

Punjab Technical University, Jalandhar
B.Sc Biotechnology
(Study Scheme and Syllabus to be made effective on students from 2010 batch)

1st Semester

Hours: 31 hrs.

Course Code	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BSBT-101	Technical Writing & Communication Skills	2	-	-	40	60	100	2
BSBT-103	Inorganic Chemistry	3	1	-	40	60	100	4
BSBT-105	Introduction & Fundamentals of Biotechnology	3	1	-	40	60	100	4
BSBT-107	Computer Application in Biotechnology	3	1	-	40	60	100	4
BSBT-109	Biostatistics	4	-	-	40	60	100	4
BSBT-109(B)**	Basics of Biosciences	3	-	-	20	30	50	3
BSBT-111	Inorganic Chemistry Lab	-	-	2	40	60	100	1
BSBT-113	Introduction & Fundamentals of Biotechnology Lab	-	-	2	40	60	100	1
BSBT-115**	Basics of Biosciences Lab	-	-	4	20	30	50	2
BSBT-117	Computer Application in Biotechnology Lab	-	-	2	40	60	100	1
		18	03	10	360	540	800	26

BSBT-109(B)** and BSBT-115** : For students having passed 10+2 with Math to take compulsory deficiency course and to be awarded Satisfactory and Non- Satisfactory during their final results by PTU.

(BSBT – 101) Technical Writing & Communication Skills

Unit –I

Communication, its types and significance: - Communication, Process of communication its kinds, channels and role in the society.

Reading skills: - Process of reading, reading purposes, models, strategies methodologies, reading activities, structure of meaning techniques.

Unit –II

Writing skills: - Elements of effective writing, writing styles, scientific and technical writing.

Grammar: - Transformation of sentences, words used as different parts of speech, one word substitution, abbreviations, technical terms etc.

Business correspondence: - Business letters, elements of business writing, kinds of business letters, office order memorandum, report, purchase order, quotations and tenders, job application letters, personal resume and curriculum vitae etc.

Unit –III

Listening skills: - Process of listening, barriers to listening, effective listening skills, feedback skills.

Speaking skills: - Speech mechanism, organs of speech, production and classification of speech sounds, phonetic transcription, skills of effective speaking, components of an effective talk, oral presentation and the role of audio visual aids in it.

Unit –IV Discussion, meeting and telephone skills: - Group discussion, conducting a meeting, attending telephonic calls

Recommended Books

1. Bhattacharya, Indrajit. An approach to Communication Skills
2. Bansal, RK and Harrison, JB. Spoken English
3. Wright, Chissie. Handbook of Practical Communication Skills

(BSBT – 103) Inorganic Chemistry

Unit-I

Periodic Properties Position of elements in the periodic table, effective nuclear charge and its calculations, atomic and ionic radii, ionization energy, electron affinity and electro negativity definition, methods of determination trends in periodic table and applications in predicting and explaining the chemical behavior. Chemistry of Noble gases Chemical properties of noble gases, chemistry of xenon, structure and bonding, in xenon compounds, clathrates, types and stability.

Unit –II

Chemical Bonding

(a) Covalent bond, directional characteristics of covalent.

(b) Valence bond theory and its limitations.

(c) Various types of hybridization and shapes of inorganic molecules and ions-BeF₂, SnCl₂, XeF₄, BF₃, NH₄, H₂O, ClF₄, ICl₂, PF₆, SF₆ and IF₇.

(d) Molecular orbital theory, Homonuclear (elements and ions of 1st and 2nd row) and heteronuclear BO, CN, CO, NO, CO, CN), Multicenter bonding in electron deficient molecules (BORANES).

(e) Weak interactions, Hydrogen bonding & van der Waals forces.

Unit –III

Coordination compounds Introduction, Werner's coordination theory, naming of coordination compounds, stereochemistry, Geometrical isomerism and optical isomerism in compounds having coordination number 4 and 6.

Unit –IV

Bonding in metal complexes Valence bond theory, electro neutrality and back bonding, limitations of VB theory, Crystal field theory, Splitting of d orbitals, calculation of CFSE in high spin and low spin, octahedral and high spin tetrahedral complexes, thermodynamic effects of CF splitting, paramagnetism, diamagnetism, ferromagnetism and anti-ferromagnetism. Molecular Orbital theory, π acid complexes

Recommended Books

- 1) J.D. Lee, Inorganic Chemistry, 5th edition Chapman & Hall, London.
- 2) Inorganic Chemistry by Puri, Sharma and Kalia
- 3) F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry
- 4) F. Basalo and R.C. Johnson, Co-ordination Chemistry, 1964.

