochemistry		
I General principles of Pharmacology	Mechanism of drug action; drug receptors and biological responses; second-messenger systems, the chemistry of drug-receptor binding; dose-response relationship; therapeutic index; ED, LD; Potency and Intrinsic Activity; Drug antagonism	2.5	15
II Drug Absorption and Distribution	Absorption of drugs from the alimentary tract ; factors affecting rate of gastrointestinal absorption; absorption of drugs from lungs; skin; absorption of drugs after parenteral administration factors influencing drug distribution, binding of drugs to plasma proteins, Physiological barriers to drug distribution.		15
III Metabolism and Excretion	Drug metabolism: enzyme systems: oxidative and reductive enzymes: phase I reactions; conjugative enzymes: phase II reactions; Pharmacogenomics of drug metabolizing enzymes; Excretion of drugs: Renal excretion; Biliary Excretion; Pulmonary excretion; Excretion in other body fluids : sweat, saliva; Drug concentration-time profiles and basic pharmacokinetic parameters; Additional pharmacokinetic parameters: Bioavailability, clearance, distribution		15
IV Neurochemistry	Anatomy and functioning of the brain -; Neuronal pathways; Propagation of nerve impulses; Neuronal excitation and inhibition, Synapses and gap junctions; Action of Neuro toxins and neurotransmitters, Incapacitating agents.		15
Total			

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT64	Environmental Biotechnology		
Course Objectives	To emphasize upon the importance of industrial effluent treatment and waste water management To acquaint the students with alternatives of traditional non-renewable energy resources		
I Renewable sources of energy	Energy sources renewable – solar energy, wind power, geothermal energy and hydropower, biomass energy; Biogas technology- biogas plant & types, biodigester. Biogas-composition, production and factors affecting production, uses; Biofuels – ethanol production. Microbial hydrogen production Biodiesel, Petrocrops.	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; Anaerobic biological treatment- contact digesters, packed bed reactors, anaerobic baffled digesters, UASB; Solid waste treatment; pollution indicators & biosensors; biodegradation of xenobiotics- persistent compounds, chemical properties influencing biodegradability, microorganisms in biodegradation; Use of immobilized enzymes or microbial cells for treatment		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, Heavy metal pollution – sources, microbial systems for heavy metal accumulation, techniques used for heavy metal removal, biosorption by bacteria, fungi and algae, factors affecting biosorption limitations of biosorption		15
IV Hazardous waste management	Biodegradation of waste from tanning industry; petroleum industry; paper & pulp industry; Dairy, Distillery, Dye, Antibiotic industry; Removal of oil spillage & grease deposits		15
Total			60

PRACTICALS

SIUSBTP67

3 credits

72hrs

(Practicals based on SIUSBT63, SIUSBT64 and Skill based project)

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

APPLIED COMPONENT

COURSE CODE	TITLE	CREDITS	LECTURES
SIUSBT65	Agricultural Biotechnology		
Course Objectives	To teach the application of biotechnology in agriculture using various techniques such as plant tissue culture, molecular markers. Students would be exposed to the significance of biopesticide, biofertilizers and the effect of stress on plant growth		
I Plant Tissue Culture	Initiation and maintenance of callus, organogenesis, virus elimination, plant cell culture as a system for production of fine chemicals, plant suspension cultures, elicitation and permeabilization, biotransformation, Hairy root culture, Micropropagation, Somatic embryogenesis and synthetic seeds	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; 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		12
III Molecular Markers in Plant Breeding	Genetic markers in plant breeding-- Classical markers, DNA markers (RFLP, RAPD, AFLP, SSR, SNP; Application of Molecular Markers to Plant Breeding [quantitative trait locus (QTL) mapping]; Plant DNA Barcoding- Barcoding Markers (matK, rbcL, ITS, tmHpsbA), steps, recent advances, Benefits, Limitations		12
IV Biofertilizers And Biopesticides	Biofertilizer: Nitrogen-fixing Rhizobacteria - Symbiotic Nitrogen Fixers, Anammox; Nonsymbiotic Nitrogen Fixers Plant Growth Promoting Microorganisms-Phosphate-Solubilizing Microbes (PSM), Phytohormones and Cytokinins, Induced Systemic Resistance; Plant Growth Promotion by Fungi-- Mycorrhizae Arbuscular Mycorrhizae Ectomycorrhizae; Microbial Inoculants -- Inocula, Carriers, and Applications, Monoculture and Co-culture Inoculant Formulations Biocontrol, Polymicrobial Inoculant Formulations; Biopesticides – types, Bacillus thuringiensis, insect viruses and entomopathogenic fungi (characteristics, physiology, mechanism of action and application)		12
Total			48

PRACTICALS

SIUSBTP68

2 credits

48 hrs

Practicals based on Applied component

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)
7. Estimation of antioxidants and antioxidant enzymes - Ascorbate, Catalase, and Peroxidase
8. Visit to green house facility and submission of field visit report.

