Bachelor of Science (Biotechnology Hons.)

Course Structure

INVERTIS UNIVERSITY

Invertis Village, Delhi Lucknow Highway
NH-24, Bareilly, Uttar Pradesh Pin - 243
123, India

Programme Outcomes (PO) of B.Sc Biotechnology:

After completion of the program of study of B.Sc. in Biotechnology, every student will know the following attributes:

PO1: Ability to apply the **fundamentals** of **mathematics, science and engineering** for biotechnological processes

PO2: Ability to **well design a specific problem or appropriate protocol** based on review of literature or biological data so that it can be solved or reach the conclusions in the areas of Biotechnology such as bioprocess engineering, plant biotechnology, medical biotechnology, biophysics, molecular biology and environmental biotechnology.

PO3: Ability to design a system, a component or biological process within the umbrella of realistic constraints such as economic, environmental, societal, health and safety, manufacturability and sustainability.

PO4: Ready to carry out research and solve complex problems by utilizing sophisticated biotechnology tools such as NMR spectroscopy, microarray technology, crystallography, flowcytometry, next generation sequencing in different fields of biotechnology resulting in patents, journal publications and product development.

PO5: Ability to use the **conceptualized biotechnology solutions** towards the sustainable development and focus on the **environmental sustainability** such as preventing the loss of biodiversity due to Desertification and Deforestation, use of white biotechnology, Bioremediation, Biofuels, Biosensors, Biocatalyst, Biomining and other technologies to prevent continuous degradation of the environment and making its more sustainable to ideal environment.

PO6: Knowledge on different aspects of **ethics** related to biotechnology areas such as genetically modified species, patenting human biological materials, organ transplantation, diagnosis of genetic defects, and use of genetically engineered crops and uses this knowledge very professionally and legally so that it will be not hurt the moral code of the society.

PO7: Ability to **tackle** the issues effectively either as a member and/or in a heterogeneous work environment or should be able to work in **interdisplinary areas** of biotechnology to manage the project financially and effectively with their limitations.

PO8: Attend good **writing skills** (such as abstract, summary, project report) or **oral presentation** and contribute better in interdisplinary areas of biotechnology or in the society at large and to develop habit of lifelong learning with the **technological changes**.

STUDY AND EVALUATION SCHEME
Bachelor of Science [Biotechnology]

(Effective from Session 2020-2021)

YEAR I, SEMESTER I

COURSE CODE	COURSE TITLE	COURSE CATEGORY	HOURS			EVALUATION SCHEME		SUBJECT TOTAL	CREDIT
			L	T	P	CA	EE		
BST101	Introduction to Biotechnology	CC	3	1	0	30	70	100	4
BST102	Cell Biology	CC	3	1	0	30	70	100	4
BST103	Computer Fundamental	AECC	3	1	0	30	70	100	4
BST104	Elementary Math I	GE*	3	1	0	30	70	100	4
BST105	Remedial Biology I	GE*	3	1	0	30	70	100	4
BST151	Biotechnology Lab I	AEC	0	0	4	15	35	50	2
TOTAL			**4**	**4**	**4**	**140**	**310**	**450**	**18**

CC-Core Courses; AECC-Ability Enhancement Compulsory Course; GE-Generic Elective;

AEC-Ability Enhancement Course; SEC-Skill Enhancement Courses; DSE-Discipline Specific Elective

L – Lecture; T – Tutorial; P – Practical; C – Credit; CA-Continuous Assessment; EE – End Semester Exam
GE* - Elect any one from the prescribed; DSE^ - Elect any two from the prescribed

YEAR I, SEMESTER II

COURSE CODE	COURSE TITLE	COURSE CATEGORY	HOURS			EVALUATION SCHEME		SUBJECT TOTAL	CREDIT
			L	T	P	CA	EE		
BST201	Biochemistry	CC	3	1	0	30	70	100	4
BST202	Microbiology	CC	3	1	0	30	70	100	4
BST203	Ecology & Environment Biotechnology	AECC	3	1	0	30	70	100	4
BST204	Elementary Math II	GE*	3	1	0	30	70	100	4
BST205	Remedial Biology II	GE*							
BST251	Biotechnology Lab II	AEC	0	0	4	15	35	50	2
TOTAL			**12**	**4**	**4**	**135**	**315**	**450**	**18**

