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	Chemistry I	CC	3	1	0	30	70	100	4
BST104	Computer Fundamental	AEC	3	1	0	30	70	100	4
BST105	Elementary Math I	GE*	3	1	0	30	70	100	4
BST106	Remedial Biology I	GE*							
BST151	Cell Biology Lab	SEC	0	0	4	15	35	50	2
BST 152	Chemistry lab I	SEC	0	0	4	15	35	50	2
TOTAL			**15**	**5**	**8**	**180**	**420**	**600**	**24**

CC-Core Courses; GE-Generic Elective; AEC-Ability Enhancement Course; SEC-Skill Enhancement Courses

L – Lecture; T – Tutorial; P – Practical; C – Credit; CA-Continuous Assessment; EE – End Semester Exam
GE* - Elect any one 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
BST 203	Chemistry II	CC	3	1	0	30	70	100	4
BST204	Ecology & Environment Biotechnology	AEC	3	1	0	30	70	100	4
BST205	Elementary Math II	GE*	3	1	0	30	70	100	4
BST206	Remedial Biology II	GE*							
BST251	Microbiology Lab	SEC	0	0	4	15	35	50	2
BST 252	Chemistry Lab II	SEC	0	0	4	15	35	50	2
TOTAL			**15**	**5**	**8**	**180**	**420**	**600**	**24**

CC-Core Courses; GE-Generic Elective; AEC-Ability Enhancement Course; SEC-Skill Enhancement Courses;

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STUDY AND EVALUATION SCHEME

Bachelor of Science [Biotechnology]

(Effective from Session 2020-2021)

YEAR II, SEMESTER III

COURSE CODE	COURSE TITLE	COURSE CATEGORY	HOURS			EVALUATION SCHEME		SUBJECT TOTAL	CREDIT
			L	T	P	CA	EE		
BST301	Molecular Biology	CC	3	1	0	30	70	100	4
BST302	Bioenergetics and Thermodynamics	CC	3	1	0	30	70	100	4
BST303	Chemistry III	CC	3	1	0	30	70	100	4
BST304	Computer Application & Biostatistics	AEC	3	1	0	30	70	100	4
BST305	Biotechnology-ISSUES AND ETHICAL	GE*	3	1	0	30	70	100	4
BST306	Entrepreneurship Development	GE*							
BST351	Molecular Biology Lab	SEC	0	0	4	15	35	50	2
BST 352	Chemistry Lab III	SEC	0	0	4	15	35	50	2
TOTAL			**15**	**5**	**8**	**180**	**420**	**600**	**24**

CC-Core Courses; AEC-Ability Enhancement Course; SEC-Skill Enhancement Courses; GE-General Elective

L – Lecture; T – Tutorial; P – Practical; C – Credit; CA-Continuous Assessment; EE – End Semester Exam

GE* - Elect any one from the prescribed;

YEAR II, SEMESTER IV

COURSE CODE	COURSE TITLE	COURSE CATEGORY	HOURS			EVALUATION SCHEME		SUBJECT TOTAL	CREDIT
			L	T	P	CA	EE		
BST401	Immunology	CC	3	1	0	30	70	100	4
BST402	Genetics	CC	3	1	0	30	70	100	4
BST403	Chemistry IV	CC	3	1	0	30	70	100	4
BST404	Enzymology	AEC	3	1	0	30	70	100	4
BST405	Animal Physiology	**GE***	3	1	0	30	70	100	4
BST406	Food Biotechnology	**GE***							
BST451	Enzymology Lab	SEC	0	0	4	15	35	50	2
BST452	Chemistry Lab IV	SEC	0	0	4	15	35	50	2
TOTAL			**15**	**5**	**8**	**180**	**420**	**600**	**24**

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STUDY AND EVALUATION SCHEME

Bachelor of Science [Biotechnology]

(Effective from Session 2020-2021)

YEAR III, SEMESTER V

COURSE CODE	COURSE TITLE	COURSE CATEGORY	HOURS			EVALUATION SCHEME		SUBJECT TOTAL	CREDIT
			L	T	P	CA	EE		
BST501	BIOPROCESS TECHNOLOGY	CC	3	1	0	30	70	100	4
BST502	RECOMBINANT DNA TECHNOLOGY	CC	3	1	0	30	70	100	4
BST503	PLANT PHYSIOLOGY	CC	3	1	0	30	70	100	4
BST504	FRONTIERS IN BIOTECHNOLOGY	AEC	3	1	0	30	70	100	4
BST505	MEDICAL MICROBIOLOGY	GE*	3	1	0	30	70	100	4
BST506	PLANT BIOTECHNOLOGY	GE*							
BST551	RECOMBINANT DNA TECHNOLOGY LAB	SEC	0	0	4	15	35	50	2
BST 552	SEMINAR I	SEC	0	0	2	50	0	50	2
TOTAL			**15**	**5**	**6**	**215**	**385**	**600**	**24**

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YEAR III, SEMESTER VI

COURSE CODE	COURSE TITLE	COURSE CATEGORY	HOURS			EVALUATION SCHEME		SUBJECT TOTAL	CREDIT
			L	T	P	CA	EE		
BST601	ANALYTICAL TECHNIQUES	CC	3	1	0	30	70	100	4
BST602	GENOMICS AND PROTEOMICS	CC	3	1	0	30	70	100	4
BST603	INDUSTRIAL BIOTECHNOLOGY	CC	3	1	0	30	70	100	4
BST604	BIOINFORMATICS	AEC	3	1	0	30	70	100	4
BST605	ENVIRONMENTAL BIOTECHNOLOGY	GE*	3	1	0	30	70	100	4
BST606	INTELLECTUAL PROPERTY RIGHTS	GE*							
BST651	INDUSTRIAL BIOTECHNOLOGY LAB	SEC	0	0	4	15	35	50	2
BST 652	SEMINAR II	SEC	0	0	2	50	0	50	2
TOTAL			**15**	**5**	**6**	**215**	**385**	**600**	**24**

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Bachelor of Science (Biotechnology Hons.)

1st Year Course Structure

INVERTIS UNIVERSITY

Invertis Village, Delhi Lucknow Highway

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, flow cytometry, 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

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BST104	Computer Fundamental	AEC	3	1	0	30	70	100	4
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YEAR I, SEMESTER II

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			L	T	P	CA	EE		
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BST202	Microbiology	CC	3	1	0	30	70	100	4
BST 203	Chemistry II	CC	3	1	0	30	70	100	4
BST204	Ecology & Environment Biotechnology	AEC	3	1	0	30	70	100	4
BST205	Elementary Math II	GE*	3	1	0	30	70	100	4
BST206	Remedial Biology II	GE*							
BST251	Microbiology Lab	SEC	0	0	4	15	35	50	2
BST 252	Chemistry Lab II	SEC	0	0	4	15	35	50	2
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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 cell biology
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 and Eukaryotes, Ultra structure and function of cell and cell organelles, 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

l 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 :Chemistry I	
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 Chemistry of intermediate standard

Course Objectives:

1. To give an overview of Chemical reactions
2. To give basic knowledge of chemicals and their reactions
3. To have an overview of bond formation and its types.
4 To explain the various types of isomerism.
5. To explain the molecular orbital theory.
6. To explain the kinetic theory of gases.
7.

Course Outcomes:

After completing the course, students will be able to:

1. Understand various types of chemical reactions
2. Analyze different chemicals and their usage in day to day life and in industries and other sectors
3Identify various bonds that exist in a molecule or a compound
4. Understand the concept of orbitals and sharing of electrons
5. Evaluate the role of kinetic theory of gases
6. Understand the concept of vander walls forces and weak bonds

Detail syllabus

Unit-1 Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, shapes of s. p, d orbital's. Aufbau and Pauli exclusion principles, Hund's multiplicity rule.
Unit-2 Bonding concept: Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bond, Vander Waals interactions, Hydrogen bonding and its applications.Molecular orbital theory: and its applications for homo and hetro nuclear diatomic molecules. Concept of isomerism:Types of isomerism. molecular chirality, enantiomers, optical activity, properties of enantiomers, meso compounds.
Unit -3 Postulates of kinetic theory of gases, deviation from ideal behavior, van der Waals equation of state. Critical Phenomena:PV isotherms of real gases, continuity of states, Vander Waals equation, relationship between critical constant and Vander Waals constants, the law of corresponding states, reduced equation of state.

Text and Reference Books

1. A Textbook of Physical Chemistry, A. S. Negi, S. C. Anand
2. Physical Chemistry, Gilbert William Castellan
3. Physical chemistry, Walter John Moore
4. Organic Chemistry, Benjamin List, KeijiMaruoka
5. Advanced Organic Chemistry, 4th ed. Part A: Structure and Mechanisms F. Carey and R. Sundberg, Kluwer Academic

B.Sc. Biotechnology: Semester-I **BST-104 :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-105: 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 106 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: Cell Biology Lab	
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-I BST 152: Chemistry Lb 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: - General knowledge of Computer fundamentals of intermediate standard

Course Objectives:

1. To give an overview of Chemical reactions
2. To give basic knowledge of chemicals and their reactions
3. To have an overview of bond breakage and bond formation
4. To explain the various types of isomerism and chiral activity
5. To explain the reaction mechanisms.
6. To have an idea of gases.

Course outcomes

1. Understand various types of chemical reactions
2. Analyze different chemicals and their usage in day to day life and in industries and other sectors
3.Identify various bonds that exist in a molecule or a compound
4. Understand the concept of orbitals and sharing of electrons
5. Evaluate the role of kinetic theory of gases
6. Understand the concept of vander walls forces and weak bonds

Detail Syllabus

1. Preparation of solutions of different Molarity / Normality of titrants
2. Estimation of carbonate and hydroxide present together in mixture.
3. Estimation of Fe (II) and oxalic acid solutions using standardized KMnO4 solution.
4. To determine the ferrous content in the supplied sample of iron ore by titrimetric analysis against standard K_2Cr_2O7 solution using potassium ferricyanide $[K_3Fe(CN)_6]$ as external indicator.
5. Determination of the melting points of organic compounds and unknown organic compounds (electrically heated melting point apparatus).
6. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds.
7. Determination of boiling point of liquid compounds. (Boiling point lower than and more than 100° C).

Text and Reference Books

1. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.
2. Vogel, A.I. A Textbook of Practical Organic Chemistry, ELBS

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, peptides and polypeptides
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: Monosaccharide's and Disaccharides, Polysaccharides, Glyco-conjugates: 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

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, Triacylglycerides, Phospholipids, polar and non polar 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, 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

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 Chemistry 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 Chemistry

Course Objectives:

1. To give an overview of Chemical kinetics
2. To give basic knowledge of chemicals and their reactions
3. To have an overview of mathematical characteristics of simple chemical reactions
4. Aromatic electrophilic substitution- general pattern of the mechanism,
5. Activating and deactivating substituents
5. To explain the complexation tendencies including their function in biosystems

Detail Syllabus

Module-1

Chemical kinetics and its scope, rate of a reaction, Order of the reactions. Concentration dependence of rates, mathematical characteristics of simple chemical reactions-zero order, first order, second order, pseudo order, half life and mean life.

Module-2

Aromatic electrophilic substitution- general pattern of the mechanism, Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction, Activating and deactivating substituents, orientation and ortho/para ration.

Module-3

s-Block Elements Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, and introduction to alklys and aryls.

p-Block Elements Comparative study (including diagonal relationship) of groups 13-17 elements, compounds like hydrides, oxides and halides of groups 13-16, hydrides of boron diborane and higher boranes, borazine, borohydrides.

Text and Reference Books

1. A Textbook of Physical Chemistry, A. S. Negi, S. C. Anand
2. Physical Chemistry, Gilbert William Castellan
3. Physical chemistry, Walter John Moore
4. Organic Chemistry, Benjamin List, KeijiMaruoka
5. Advanced Organic Chemistry, 4th ed. Part A: Structure and Mechanisms F. Carey and R. Sundberg, Kluwer Academic

Course outcomes:

After completing the course, students will be able to:

1. Understand various types of chemical reactions and their order
2. Analyze different aromatic electrophilic substitution
3. Mechanism of nitration, halogenation, sulphonation, mercuration
4. To analyse s-Block Elements Comparative study, diagonal relationships
5. To analyse p-Block Elements Comparative study
6. To learn complexation tendencies including their function in biosystems

B.Sc. Biotechnology: Semester-II BST 204 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, Nuclear, Solar, Biomass and Bio-

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 BST205 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 206 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: Microbiology Lab	
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:

Practicals

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

B.Sc. Biotechnology: Semester-II BST252: Chemistry 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: - General knowledge of Computer fundamentals of intermediate standard

Course Objectives:

1. To give an overview of Chemical reactions
2. To give basic knowledge of chemicals and their reactions
3. To have an overview of bond breakage and bond formation
4. .To explain the various types of isomerism and chiral activity
5. To explain the reaction mechanisms.
6. To have an idea of gases.