(BSBT – 105) Introduction & Fundamentals of Biotechnology

(To be made effective on students taking admission in 2010)

Unit –I

Introduction to Biotechnology: Modern Biotechnology, Branches of Biotechnology and its scope.

Unit –II

Biological systems in Biotechnology: Prokaryotic systems (E. coli, Bacillus), eukaryotic systems (Saccharomyces), mammalian and non-mammalian cells in culture, organismal systems.

Unit –III

Basic techniques in Biotechnology:

- Centrifugation (Principle, types and applications)
- Electrophoresis (Principle, support media, protein and N.S. Electrophoresis)
- Chromatography (Principle, types and applications)
- Lyophilization (Principle, mechanism and applications)
- Basic Microscopy (Principle, various types of microscopes and introduction to electron microscopy)
- Radioisotopy (various types of radioisotopes and instrumentation)
- Spectroscopy

Unit –IV

Microbiology and its scope, Microbial culture- its characteristics and types, Methods of isolating pure culture, Maintenance and preservation of cultures, Media (used for cultivation of microbes) and its types Cultivation of micro organisms: Bacteria, Algae and Fungi.

Books Recommended

1. McGregor, C.W.; Membrane separation in Biotechnology; Marcel Dekker, Inc, New York.
2. Frierferder, S.; Physical Biochemistry; Freeman and Co., New York.
3. Biotol Series (I - IV); Techniques used in Bioproduct Analysis; Buterworth Heineman,U.K.
4. Work, T.S.; Lab. Techniques in Biochemistry and Molecular Biology, Elsevier, New York.
5. Microbiology: Michael J. Pelczar Jr., E. C. S Chan, Noel R. Krieg

Computer Application in Biotechnology (BSBT – 107)

Unit –I

General introduction: computers, organization of computers, digital and analogue computers, computer algorithms. Introduction to computers and its uses: milestones in hardware and software, batch oriented/ online/ real. Computers as a system: Basic concepts, stored programs, functional units and their interrelation: communication with computer.

Unit –II

Data storage devices primary storage: storage addressed and capacity, type of memory, Secondary storage Devices, Magnetic Tape-data representation and R/W, Magnetic disks, fixed and removable, data representation and R/W: Floppy and hard disks, Optical disks CD-Rom, Mass Storage Devices.

Unit –III

Input/Output Devices: Key-tape/diskette devices, light pen mouse, joystick, source data automation, Printed outputs: serial, line, page, printers, Plotters, voice response units

Unit –IV

Introduction to Bioinformatics: Internet and the Biologist, Bibliographic databases, genbank sequence database, sequence analysis using GCG, sequence alignment and database searching, Multiple sequence alignments, Phylogenetic analysis, Prediction of Protein structures, submitting DNA sequences to the database, The NCBI data model

Recommended Books

1. Bioinformatics: The Machine Learning Approach, Eds – P. Baldi and S. Brunak
2. Trends in Biotechnology: Trends guide to Bioinformatics, Trends Supplement, Elsevier Trends Journals

(BSBT-109) Biostatistics

(To be made effective on students taking admission in 2010)

Unit –I

Logarithms And Antilogarithms (Basic Concepts), Definition- Biostatistics and its importance- Collection and Classification of data- Sample Methods of sampling- Classification of data, Representation Of Data : Frequency distribution- Histogram- Frequency Polygon- Frequency Curve- Normal Frequency Curve Relative Frequency Curve- Cumulative Frequency Curve or Ogive

Unit –II

Measures Of Central Tendency : Objectives- Arithmetic Mean- Geometric Mean- Harmonic Mean- Mode- Median, Quartiles, Deciles, Percentiles, Measures Of Dispersion : Range- Quartile Deviation- Mean Deviation- Standard Deviation- Coefficient of Variation

Unit –III

Probability : Measure of Probability- Terminology- Permutations and Combinations- Laws of Probability and Set Theory- Bayes' Theorem. Theoretical Distribution Introduction- Binomial Distribution- Poisson Distribution- Normal Distribution- Standard Normal Distribution