CC-Core Courses; AECC-Ability Enhancement Compulsory Course; GE-Generic Elective;

AEC-Ability Enhancement Course; SEC-Skill Enhancement Courses; DSE-Discipline Specific Elective

L – Lecture; T – Tutorial; P – Practical; C – Credit; CA-Continuous Assessment; EE – End Semester Exam
GE* - Elect any one from the prescribed

SCHEME OF EVALUATION

B.Sc -BIOTECHNOLOGY

B.Sc Biotechnology: Semester-I **BST 101: Introduction to Biotechnology**	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: - General knowledge of Biotechnology of intermediate standard

Course Objectives:

1. To give an overview of biomolecules and their significance
2. To give basic knowledge of Structure, biosynthesis and function of Macromolecules (Carbohydrates, Proteins and Lipids).
3. To have an overview of Microorganism: Origin of microbiology, Types of microbes, Classification of microbes.
4. To explain about the Introduction Genes & Genome.
5. To explain the Bioinformatics, Biological databases (nucleotide and Protein Databases, Structure databases).
6. To explain the Basic Local Alignment Search Tool (BLAST) & its types.

Course Outcomes:

After completing the course, students will be able to:

CO1: Understand various applications of Biotechnology
CO2: Analyze various biomolecules and their significance, structure and function
CO3: Identify different types of microbes and their importance
CO4: Understand the concept of databases used in sequence alignment
CO5: Knowledge of Genes and their impact
CO6: To understand the biodiversity analysis tools

Detailed Syllabus

UNIT-1 Introduction of Biomolecules
Introduction of Biomolecules - Structure and dynamics, Structure, biosynthesis and function of Macromolecules (Carbohydrates, Proteins and Lipids). Enzymes: History, Nomenclature & Classification of Enzymes, Intracellular and Extracellular Enzymes, Purification and characterization of enzymes from natural sources, industrial application of enzymes.
UNIT-2 Cell as a basic UNIT of life
Cell as a basic UNIT of life, Microorganism: Origin of microbiology, Types of microbes, Classification of microbes macro and micro molecules required for growth of microorganism, Media: defined and undefined, Study of Microbes (culture techniques and staining method), Application of microbes in fermentation biotechnology, Basics of Chromatography: Concept, types and Application.
UNIT-3 Central Dogma of Life

Central Dogma of Life, Introduction Genes & Genome, Human Genome Project, Concept of Annotation, ORF & Gene Prediction, Genome similarity, Single Nucleotide Polymorphism (SNP), comparative genomics. History of Bioinformatics, Biological databases (nucleotide and Protein Databases, Structure databases), Primary and Secondary Database, Information retrieval from Databases, Sequence file formats. Basics of pattern matching and Sequence Analysis, Basic Local Alignment Search Tool (BLAST) & it's types.

Text and Reference Books

1. H.K.Dass, "Text book of Biotechnology" (Wiley India publication)
2. B.D.Singh,"Biotechnology" (Kalyani Publishers)
3. R.C.Dubey, "Text book of Biotechnology" (S. Chand and company)
4. William J. Thiemann," Introduction to Biotechnology", Michael A. Palladino, Publisher: Benjamin Cummings.
5. Colin Ratledge," Basic Biotechnology Publisher": Cambridge University Press

B.Sc Biotechnology: Semester-I BST102: Cell Biology	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: - General knowledge of Biology of intermediate standard

Course Objectives:

1. To give an overview of cell biology and their significance.
2. To give basic knowledge of Structure, biosynthesis and function of Macromolecules (Carbohydrates, Proteins and Lipids).
3. To explain about the Introduction evolution of cell.
4. To explain the cell signaling
5. To explain the Cellular transport mechanism

Course Outcomes:

After completing the course, students will be able to:

CO1: Understand various applications of cellbiology
CO2: Analyze various biomolecules and their significance, structure and function
CO3: Identify different types of cells and their importance
CO4: Understand the concept of cell and signaling mechanism
CO5: Knowledge of Genes, genetic disabilities and apoptosis cell pathways and regulators.