Detailed Syllabus

1. To perform limit test of chloride, sulphate, Iron, Heavy metal and arsenic in the given sample.
2. Salt analysis
3. Preparation of Boric acid
4. Preparation of Magnesium sulphate
5. Preparation of Heavy magnesium carbonate
6. Preparation of Calcium Carbonate
7. Preparation of Alum
8. Preparation of Bakelite resin

Text and Reference Books

1.Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.
2.Vogel, A.I. A Textbook of Practical Organic Chemistry, ELBS

Course Outcomes:

1. Understand various types of chemical reactions
2. Analyze different chemicals and their usage in day to day life and in industries and other sectors
3. Identify various bonds that exist in a molecule or a compound
4. Understand the concept of orbitals and sharing of electrons
5. Evaluate the role of kinetic theory of gases
6. Understand the concept of vander walls forces and weak bonds

Bachelor of Science (Biotechnology Hons.)

(2nd Year) Course Structure

INVERTIS UNIVERSITY

Invertis Village, Delhi Lucknow Highway NH-24, Bareilly
Uttar Pradesh Pin - 243123, 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, flow cytometry, 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, Bio-fuels, Biosensors, Biocatalyst, Bio-mining 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 II, SEMESTER III

COURSE CODE	COURSE TITLE	COURSE CATEGORY	HOURS			EVALUATION SCHEME		SUBJECT TOTAL	CREDIT
			L	T	P	CA	EE		
BST301	Molecular Biology	CC	3	1	0	30	70	100	4
BST302	Bioenergetics and Thermodynamics	CC	3	1	0	30	70	100	4
BST303	Chemistry III	CC	3	1	0	30	70	100	4
BST304	Computer Application & Biostatistics	AEC	3	1	0	30	70	100	4
BST305	Biotechnology-Issues and ethical	GE*	3	1	0	30	70	100	4
BST306	Entrepreneurship Development	GE*							
BST351	Molecular Biology Lab	SEC	0	0	4	15	35	50	2
BST 352	Chemistry Lab III	SEC	0	0	4	15	35	50	2
TOTAL			**15**	**5**	**8**	**180**	**420**	**600**	**24**

CC-Core Courses; AEC-Ability Enhancement Course; SEC-Skill Enhancement Courses; GE-General Elective

L – Lecture; T – Tutorial; P – Practical; C – Credit; CA-Continuous Assessment; EE – End Semester Exam

GE* - Elect any one from the prescribed;

YEAR II, SEMESTER IV

COURSE CODE	COURSE TITLE	COURSE CATEGORY	HOURS			EVALUATION SCHEME		SUBJECT TOTAL	CREDIT
			L	T	P	CA	EE		
BST401	Immunology	CC	3	1	0	30	70	100	4
BST402	Genetics	CC	3	1	0	30	70	100	4
BST403	Chemistry IV	CC	3	1	0	30	70	100	4
BST404	Enzymology	AEC	3	1	0	30	70	100	4
BST405	Animal Physiology	**GE***	3	1	0	30	70	100	4
BST406	Food Biotechnology	**GE***							
BST451	Enzymology Lab	SEC	0	0	4	15	35	50	2
BST452	Chemistry Lab IV	SEC	0	0	4	15	35	50	2
TOTAL			**15**	**5**	**8**	**180**	**420**	**600**	**24**

CC-Core Courses; GE-Generic Elective; AEC-Ability Enhancement Course; SEC-Skill Enhancement Courses

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

B. Sc. Biotechnology: Semester-III BST 301 : Molecular Biology	
Teaching Scheme Lectures: 3 hrs/Week Tutorials:1hrs/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: - BST 103 Cell Biology and BST 102 Introduction to Biotechnology, BST152 Biotechnology Lab

Course Objectives:

1. To give overview of concept of gene and chromosomes
2. To give complete knowledge of structure of DNA , Bacterial Chromosomes and Extra-chromosomal DNA, Organelles of Eukaryotic Cells Contain DNA, DNA Supercoiling
3. To describe Structure of DNA, Watson & Crick's Model, Types of DNA, Meselsen and Stahl's experiment, DNA replication with Enzymes and Protein factors in DNA Replication, genome complexity
4. To explain the DNA Dependent synthesis of RNA, RNA Polymerases, Structure and types of RNA and their functions
5. To explain the Genetics code, Protein synthesis: Ribosomes, tRNA, Aminoacyl-tRNA Synthetases
6. Genetic recombination, Molecular aspects of recombination, Homologous and heterologous recombination

Course Outcomes:

After completing the course, students will be able to:

CO1: Understand and apply the principles and techniques of molecular biology which prepares students for further education and/or employment in teaching, basic research, or the health professions

CO2: Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments

CO3: Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems

CO4: 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

CO5: Students will be able to explore new areas of research in both molecular biology and Allied fields of science and technology

CO6: Research Development and Practice that is Formulate and carryout independent and collaborative research projects

CO7: Students will be able to develop the communication skills in presenting their research findings through effective oral and written presentations.

Detailed Syllabus:

UNIT-1 Genes and Chromosomes: Structure of DNA, Bacterial Chromosomes and Extra-chromosomal DNA, Organelles of Eukaryotic Cells Contain DNA, DNA Super-coiling , Chromatin and Nucleoid Structure, DNA as the genetic material Hershey and Chase experiment, Conrat and Singer's experiment, Watson & Crick's Model, Types of DNA, Meselsen & Stahl's experiment, Enzymes and Protein factors in DNA Replication, genome complexity
UNIT-2 DNA Dependent synthesis of RNA, RNA Polymerases, Structure and types of RNA and their functions, Basic Concept of RNA Processing, Transcription in prokaryotes and eukaryotes, Steps in transcription, Translation; Genetics code, Protein synthesis: Ribosomes, tRNA, Aminoacyl-tRNA Synthetases, Comparison between prokaryotic and eukaryotic translation, Post translational processing of proteins in Eukaryotes and Prokaryotes
UNIT-3 Genetic recombination: Molecular aspects of recombination, Homologous and Heterologous recombination. Holliday Model, Gene regulation: principles of gene expression, Gene regulation in mitochondrion and chloroplast, Regulation of g e n e expression in prokaryotes and Eukaryotes, Operon concept - details of lac and tryp operon

Text and Reference Books

1. Molecular Biology of the Gene -Lewin
2. Molecular biology JD Watson.

B. Sc. Biotechnology: Semester-III BST 302: Bioenergetics and Thermodynamics	
Teaching Scheme Lectures: 3 hrs/Week Tutorials:1hrs/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: - BST 103 Cell Biology and BST 102 Introduction to Biotechnology, BST 202 Biochemistry

Course Objectives:

1. To give over view of Principles of Bioenergetics
2. To give complete knowledge of **E**nergy yielding and Energy Requiring Reactions, Equilibrium Concentrations, Oxidation-Reduction Reactions
3. To describe Thermodynamic considerations: First and Second Law of Thermodynamics, Enthalpy and Entropy, Activation Energy
4. To explain the Catabolism and the Generation of Chemical Energy
5. To explain the Metabolic Strategies, General Principles of Intermediary Metabolism, Regulation of Pathways, Strategies for Pathway Analysis
6. To explain Oxidative Phosphorylation, Electron Transport and ATP Synthesis in Bacteria

Course Outcomes:

After completing the course, students will be able to:

CO1: Disciplinary knowledge and understanding of biochemistry, structure and function of biological molecules

CO2: Explain biological mechanisms, such as the processes and control of bioenergetics and metabolism, as chemical reactions

CO3: Explain the biochemical processes that underlie the relationship between genotype and Phenotype

CO4: Demonstrate an understanding of the principles, and have practical experience of, a wide range of biochemical techniques (e.g. basic molecular biology, cell biology and microbiology methods, spectrophotometry, the use of standards for quantification, enzyme kinetics; macromolecular purification, chromatography electrophoresis, etc.).

CO5: Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.

CO6: Demonstrate an experiential learning and critical thinking of the structure and function of both prokaryotic and eukaryotic cells (including the molecular basis and role of sub-

cellular compartmentalization)

CO7: Analyze biochemical data (e.g. in enzyme kinetics, molecular structure analysis and biological databases

Detailed Syllabus:

UNIT-1 Bioenergetics
Principles of Bioenergetics, Energy Yielding and Energy Requiring Reactions, Equilibrium constant, Oxidation-Reduction Reactions, Metabolism and ATP Yield, Structure and properties of ATP, Photosynthetic Phosphorylation, Active Transport, Thermodynamic considerations: First and Second Law of Thermodynamics, Enthalpy and Entropy, Activation Energy
UNIT-2 Catabolism and the Generation of Chemical Energy
Catabolism and the Generation of Chemical Energy. Metabolic Strategies: General Principles of Intermediary Metabolism, Regulation of Pathways, Strategies for Pathway Analysis, Glycolysis, Gluconeogenesis, and the Pentose Phosphate Pathway & their regulation, Tricarboxylic Acid Cycle: Discovery of the TCA Cycle, Steps in the TCA Cycle, Stereo-chemical aspects of TCA Cycle Reactions, Thermodynamics of the TCA Cycle
UNIT-3 Mitochondria Electron Transport Chain
Mitochondria Electron Transport Chain, Oxidative Phosphorylation, Electron Transport and ATP Synthesis in Bacteria

Reference Books:

1. Smith and Vannes. Introduction to Chemical Engineering thermodynamics (Mcgraw Hill)
2. Y.V.C. rao. Chemical engineering thermodynamics (New age international)
3. J.B.Hawkins. Engineering Thermodynamics (University Press)
4. Spading and Cole. Engineering Thermodynamics (ELBS).
5. Biochemistry by Lehninger. McMillan publishers
6. Biochemistry by Lubert Stryer. W. H. Freeman & Company, NY

B. Sc. Biotechnology: Semester-III BST303: Chemistry III	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1hrs/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: - Basic knowledge of chemistry

Course Objectives:

1. To give overview of concept of thermodynamics and energy
2. To give complete knowledge of Joule's law-joule-Thomson coefficient and inversion temperature
3. Calculation of w, q, dU, & dH for the expansion of ideal gases under isothermal andadiabatic conditions for reversible process
4. To describe Classification and nomenclature
5. To explain the different methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters
6. To explain the methods of formation, chemical reactions of vicinal glycols, and pinacol-pinacolone rearrangement

Course Outcomes:

After completing the course, students will be able to:

CO1: Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in Analytical, Inorganic, Organic and Physical Chemistries

CO2: Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments

CO3: Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems

CO4: 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

CO5: Students will be able to explore new areas of research in both chemistry and allied fields of science and technology

CO6: Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behavior in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and medicine

CO7: Students will be able to explain why chemistry is an integral activity for addressing social, economic, and environmental problems

Detailed Syllabus:

UNIT-1 Definition of thermodynamic terms
Definition of thermodynamic terms: system, surroundings etc. Types of systems, intensive and extensive properties. Thermodynamic process. Concept of heat and work. First Law of Thermodynamics: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law-joule-Thomson coefficient and inversion temperature. Calculation of w, q, dU, & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process
UNIT-2 Classification and nomenclature
Classification and nomenclature, Monohydric alcohols-nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols, Dihydric alcohols-nomenclature, methods of formation, chemical reactions of vicinal glycols, and pinacol-pinacolone rearrangement
UNIT-3 Characteristic properties of d-block elements
Overview and characteristic properties of s, p, d-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and Effective atomic number

Text and Reference Books

1.A Textbook of Physical Chemistry, A. S. Negi, S. C. Anand
2. Physical Chemistry, Gilbert William Castellan
3. Physical chemistry , Peter Atkin
4.Physical chemistry, Walter John Moore
5.Organic Chemistry, Benjamin List, Keiji Maruoka Advanced Organic Chemistry, 4th ed. Part A: Structure and Mechanisms F. Carey and R. Sundberg, Kluwer Academic

B.Sc. Biotechnology: Semester-III BST304: Computer Application and Biostatistics	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1hrs/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: - BST106 Computer Fundamentals

Course Objectives:

1. To give overview of Introduction of computer science in biotechnology
2. To give complete knowledge of Computer software's & hardware
3. To describe ethical issues against the molecular technologies
4. To explain the Planning a program: Algorithm, Flowchart, Pseudo code, Plan of logic computer program
5. To explain Common terms, notions and Applications; Statistical population and Sampling Methods
6. To explain Fundamental principle of counting

Course Outcomes:

After completing the course, students will be able to:

CO1: Students will gain knowledge about to Know the various statistical methods to solve different types of problems

CO2: Students will gain knowledge to Operate various statistical software packages

CO3: This course will provide complete package to the students to identify activities and constitute IP infringements and the remedies available to the IP owner and describe the precautious steps to be taken to prevent infringement of proprietary rights in products and technology development

CO4: Students will be able to clearly communicate and Appreciate the importance of Computer in hospital and Community Pharmacy

CO5: Students will be able to explore new areas of research allied fields of science and Technology

CO6:Students will Appreciate the statistical technique in solving the pharmaceutical Problems

CO7: Apply the knowledge of mathematics and computing fundamentals to pharmaceutical

applications for any given requirement and design and develop solutions to analyze pharmaceutical problems using computers.