References

1. Ali, M. A., Gyulai, G., & Al-Hemaid, F. (2015). *Plant DNA Barcoding and Phylogenetics*. LAP LAMBERT Academic Publishing.
2. Altieri, M. A. (2018). *Agroecology: the science of sustainable agriculture*. CRC Press.
3. Altman, A., & Hasegawa, P. M. (Eds.). (2011). *Plant biotechnology and agriculture: prospects for the 21st century*. Academic press.
4. Barnes, R. S. K., & Hughes, R. N. (1999). *An introduction to marine ecology*. John Wiley & Sons.
5. Brown, M. J., Sharma, P., Mir, F. A., & Bennett, P. N. (2018). *Clinical Pharmacology* 11th edn. Elsevier Health Sciences.
6. Brown, T. A. (2016). *Gene cloning and DNA analysis: an introduction*. John Wiley & Sons.
7. Brown, T.A. (2002). *Genomes* 2nd edition. Department of Biomolecular Sciences, UMIST, Manchester, UK. Oxford: Wiley-Liss.
8. Bruce, A., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2007). *Molecular Biology of the Cell* 5th edn (New York: Garland Science).
9. Burton, J. C., & Peppler, H. J. (1967). *Microbial Technology* 2nd edn. Ed. Peppler, Reingold, New York.
10. Cantor, C. R., & Smith, C. L. (1999). *Genomics*. John Wiley & Sons.
11. Chosewood, L. C. (2007). *Biosafety in microbiological and biomedical laboratories*. Diane Publishing.
12. Cooper, G. M., & Hausman, R. E. (2013). *The cell: Molecular approach* 6th edn. Sinauer Associates, Inc. USA
13. Craig, C. R., & Stitzel, R. E. (Eds.). (2004). *Modern pharmacology with clinical applications* 5th edn. Lippincott Williams & Wilkins.
14. Denyer, S. P., Hodges, N. A., & Gorman, S. P. (Eds.). (2008). *Hugo and Russell's pharmaceutical microbiology*. John Wiley & Sons.
15. Gilbert, S. F. (2010). *Developmental Biology*. 9th edn. Sinauer Associates, Inc. USA
16. Glare, T. R., Moran-Diez, M. E., & Glare. (2016). *Microbial-Based Biopesticides*. Springer Science+ Business Media New York.
17. Glick, B. R., & Pasternak, J. J. (1998). *Molecular Biotechnology. Principles and Applications of Recombinant DNA*. Washington. C.: ASM Press.
18. Glick, B. R., & Pasternak, J. J. (1998). *Principles and applications of recombinant DNA*. ASM, Washington DC, 683.
19. Goering, R., Dockrell, H., Zuckerman, M., & Chiodini, P. L. (2018). *Mims' Medical Microbiology* 5th edition. Elsevier Health Sciences.
20. Guyton, A., & Hall, J. (2006). *Textbook of medical physiology*, 11th.
21. Hayes, M. (Ed.). (2011). *Marine bioactive compounds: Sources, characterization and applications*. Springer Science & Business Media.
22. Hernández-Ledesma, B., & Herrero, M. (Eds.). (2013). *Bioactive compounds from marine foods: plant and animal sources*. John Wiley & Sons.
23. Jawetz, E., Melnick, J. L., & Adelberg, E. A. (1995). *Jawetz, Melnick & Adelberg's medical microbiology*. Appleton & Lange.
24. Jogdand, S. N. (2010). *Environmental biotechnology (Industrial pollution management)*. Himalaya Pub. House,
25. Karp, G. (2010). *Cell biology* 6th edn. John Wiley & Sons.
26. Kim, S. K. (Ed.). (2015). *Springer handbook of marine biotechnology*. Springer.
27. Leung, H., & Mukhopadhyay, S. C. (Eds.). (2015). *Intelligent Environmental Sensing (Vol. 13)*. Springer.
28. Lodish, H., Berk, A., Darnell, J. E., Kaiser, C. A., Krieger, M., Scott, M. P. & Matsudaira, P. (2008). *Molecular cell biology*. Macmillan.