Detailed Syllabus

UNIT-1 The Evolution of the Cell
The Evolution of the Cell: From Molecules to Procaryotes to Eukaryotes, Ultra structure and function of cell and cell organalies. Membrane Structure: Physicochemical Properties; Molecular Organization – asymmetrical organization of lipids, proteins and carbohydrates,. Eukaryotic cell division cycle: Different phases and molecular events. Control of cell division cycle, Transport of Small Molecules Across Cell Membranes: Carrier protein and channel protein, Active Transport
UNIT-2 Intracellular Compartments and Protein Sorting
Intracellular Compartments and Protein Sorting: Structure, function and transport of proteins into mitochondria and chloroplast. Transport by vesicle formation: Endocytosis and Exocytosis and molecular Mechanism of vesicular transport. Intracellular communication through cell junctions: Occluding junctions, anchoring junctions and communicating junctions. Molecular mechanism of cell-cell adhesions: Extra-cellular matrix of animals: organization and functions.
UNIT-3 Signaling

Signaling: Signaling via G-Protein linked cell surface receptors, MAP kinase pathways and tyrosine kinase pathway: Initiation, interaction and regulation. Cohesins and condensins Apoptosis: Phases and significance, Morphological and biochemical changes associated with apoptotic cells, Apoptotic pathways and regulators.

Text and Reference Books

1. Cohn, N.S. (1964). Elements of Cytology Brace and World Inc., New Delhi.
2. Darington, C.D.(1965). Cytology, Churchill, London.
3. Darnell, J., Lodish, KL and Baltimore, D (1991). Molecular Cell biology, Scientific American books.
4. De Robertis, E.D.P. and Robertis, E.M.F.(1991). Cell and Molecular biology. Lea and Febiger, Washington.
5. Dobzhansky, B (1961). Genetksiand The origin of species, Columbia University press,New York.

B.Sc Biotechnology: Semester-I BST-103 :Computer Fundamental	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6 Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: - General knowledge of Computer fundamentals of intermediate standard

Course Objectives:

1. To give an overview of computer science and its significance
2. To give basic knowledge Evolution of computers
3. To have an overview of Computer peripherals input/output devices
4. To explain about the Basic Gates and Number Systems
5. Introduction to MS-OFFICE-2003, word 2003
6. To explain the Excel-2003, Editing, working Retrieval, Important functions

Course Outcomes:

After completing the course, students will be able to:
CO1: Understand various applications of computing
CO2: Idea about MS Word and excel.
CO3: Identify different types of Basic Gates used in computers.
CO4: Database system concepts, Data models schema and instance
CO5: Working on Query and use of database

Detailed Syllabus

UNIT-1 Digital Computer
Digital Computer: Introduction, Basic diagram, Evolution of computers, Gener ation of Computers, Computer peripherals input/output devices. Computer classification, Microcomputer, Minicomputer, Main frame computer, Super computer, Types of printers-Dot matrix, Inkjet, Laser. Basic Gates and Number Systems: Basic Gates - AND gate OR gate OR NAND gate, NOR gate, EX-OR gates, NOT gate logic diagram of gates, Number Systems - Binary number, Decimal, Hexadecimal, Octal, BCD conversion of number systems.
UNIT-2 Introduction to MS-OFFICE-2003

Introduction to MS-OFFICE-2003, word 2003 Document creation, Editing, formatting table handling, Excel-2003, Editing, working Retrieval, Important functions, short cut keys used in EXCEL. MS-Power point 2003-Job Profile, Elements of Power point , ways of delivering Presentation, concept of Four P's (Planning, Preparation, Practice and Presentation) ways of handling presentations e.g. creating, saving slides show controls, Adding formatting, animation and multimedia effects.
UNIT-3 Database system concepts
Database system concepts, Data models schema and instance, Database language, Introduction to MS-Access 2003, main components of Access tables, Queries, Reports, Forms table handling,working on Query and use of database. History of Internet, equipment required for Internet connection, browser (Internet Explorer, Mozilla Firefox, Google Chrome)

Text and Reference Books

1. Sinha, P.K., Computer Fundamentals, BPB Publications.
2. Raja Raman, V, Computer Programming in 'C', PHI Publication.
3. Hunt N and Shelley J. "Computers and Common Sense" Prentice Hall of India.
4. Alexis Leon, "Introduction to Computers" Vikas Publishing House

B.Sc Biotechnology: Semester-I BST-104: Elementary Math I	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: - General knowledge of Mathematics of intermediate standard

Course Objectives:

1. To give an overview of mathematical concepts and their significance
2. To give basic knowledge of algebra, geometry and trigonometry.
3. To have an overview of Integration as inverse process of differentiation.
4. .To explain about the applications in finding the area under simple curves
5. To explain the Formation of differential equation whose general solution is given.
6. To explain the simple integrals of the type to be evaluated.