Detailed Syllabus:

UNIT-1 Introduction of computer science in biotechnology
Introduction of computer science in biotechnology, Computer software's & hardware's, Relationship between hardware, system software, application software and user of a computer, ways of accruing software, steps involved in software development, Firmware & middleware. Planning a program: Algorithm, Flowchart, Pseudo code, Plan of logic computer program, Commonly used program for planning. Basic of Computer Language: Machine, Assembly and High Level Languages
UNIT-2 Introduction to Biostatistics
Introduction to Biostatistics, Common terms, notions and Applications; Statistical population and Sampling Methods; Diagrammatic and graphical presentation, Measures of Central Tendency (Mean, Median, Mode), Measures of dispersion (Range, Mean Deviation, Standard Deviation, Standard error, Quartile Deviation), combined mean and variance, covariance, Coefficient of variation
UNIT-3 Fundamental Statistics
Fundamental principle of counting, Factorial, Permutations and combinations, derivation of formulae and their connections, simple applications, Hypothesis testing, Chi square test and F-tests, Variant, One way and two way analysis of variants, ANOVA, Principles of experimental design and analysis

Text and Reference Books

1. A Textbook of Physical Chemistry, A. S. Negi, S. C. Anand
2. Physical Chemistry, Gilbert William Castellan
3. Physical chemistry, Walter John Moore
4. Organic Chemistry, Benjamin List, Keiji Maruoka Advanced Organic Chemistry, 4th ed. Part A: Structure and Mechanisms F. Carey and R. Sundberg, Kluwer Academic

B.Sc. Biotechnology: Semester-III BST305: Biotechnology –Issue and Ethical	
Teaching Scheme Lectures: 3 hrs/Week Tutorials:1 hrs/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: BST 206 Ecology & Environment Biotechnology

Course Objectives:

1. To give overview of Genetic screening for any predisposition symptoms
2. To give complete knowledge of Social issue, public opinions against the molecular technologies
3. To describe ethical issues against the molecular technologies
4. To explain the Legality, morality and ethics, the principles of bioethics: autonomy, human rights, beneficence, privacy, justice, equity etc.
5. To explain biomedical practice to biotechnology, ethical conflicts in biotechnology
6. To explain Intellectual Property Rights

Course Outcomes:

After completing the course, students will be able to:

CO1: Understand and apply the principles and techniques of molecular biology which prepares students for further education and/or employment in teaching, basic research, or the health professions

CO2: Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments

CO3: Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems

CO4: 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

Detailed Syllabus:

UNIT-1 Molecular technologies
Molecular technologies – an overview of Genetic screening for any predisposition symptoms, Cancer screening, Cloning, Gene therapy, DNA fingerprinting (Paternity and Forensics) in vitro fertilization, surrogate motherhood, PGD, transgenic organisms, Xeno-transplantation, GMOs, Social issues - public opinions against the molecular

Technologies, Legal issues – legal actions taken by countries for use of the molecular technologies. Ethical issues – ethical issues against the molecular technologies
UNIT-2 Legality, morality and ethics
Legality, morality and ethics, the principles of bioethics: autonomy, human rights, beneficence, privacy, justice, equity etc., biomedical practice to biotechnology, ethical conflicts in biotechnology - interference with nature, bioethics vs. business ethics, Necessity of Bioethics, different paradigms of Bioethics – National & International
UNIT-3 Intellectual Property Rights
Intellectual Property Rights – Why IPR is necessary, TRIPS & IPR, IPR – national & international scenario, IPR protection of life forms, Biotechnology and bio-safety concerns at the level of individuals, institutions, society, region, country and the world. Roleof patent in pharmaceutical industry, computer related Innovations, Case studies Rice, Haldi, Neem, etc. and challenges ahead

Reference Books:

1. The law and strategy of Biotechnological patents by Sibley. Butterworth publications.

2. Intellecutla property rights – Ganguli – Tata McGrawhill

3. Intellectual property right – Wattal – Oxford Publishing House.

B.Sc. Biotechnology: Semester-III BST306: Entrepreneurship Development	
Teaching Scheme Lectures: 3 hrs/Week Tutorials:1hrs/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: BBT-501 Environmental Biotechnology, BBT-502 Genetic Engineering, BBT-503 Animal Biotechnology, BBT- 504 Bioprocess Engineering, BBT- 505 genomics and proteomics, BBT-506 Molecular Dynamics & Bioenergetics, BBT-551 Environmental Biotechnology Lab, BBT-552 Bioprocess Engineering Lab

Course Objectives:

1. Understanding basic concepts in the area of entrepreneurship
2. Understanding the role and importance of entrepreneurship for economic development
3. Developing personal creativity and entrepreneurial initiative
4. Adopting of the key steps in the elaboration of business idea
5. Understanding the stages of the entrepreneurial process
6. The resources needed for the successful development of entrepreneurial ventures

Course Outcomes:

After completing the course, students will be able to:

CO1: Explore entrepreneurial leadership and management style
CO2: To explore different biotech business models and to acquire the fundamentals of biotech business management
CO3: To understand the requirements of a biotech business plan in particular from the perspective of prospective funders
CO4: To be able to manage issues in intellectual property and licensing as they pertain to Biotech
CO6: To understand the nature of business incubation and its place in the biotech value Chain
CO7: To develop fundamental notions with regard to marketing in the biotech space and to understand the complexity of the interface between stakeholders

Detailed Syllabus:

UNIT-1 Accounting and Finance
Accounting and Finance Taking decision on starting a venture; Assessment of feasibility of a given venture/new venture; Approach a bank for a loan; Sources of financial assistance; Making a business proposal/Plan for seeking loans from financial institution and Banks; Funds from bank for capital expenditure and for working; Statutory and legal requirements for starting a company/venture; Budget planning and cash flow management; Basics in accounting practices: concepts of balance sheet, P&L account, and double entry bookkeeping; Estimation of income, expenditure, profit, income tax etc. **Marketing** Assessment of market demand for potential product(s) of interest; Market conditions, segments; Prediction of market changes; Identifying needs of customers including gaps in the market, packaging the product; Market linkages, branding issues; Developing distribution channels; Pricing/Policies/Competition; Promotion/ Advertising; Services
UNIT-2 Negotiations/Strategy
Negotiations/Strategy With financiers, bankers etc.; With government/law enforcement authorities; With companies/Institutions for technology transfer; Dispute resolution skills; External environment/changes; Crisis/ Avoiding/Managing; Broader vision–Global thinking **Information Technology** How to use IT for business administration; Use of IT in improving business performance; Available software for better financial management; E-business setup, management **Human Resource Development (HRD)** Leadership skills; Managerial skills; Organization structure, pros & cons of different structures; Team building, teamwork; Appraisal; Rewards in small scale set up **Fundamentals of Entrepreneurship** Support mechanism for entrepreneurship in India **Role of knowledge centre and R&D** Knowledge centers like universities and research

institutions; Role of technology and upgradation; Assessment of scale of development of Technology; Managing Technology Transfer; Regulations for transfer of foreign technologies; Technology transfer agencies

UNIT-3 Case Study

Case Study

1. Candidates should be made to start a 'mock paper company', systematically following all the procedures.

- The market analysis developed by them will be used to choose the product or services
- A product or service is created in paper and positioned in the market. As a product or services available only in paper to be sold in the market through the existing links. At this juncture, the pricing of the product or the service needs to be finalized; linking the distribution system until the product or services reaches the end consumer
- Candidates who have developed such product or service could present the same as a project work to the Panel of Experts, including representatives from industry sector. If the presented product or service is found to have real potential, the candidates would be exposed to the next level of actual implementation of the project

2. Go to any venture capital website (like sequoiacap.com) and prepare a proposal for funding from venture capital

B.Sc. Biotechnology: Semester-III BST 351 : Molecular Biology Lab	
Teaching Scheme	**Examination Scheme**
Lectures: 0 hrs/Week Tutorials: 0 hrs/ Week	Internal Assessment - 15Marks External Assessment- 35 Marks
Practical's:4 hrs/Week	End Semester Exam – 50 Marks
Credits: 2	

Prerequisite: - BST 103 Cell Biology and BST 102 Introduction to Biotechnoogy,BST152 Biotechnology Lab

Course Objectives:

1. To give over view of concept of gene and chromosomes.
2. To give complete knowledge of Structure of DNA Molecules , Bacteria Contain Chromosomes and Extrachromosomal DNA, Organelles of Eukaryotic Cells Contain DNA, DNA Supercoiling
3. To describe Structure of DNA. Watson & Crick's Model, Types of DNA. Meselsen & Stahl's experiment, DNA replication with Enzymes and Protein factors in DNA Replication, genome complexity
4. To explain the DNA Dependent synthesis of RNA, RNA Polymerases, Structure and types of RNA and their functions
5. To explain the Genetics code, Protein synthesis: Ribosomes, tRNA, Aminoacyl-tRNA Synthetases
6. Genetic recombination, Molecular aspects of recombination, Homologous and heterologous recombination

Course Outcomes:

After completing the course, students will be able to:

CO1: Understand and apply the principles and techniques of molecular biology which prepares students for further education and/or employment in teaching, basic research, or the health professions

CO2: Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments

CO3:Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems

CO4: 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

CO5: Students will be able to explore new areas of research in both molecular biology and allied fields of science and technology

CO6: Research Development and Practice that is Formulate and carryout independent andcollaborative research projects.

CO7: Students will be able to develop the communication skills in presenting their researchfindings through effective oral and written presentations

Detailed Syllabus:

UNIT1: Biotechnology Practical's
1. Preparation of serum protein from blood 2. Preparation of nutrient agar slants, plates and nutrient broth and their sterilization 3. Inoculation of agar slants, agar plate and nutrient broth 4. Culture of microorganisms using soil sample 5. Culture of microorganisms using soil sewage water 6. Simple and differential staining procedures, endospore staining, flageller staining, cell wall staining, capsular staining, negative staining 7. Bacterial colony counting 8. Isolation of DNA from blood samples 9. Isolation of RNA from leaves

B.Sc. Biotechnology: Semester-III BST352: Chemistry Lab III	
Teaching Scheme Lectures: 0 hrs/Week Tutorial: 0 hrs/Week Practical's: 4 hrs/Week Credits: 2	**Examination Scheme** Internal Assessment - 15Marks External Assessment- 35 Marks End Semester Exam – 50 Marks

Prerequisite: - BST 101, BST151, Chemistry-1 and chemistry lab BST 201 and BST 251 Chemistry

Course Objectives:

1. To give over view of concept of thermodynamics and energy.
2. To give complete knowledge of Joule's law-joule-Thomson coefficient and inversion temperature
3. Calculation of w,q, dU, & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process
4. To describe Classification and nomenclature
5. To explain the different methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters
6. To explain the methods of formation, chemical reactions of vicinal glycols, and pinacol-pinacolone rearrangement
7. To explain the Properties of the elements of the first transition series, their binary compounds and complexes

Course Outcomes:

After completing the course, students will be able to:

CO1: Students will learn common laboratory techniques including pH measurement, acid/base titrations, UV/Visible spectroscopy in emission and absorption mode, calorimetric, and colorimetric

CO2: Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments

CO3: Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems

CO4: 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.