29. Marth, E. H., & Steele, J. (Eds.). (2001). Applied dairy microbiology 2nd edn. CRC Press.
30. Metzler, D. E. (2003). Biochemistry (2 Volume Set): The Chemical Reactions of Living Cells. Elsevier.
31. Murray, P. R., Rosenthal, K. S., & Pfaller, M. A. (2015). Medical microbiology. Elsevier Health Sciences.
32. Murray, R. K., Granner, D. K., Mayes, P. A., & Rodwell, V. W. (2009). Harper's illustrated biochemistry. McGraw Hills.
33. Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2005). Lehninger principles of biochemistry 4th edn. Macmillan. W.H. Freeman and Company, New York.
34. Nollet, L. M. (Ed.). (2016). Marine Microorganisms: Extraction and Analysis of Bioactive Compounds. CRC Press.
35. Paithankar, H. V. (2013) International journal of universal pharmacy and bio sciences. 2(4): July- August.
36. Park, T. K., & Talaro, A. (2008). Foundations in Microbiology.
37. Pattabhi, V., & Gautham, N. (2002). Biophysics. Kluwer Academic Publishers
38. Prescott, L., Harley, J., & Klein, D. (2002). Microbiology 5th edn. McGraw-Hill.
39. Prescott, S. C., & Dunn, C. G. (1949). Industrial microbiology. Industrial microbiology.
40. Primrose, S. B., & Twyman, R. (2013). Principles of gene manipulation and genomics. John Wiley & Sons.
41. Purohit, S. S. (2005). Biotechnology: Fundamentals and applications. Agrobios (India).
42. Reddy, P. P. (2016). Sustainable crop protection under protected cultivation (pp. 13-21). Singapore: Springer.
43. Russell, P. J., & Gordey, K. (2002). IGenetics: A Molecular Approach (No. QH430 R87). San Francisco: Benjamin Cummings.
44. S.B. Anderson. (2013). Plant Breeding from Laboratories to Fields, InTech.
45. Satyanarayana, U. (2017). Biochemistry 4th edn. Chakrapani, Books & Allied (P) Ltd.
46. Scragg, A. H. (2005). Environmental biotechnology. New York: OXFORD university press.
47. Sheehan, D. (2013). Physical biochemistry: principles and applications. John Wiley & Sons.
48. Shors, T. (2011). Understanding viruses. Jones & Bartlett Publishers.
49. Singh, B. D. (2010). Biotechnology 4th edn. Kalyani Publishers.
50. Srilakshmi, B. (2006). Nutrition Science 6th edn. New Age International.
51. Stanbury, P. F., Whitaker, A., & Hall, S. J. (2013). Principles of fermentation technology. Elsevier.
52. Thakur, I. S. (2011). Environmental biotechnology: basic concepts and applications. New Delhi: IK International.
53. Trease, G. E., & Evans, W. C. (2002). Pharmacognosy, Saunders. Elsevier, Amsterdam, The Netherlands, 36, 51.
54. Voet, D., & Voet, J. G. (2004). Biochemistry. Hoboken. John Wiley & Sons, 1, 591.
55. Wilson, K., & Walker, J. (Eds.). (2010). Principles and techniques of biochemistry and molecular biology 7th edn. Cambridge university press.
56. Yadav and Grower. Dairy technology.

EVALUATION SCHEME

The performance of the learner shall be evaluated into TWO Parts.

The learner's performance shall be assessed by Internal Assessment of **40 Marks** and Semester End Examination (theory) of **60 Marks for each term**.

Practical examination will be conducted at end of each semester for **300 Marks**.

The allocation of marks for the Internal Assessment and Semester End Examinations are as follows:-

Internal Assessment – 40 Marks

There will be **two** internal assessment tests:

S. No.	Particulars	Marks
1.	Internal Assessment 1	20 Marks
2.	Internal Assessment 2	15 Marks
3.	Active participation	05 Marks

Semester End Examination – 60 Marks

S. No.	Particulars	Marks
All questions are compulsory Number of questions – 4 (Four) Each question carries 15 Marks		
1.	Q1 – Unit I a. Answer in one sentence (any three out of five) b. Short notes (any three out of five)	3 Marks 12 Marks
2.	Q2 – Unit II a. Answer in one sentence (any three out of five) b. Short notes (any two out of three)	3 Marks 12 Marks
3.	Q3 – Unit III a. Answer in one sentence (any three out of five) b. Short notes (any three out of five)	3 Marks 12 Marks
4.	Q4 – Unit IV a. Answer in one sentence (any three out of five) b. Short notes (any three out of five)	3 Marks 12 Marks
	TOTAL	60 Marks