Course Outcomes:

After completing the course, students will be able to:

CO1: Understand various applications of mathematical concepts.
CO2: Derivation of polynomial and trigonometric functions.
CO3:Identify different types of Integration as inverse process of differentiation
CO4:Understand the area under simple curves
CO5: Analysis of differential equation.

Detailed Syllabus

UNIT-1 Derivatives
Definition, algebra of derivatives of functions, Derivatives of polynomial and trigonometric functions, Rate of change, increasing/decreasing functions, Maxima and minima (first derivative test motivated geometrically and second derivative test given as a provable tool), Simple problems (that illustrate basic principles and understanding of the subject as well as real-life situations).
UNIT-2 Integration
Integration as inverse process of differentiation, Integration of a variety of functions by substitution, by partial fractions and by parts, only simple integrals of the type to be evaluated. Applications in finding the area under simple curves, especially lines, areas of circles/parabolas/ellipses (in standard form only), area between the two above said curves (the region should be clearly identifiable).
UNIT-3 Differential equations

Definition, order and degree, General and particular solutions of a differential equation Formation of differential equation whose general solution is given, Solution of differential equations by method of separation of variables.

Text and Reference Books:

1. Mathematics Part I - Textbook for Class XI, NCERT Publication
2. Mathematics Part II - Textbook for Class XI, NCERT Publication,
3. Mathematics Class XI and XII by R D Sharma.

Reference books:

1. Glyn James , "Higher engineering mathematics" (Tata Macgraw Hill)
2. B.V.Ramana, "Advanced modern engineering mathematics" (Pearson education)

B.Sc Biotechnology: Semester-I BST 105 Remedial Biology I	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: - General knowledge of Biology of intermediate standard

Course Objectives:

1. To give an overview of biomolecules and their significance
2. To give basic knowledge of Structure, biosynthesis and function of Macromolecules (Carbohydrates, Proteins and Lipids).
3. To have an overview of Microorganism: Origin of microbiology, Types of microbes, Classification of microbes.
4. To explain about the Introduction Genes & Genome
5. To explain Plant Physiology, Movement of water, food, nutrients and gases, Respiration, Photosynthesis.
6. To explain the Human Health & Hygiene: Population and birth control, sexually transmitted diseases.

Course Outcomes:

After completing the course, students will be able to:

CO1: Identify the Diversity of living organisms, their structure and function
CO2: Systematic and binomial System of nomenclature
CO3: Cell: Structure and Function Cell: Cell theory; Prokaryotic and eukaryotic cell
CO4: Plant Physiology and different activities performed by the plants
CO5: Adolescence and drug / alcohol abuse, Basic concepts of immunology.

Detailed Syllabus

UNIT-1 Diversity in Living World
Diversity in Living World: Diversity of living organisms Classification of the living organisms (five kingdom classification, major groups and principles of classification within each kingdom), Systematic and binomial System of nomenclature, Salient features of animal and plant classification, viruses, viroid's, lichens, Botanical gardens, herbaria, zoological parks and museums.
UNIT-2 Cell: Structure and Function Cell

Cell: Structure and Function Cell: Cell theory; Prokaryotic and eukaryotic cell, cell wall, cell membrane, Nucleus and nuclear organization, Tissue, organ and organ system (elementary idea) Cell Division: Cell Cycle (elementary idea), Somatic Cell division - Mitosis, Germ Cell division – meiosis, Biomolecules of Cell: Basic chemical constituents of living bodies – Carbohydrate, Lipid, Protein, etc
UNIT-3 Plant Physiology
Plant Physiology, Movement of water, food, nutrients and gases, Respiration, Photosynthesis, Plant growth and development, Human Health & Hygiene: Population and birth control, sexually transmitted diseases, infertility. Cancer and AIDS, Adolescence and drug / alcohol abuse, Basic concepts of immunology, vaccines, Reproduction Reproductive system in male and female, menstrual cycle, production of gametes, fertilization, embryo development.