CO5: Students will be able to explore new areas of research in both chemistry and allied fields of science and technology

CO6: Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behavior in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and medicine

CO7: Students will be able to explain why chemistry is an integral activity for addressing social, economic, and environmental problems

Detailed Syllabus:

1. Determination of water equivalent of calorimeter (cooling curve)
2. Determination of strength of acid and base pH metrically
3. Heat of solution (NH_4NO_3 , $CaCl_2$)
4. Basicity of an acid by thermo chemical method
5. Redox titration : (a) Fe^{2+} / $K_2Cr_2O_7$

B.Sc. Biotechnology: Semester-IV BST401: IMMUNOLOGY	
Teaching Scheme Lectures: 3 hrs/Week Tutorials:1hrs/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

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

Course Objectives:

1. To give Overview of immune system - Innate Immunity and Adaptive Immunity
2. To give complete knowledge of Immunity Barriers, phagocytosis, inflammation, Specificity, Diversity, Immunologic memory
3. Cells and organs of the immune system: Hematopoiesis - B lymphocytes, T Lymphocytes, NK Cells and Macrophages
4. To describe Lymphoid Organs: Primary (thymus, bone marrow) and secondary lymphoid organs (Lymph nodes, spleen)
5. To explain Antigen recognition by T cells and B cells
6. To explain Structure, functions and characteristics of different classes of antibodies
7. To explain the elementary idea about types of hypersensitivity reactions

Course Outcomes:

After completing the course, students will be able to:

CO1: Students will understand the basic concept of innate and acquired immunity
CO2: Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments
CO3: Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems
CO4: 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
CO5: 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
CO6: Students will gain knowledge about immunoglobulin structures and diversity of antibodies, morphology and functions of various immune cells such as dendritic cells, macrophages, neutrophils and their association with MHC molecules will be studied
CO7: This study will make the students to understand the basic mechanisms of hypersensitivity responses and their associations with different diseases

Detailed Syllabus:

UNIT-1 Historical perspectives of Immune System
Historical perspectives of Immune System, Overview of immune system - Innate Immunity and Adaptive Immunity. Immunity Barriers, phagocytosis, inflammation, Specificity, Diversity, Immunologic memory, Self/nonself recognition. Antigenicity and Immunogenicity. Immune dysfunction and Its Consequences
UNIT-2 Cells and organs of the immune system
Cells and organs of the immune system: Hematopoiesis - B lymphocytes, T Lymphocytes, NK Cells and Macrophages. Lymphoid Organs: Primary (thymus, bone marrow) and secondary lymphoid organs (Lymph nodes, spleen). Antigens and epitopes: immunogenicity and antigenicity. Haptens and adjuvants. Antigen recognition by T cells and B cells, Properties of B-cell epitopes and T-cell epitopes, Blood group antigens
UNIT-3 Major histocompatibility systems
Structure, functions and characteristics of different classes of antibodies, Antigenic Determinants on Immunoglobulins, Basic idea of monoclonal antibody, Antigen antibody interaction - Precipitation Reactions, Agglutination Reactions. Major histocompatibility systems: MHC I and II molecule, Hypersensitivity, elementary idea about types of hypersensitivity reactions.

Text and Reference Books

1. Immunology (V Edition),- Richard A.Goldsby, Thomas. J. Kindt, A. Osborne, Janis Kuby, 2003. W.H. Freeman and company
2. Immunology, Ivan Roitt, 2001. Harcourt publishers, ltd.
3. Immunology - An Introduction, Tizard.

B.Sc. Biotechnology: Semester-IV BST402: GENETICS	
Teaching Scheme Lectures: 3 hrs/Week Tutorials:1 hrs/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: - BST103: cell biology, BST102: Introduction to biotechnology, BST302 Molecular Biology

Course Objectives:

1. To give Overview of a Genetics and Scientific Methods
2. To give complete knowledge of Mendelian principle: Principles of segregation, monoclonal cross, dominance, co dominance
3. Meiosis and Mendel's principles, Probability & Statistics
4. To describe Sex determination and linkage
5. To explain balanced concept of sex determination in Drosophila
6. To explain Principles of linkage; Crossing over
7. To explain Cytological demonstration of crossing over

Course Outcomes:

After completing the course, students will be able to:

CO1: Students will understand the basic concept of the chromosome structure, chromatin organization and variation

CO2: Students will be able to learn the concepts of Linkage concept of sex determination and sex linked inheritance

CO3: Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems

CO4: 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

CO5: To gain knowledge about the organellar inheritance. And to understand the gene expression and regulation in Prokaryotes & Eukaryotes

CO6: Students will gain the better knowledge in both Prokaryotes & Eukaryotes about the Gene Mutation, Repair Mechanisms, Nuclear Genome Organization, Genes and gene numbers

CO7:Students will become familiar with the tools and techniques of genetic engineering DNA manipulation enzymes, genome and transcriptome analysis and manipulation tools, gene expression regulation, production and characterization of recombinant proteins

Detailed Syllabus:

UNIT-1 Genetics
Genetics and Scientific Methods: History, Area; Mendelian principle: Principles of segregation, monoclonal cross, dominance, co dominance, semi-dominance, lethal genes, Principles of independent assortment: dihybrid rations, Trihybrid ratios, gene interaction, epitasis, multiple alleles. Meiosis and Mendel's principles, Probability & Statistics.
UNIT-2 Sex determination
Sex determination and linkage: Mechanisms of sex determination: Simple mechanisms, One or a few genes, identification of sex Chromosomes, XX-XY mechanism, Y Chromosome and sex determination in mammals, balanced concept of sex determination in Drosophila, haploidy and sex determination in hymenoptera, Mosaics and gynandromorphy, environmental factors in sex determination, sex differentiation sex influenced dominance. Sex limited gene expression, sex linked inheritance, Pedigree Analysis: Penetrance & expressivity, Family tree etc.
UNIT-3 Linkage
Principles of linkage; Crossing over ,cytological basis of crossing over, Diploid Mapping: Two-three point cross, Cytological demonstration of crossing over, Haploid Mapping (Tetrads Analysis): Phenotypes of Fungi, Unoorded Spores (Yeast), Ordered Spores (*Neurospora*), Somatic Crossing Over, Human Chromosomal Maps: X-Linkage, Autosomal Linkage.

Text and Reference Books

1. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons
2. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. XI Edition. Benjamin Cummings.
3. Russell, P. J. (2009). iGenetics- A Molecular Approach. III Edition. Benjamin Cummings.

B.Sc. Biotechnology: Semester-IV BST403: Chemistry IV	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1hrs/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: - Basic knowledge of chemistry

Course Objectives:

1. To give over view of Werner's coordination theory and its experimental verification
2. To give complete knowledge of valence bond theory of transition metal complexes
3. Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides
4. To describe Mechanisms of esterfication and hydrolysis
5. To explain Migration of ions and Kohlrausch law
6. To explain the Ostwald's dilution law its uses and limitations
7. To explain the Applications of conductivity measurements: determination of degree of dissociation

Course Outcomes:

After completing the course, students will be able to:

CO1: Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in Analytical, Inorganic, Organic and Physical Chemistries.

CO2: Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.

CO3: Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems.

CO4: 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.

CO5: Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.

CO6: Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behavior in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and medicine.

CO7: Students will be able to explain why chemistry is an integral activity for addressing

social, economic, and environmental problems.

Detailed Syllabus:

UNIT-1 Werner's coordination theory
Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes
UNIT-2 Structure and nomenclature
Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides, Relative stability of acyl derivatives, Physical properties, inter-conversion of acid derivatives by nucleophilic acyl substitution, Preparation of carboxylic acid derivatives, chemical Reactions, Mechanisms of esterfication and hydrolysis (acidic and basic)
UNIT-3 Electrolyte dissociation
Migration of ions and Kohlrausch law, Arrehenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law its uses and limitations. Debye-Huckel-Onsagar's equation for strong electrolytes (elementary treatment only). Transport number,definition and determination by Hittorf method and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation

Text and Reference Books

1. A Textbook of Physical Chemistry, A. S. Negi, S. C. Anand
2. Physical Chemistry, Gilbert William Castellan
3. Physical chemistry, Walter John Moore
4. Organic Chemistry, Benjamin List, Keiji Maruoka
5. Advanced Organic Chemistry, 4th ed. Part A: Structure and Mechanisms F. Carey and R. Sundberg, Kluwer Academic

B.Sc.Biotechnology: Semester-IV BST404: Enzymology	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hrs/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite:-BST303: Bioenergetics and Thermodynamics, BST103: Cell biology, BST102: Introduction to biotechnology, BST202:Biochemistry, BST203 Microbiology

Course Objectives:

1. To give Overview of a brief introduction; Mechanisms of Enzyme Action
2. To give complete knowledge of Acid Base Catalysis; Covalent catalysis, Metal ion Catalysis
3. Arrhenius Law; Transition State Theory; Kinetics of single substrate reactions; turnover number
4. To describe Random Sequential Bi Bi mechanism; Ordered Sequential Bi Bi mechanism, and Ping Pong Bi Bi mechanism
5. To explain Antigen recognition by T cells and B cells
6. To explain Types of Inhibition- kinetic models: Competitive, Uncompetitive and Non-Competitive
7. To explain the Enzyme Purification and their methods of characterization of enzymes

Course Outcomes:

After completing the course, students will be able to:

CO1: Students will understand the basic concept of enzymes and their activity.

CO2: Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.

CO3: Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems.

CO4: 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.

CO5: Basic knowledge of structure and functions of major bio-molecules will make the students to understand and implement the acquired knowledge in future.

CO6: Students will gain the understanding of metabolic pathways (catabolism as well as anabolism), their diversity and how these are specifically regulated and interrelated in different cells.

CO7: This study will make the students for Practical knowledge and hands on tools and techniques for the characterization of bio-molecules that will help the students in advanced research programs

Detailed Syllabus:

UNIT-1 Enzymes: Introduction and Classification
Enzyme commission (E. C.) nomenclature, a brief introduction; Mechanisms of Enzyme Action: General Acid Base Catalysis; Covalent catalysis, Metal ion Catalysis. Mechanism of Chymotrypsin catalysis (Serine Proteases), Specificity of enzyme action: Active Site, Stereospecificity, Lock and Key and Induced Fit Models. Arrhenius Law; Transition State Theory; Kinetics of single substrate reactions; turnover number; Importance of KM, estimation of Michaelis-Menton parameters. Lineweaver Burk plot; Multi-substrate reaction mechanisms and kinetics: Random Sequential Bi Bi mechanism; Ordered Sequential Bi Bi mechanism, and Ping Pong Bi Bi mechanism.
UNIT-2 Types of Inhibition
Types of Inhibition- kinetic models: Competitive, Uncompetitive and Non-Competitive. Regulation of enzymes activity: Allosteric Modification-Sigmoidal kinetics, Feed Back Inhibition and Covalent Modification. Factors affecting the kinetics Enzyme catalysed reactions; Physical and Chemical techniques for enzyme Immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding - examples; Biosensor; Glucose Biosensor
UNIT-3 Immobilization
Advantages and disadvantages of different Immobilization techniques; Overview of applications of immobilized enzyme systems, Applications of enzymes in analysis; Design of enzyme electrodes and their applications as biosensors in industry, health care and environment. Enzyme Purification and their methods of characterization of enzymes; development of enzymatic assays- ONPG Assay (colorimetric assay), Coupled kinetic Assay and RIA of enzymes

Text and Reference Books

1. Fundamentals of enzymology by Nicolas C. price and Lewis stevens . Oxford University Press
2. Enzymes by Trevor palmer, East west Press
3. Enzyme Technology by Messing
4. Enzymes : Dixon and Webb.(IRL Press)
5. Enzyme technology by Chaplin and Bucke. Cambridge Univerity Press
6. Alan Fersht, Structure and Mechanism in Protein Science.

B.Sc Biotechnology: Semester-IV BST405: Animal Physiology	
Teaching Scheme Lectures: 3 hrs/ eek Tutorials: 1 hrs/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: - BST103: Cell biology, BST102: Introduction to biotechnology, BST302 Molecular Biology

Course Objectives:

1. To give Overview of a Movement of water and solutes between the fluid compartments
2. To give complete knowledge of Body fluid compartments and the ionic composition of body fluids
3. Concept of homeostasis and Structure of biological membranes
4. To describe Organization structural and functional organization of the nervous system.
5. To explain Synaptic neurotransmission.
6. To explain central and peripheral nervous systems
7. To explain principles of sensory, vision, hearing physiology

Course Outcomes:

After completing the course, students will be able to:

CO1: Define the body fluids, Nerves and Cell Membrane

CO2: To understand the cell membrane composition, nerve fibres and key feature of membrane functions and signalling

CO3: To apply the principle of homeostasis, nervous system and the methods used by the body to maintain this

CO4: To differentiate how the parts of the body are linked into a functioning whole.

CO5: To evaluate the different practical knowledge of physiological techniques

CO6: To create the hypothesis about physiological topics

CO7: 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

Detailed Syllabus:

UNIT-1 Body fluids
Body fluid compartments and the ionic composition of body fluids, Movement of water and solutes between the fluid compartments, The concept of homeostasis, including set point, negative and positive feedback loops, and compensatory responses
UNIT-2 Biological Membranes

Structure of biological membranes, Function of biological membranes including the role of membrane proteins in catalysis, recognition, and transport. Intracellular and extracellular communication systems. Organization structural and functional organization of the nervous system, including the central and peripheral nervous systems, the autonomic nervous system, and the enteric nervous system
UNIT-3 Membrane Potential
The resting membrane potential, The action potential, action potential propagation along the axon, Chemical messenger molecules of the nervous system, including classical and non-classical neurotransmitters, Synaptic neurotransmission, Basic principles of sensory physiology, Vision physiology, Hearing physiology, Structure and function of skeletal muscle, including excitation-contraction coupling, sliding

Reference Books:

1. Anatomy and Physiology of Animals, Ruth Lawson
2. Animal Physiology (Looseleaf), Third Edition, Richard W. Hill Gordon A Wyse Margaret Anderson

B.Sc. Biotechnology: Semester-IV BST-406 : FOOD 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

Course Objectives:

1. To impart knowledge about the innovations in food processing technologies and their applications. To understand changes in the composition of food and comparison with conventional cooking methods.
2. To know packaging materials, their need according to different foods and to food quality parameters and their maintenance during storage.