Unit –IV

Test Of Hypothesis : Test of Significance- Sampling Distribution and Standard Error- Hypothesis Testing- Degrees of Freedom, F-Test And Analysis Of Variance : Test of Hypothesis on equality of variances- Analysis of Variance (ANOVA) - One way classification- Two way classification- Least Significance Difference (LSD) test, Chi-Square Test : Chi-square test vs other tests- Application of chi-square test- Goodness of Fit-Test of independence, Application of Computers In Biostatistics

Recommended Books

Biostatistics: A foundation for Analysis in Health Sciences (2004) by *Wayne W. Daniel* Publisher: Wiley, Edition: I

Statistical Methods by S.P.Gupta, Publisher S.Chand & Co, New Delhi

Statistics by R.S.N. Pillai & V. Bagavathi, Publisher S.Chand & Co, New Delhi

Basics of Biosciences BSBT – 109(B)

(Deficiency Course for Students having passed 10+2 with Math)

Unit I

Diversity in the living world

The living world, Biological classification, Kingdom Monera, Kingdom Protista, Kingdom Fungi, Plant kingdom, Classification of animals in general

Unit II

Structural organization in plants

Morphology of flowering plants, Anatomy of plants,

Unit III

Structural organization in animals. Structural organization in animals – animal tissues, morphology and anatomy of animals

Unit IV

Cell structure and functions

Cell – Basic unit of life

Bio-molecules

Cell cycle and cell division

Inorganic Chemistry Lab (BSBT-111)

LIST OF PRACTICALS

1. Inorganic qualitative analysis.
2. Four ions including interfering ions.
3. Volumetric Analysis.
4. Iodimetry, Iodometry, Redox titrations using $\text{Ce}(\text{SO}_4)_2$, $\text{K}_2\text{Cr}_2\text{O}_7$ and KMnO_4 , Complexometric titrations using EDTA Ca^{++} , Mg^{++} , Zn^{++} & Ni^{++}

Introduction & Fundamentals of Biotechnology Practical (BSBT-113)

LIST OF PRACTICALS

1. Introduction to instrumentation: - Centrifuges, Autoclaves, Spectrophotometers, Microscopes, Laminar hoods, incubators.
2. Centrifugation including ultra-centrifugation.
3. Polyacrylamide gel electrophoresis for proteins.

Basics of Bioscience Lab (BSBT-115)

(Deficiency Course for Students having passed 10+2 with Math)

LIST OF PRACTICALS

Taxonomy:

1. Description of flowers including floral diagram, floral formula, V.S. of flower of the representative genera of families mentioned in syllabus.
2. Each student required to submit a family wise herbarium consisting of at least 20 properly pressed and mounted plants.

Computer Application in Bio-Technology (BSBT-117)

LIST OF PRACTICALS

1. Familiarization of the computer system
2. Loading window, closing, maximizing, icon shifting & ordering.
3. Changing drives and searching files and understanding file extensions.
4. Saving files, protecting and unprotecting.
5. Formatting floppies and practice on virus recognition and protection.
6. Practice with control panel and file manager.
7. Practice with MS Word, Operating and closing document, Preparation of document, setting of document, familiarization with various tools, mail-merge practice.
8. Internet Browsing.

2nd Semester

S. No	Course No	Course Title	L	T	P	Internal marks	External marks	Total marks
1.	BSBT-102	Cell Biology	4	-	-	40	60	100
2.	BSBT-104	General Microbiology	4	-	-	40	60	100
3.	BSBT-106	Physical Chemistry	4	-	-	40	60	100
4.	BSBT-108	Biochemistry	4	-	-	40	60	100
5.	BSBT-110	Genetics	4	-	-	40	60	100
6.	BSBT-112	Cell Biology Lab	-	-	2	40	60	100
7.	BSBT-114	General Microbiology Lab	-	-	2	40	60	100
8.	BSBT-116	Physical Chemistry Lab	-	-	2	40	60	100
9.	BSBT-118	Biochemistry Lab	-	-	2	40	60	100
10	BSBT-120	Genetics Lab	-	-	2	40	60	100
	Total		20		10	400	600	1000

Cell Biology (BSBT-102)
(Subject Syllabus Made effective from 2008 Batch)

Unit I

Cell as a basic unit of living systems: The cell theory. Broad and detailed classification of cell types within an organism. Different levels of organization of cells.