Text and Reference Books

1. Biology - Textbook for Class XI, NCERT Publication

Reference book:

1. Peter H Raven, George B Johnson, Kenneth A. Mason, Jonathan Losos, Susan Singer, Biology,(Macgraw Hill)
2. Sharma, P.D. (2005) 2nd Edition. Microbiology, Rastogi Publications.
3. Pelczar M. J., E. C. S. Chan and N. R. Krieg (2003) Microbiology, 5th Edition; Tata McGraw Hill Publishing Company , New Delhi

B.Sc Biotechnology: Semester-I BST 151: Biotechnology Lab I	
Teaching Scheme Lectures: 0 hrs/Week Tutorials: 0 hrs/Week Practicals: 4 Credits: 2	**Examination Scheme** Internal Assessment -15Marks External Assessment - 35Marks End Semester Exam – 50 marks

Prerequisite: - Basic understanding of Intermediate biology lab

Course Objectives:

1. To give overview of basic concepts of instruments used in biotechnology laboratory.
2. To give complete knowledge of centrifugation, its principles, working mechanism and types.
3. To learn about the basic spectroscopic techniques and mass spectrometry.
4. To describe the importance of various bioinformatics tools.
5. To develop an understanding of the various aspects of Bioprocess Technology

Course Outcomes:

After completing the course, students will be able to:

CO1: Understand various applications of Biotechnology

CO2: Analyze various biomolecules and their significance, structure and function

Detailed Syllabus

UNIT-1: Biotechnology Practical's
1.To identify the class of bacteria using gram staining technique.
2.To extract protein from leaves with the help of centrifuge.
3.To demonstrate beer lamberts law.
4. To check the anti-bacterial property of natural agents.
5. To test the susceptibility of microbial species against different antibiotic agents ampicillin and tetracyclin.
6. To check the quality of milk with MBRT test.

B.Sc Biotechnology: Semester-II BST 201 Biochemistry	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: - General knowledge of BST102 Cell Biology

Course Objectives:

1. To give an overview of biomolecules and their significance
2. To give basic knowledge of : properties of water, weak interaction in aqueous systems, Ionization of water

3. To have an overview of Protein: Amino acids, peptieds and polypeptiedes
4. To explain about the different biosynthetic pathways.
5. To explain the translation and post translational modification of proteins
6. To explain about the different types of lipids

Course Outcomes:

After completing the course, students will be able to:
CO1: Understand various applications of Biomolecules,their structure and function
CO2: Analyze the Gibbs frees energy and enthalpy
CO3: Identify different types of biosynthetic pathways of different biomolecules
CO4: Understand the concept of lipids and their significance
CO5: Knowledge of Electron-Transfer Reactions in Mitochondria. ATP Synthesis, Regulation of Oxidative Phosphorylation.

CO6: Understand various aspects of metabolism of biomolecules

Detailed Syllabus:

UNIT-1 Water
Water: properties of water, weak interaction in aqueous systems, Ionization of water, weak acids & weak base, Concept and calculation: pH, pKa, Gibbs frees energy and enthalpy. Protein: Amino acids, peptieds and polypeptiedes, Primary, secondary and tertiary structure, ramchandran plot, translation and post translational modification. Metabolic Fates of Amino Groups, Nitrogen Excretion and the Urea Cycle, Pathways of Amino Acid Degradation
UNIT-2 Carbohydrates

Carbohydrates: Monosaccharides and Disaccharides, Polysaccharides, Glycoconjugates: Proteoglycans, Glycoproteins and Glycolipids. Glycolysis, Feeder Pathways for Glycolysis, Fates of Pyruvate under Anaerobic Conditions: Fermentation, Gluconeogenesis, Pentose Phosphate Pathway of Glucose Oxidation, citric acid cycle: Production of Acetyl-CoA, Reactions of the Citric Acid Cycle, Regulation of the Citric Acid Cycle, The Glyoxylate Cycle. Electron transport chain: Electron-Transfer Reactions in Mitochondria. ATP Synthesis, Regulation of Oxidative Phosphorylation.
UNIT-3 Lipid
Lipid: Storage Lipids, Structural Lipids in Membranes, Lipids as Signals, Cofactors, and Pigments, Digestion, Mobilization, and Transport of Fats, Oxidation of Fatty Acids, Ketone Bodies, Triacylglycrides, Phospholipids, polar and nonpolar lipids. Cholesterol, Sphingolipids, cerebrolipids.