Course Outcome:

After completing the course, students will be able to:

CO1: Identify the conditions under which the important pathogens are commonly inactivated, killed or made harmless in foods
CO2: Understand the principles involving food preservation via irradiation.
CO3: Understand the principles that make a food product safe for consumption
CO4: Understand the principles and current practices of processing techniques and the effects of processing parameters on product quality

Detailed Syllabus:

UNIT 1 History of Microorganisms
History of Microorganisms in food, Historical Developments. Role and significance of microorganisms in foods. Intrinsic and Extrinsic parameters of Foods that affect microbial growth. Basic principles, unit operations, and equipment involved in the commercially important food processing methods and unit operations **Microorganisms** Microorganisms in fresh meats and poultry, processed meats, seafood's, fermented dairy products and miscellaneous food products. Starter cultures, cheeses, beer, wine and distilled spirits, SCP, medical foods, probiotics and health benefits of fermented milk and foods products. Brewing, malting, mashing, hops, primary & secondary fermentation: Biotechnological improvements: catabolic repression, High gravity brewing, B-glucan problem, getting rid of diacetyl. Beer, wine and distilled spirits
UNIT 2 Nutritional boosts and flavor enhancers
Emerging processing and preservation technologies for milk and dairy products. Microbiological Examination of surfaces, Air Sampling, Metabolically Injured Organisms. Enumeration and Detection of Food-borne Organisms and indicators. Bioassay and related Methods **Food Preservation**-Food Preservation Using Irradiation, Characteristics of Radiations of Interest in Food Preservation. Principles Underlying the Destruction of Microorganisms by Irradiation, Processing of Foods by Irradiation, Application of Radiation, Radappertization, Radicidation, and Radurization of Foods. Legal Status of Food Irradiation, Effect of Irradiation of Food constituents
UNIT 3 Storage Stability Food
Preservation with Low Temperatures, Food Preservation with High Temperatures, Preservation of Foods by Drying, Other Proven and Suspected Food-borne Pathogens, Rheology of Food Production

Reference Books:

1. Frazier, W.S. and Weshoff, D.C., 1988. Food Microbiology, 4th Edn., McGraw Hill Book Co., New York.
2. Mann & Trusswell, 2007. Essentials of human nutrition. 3rd edition .oxford university press.
3. Jay, J.M., 1987. Modern Food Microbiology, CBS Publications, New Delhi.
4 Lindsay, 1988. Applied Science Biotechnology. Challenges for the flavour and Food Industry. Willis Elsevier.
5. Roger, A., Gordon, B. and John, T., 1989. Food Biotechnology

B.Sc. Biotechnology: Semester-IV BST451: ENZYMOLOGY LAB	
Teaching Scheme Lectures: 0 hrs/Week	**Examination Scheme** Internal Assessment - 15Marks
Tutorials: 0 hrs/Week Practicals: 4 hrs/Week	External Assessment- 35 Marks
Credits: 2	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 immune system - Innate Immunity and Adaptive Immunity
2. To give complete knowledge of Immunity Barriers, phagocytosis, inflammation, Specificity, Diversity, Immunologic memory
3. Cells and organs of the immune system: Hematopoiesis - B lymphocytes, T Lymphocytes, NK Cells and Macrophages
4. To describe Lymphoid Organs: Primary (thymus, bone marrow) and secondary lymphoid organs (Lymph nodes, spleen)
5. To explain Antigen recognition by T cells and B cells
6. To explain Structure, functions and characteristics of different classes of antibodies
7. To explain the elementary idea about types of hypersensitivity reactions

Course Outcomes:

After completing the course, students will be able to:

CO1: Students will understand the basic concept of innate and acquired immunity.

CO2: Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.

CO3: Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems.

CO4: 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.

CO5: 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.

CO6: Students will gain knowledge about immunoglobulin structures and diversity of antibodies, morphology and functions of various immune cells such as dendritic cells, macrophages, neutrophils and their association with MHC molecules will be studied.

CO7: This study will make the students to understand the basic mechanisms of hypersensitivity responses and their associations with different diseases.

Detailed Syllabus:

UNIT1: Biotechnology Practical's
1. Different types of antigen –antibody cross reaction 2. Isolation, purification and identification of immunoglobulin from goat blood 3. Double diffusion techniques for identification of antigen-antibody samples 4. SDS - PAGE 5. Agarose gel electrophoresis 6. ELISA (Enzyme linked Immunosorbent Assay) 7. Isolation of DNA from plant cell 8. Isolation of DNA from animal cells 9. Plasmid isolation from bacteria

B.Sc Biotechnology: Semester-II BST452: Chemistry IV	
Teaching Scheme Lectures: 0 hrs/Week	**Examination Scheme** Internal Assessment - 15Marks
Tutorials: 0 hrs/Week Practicals: 4 hrs/Week	External Assessment- 35 Marks
Credits: 2	End Semester Exam – 50 Marks

Prerequisite: - BST 101, BST151, Chemistry-1 and chemistry lab BST 201 and BST 251 Chemistry

Course Objectives:

1. To give over view of Werner's coordination theory and its experimental verification
2. To give complete knowledge of valence bond theory of transition metal complexes
3. Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides
4. To describe Mechanisms of esterfication and hydrolysis
5. To explain Migration of ions and Kohlrausch law
6. To explain the Ostwald's dilution law its uses and limitations
7. To explain the Applications of conductivity measurements: determination of degree of dissociation

Course Outcomes:

After completing the course, students will be able to:

CO1: Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in Analytical, Inorganic, Organic and Phvsical Chemistries

CO2: Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments

CO3:Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems

CO4: 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

CO5: Students will be able to explore new areas of research in both chemistry and allied

fields of science and technology

CO6: Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behavior in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and medicine

CO7: Students will be able to explain why chemistry is an integral activity for addressing social, economic, and environmental problems

Detailed Syllabus:

UNIT1: Chemistry Practical
1. Viscosity-composition curve for a binary liquid mixture
2. Surface tension-composition curve for a binary liquid mixture
3. Determination of indicator constant – colorimetry
4. Determination of pH of a given solution using glass electrode
5. Determination of conductivity of solvents

CBCS Course Curriculum (Effective from Session 2020-21)

[Bachelor of Science (Biotechnology)]

Bachelor of Science (Biotechnology Hons.)

(3rd Year)Course Structure

STUDY AND EVALUATION SCHEME
Bachelor of Science [Biotechnology]

(Effective from Session 2020-2021)

YEAR III, SEMESTER V

COURSE CODE	COURSE TITLE	COURSE CATEGORY	HOURS			EVALUATION SCHEME		SUBJECT TOTAL	CREDIT
			L	T	P	CA	EE		
BST501	BIOPROCESS TECHNOLOGY	CC	3	1	0	30	70	100	4
BST502	RECOMBINANT DNA TECHNOLOGY	CC	3	1	0	30	70	100	4
BST503	PLANT PHYSIOLOGY	CC	3	1	0	30	70	100	4
BST504	FRONTIERS IN BIOTECHNOLOGY	AEC	3	1	0	30	70	100	4
BST505	MEDICAL MICROBIOLOGY	GE*	3	1	0	30	70	100	4
BST506	PLANT BIOTECHNOLOGY	GE*							
BST551	RECOMBINANT DNA TECHNOLOGY LAB	SEC	0	0	4	15	35	50	2
BST 552	SEMINAR I	SEC	0	0	2	50	0	50	2
TOTAL			**15**	**5**	**6**	**215**	**385**	**600**	**24**

CC-Core Courses; GE-Generic Elective; AEC-Ability Enhancement Course; SEC-Skill Enhancement Courses

L – Lecture; T – Tutorial; P – Practical; C – Credit; CA-Continuous Assessment; EE – End Semester Exam

GE* - Elect any one from the prescribed;

YEAR III, SEMESTER VI

COURSE CODE	COURSE TITLE	COURSE CATEGORY	HOURS			EVALUATION SCHEME		SUBJECT TOTAL	CREDIT
			L	T	P	CA	EE		
BST601	ANALYTICAL TECHNIQUES	CC	3	1	0	30	70	100	4
BST602	GENOMICS AND PROTEOMICS	CC	3	1	0	30	70	100	4
BST603	INDUSTRIAL BIOTECHNOLOGY	CC	3	1	0	30	70	100	4
BST604	BIOINFORMATICS	AEC	3	1	0	30	70	100	4
BST605	ENVIRONMENTAL BIOTECHNOLOGY	GE*	3	1	0	30	70	100	4
BST606	INTELLECTUAL PROPERTY RIGHTS	GE*							
BST651	INDUSTRIAL BIOTECHNOLOGY LAB	SEC	0	0	4	15	35	50	2
BST 652	SEMINAR II	SEC	0	0	2	50	0	50	2
TOTAL			**15**	**5**	**6**	**215**	**385**	**600**	**24**

CC-Core Courses; GE-Generic Elective; AEC-Ability Enhancement Course; SEC-Skill Enhancement Courses

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

B.Sc. Biotechnology: Semester-V BST 501: Bioprocess Technology	
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: - BST203 Microbiology, BST404 Genetics

Course Objectives:

1 To give the basic concept of fermentation and types of bioreactors in fermentation industry.

2. To give complete knowledge of various types of fermentation, sterilization and microbes used in fermentation industry.

3. To explain the process of different techniques of upstream and downstream processing.

4. To explain the importance of processing of major fermented foods and beverages.

5. To explain and emphasize the importance of food additive: colors, flavors, preservatives in food industry.

Course Outcomes:

After completing the course, students will be able to:

CO1: To define the basic concept of fermentation and types of fermentors and bioreactors used in fermentation industry: their working mechanism.
CO2: To understand various types of fermentation like Batch, fed batch and continuous; Conventional fermentation v/s biotransformation; Solid substrate, surface and submerged fermentation
CO3: To determine the mechanisms sterilization and their types.
CO4: To analyze different techniques of upstream and downstream processing in detail: Bioseparation - filtration, centrifugation, sedimentation, flocculation; Cell disruption; Liquid-liquid extraction; Purification by chromatographic techniques; Reverse osmosis and ultra filtration; Drying; Crystallization; Storage and packaging; Treatment of effluent and its disposal.
CO5: To evaluate the processing of major fermented foods and beverages; Food ingredients and additives prepared by fermentation and their purification.
CO6: To explain the use of microbes and their use in pickling, producing colours and flavours, alcoholic beverages and other products; Process wastes-whey, molasses, starch substrates and other food wastes for bioconversion to useful products.
CO7: To explain role of preservatives in food industry: Bacteriocins from lactic acid bacteria – Production and applications in food preservation.

Detailed Syllabus::

UNIT-1 Bioreactor designs
Bioreactor designs; Types of fermentation and fermenters; Concepts of basic modes of fermentation - Batch, fed batch and continuous; Conventional fermentation v/s biotransformation; Solid substrate, surface and submerged fermentation; Fermentation economics; Fermentation media; Fermenter design- mechanically agitated; Pneumatic and hydrodynamic fermenters; Large scale animal and plant cell cultivation and air sterilization; Upstream processing: Media formulation; Sterilization; Aeration and agitation in bioprocess; Measurement and control of bioprocess parameters; Scale up and scale down process
UNIT-2 Bioseparation
Bioseparation - filtration, centrifugation, sedimentation, flocculation; Cell disruption; Liquid-liquid extraction; Purification by chromatographic techniques; Reverse osmosis and ultra filtration; Drying; Crystallization; Storage and packaging; Treatment of effluent and its disposal
UNIT-3 Fermented foods and beverages
Fermented foods and beverages; Food ingredients and additives prepared by fermentation and their purification; fermentation as a method of preparing and preserving foods; Microbes and their use in pickling, producing colours and flavours, alcoholic beverages and other products; Process wastes-whey, molasses, starch substrates and other food wastes for bioconversion to useful products; Bacteriocins from lactic acid bacteria – Production and applications in food preservation

Text and Reference Books

1. Voet D, Voet JG & Pratt CW, Fundamentals of Biochemistry, 2nd Edition. Wiley Jackson AT., Bioprocess Engineering in Biotechnology, Prentice Hall, Engelwood Cliffs, 1991.
1. Shuler ML and Kargi F., Bioprocess Engineering: Basic concepts, 2nd Edition, Prentice Hall, Engelwood Cliffs, 2002.
2. Stanbury RF and Whitaker A., Principles of Fermentation Technology, Pergamon press, Oxford, 1997.
3. Baily JE and Ollis DF., Biochemical Engineering fundamentals, 2nd Edition, McGraw-Hill Book Co., New York, 1986.
4. Aiba S, Humphrey AE and Millis NF, Biochemical Engineering, 2nd Edition, University of Tokyo press Tokyo, 1973.
5. Comprehensive Biotechnology: The Principles, Applications and Regulations of Biotechnology in Industry.