Unit II

Cell division and Cell cycle: Cell interaction. Cell locomotion. Muscle and Nerve cells. Cell senescence and death, Cell differentiation.

Unit III

Structure and function of cell organelles: Ultrastructure of cell membrane, cytosol, golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes. Cytoskeletal structures (actin, microtubules etc.) Mitochondria, chloroplasts, lysosomes, peroxisomes. Nucleus(nuclear membrane, nucleoplasm, nucleolus, chromatin)

Unit IV

Fixation and Staining; Freeze drying and freeze substitution, Microtome and Embedding, Chemical basis of staining, Cytophotometric Methods.

Recommended Books

Cell and molecular Biology: De Roberties
Cell Biology: Bruce Albert's
Cell Biology: Dowben

General Microbiology (BSBT – 104)

Unit I

History of Microbiology: A. Leeuwenhoek, L.Pasteur, R.Koch, J.Lister, J.Tyndall, etc. Biogenesis vs Abiogenesis, Koch Postulates, Discovery of antibiotics.

Principle of Microscopy: Bright field, Dark field, Phase contrast, Fluorescent, Electron Microscopy.

Unit II

Microbial classification : Bacteria, Fungi and Algae. Morphology of bacteria, viruses and fungi with major emphasis on bacterial structure specially cell wall. Gram positive and Gram negative bacteria. Microbial spores, Sporulation and germination process.

Unit III

Microbial growth, nutritional biodiversity, phases of growth, generation time, growth rates, monoauxic, diauxic and synchronous growth, chemostat
Microbes in extreme environment like high temperature and high/ low pH
Physical and chemical agents to kill microbes, sterilization and pasteurization processes

Unit IV

Normal micro flora in humans/animals. Types of microbial pathogens and diseases caused by them. Microbial interactions like symbiosis and antibiosis etc. Host defense mechanism against pathogens.

Nitrogen fixing microbes in agriculture.

Microbial metabolism, unique pathways, photosynthesis, fermentation and its products, production of heterologous proteins in microbes.

Recommended books

1. Davis, B.D Dulbecco, R., Eiser, H.N. and Ginsberg, H.S. (1990). Microbiology, 4th edition, Harper and Row, Publishers, Singapore.
2. Tortora, G.J., Funke, B.R., and Case, C.L. (1994). Microbiology: an introduction, 5th edition, the Benjamin/Cummings Publishing Company, Inc.
3. Stanier, R.Y. (1995). General Microbiology, MacMillian Press London.
4. Pelczar, M.T. (1995). Microbiology, Tata McGraw Hill Publication, New Delhi.
5. Schegel, H.G., (1995). General microbiology 7th ed. Cambridge University Press.
6. Prescott and Dunn (1999). Industrial Microbiology, 4th ed. By S.K Jain for CBS Publishers and Distributors.
7. Purohit, S.S. (2000). Microbiology: Fundamentals and Applications (6th edition), Agrobios (India)
8. Postgate, J. (2000). Microbes and Man : 4th ed, Cambridge University Press.

Physical Chemistry (BSBT-106)
(Amended Syllabus made effective from 2008 Batch)

Unit-1

Chemical Thermodynamics: State of a system, state variables, thermodynamic equilibrium, thermodynamic properties, intensive and extensive properties, various types of processes, First law of thermodynamics, internal energy and enthalpy, change in internal energy and change in enthalpy for expansion of real and ideal gases under isothermal and adiabatic conditions for reversible and irreversible processes. Relation between C_p and C_v internal energy change and enthalpy change in a chemical process. Hess's Law of heat summation. Enthalpy of formation, enthalpy of ionisation and second law of thermodynamics, entropy and Gibbs's free energy, Carnot's cycle, Gibbs's Helmholtz equation, Third law of thermodynamics, Nernst heat theorem.

Thermodynamics of simple mixture, partial molar quantities and their significance, chemical potential, chemical potential in a mixture of ideal gases.

Unit-2

Solution: Definition, types of solutions, vapour pressure of solution and Raoult's law. Factors influencing the solubility of gas in liquids, Henry's Law. Ideal solutions, Distillation of ideal solutions, lever rule, vapour pressure of ideal solutions and non ideal pressure, depression in freezing point, elevation in boiling point, osmotic pressure. Their common features and applications.