Text and Reference Books

1. Analytical Biochemistry 3rd Ed. by Holme, D. J. & Peck, H.
2. Basic Concepts in Biochemistry A Student's Survival Guide by Gilbert, H. F.
3. Biochemistry (3rd ed. 1994) by Rawn J. D.
4. Biochemistry by Todd, W. B., Mason, M., Bruggen, R. V. & Macmillan.
5. Biochemistry by Voet&Voet

B.Sc Biotechnology: Semester-II BST 202 Microbiology	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: - General knowledge of Microbiology of intermediate level.

Course Objectives:

1.To give an overview of Classification of Microorganisms, Role of Microorganisms in Disease, Study of Microbial Structure
2. To give basic knowledge of Procaryotic & Eucaryotic Cell: Structure Size, Shape and Function
3. To have an overview of Microbial Nutrition and Microbial Growth
4. To explain about the different Types of Media, Isolation of Pure Cultures, Growth Curve,

measurement of Microbial Growth, Cell Numbers & Cell Mass.

5. To explain the General Characteristics, Cultivation & Purification, Structure of Viruses

6.To explain about the different types of Antimicrobial Agents, Antibacterial Drugs, Antifungal Drugs, Antiviral Drugs. Drug Resistance

Course Outcomes:

After completing the course, students will be able to:
CO1: Understand various applications of microbes in our day to day life
CO2: Study and isolate the different types of microbes on the basis of staining techniques
CO3:Identify different types of growth media and factors affecting growth of microbes
CO4: Control of Microorganisms by Physical and Chemical Agents
CO5: Drug Resistance and the Mechanisms of Drug Resistance

Detailed Syllabus:

UNIT-1 History and Scope of Microbiology
History and Scope of Microbiology, Classification of Microorganisms, Role of Microorganisms in Disease, Study of Microbial Structure (Microscopy), Procaryotic & Eucaryotic Cell: Structure Size, Shape and Function, Procaryotic Cell Wall, Peptidoglycan Structure, Gram-Positive Cell Walls, Gram-Negative Cell Walls, Mechanism of Gram Staining, Capsules, Slime Layers, and S-Layers, Pili and Fimbriae, Flagella and Motility, Chemotaxis, The Bacterial Endospore .
UNIT-2 Microbial Nutrition and Microbial Growth

Microbial Nutrition and Microbial Growth: Nutrient Requirements (C, H, O, N, P, S), Nutritional Types of Microorganisms, Growth Factors, Uptake of Nutrients by the Cell, Group Translocation, Iron Uptake, Types of Media, Isolation of Pure Cultures, Growth Curve, Measurement of Microbial Growth, Cell Numbers & Cell Mass, Chemostat & Turbidostat, Sterilization, Control of Microorganisms by Physical and Chemical Agents, Antimicrobial Agent Activity & Evaluation, Bacterial Recombination: General Principles, Bacterial Plasmids, DNA Transformation, Transduction, Recombination and Genome Mapping in Viruses.
UNIT-3 Viruses
Viruses: Introduction, General Characteristics, Cultivation & Purification, Structure of Viruses, Virion Size, Structural Properties, Helical Capsids, Icosahedral Capsids, Principles of Virus Taxonomy. Antimicrobial Drugs, Dilution Susceptibility Tests, Disk Diffusion Tests, MIC, Mechanisms of Action of: Antimicrobial Agents, Antibacterial Drugs, Antifungal Drugs, Antiviral Drugs. Drug Resistance, Mechanisms of Drug Resistance, Cinical Microbiology, Microbiology of Food, Industrial Microbiology and Biotechnology

Text and Reference Books

1. Powar C. B. and H. F. Daginawala (2003).General Microbiology Vol.II; Himalaya Publishing House.
2. Dubey R. C. and D. K. Maheshwari (2004). A Text book of microbiology, 1st Edition; S. Chand and Company Ltd.
3. H.C. Dube (2005)A Textbook of Fungi, Vikas Publishing House.
4. A Textbook of Fungi- Vashistha (2003) S. Chand and Company Ltd.
5. Davis and Harper, General Microbiology
6. Alexopoulos C. J. and C. W. Mims (1996). Introductory Mycology, 4th Edition; John Wiley and Sons, Inc. USA.
7. Stanier, R.Y., J.L. Ingraham, M.L. Wheelis and P.R. Painter (1987) Vth edition. General Microbiology, Macmillan Press Ltd.