B.Sc. Biotechnology: Semester-V BST 502: Recombinant DNA Technology	
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: - BST302 Molecular Biology, BST402 Immunology

Course Objectives:

1 To give brief introduction about Recombinant DNA Technology

2. To give complete knowledge about the construction of genomic and cDNA library

3. To explain the process of gene transfer mechanism in bacteria, plants and animals

4. To explain the importance of edible vaccines

5. To explain and emphasize on the production of monoclonal antibody production and its applications

Course Outcomes:

After completing the course, students will be able to:

CO1: To remember Restriction enzymes their types and properties, properties of a Cloning vehicles, plasmids as cloning vectors, viruses (phage lambda and mu) as a cloning vectors.
CO2: To understand the concept of Concept of cloning and HAT selection.
CO3: To apply the techniques of recombinant DNA technology for the production of transgenic plants.
CO4: To analyze Gene transfer mechanisms in bacteria, plants and animals i.e. transformation, conjugation, transduction, particle gun, liposome mediated and microinjection.
CO5: To evaluate the procedure of forming cDNA and genomic library.
CO6: To create edible vaccines from plants using recombinant DNA technology.
CO7: To explain and analyze various applications of microbial genetic engineering in biotechnology.

Detailed syllabus::

UNIT-1 Introduction of RDT
Introduction of RDT, Restriction enzyme, DNA manipulative enzymes and DNA modifying enzymes, concept of cloning, properties of cloning vehicle, plasmid as cloning vectors, viruses (phage, lambda and mu) as cloning vectors, insertion of a DNA molecule in cloning vector, expression of cloned genes, recombinant selection and screening , genomic and cDNA libraries
UNIT-2 Gene transfer mechanisms in bacteria
Gene transfer mechanisms in bacteria: principles and applications of transformation, conjugation, transduction, particle gun, liposome mediated and microinjection, Applications

of microbial genetic engineering in biotechnology.
UNIT-3 Gene transfer mechanism in plants
Gene transfer mechanism in plants: agrobacterium mediated. Applications of transgenic plants, edible vaccines from plants. Gene transfer mechanism in animals: transfection of animal cell lines, HAT selection. Selectable markers and transplantation of cultured cells. Expression of cloned proteins in animal cells – expression vectors

Text and Reference Books

1. OLD, R.W AND PRIMROSE S.B 1994. Principles of gene manipulation – An introduction to genetic engineering. Fifth edition. Blackwell Scientific Publication.

2. T.A BROWN. Gene cloning and DNA analysis. Sixth Introduction. Wiley and Blackwell.

3. Recombinant DNA 2nd edition. Watson, James D. and Gilman, M. (2001) W.H Freeman Company, New York.

4. An introduction to genetic Engineering 2nd edition Desmond Nicholl S.T (2002) Cambridge University Press.

5. Sambrook. Fritsch E.F and Maniatis. 1989. Molecular Cloning – A laborartory.

B.Sc. Biotechnology: Semester-V BST 503: Plant Physiology	
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: - BST405 Animal Physiology

Course Objectives:

1 To give extensive knowledge of physiological behavior of different plant under different environmental conditions.

2. To give complete knowledge of mechanism of trapping sun light by the plant to prepare food and other useful metabolites and the mechanism of energy consumption are the main highlights of the course.

3. To explain the process of growth and development of plants and their movement.

4. To explain the importance of relationship between soils, water and plants.

5. To explain and emphasize on the common physiological processes such as diffusion, osmosis, transpiration, photosynthesis and respiration.

Course Outcomes:

After completing the course, students will be able to:

CO1: To define physiological mechanisms involved in the uptake and transport of water and the translocation of food by plants.

CO2: To understand the mechanisms for procurement of mineral ions by plants and mineral nutrition and the role these minerals play in organic molecule synthesis and use.

CO3: To determine the interrelationships among plants and micro-organisms, symbiosis in nitrogen and phosphorous acquisition by plants

CO4: To analyze different factors involved in water absorption (like DPD, OP, TP etc.) and the role of environmental and plant factors in photosynthesis and influence upon carbon metabolism in plants (e.g. with respect to alternative fixation pathways photo inhibition, and photorespiration)

CO5: To evaluate major affects on physiological and biochemical mechanisms of growth regulators (hormones) in plants.

CO6: To explain and construct growth curve for investigating the growth pattern.

CO7: To explain the electron transport chain, phosphorylation and ATP production, Comparison of photosynthetic systems of plants and bacteria. Photorespiration. Respiration; Glycolytic pathway .Citric acid cycle, glyoxylate cycle, Pentose phosphate pathway, their significance, energetics and enzymology

Detailed syllabus:

UNIT-1 Water Relations
Water Relations, Osmosis, and Water movement, Transpiration, Stomatal Behavior, Mineral nutrition/Absorption of minerals/Assimilation of nitrogen and sulfur, The Soil as a Nutrient Reservoir: Nutrient Uptake, Selective Accumulation of Ions by Roots, Electrochemical Gradients and Ion Movement, Electrogenic Pumps are Critical for Cellular Active Transport, Cellular Ion Uptake Processes are Interactive, Root Architecture is Important to Maximize Ion Uptake, The Radial Path of Ion Movement Through Roots, Root-Microbe Interactions
UNIT-2 Photosynthesis
Photosynthesis, Diversity of Phototrophs, Chloroplast structure, Pigments involved in photosynthesis chlorophylls, carotenoids, xanthophylls and phycobillins, Light and dark reaction, C3 and C4 pathways, Electron transport chain, Phosphorylation and ATP production, Comparison of photosynthetic systems of plants and bacteria, Photorespiration, Respiration; Glycolytic pathway, Citric acid cycle, glyoxylate cycle, Pentose phosphate pathway, their significance, Energetics and enzymology
UNIT-3 Plant Hormones
Hormones: Auxins, Gibberellins, Cytokinins, Abscisic Acid, Ethylene, and Brassinosteroids, Photomorphogenesis: Responding to Light, Tropisms and Nastic Movements: Orienting Plants in Space, Secondary Metabolites: A.K.A Natural Products, Terpenes, Glycosides, Phenylpropanoids, Alkaloids

Text and Reference Books

1. Maheswari P. Introduction to Embryology of Angiosperms
2. Datta, S. C. (1989) Plant Physiology , Central Book Depot, Allahabad.
3. Hopkins,W.G.(1999) Introduction to Plant Physiology,John Wiley &SonInc. New York
4. Levitt, J.(1969) Introduction to plant physiology , C.V.Koshy Co. Tokyo.
5. Malik, C.P. (1980) Plant Physiology, Kalyani Publishers, New Delhi.

B.Sc. Biotechnology: Semester-V BST 504: Frontiers in 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: - BST302 Molecular Biology, BST503 Genomics and Proteomics, BST504 Bioprocess Technology

Course Objectives:

1. To give knowledge of key technologies and their applications to the study of human and model organism genomes.

2. To give complete knowledge of closely related areas of functional, structural and comparative genomics.

3. To explain the current state of expression, cell map and modular proteomics.

4. To explain Geo-Genomics and Human migrations, High throughput screening in genome for drug discovery, Pharmacogenetics and drug development.

5. To explain the concept of Stem cell technology and Nanotechnology

Course Outcomes:

After completing the course, students will be able to:

CO1: To define Genetically modified food, plants and animals in brief, future goals in GM food crops and animals as well as biotechnology Commercial products: Insulin, Golden rice, BT Cotton etc.
CO2: To understand mutation and its types, allele specific oligonucleotides, ARMS, oligonucleotide ligation and disease diagnosis with linked genetic markers
CO3: To determine the concept of Micro RNA, Gene silencing and RNAi and fluorescently labeled DNA sequencing.
CO4: To analyze the concept of stem cells technology: Definition, properties, proliferation, medical applications, ethical and legal issues in use of stem cells.
CO5: To evaluate the principle of Nanotechnology, hybrid nanoparticles, smart drug delivery,biomolecule control, nanofluids, nanotechnology in medicine and biosensors.
CO6: To explain Meeting of human populations & its genetic imprint; Detection of admixture (based on allele frequencies & DNA data); Y Chromosome& mitochondrial DNA markers in genealogical studies.
CO7: To explain Geo-Genomics and Human migrations; Culture and human evolution: High throughput screening in genome for drug discovery-identification of gene targets, Pharmacogenetics and drug Development

Detailed syllabus: :

UNIT-1 Genetically modified organisms
Genetically modified organisms: Genetically modified food crops, food animals - examples and mode of production in brief. Future goals in GM food crops and animals, scientific valuation of public concerns, legal requirements in production of GMO Biotechnology Commercial products: Insulin, Golden rice, BT Cotton etc
UNIT-2 Human molecular medicine
Human molecular medicine: Gene mutation, point mutation, allele specific oligonucleotides, ARMS, oligonucleotide ligation, disease diagnosis with linked genetic markers, fluorescently labeled DNA sequencing. Micro RNA, Gene silencing and RNAi, Stem cells technology: Definition, properties, proliferation, culture of stem cells, medical applications of stem cells, ethical and legal issues in use of stem cells. Nanotechnology: Introduction & definition, hybrid nanopracticles, smart drug delivery, biomolecule control, nanofluids, nanotechnology in medicine, Biosensors
UNIT-3 Human evolution
Meeting of human populations & its genetic imprint; Detection of admixture (based on allele frequencies& DNA data); Y Chromosome& mitochondrial DNA markers in genealogical studies; Peopling of continents (Europe, Africa, Asia): Geo-Genomics and Human migrations; Culture and human evolution: High throughput screening in genome for drug discovery-identification of gene targets, Pharmacogenetics and drug development

Text and Reference Books:

1. The Cell - A molecular Approach, Geoffrey M. Cooper and Robert E. Hausman, ASM Press
2. Molecular Biology and Biotechnology, 4th Edn, J.M Walker and R. Rapley, Panima Books
3. Cell Biology, David. E. Sadava, Panima Books, Stem Cell Biology, Daniel Marshak, Richard L. Gardener and David Gottlieb, Cold Spring Harbour Laboratory Press
4. Environmental Microbiology, 2nd Edition, Ian L .Pepper and Charles P. Gerba, Elsevier Pub.
5. Environmental Biotechnology–Concepts and Application, Hans–Joachim Jordening and Jesefwinter – Wiley – VCH
6. Affinity Biosensors: Techniques and Protocols, K.R. Rogers and A. Mulchandani, Humana Press.
7. Biosensors and their Applicatrions, V.C. Yang and T.T. Ngo, Plenum Publishing Corporation.

B.Sc. Biotechnology: Semester-V BST 505:Medical 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: - BST-Microbiology, BST503 Genomics and Proteomics, BST504

Course Objectives:

1 To give the basic knowledge of microbiology and diversity of microbes.

2. To give complete knowledge of various types of microbes involved in pathogenesis.

3. To explain the antibiotic resistant and sensitivity of pathogenic microbes.

4. To explain the importance of antibiotics and mechanisms of inhibitions.

Course Outcomes:

After completing the course, students will be able to:

CO1: This course provides learning opportunities in the basic principles of medical microbiology and infectious disease.

CO2: It covers mechanisms of infectious disease transmission, principles of aseptic practice, and the role of the human body's normal microflora

CO3: The course provides the conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause disease in the human body.

CO4: It also provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.

CO5: To understand the importance of pathogenic bacteria in human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.

CO6: Helps to understand the use of lab animals in medical field.

CO7: Recall the relationship of this infection to symptoms, relapse and the accompanying pathology.

CO8: Explain the methods of microorganism's control, e.g. chemotherapy & vaccines. Solve problems in the context of this understanding.

Detailed Syllabus:

UNIT-1 General topics on Medical Microbiology
General topics on Medical Microbiology: History and development, Koch's postulates, classification of medically important bacteria. Infection: source, modes of transmission, portal of entry into the susceptible host and prevention

UNIT-2 Bacterial pathogenicity
Bacterial pathogenicity, identification of bacteria: staining methods, culture methods, biochemical tests and other recent methods. Sterilization and disinfection. Normal microbial flora, antimicrobial agents, drug resistance and drug sensitivity test
UNIT-3 Systematic Microbiology
Systematic Microbiology: Diseases caused by Gram positive and Gram Negative bacteria, pneumonia, gonorrhea, Tuberculosis, UTI, Overview of Medical Mycology, Important Fungal Diseases – Superficial, and Overview of Medical Virology, Important Viral Diseases– Herpesvirus, Poliovirus

Text and Reference Books

1. Greenwood D (2007). Medical Microbiology. I.K. International.

2. Murray PR, Pfaller MA, Tenover FC and Yolken RH (2007). Clinical Microbiology. ASM Press.

3. Talaro KP and Talaro A. (2006). Foundations in Microbiology. McGraw-Hill College Dimensi.

4. Willey J, Sherwood L. and Woolverton C (2007). Prescott/Harley/Klein's Microbiology, McGraw Hill.

5. Atlas RM (1997). Principles of Microbiology. McGraw Hill.

6. Nester E.W, Anderson DG and Nester MT (2006). Microbiology. A Human Perspective. McGraw Hill.

7. Harvey, R.A., Champe, P.C. and Fisher, B.D. 2007. Lippincott’s Illustrated Reviews : Microbiology.

Lippincott Williams and Wilkins, New Delhi/New York.