Phase Equilibria:

Definition of phase, component and degree of freedom phase rule and its thermodynamic derivation Clausius Clapeyron (Derivation not included) phase diagrams of water system, KI water system.

Unit-3

Chemical Kinetics:

Rate of reaction, constant factors influencing rate of reaction, order, molecularity, rate equations for 1st order, 2nd order & 3rd order reactions. Half life complex reactions, consecutive reactions, parallel reactions, chain reactions and opposing reactions. Activation energy and theories of reaction rates collision theory and transition state theory of bimolecular processes. Catalysis, acid base catalysis.

Unit-4

Electrochemistry

Specific conductance, molar conductance and their dependence on electrolyte concentration, ionic equilibria and conductance, theory of strong electrolytes. Transport number conductometric titrations. pH scale. Buffer solutions, salt hydrolysis.

Electrochemical Cells:

Electrochemical cells, calculations of ΔG , ΔH , ΔS and potentiometer determination of pH, Potentiometer titrations.

Recommended Books

1. Atkin's Physical Chemistry by Peter Atkins and Julio de Paulk. Publisher Oxford University Press
2. Textbook of Physical chemistry by Samuel Glasston. MacMillan India Ltd
3. Kalyani Physical Chemistry by K.L. Chug and S.L. Agnish. Kalyani Publisher

Biochemistry (BSBT – 108)

Unit-I

Enzymes: General properties factors affecting enzyme activity regulation of enzyme activity, steady state kinetics, first order and second order kinetics, covalent modifications, classification, nomenclature types of inhibitors, inhibitors, immobilized enzymes, Ribozymes.

Unit-II

Metabolism: Metabolic pathways, biochemical reaction mechanism, energy rich metabolites, inter organ metabolic pathways.

Carbohydrate metabolism: Biosynthesis and degradation of carbohydrates; feed pathways for glycolysis; Pentose pathway
Kreb's Cycle: Enzymes of Kreb's cycle, amphibolic nature of the Kreb's cycle; regulation of Kreb's cycle, Regulation of carbohydrate metabolism

Unit-III

Electron transport and Oxidative phosphorylation

Mitochondrial electron transport chain, oxidative phosphorylation; regulation of ATP synthesis.

Unit-IV

Lipid Metabolism: Digestion and absorption Biosynthesis and degradation of fatty acids; metabolism of triacyl glycerols; cholesterol metabolism, ketonobodies.

Nitrogen Metabolism: Reduction and assimilation of atmospheric nitrogen, Biosynthesis and degradation of amino acids; amino acids as precursors of heme; biogenic amines; biosynthesis of degradation of nucleic acids.

Porphyryns : Translation, Transcription, Replication

Recommended Books

1. Lehninger, A.L. Nleson, D.L. and Cox, M.M. (1993), Principles of Biochemistry, 2nd Ed., Worth Publishers, New York.
2. Rawn, J.D. (1989), Biochemistry, Niel Patterson Publications, North Carolina.
3. Berg, Tymoezko and Stryer, L (2002), Biochemistry, 5th ed. W.H. Freman & Co. San Francisco
4. Voet D. and Voet, J.G. (2004), Biochemistry 3rd ed. John Wiley and Sons Inc. New York.
5. Voet, D., Voet, J.G. and Pratt, C.W. (1999), Fundamentals of Biocemistry, John Wilay and Sons, New York.

Genetics (BSBT 110)

Introduction: Introduction to gene and protein, splice variants, secondary structure, triplet coding.

Sex determination. Dosage compensation, sex chromatin, chromosomal inheritance,

Mitochondrial and chloroplast genetic system.

Gene expression: Gene organization and expression in prokaryotes and Eukaryotes.

Gene regulation. Prokaryotic and Eukaryotic gene regulation. Genetic control and Development. Genetics of immunity. Transcription and translation in Eukaryotes.

Protein structure and function. Chromosomal variation. Genetics of Cancer.

Population Genetics; Hardy-Weinberg equilibrium, evolutionary genetics

Analysis of mutation in biochemical pathway. One gene-one enzyme hypothesis. Isolation of auxotrophs, replica- plating technique.