B.Sc Biotechnology: Semester-II BST 203 Ecology&Environment Biotechnology	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: - General knowledge of Ecology and Environment Biotechnology

Course Objectives:

1.To give an overview of Environment and factors associated with it.
2.To give basic knowledge of Effects of human activities on environment-Agriculture, Housing,Industry, Mining and Transportation activities

3.To have an overview of Natural Resources- Water Resources- Availability and Quality aspects.

4 To explain about the Environmental Pollution, their types and their effects.
5.To explain the Current Environmental Issues of Importance

6.To explain the Human Health & Hygiene: Population and birth control, sexually transmitted diseases.

Course Outcomes:

After completing the course, students will be able to:
CO1: Identify the factors governing the environment and their impact.
CO2: Current Environmental Issues and solution to curb it.
CO3: Initiatives taken by Government and Non-governmental Organizations (NGO)
CO4: Judicious use of Conventional and Non-Conventional sources
CO5: Legal aspects pertaining to protection of environment.

Detailed Syllabus:

UNIT-1 Environment :Scope & Definition
Definition, Scope & Importance, Need For Public Awareness- Environment definition, Eco system Balanced ecosystem, Human activities – Food, Shelter, Economic and social Security. Effects of human activities on environment-Agriculture, Housing, Industry, Mining and Transportation activities, Basics of Environmental Impact Assessment.
UNIT-2 Natural Resources

Natural Resources- Water Resources- Availability and Quality aspects. Water borne diseases, Water induced diseases, Fluoride problem in drinking water. Mineral Resources, Forest Wealth, Material cycles- Carbon, Nitrogen and Sulphur Cycles. Energy – Different types of energy, Electro-magnetic radiation. Conventional and Non-Conventional sources – Hydro Electric, Fossil Fuel based, Nuclear, Solar, Biomass and Bio-gas. Hydrogen as an alternative future source of Energy.
UNIT-3 Environmental Pollution
Environmental Pollution and their effects. Water pollution, Land pollution. Noise pollution, Public Health aspects, Air Pollution, Solid waste management. Current Environmental Issues of Importance: Population Growth, Climate Change and Global warming- Effects, Urbanization, Automobile pollution. Acid Rain, Ozone Layer depletion, Animal Husbandry. Environmental Protection- Role of Government, Legal aspects, Initiatives by Non-governmental Organizations (NGO), Environmental Education, Women Education.

Text and Reference Books

1. Benny Joseph – "Environmental Studies" –Tata McgrawHill-2005
2. Dr. D.L. Manjunath, "Environmental Studies" –Pearson Education-2006.
3. R. Rajagopalan – "Environmental studies" –Oxford Publication – 2005.
4. M. Anji Reddy – "Text book of Environmental Science & Technology" –BS Publication.
5. P. Venugoplan Rao, "Principles of Environmental Science and Engineering" – Prentice Hall of India.

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B.Sc Biotechnology: Semester-II BST204 Elementary Math II	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Course Objective:

To give an overview of Mathematical sciences and their significance.To give basic knowledge of mathematics for understanding of evolutionary biology. To have an overview of new domain mathematical biology

Course Learning Outcomes:

After completing the course, the student shall be able to:

CO1: To define the basic application of mathematics in science and biotechnology,

CO2: To summarize the applied mathematics in life sciences,

CO3: To determine basic principles of vectors, algebra and 3D geometry.