B.Sc. Biotechnology: Semester-V BST 506:Plant 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: - BST-Microbiology, BST503 Genomics and Proteomics, BST504

Course Objectives:

1To give the basic knowledge of plant tissue culture.

2. To give complete knowledge of various types of plant tissue culture and involved in regeneration of plants in shorter period of time.

3. To understand the utility of plant tissue culture in genetic modified plant production.

4. To understand the role of plant tissue culture in haploid plant production.

5. To understand the consepet abiotic stress tolerant plant through somaclonal variations.

Course Outcomes:

CO1: This course provides basic concepts of tissue culture**.**
CO2: Recall the basic concept of biotechnology and explain fundamental cellular events during the process of plant cell culture developments.

Detailed syllabus:

UNIT-1 Tissue Culture:
Historical benchmarks of plant cell and tissue culture; Culture media components and modifications; Sterilization techniques; Various types of culture: callus, suspension, nurse, root.
UNIT-2 In vitro differentiation:
In vitro differentiation: Organogenesis and somatic embryogenesis; Plant growth regulators: mode of action, effects on in vitro culture and regeneration. Synthetic seeds; In vitro fertilization; Embryo rescue in wide hybridization; Endosperm culture, cryopreservation
UNIT-3 Micropropagation

Micropropagation; Anther and microspore culture; Somaclonal variation; In vitro mutagenesis; Production of secondary metabolites; Protoplast isolation, culture and regeneration; Somatic hybridization: cybrids, asymmetric hybrids; In vitro germplasm conservation

Text and Reference Books:

1. Bhojwani SS &Razdan MK. 1996. Plant Tissue Culture: Theory and Practice. Elsevier.
2.Debergh PC & Zimmerman RH. 1991. Micropropagation: Technology and Application. Kluwer Academic.
3. Chawla H.S. Introduction to Plant Biotechnology
4. Dey Kumar K. Plant Tissue Culture. New Central Book Agency (P) Ltd. Reference Books: 5.Dixon RA & Gonzales RA. Plant Cell Culture: A Practical Approach. Oxford University press.
5. George EF, Hall MA & Klerk GJD. 2007. Plant Propagation by Tissue Culture. 3rd Ed. Volume 1. Springer Science & Business Media Exercise No

B.Sc Biotechnology: Semester-V BST551: Recombinant DNA Technology Lab	
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 immune system - Innate Immunity and Adaptive Immunity.
2. To Give complete knowledge of Immunity Barriers, phagocytosis, inflammation, Specificity, Diversity, Immunologic memory.
3. Cells and organs of the immune system: Hematopoiesis - B lymphocytes, T Lymphocytes, NK Cells and Macrophages.
4. To describe Lymphoid Organs: Primary (thymus, bone marrow) and secondary lymphoid organs (Lymph nodes, spleen).
5. To explain Antigen recognition by T cells and B cells.
6. To explain Structure, functions and characteristics of different classes of antibodies.
7. To explain the elementary idea about types of hypersensitivity reactions.

Course Outcomes:

After completing the course, students will be able to:

CO1: Students will understand the basic concept of innate and acquired immunity.
CO2: Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.
CO3: Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems.
CO4: 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.
CO5: 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.
CO6: Students will gain knowledge about immunoglobulin structures and diversity of antibodies, morphology and functions of various immune cells such as dendritic cells, macrophages, neutrophils and their association with MHC molecules will be studied.
CO7: This study will make the students to understand the basic mechanisms of

hypersensitivity responses and their associations with different diseases.

Detailed Syllabus:

UNIT1: Biotechnology Practical's
1. Preparation of metaphase chromosome 2. DNA isolation and digestion by restriction enzymes 3. SDS PAE 4. Agarose gel electrophoresis 5. Competent cell preparation and transformation 6. Blue white selection 7. DNA ligation reaction

BST 552: SEMINAR I	
Teaching Scheme Lectures: 2 hrs/Week Credits: 2	**Examination Scheme** End Semester Exam – 50 marks

Prerequisite: - BST201 Biochemistry, BST202 Microbiology, BST102 Cell Biology, BST301 Molecular Biology etc..

Course Objectives:

1. To understand and learn the concepts of any topic that he is interested in.
2. To learn how to present a scientific topic in front of examiner.
3. To understand basic principle of the technique.
4. To learn and explain the application of the methods.
5. To enhance the computational skills.
6. To get to know the various technical objective and conclusion of his topic.

It's compulsory for all the students to give a seminar on the topic assigned by the Department of Biotechnology in the staring of the semester, in the supervision of the assigned supervisor. If the discussion session of seminar / presentation is not found satisfactory then the next date for the said presentation will be given immediately.

Presentation Time duration : 30 - 45 minutes
Discussion duration : 15 - 20 minutes

Course Outcomes: After this course, students will be able to understand
1. Will enhance his communication and computational skills.
2. Will leads to enhance the confidence and personal aptitude.
3. Analyze the procedure and instrumentation required for proving his hypothesis.
4. Will teach him to boldly accept the outcomes and conclusion of topic.
5. Will teach him how to represent a data.
6.Will learn to present research data

B.Sc. Biotechnology: Semester-VI BST 601: Analytical Techniques 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: - BST102 Introduction to Biotechnology, BST151 Biotechnology Lab-I

Course Objectives:

1 To give basic overview of different types of microscopic techniques.

2. To give complete knowledge of Phase contrast microscopy, Transmission Electron Microscope and Scanning Electron Microscope.

3. To explain the technique of electrophoresis and its various types.

4. To explain the importance of western blotting.

5. To explain and focus on various types of chromatographic techniques.

Course Outcomes:

After completing the course, students will be able to:

CO1: To state the principle and working of various types of Microscopic Techniques i.e. Simple, compound, inverted, stereo, fluorescence, dark field and bright field microscope.
CO2: To understand the concept of phase contrast microscopy.
CO3: To explain the principle and working mechanism of TEM and SEM.
CO4: To analyze and distinguish between different types of electrophoretic techniques.
CO5: To evaluate and outline the concept of western blotting.
CO6: To explain the principle, application, affinity, mobile phase and stationary phase, types of columns, used in various chromatographic techniques.
CO7: To explain the concept of Paper Chromatography, Gel filtration Chromatography, ion-exchange chromatography, affinity chromatography, High Performance Liquid Chromatography (Normal phase and reverse phase).

Detailed syllabus::

UNIT-1 Microscopic Techniques
Microscopic Techniques: History, basic types of light microscopy and their applications in brief; Simple, compound, inverted, stereo, fluorescence, dark field and bright field microscope. Phase contrast microscopy: Amplitude and phase objects, wave terminology, positive or dark phase contrast and negative or bright phase contrast microscopy. Electron microscopy: Transmission Electron Microscope and Scanning Electron Microscope, sample preparation for EM, basic concept of confocal microscope
UNIT-2 Electrophoresis
Electrophoresis: Principle and types of electrophoresis. Gel electrophoresis: Agarose gel electrophoresis, Sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE), Immuno electrophoresis, Capillary or tube gel electrophoresis, isoelectric focusing (IF), Two-dimensional (2D) electrophoresis. Western blotting technique
UNIT-3 Chromatographic Techniques
Chromatographic Techniques: Principle, application, affinity, mobile phase and stationary phase, types of columns, etc. Types of chromatography: Paper Chromatography, Gel filtration Chromatography, ion-exchange chromatography, affinity chromatography, High Performance Liquid Chromatography (Normal phase and reverse phase)

Text and Reference Books:

1. Freifelder D., Physical Biochemistry, Application to Biochemistry and Molecular Biology, 2nd Edition, W.H.Freeman& Company, San Fransisco, 1982.

2. Keith Wilson and John Walker, Principles and Techniques of Practical Biochemistry, 5th Edition, Cambridge

University Press, 2000.

3. D. Holme& H. Peck, Analytical Biochemistry, 3rd Edition, Longman, 1998.

4. R. Scopes, Protein Purification - Principles & Practices, 3rd Edition, Springer Verlag, 1994.

5. Selected readings from Methods in Enzymology, Academic Press.

B.Sc. Biotechnology: Semester-VI BST 602: Genomics and Proteomics	
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 Objectives:

1 To give extensive knowledge of structure and organization of prokaryotic and eukaryotic genomes - nuclear, mitochondrial and chloroplast genomes; Human genome project.

2. To give complete knowledge about expression profiling of gene, microarray and data analysis.

3. To analyze tools for genome analysis as well as give detailed information about hybridization based assays, Polymerization based assays, Ligation based assays.

4. To explain and give an outline of a typical proteomics experiment.

5. To explain tryptic digestion of protein, peptide fingerprinting and protein-protein interactions

Course Outcomes:

After completing the course, students will be able to:

CO1: To define Structure and organization of prokaryotic and eukaryotic genomes - nuclear, mitochondrial and chloroplast genomes; Human genome project.
CO2: To understand the mechanisms for Human disease genes; DNA polymorphism including those involved in diseases; Hemoglobin and the anemias; Phenylketonuria (monogenic) and diabetes (multigenic) genetic disorders; 'disease' gene vs. 'susceptibility' gene.
CO3: To determine Clinical aspect of expression profiling of gene, microarray and data analysis, difference in gene expression in nuclear, mitochondrial and chloroplast gene, taxonomic classification of organisms using molecular markers- 16S rRNA typing/sequencing.
CO4: To analyze Tools for genome analysis – PCR, RFLP, DNA fingerprinting, RAPD, automated DNA sequencing; Linkage and pedigree analysis; construction of genetic maps; physical maps, FISH to identify chromosome landmarks.
CO5: To explain and give an outline of a typical proteomics experiment; Identification and analysis of proteins by 2D analysis.
CO6: To explain tryptic digestion of protein and peptide fingerprinting. Protein-protein interactions, Yeast two hybrid system; Phage display; Protein interaction maps; Protein arrays-definition; Applications- diagnostics, expression profiling

Detailed syllabus:

UNIT-1 Structure and organization of prokaryotic and eukaryotic genomes
Structure and organization of prokaryotic and eukaryotic genomes - nuclear, mitochondrial and chloroplast genomes; Human genome project-landmarks on chromosomes generated by various mapping methods; BAC libraries and shotgun libraries preparation; Physical maps – cytogenetic map, contig map, restriction map. Human disease genes; DNA polymorphism including those involved in diseases; Hemoglobin and the anemias; Phenylketonuria (monogenic) and diabetes (multigenic) genetic disorders; 'disease' gene vs. 'susceptibility' gene; SNP detection:
UNIT-2 Clinical aspect of expression profiling of gene
Clinical aspect of expression profiling of gene, microarray and data analysis, difference in gene expression in nuclear, mitochondrial and chloroplast gene, taxonomic classification of organisms using molecular markers- 16S rRNA typing/sequencing. Tools for genome analysis– PCR, RFLP, DNA fingerprinting, RAPD, automated DNA sequencing; Linkage and pedigree analysis, FISH
UNIT-3 Overview of protein
Overview of protein structure- primary, secondary, tertiary and quaternary structure; Relationship between protein structure and function; Outline of a typical proteomics experiment; Identification and analysis of proteins by 2D analysis; Spot visualization and picking; Tryptic digestion of protein and peptide fingerprinting. Protein-protein interactions. Yeast two hybrid system; Phage display; Protein interaction maps; Protein arrays-definition; Applications- diagnostics, expression profiling

Text and Reference Books

1. Voet D, Voet JG & Pratt CW, Fundamentals of Biochemistry, 2nd Edition. Wiley 2006
2. Brown TA, Genomes, 3rd Edition. Garland Science 2006
3. Campbell AM &Heyer LJ, Discovering Genomics, Proteomics and
4. Bioinformatics, 2nd Edition. Benjamin Cummings 2007
5. Primrose S &Twyman R, Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell, 2006.