Genomics. Introduction, genome sequencing projects, comparative genomic, gene prediction and counting. Genome evolution.

Recommended Books

1. Current Perspectives in Genetics: Insights and Applications in Molecular, Classical, and Human Genetics, 2000 Edition by Shelly Cummings, Paperback: 170pages, Publisher: Books Cole.
2. Genes VIII by Benjamin Lewin. Publisher: Prentice Hall.

Cell Biology Lab (BSBT-112)
(Amended Syllabus made effective from 2008 Batch)

List of Practicals

1. Sub Cellular Fractionation and marker enzymes
2. Mitosis and Meiosis
3. Vital staining for visualizing cell organelles
4. Histochemical Techniques.
5. Instrumental methods for Cell Biology- Centrifugation, Chromatography.
6. Microscopy: Bright field, phase contrast and fluorescence microscopy.

General Microbiology Lab (BSBT-114)

1. Aseptic techniques
2. Cleaning of glass wares, Preparation of media, Cotton plugging and sterilization
3. Personal hygiene Microbes from hands, Tooth-Scum and other body parts.
4. Isolation of microorganisms from air, water and soil samples
5. Dilution and pour plating techniques.
6. Enumeration of microorganisms-total vs viable counts.
7. Identification of isolated bacteria
8. Gram staining, other staining methods, metabolic characterization (e.g., IMVic) tests
9. Growth curve of microorganisms.
10. Antibiotics sensitivity of microbes. Using antibiotic discs.
11. Testing of water quality
12. Test for antibodies against given bacteria
13. One step growth of bacteriophage.
14. Culture from body fluids (Stool, Urine, Blood).
15. Alcoholic and mixed acid fermentation.

Books recommended

Cappuccino, J.G and Sherman, N. (1992). Microbiology: Laboratory manual 3rd Edition,
Benjamin/Cummings Publishing Company.

Physical Chemistry Lab (BSBT-116)

LIST OF PRACTICALS

1. Study of distribution law by iodine distribution between water and CCl_4 . Given standard solution $\text{Na}_2\text{S}_2\text{O}_3$.
2. Study of distribution law of benzoic acid between benzene and water.
3. Determination of adsorption isotherm of oxalic acid on charcoal.
4. Surface tension: determination of surface tension of a given liquid by Stalgmimeter.
5. Determination of viscosity of a pure liquid (acetone, ethanol, propanol, butanol, glycol)
(effect of hydrogen bonding on viscosity).
6. Refractometry: Determine refractive index of a given liquid as a criterion for its purity.
Benzene *i.e.*, commercial benzene + (A.R.) acetone.
7. Polarimetry: Determine the %age composition of an optically active solution.
8. Conductometry:
 - a) Determination of cell constant
 - b) Determination of specific and equivalent conductance of electrolyte (NaCl and HCl).
 - c) Precipitation titration of Na_2SO_4 vs BaCl_2 .
 - d) Neutralization titrations NaOH vs HCl and NaOH vs CH_3COOH .
9.
 - a) pH of buffer solution.
 - b) Acid-base titration HCl vs NaOH .
 - c) Determination of ionization constant of a weak acid (CH_3COOH).
10. Calorimetry:
 - a) Determination of Heat of neutralization
 - i) Strong acid-strong base
 - ii) Weak acid-strong base
11. Photometry:
Verification of Lambert-Beer's law for solution of $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ (in water) and $\text{K}_2\text{Cr}_2\text{O}_7$ (in water).

Biochemistry Lab (BSBT-118)

LIST OF PRACTICALS

1. Estimation of α -amylase activity from saliva
2. Assay of acid phosphatase activity
3. Effect of temperature on enzyme activity
4. Effect of pH on enzyme activity
5. Determination of K_m for acid phosphatase
6. Purification of protein using salt precipitation
7. Chromatographic methods for separation of macromolecules
 - Paper chromatography
 - Thin layer chromatography
 - Gel permeation chromatography

Recommended Books:

1. Plumer D.T. (1998), An Introduction of Practical Biochemistry, 3rd Ed. Tata McGraw Hill Publishers Co. Ltd., New Delhi.
2. Bansal, D.D., Khardori, R & Gupta, M.M. (1985), Practical Biochemistry, Standard Publication Chandigarh.