UNIT-I: ALGEBRA
ALGEBRA: Statement of Fundamental Theorem of Algebra, solution of quadratic equations in the complex number system. Linear Inequalities: Linear inequalities. Algebraic solutions of linear inequalities in one variable and their representation on the number line. Graphical solution of linear inequalities in two variables.Solution of system of linear inequalities in two variables-graphically. Series: Series. Arithmetic progression (A.P.). arithmetic mean (A.M.) Geometric progression (G.P.), general term of a G.P., sum of n terms of a G.P., geometric mean (G.M.), relation between A.M. and G.M. Sum to n terms of the special series _n, _n2 and _n3.
UNIT- II: COORDINATE GEOMETRY
Straight Lines: Brief recall of 2D from earlier classes. Slope of a line and angle between two lines. Various forms of equations of a line: parallel to axes, point-slope form, slope-intercept form, two point form, intercepts form and normal form. General equation of a line.Distance of a point from a line. Conic Sections: Sections of a cone: circle, ellipse, parabola, hyperbola, a point, a straight line and pair of intersecting lines as a degenerated case of a conic section. Standard equations and simple properties of parabola, ellipse and hyperbola.Standard equation of a circle.
UNIT- III: VECTORS
Vectors: Vectors and scalars, magnitude and direction of a vector. Types of vectors (equal, unit, zero, parallel and collinear vectors), position vector of a point, negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar, position vector of a point dividing a line segment in a given ratio. Scalar (dot) product of vectors, projection of a vector on a line. Vector (cross) product of vectors.

- Mathematics Part I - Textbook for Class XI and XII, NCERT Publication
- Mathematics Part II - Textbook for Class XI and XII, NCERT Publication
- 3)Higher engineering Mathematics by B.V. Ramana (Tata Macgraw Hill)

B.Sc Biotechnology: Semester-II BST 205 Remedial Biology II	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: - General knowledge of Biology of intermediate standard

Course Objectives:

1. To give an overview of Animal Physiology and its role and significance
2. To give basic knowledge of Functional Anatomy.
3. To have an overview of Biological Sciences.
4. To explain Reproductive health care principles.

Course Outcomes:

After completing the course, students will be able to:

CO1: To understand basic human biology concepts

CO2: To summarize the different types of human health parameters

Detailed Syllabus:

UNIT-1 Animal Physiology
Animal Physiology-I Digestion and absorption. Breathing and respiration. Body fluids and circulation. **Animal Physiology-II** Neural control and coordination, chemical coordination and regulation
UNIT-2 Reproduction
Reproductive system in male and female, menstrual cycle, production of gametes, fertilization, embryodevelopment.
UNIT-3 Human Health

Human Health & Hygiene: Population and birth control, sexually transmitted diseases, infertility.Cancer and AIDS. Adolescence and drug / alcohol abuse. Basic concepts of immunology, vaccines.

Text and Reference Books

1. Biology - Textbook for Class XI, NCERT Publication
2. Biology - Textbook for Class XII, NCERT Publication
3. Human anatomy and physiology by Marieb (pierson Education)
4. Textbook of human physiology by Chakraborthy and Ghosh (2nd ed. Calcutta, The NewBookstall)
5. Human Physiology by Pocock and Richards (oxford University press)

B.Sc Biotechnology: Semester-II BST251: Biotechnology Lab II	
Teaching Scheme Lectures: 0 hrs/Week Tutorials: 0 hrs/Week Practicals: 4 hrs/Week Credits: 2	**Examination Scheme** Internal Assessment - 15Marks External Assessment- 35 Marks End Semester Exam – 50 Marks

Prerequisite: - BST 103 cell biology, BST102 Introduction to biotechnology, BST 202 Biochemistry, BST203 Microbiology

Course Objectives:

1. To give overview of biotechnology instruments.
2. To Give complete knowledge of genomic DNA and Plasmid DNA.
3. Explain microbial pathogenicity tests.
4. To describe electrophoresis.
5. To explain DNA Isolation.

Course Outcomes:

After completing the course, students will be able to:

CO1: Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.

CO2: Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems.

CO3: Students will be able to clearly communicate the results of scientific work in oral, written and electronic formats to both scientists and the public at large.

CO4: The main goal of the course is to provide basic understanding of immunology and immune responses in response to various infectious and non infectious diseases.

Detailed Syllabus:

UNIT1: Biotechnology Practical's
1. Preparation of solutions for Molecular Biology experiments. 2. Isolation of chromosomal DNA from bacterial cells. 3. Isolation of Plasmid DNA by alkaline lysis method 4. Agarose gel electrophoresis of genomic DNA & plasmid DNA 5. Preparation of restriction enzyme digests of DNA samples 6. Demonstration of AMES test or reverse mutation for carcinogenicity