B.Sc Biotechnology: Semester-VI BST 603: Industrial 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: - BST404 Enzymology, BST504 Bioprocess Technology

Course Objectives:

1 To develop an understanding of the various aspects of Bioprocess Technology

2. Understand principles underlying design of Fermentor, Fermentation Process and downstream processing

3. To develop skills associated with screening of Industrially Important Strains.

4. To explain the importance of fermentative productions like Enzymes, antibiotics, vitamin, beverages.

5. To explain and emphasize on the recovery and purification of biomolecules

Course Outcomes:

After completing the course, students will be able to:
CO1: To define the basics of fermentation technology.
CO2: To understand the traditional as well as modern methods of fermentation technology.
CO3: To determine the basic concepts of Upstream and Downstream processing.
CO4: To analyze Fermentative productions like Enzymes, antibiotics, vitamin, beverages.
CO5: To evaluate the production of primary and secondary metabolites.
CO6: To explain and learn the concept of producing industrial Enzymes, Bio-pesticides, Bio-fertilizers, Bio-preservatives, Biopolymers Biodiesel.
CO7: To create recombinant proteins having therapeutic and diagnostic applications, vaccines. Bioprocess strategies in Plant Cell and Animal Cell culture

Detailed Syllabus:

UNIT-1
Introduction to industrial bioprocess: Fermentation- Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology- A brief survey of organisms, processes, products. Basic concepts of Up-stream and Downstream processing in Bioprocess, Process flow sheeting – block diagrams, pictorial representation.
UNIT-2
Production of primary metabolites: Primary Metabolites- Production of commercially important primary metabolites like organic acids, amino acids and alcohols. Production of secondary metabolites: Secondary Metabolites- Production processes for various classes of secondary metabolites: Antibiotics, Vitamins and Steroids.

UNIT-3

Production of enzymes and other bio-products: Production of Industrial Enzymes, Bio-pesticides, Bio-fertilizers, Bio-preservatives, Biopolymers Biodiesel. Cheese, Beer, SCP & Mushroom culture, Bioremediation. Production modern biotechnology products: Production of recombinant proteins having therapeutic and diagnostic applications, vaccines. Bioprocess strategies in Plant Cell and Animal Cell culture.

Text and Reference Books

1. Satyanarayana, U. "Biotechnology" Books & Allied (P) Ltd., 2005.
2. Kumar, H.D. "A Textbook on Biotechnology" 2 nd Edition. Affiliated East West Press Pvt. Ltd., 1998.
3. Balasubramanian, D. etal., "Concepts in Biotechnology" Universities Press Pvt.Ltd., 2004.
4. Ratledge, Colin and Bjorn Kristiansen "Basic Biotechnology" 2 nd Edition Cambridge University Press, 2001. v
5. Dubey, R.C. "A Textbook of Biotechnology" S.Chand& Co. Ltd., 2006.

B.Sc Biotechnology: Semester-VI BST 604: Bioinformatics	
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: - BST302 Molecular Biology, BST404 Enzymology

Course Objectives:

1 To give basic overview of databases and tools used in bioinformatics.

2. To give complete knowledge of DNA and protein sequencing techniques.

3. To explain the concept of different bioinformatic tools such as BLAST, ClustalX, MEGA, Pymol, RASMOL, CHIME.

4. To explain the importance of homology modeling and molecular docking.

5. To explain and emphasize on the concept of computer Aided drug designing, ORF prediction, Gene prediction and analysis.

Course Outcomes:

After completing the course, students will be able to:

CO1: To give practical and hands-on experience with common bioinformatics tools and databases like as BLAST, ClustalX, MEGA, Pymol, RASMOL, CHIME.

CO2: To understand basic theory and application of programs used for database searching, protein and DNA sequence analysis, prediction of protein function, and building phylogenetic trees.

CO3: To determine and execute basic competences in the use of bioinformatics tools.

CO4: To analyze and compare different bioinformatics tools.

CO5: To evaluate information networks and bioinformatics tools on the internet.

CO6: To explain and the knowledge of bioinformatics tools for computer Aided drug designing, ORF prediction, Gene prediction and analysis.

CO7: To explain the concept of homology modeling, molecular docking and protein-protein interaction.

Detailed syllabus:

UNIT-1 Introduction of Bioinformatics
Introduction of Bioinformatics and its role in biotechnology, NCBI, EBI, PDB, Searching and retrieval of DNA and protein, protein structure (PDB), DNA sequencing (chemical chain termination, Dideoxy chain termination method, Automatic sequencer), Generation and analysis of biological data and their submission. Protein sequencing (Edmand degradation method).

UNIT-2 Sequence alignment
BLAST, ClustalX, MEGA, Sequence alignment (pairwise and multiple, global and local), Phylogenetic analysis. Extraction of phylogenetic data set. Tree building methods and tree evaluation. Comparative genome analysis. Reconstruction of metabolic pathways. Computationaltools for expression analysis. Prediction and designing of primers & probes for diagnosis and analysis, Prediction of RNA secondary structure, codon optimization, computer Aided drug designing, ORF prediction, Gene prediction and analysis.
UNIT-3 Identification of target protein
Identification of target protein for disease, identification and analysis of epitope, identification of promoter, transcription factor, gene designing, prediction and analysis of protein structure (primary, secondary and tertiary), Homology modeling, protein threading, *In silico* protein validation, protein folding and activity, Basic of molecular docking, Structure visualization methods (Pymol, RASMOL, CHIME etc.), protein-protein interaction, construction of metabolic gene network, drug target, vaccine designing.

Text and Reference Books

1. Bioinformatics: Principles and applications by Ghosh and Mallick (oxford) university press)
2. Bioinformatics by Andreas D Boxevanis (Wiley Interscience)
3. Fundamental concept of bioinformatics by Dan e. krane
4. Introduction to bioinformatics by Attwood and Parry Smith (Pierson educationPublication)
5. Instant notes in Bioinformatics by Westhead, parish and Tweman (Bios scientific publishers)

B.Sc. Biotechnology: Semester-VI BST 605: Environmental 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: BST203 Microbiology, BST404 Genetics

Course Objectives:

After the completion of the subject the student will able to understand about the

1. To develop the basis knowledge of environment, ecology and ecolsystem.
2. To develop the basic knowledge of environmental pollution and serious effects on living organisms.
3. To develop the basic concept of the bioremediation and biorestoration.
4. To develop the basic information of the waste water treatments by conventional and advanced treatment technology.

Course Outcomes:

After completing the course, students will be able to:

CO1: Classify microbes according to energy source and carbon source and evaluate energy outcome of the energy metabolism according to electron acceptor and electron donor usage.

CO2: Apply Monods kinetics and basic chemostat theory to determine microbial growth rates, biomass yield, and substrate concentration and removal rate.

CO3: Carry out an experiment with nitrification in a continuous lab-scale bioreactor for ammonia removal.

CO4: Outline the principles of methods for quantification of organic carbon in wastewater and calculate the theoretical oxygen demand (ThOD) for simple organic compounds

Detailed syllabus:

Unit-1 Introduction to Environment
Introduction to Environment: Concept of ecology and ecosystem, environmental pollution (Water, soil and air) noise and thermal pollution, their sources and effects. Environmental laws and policies. Bioremediation and Biorestoration: Reforestation through micropropagation, development of stress tolerant plants, use of mycorrhizae in reforestation, use of microbes for improving soil fertility, reforestation of soils contaminated with heavy metals.
Unit-2 Sewage and waste water treatments

Sewage and waste water treatments anaerobic and aerobic treatment, conventional and advanced treatment technology, methanogenesis, methanogenic, acetogenic, and fermentative bacteria technical process and conditions, emerging biotechnological processes in waste-watertreatment.

Solid waste management: Landfills, composting, earthworm treatment, recycling and processing of organic residues. Biodegradation of xenobiotic compounds, organisms involved in degradation of chlorinated hydrocarbons, substituted simple aromatic compounds, polyaromatic hydrocarbons, pesticides, surfactants and microbial treatment of oil pollution.

Unit-3 Environmental Biotechnology

Environmental Biotechnology in Agriculture: Biofertilizers and microbial inoculants, biopesticide, bioinsecticides, bioherbicides Biofuel: Plant derived fuels, Energy crops, Biogas, Bioethanol, biohydrogen Environmental genetics: degradative plasmids, release of geneticallyengineered microbes in environment.

Text and Reference Books:

1. Environmental Biotechnology by Alan Scragg (1999); Longman.

2. An Introduction to Environmental Biotechnology by Milton Wainwright (1999): Kluwer Press.

B.Sc. Biotechnology: Semester-VI BST 606:Intellectual Property Right	
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: - Basic knowledge of biological system

Course Objectives:

1. To give basic overview of knowledge of intellectual property right of the novel res
2. To give complete knowledge about of patent of biological material or novel isolate
3. To give the complete knowledge of copyright of the research.
4. To give the complete knowledge of Concept of inventive Step in Biotechnological Inventions.

Course Outcomes:

After completing the course, students will be able to:

CO1: Apply intellectual property law principles (including copyright, patents, designs and trademarks) to real problems and analyse the social impact of intellectual property law and policy.

CO2: Analyse ethical and professional issues which arise in the intellectual property law context.

Detailed Syllabus:

Unit-1 Intellectual property right (IPR)
Introduction and the need for intellectual property right (IPR). IPR in India –Genesis and Development. Some important examples of IPR. Macro-economic impact of the patent system. Patent and kind of inventions protected by a patent. Patent document. How to protect your inventions? Granting of patent. Rights of a patent. How extensive is patent protection? Why protect inventionsby patents? Searching a patent. Drafting of a patent. Filing of a patent
Unit-2 Copyright

What is copyright? What is covered by copyright? How long does copyright last? Why protect copyright? Related rights: What are related rights? Distinction between related rights and copyright. Rights covered by copyright. Definition of trademark. Rights of trademark. Kinds of signs that can be used as trademarks. Types of trademark. Function that a trademark performs. How is a trademark protected? How is a trademark registered? How long is a registered trademark protected for? How extensive is trademark protection? What are well-known marks and how are they protected? Domain name and how does it relate to trademarks?
Unit-3 Intellectual Property Protection in biotechnology
Rationale for Intellectual Property Protection in biotechnology. Concept of Novelty in Biotechnological Inventions. Concept of Inventive Step in Biotechnological Inventions. Microorganisms as Biotechnological Inventions. Patenting biological inventions. Patenting microorganisms. Patenting other biological processes and products. Protection of new varieties of plants. Justification for Protection. Biotechnology and International Treaties such as Convention on Biological Diversity and TRIPs, WTO, GATT Agreement, and Biosafety

Text and Reference Books

1. T. M Murray, M.J. Mehlman. 2000. Encyclopaedia of Ethical, Legal and Policy issues in Biotechnology, John Wiley & Sons
2. P.N. Cheremisinoff , R.P. Ouellette and R.M. Bartholomew.1985. Biotechnology Applications and Research, Technomic Publishing Co., Inc. USA.
3. D. Balasubramaniam, C.F.A. Bryce, K. Dharmalingam, J. Green and K. Jayaraman, 2002. Concepts in Biotechnology, University Press (Orient Longman Ltd.).
4. Bourgagaize, Jewell and Buiser. 2000. Biotechnology: Demystifying the Concepts, Wesley Longman, USA.
5. AjitParulekar, Sarita D' Souza. 2006. Indian Patents Law –Legal & Business Implications; Macmillan India.

B.Sc. Biotechnology: Semester-VI BST 651: Industrial Biotechnology Lab	
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 451 Biotechnology Lab IV and BST 551 Biotechnology lab V

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 Bioproces Technology.
6. To give knowledge about the role of Food additives, flavor enhancers and supplements -probiotics, health care products, vitamins and antibiotics
7. To state the brief introduction, history, importance and applications of biotechnology in food processing.

Course Outcomes:

After completing the course, students will be able to:

CO1: To learn the working of spectrophotometer while demonstrating beer lamberts law.

CO2: To understand the working of centrifugation while doing protein separation from leaves with the help of lysis buffer.

CO3: To check the quality of milk with MBRT test.

CO4: To analyze the anti bacterial property of natural agents.

CO5: To test the susceptibility of microbial species against different antibiotic agents ampicillin and tetracyclin.

CO6: To identify the class of bacteria using gram staining technique.

CO7: To collect industrial water and estimate the colony forming unit.

Detailed Syllabus:

UNIT1: 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

BST652: SEMINAR II	
Teaching Scheme Lectures: 2 hrs/Week Credits: 2	**Examination Scheme** End Semester Exam – 50 marks

Prerequisite: - BST201 Biochemistry, BST204 Environmental biotechnology, BST404 Enzymology, BST401 Immunology etc..

Course Objectives:

1. To understand and learn the concepts of any topic that he is interested in.
2. To learn how to present a scientific topic in front of examiner.
3. To understand basic principle of the technique.
4. To learn and explain the application of the methods.
5. To enhance the computational skills.
6. To get to know the various technical objective and conclusion of his topic

It's compulsory for all the students to give a seminar on the topic assigned by the Department of Biotechnology in the staring of the semester, in the supervision of the assigned supervisor. If the discussion session of seminar / presentation is not found satisfactory then the next date for the said presentation will be given immediately.

Presentation Time duration : 30 - 45 minutes
Discussion duration : 15 - 20 minutes

Course Outcomes: After completing this course, students will be able to understand

1. Will enhance his communication and computational skills.
2. Will leads to enhance the confidence and personal aptitude.
3. Analyze the procedure and instrumentation required for proving his hypothesis.
4. Will teach him to boldly accept the outcomes and conclusion of topic.
5. Will teach him how to represent a data.
6.Will learn to present research data