Genetics Lab (BSBT-120)

1. Probability – Coin tossing and color blindness
2. Spotters related to theory: To show gene interaction, Rh factor – Erythroblastosis foetalis, Freemartin, Human abnormalities, Holandric genes (Hypertrochosis), DNA model – window cutting of mutation and replication, structure of bacteriophage.
3. Model Preparation related to theory

3rd Semester

S. No	Course No	Course Title	L	T	P	Internal marks	External marks	Total marks
1.	BSBT-201	Organic Chemistry	4	1	-	40	60	100
2.	BSBT-203	Biophysics	4	1	-	40	60	100
3.	BSBT-205	Immunology – I	4	1	-	40	60	100
4.	BSBT-207	Techniques in Biotechnology-I	4	1	-	40	60	100
5.	BSBT-209	Biochemistry-II	4	1	-	40	60	100
6.	BSBT-211	Organic Chemistry Lab	-	-	3	40	60	100
7.	BSBT-213	Biochemistry-II Lab	-	-	3	40	60	100
8.	BSBT-215	Immunology – I Lab	-	-	3	40	60	100
			20	5	9	320	480	800

Organic Chemistry (BSBT-201)

Fundamental Aspects Of Organic Chemistry: Inductive effects, electrometric effects, resonance, hyper conjugation, type of reagents, electrophile and nucleophile, types of organic reactions, reaction intermediates, carbocations, carbanions, free radical carbenes with complex.

Nomenclature and Classification of Alkyl Halides: Methods of formation, chemical reactions, and preparation of aryl halides. Elimination-addition mechanism (benzene mechanism (Benzene mechanism) and nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides vs allyl, vinyl and aryl halide.

Alcohols And Phenols: Nomenclature, methods of formation, physical and chemical properties (Measurement of dehydration, acidity, mechanism of Kolbe's reaction, Reimer Tiemann reaction and mechanism).

Carboxylic Acids And Derivatives: Structure of carboxylic acid and derivatives, methods of formation, physical and chemical properties.

Alkenes, Cycloalkenes, Dienes And Alkynes: Nomenclature, methods of formation, physical and chemical properties, conformation of Alkenes and cycloalkenes.

Dienes – Structure and properties, Conjugation and resonance, polymerization, structure of butadienes and allenes.

Alkynes-industrial source of acetylene, physical and chemical properties, Bonding of alkynes, acidity of alkynes.

Alkanes And Cycloalkanes: Nomenclature, methods of formation, physical and chemical properties.

Arenes And Aromaticity: Nomenclature of benzene derivatives, aryl group, aromatic nucleus and side chain, structure of benzene, molecular formula, Kekule structure, stability, Carbon-carbon bond length of Benzene, resonance structure, MO picture.

RECOMMENDED BOOKS

1. ORGANIC CHEMISTRY – FINAR IL
2. Organic Chemistry _ Morrison and Boyd
3. Voge's text book of Organic Chemistry – Furniss
4. Organic Chemistry – Ege Sezham

Biophysics (BSBT-203)

(Amended Syllabus made effective from 2008 Batch)

Radiology: Concepts and Definitions, Detection and measurement of radiation, sources of radiation, Radioisotopes in medicine and Biology.

X-ray Crystallography: Introduction, Crystal systems, Point group and Space groups, X-ray diffraction, X-ray Data collection, Structure solution, Refinement of the structure.

Optics: Electromagnetic waves, nature of light, Interaction of light and Biological system, Biophysics of vision.

Biomechanics: Introduction, Striated muscles, Mechanical properties of muscles, Biomechanics of the cardiovascular system.

Neurobiophysics: Introduction, Nervous system, Physics of membrane potentials, Sensory Mechanism, Signal Transduction.

Recommended Books

1. Introduction: N.Gautam
2. Introduction to Physical Chemistry: David Frieflder
3. Medical Physiology: Guyton
4. Introduction to Biophysics: Ramesh Chandra

Immunology – I (BSBT-205)

Introduction: Overview, Milestones in immunology, general immuno-biology, introduction to specific and non-specific immunity, and features of immune response.

Cells And Organs Of The Immune System: lymphoid cells, heterogeneity of lymphoid cells, T cells, B cells, Null Cells, Monocytes, Polymorphs, primary and secondary lymphoid organs- thymus. Bursa of fabricus, spleen, lymph nodes, lymphatic system, mucosa associated lymphoid tissue (MALT), lymphocyte traffic.

Humoral Immunity: Structure and function of antibody, structure and function of antigen, Antigen- Antibody reaction, affinity and avidity, high and low affinity antibody, immuno-globulins, classes and structure, molecular mechanism of generation of antibody, diversity, complement fixing antibodies and complement cascade.

Cell Mediated Immunity: T-cell subsets and surface markers, T dependent and T independent antigen, recognition of antigens by T cells and role of MHC, class of MHC, structure of T cells antigen receptor, examples of cell mediated immunity.

Recommended Books

1. Immunology- Robin IM, Brostoff J and Male DK.
2. Principles of Cellular and molecular Immunology- Austyn JM and Wood KJ.
3. Immunology and Medical Microbiology -Singh RP
4. Introductory Immunology – Shetty, Nandini
5. Immuno-biotechnology – Yadav and Tyagi
6. Immuno-biotechnology- Naha and Narain.
7. Immunology –Singh and Bharat
8. Medical Immunology- StritesDP, Terr AL Opar TG.

Techniques In Biotechnology-I (BSBT- 207)

Cultivation Of Microbes; Basic equipment (Incubators, sterilizers), Bacteriological techniques – culturing, sterilization, etc. Growth media and selection, Introduction to Industrial microorganisms.

Techniques and Types of Microscopy in Biotechnology: Introduction, brief History, Types of microscope and role in microbiology. Structure and function of microscope like Compound microscope, dissecting microscope, phase contrast microscope, Electron Microscope – Scanning electron microscopy, CT scan, Digital microscopy and their uses in biotechnology.

Spectroscopy: Introduction, UV/Visible and spectrophotoflourimeter, basic principles involved, different types of spectrometry – NMR, Magnetic resonance spectroscopy. Scope and use in biotechnology. Structural determination and analysis of biomolecules: Absorption spectroscopy and other optical techniques like fluorescence, infrared and Raman;

Chromatography: Introduction, principle, types – paper, two dimensional, thin layer, HPLC, ion-exchange chromatography etc. Uses, advantages and limitations.

Detection methods and Introduction to some emerging technologies: Brief Introduction to Hybridization and transfers techniques, PCR, Quantitative methods of nucleic acids, Electrophoresis, Radioisotope techniques, X-ray crystallography. pH and buffer concept. Microarrays, microwave technology, Genomics, proteomics, microfluidics, nanotechnology.

Recommended Books

1. Biotechnology B D Singh, Kalyani Publication.
2. Introduction to Applied Biology and Biotechnology. K Vaidyanath, K Pratap Reddy, K Satya Prasad.

Biochemistry – II (BSBT-209)

Structure of functions of lipids, fatty acids, triacylglycerols, glycerophospholipids, sphingomyelins, lipoproteins, Liposomes, biological membranes & micelles.

Nucleic acids: Structure & properties of purine and pyrimidine bases. Nucleosides & nucleotides, biological functions of DNA and RNA species. Double helical model of DNA & forces responsible for it, short hand representation of nucleic acid back bone, denaturation of DNA, methods for isolation and purification of nucleic acids.

Introduction to enzymes & coenzymes, units of enzymes activity, enzyme nomenclature & classification, Enzyme Kinetics, effect of substrate concentration on Michaelis – Menten equation, determination of K_m & its significance, effect of pH and temperature on rates of enzymes catalyzed reaction.

Enzyme inhibitors & their importance, chemical methods of active site studies, Introduction to multisubstrate enzymes, allosteric enzymes & enzyme regulation, isoenzymes, enzyme immobilization.

Books Recommended

1. Principles of Biochemistry 3rd edition, 200 : Lehninger, Nelson & Cox.
2. Biochemistry, 4th edition, 1995 : Luberts Stryer. W.H. Freeman and Company, New York.
3. Text Book of Biochemistry, 3rd Edition, 1986. K. Rangnathan Rao.
4. Fundamentals of Biochemistry, 5th edition, 2000- J.L. Jain, Chand and Co., New Delhi.

Organic Chemistry Lab (BSBT – 211)

1. Introduction to laboratory techniques through demonstration involving synthesis of selected organic compounds (e.g Aspirin, parabromoacetanilide, anthraquinone from anthracene, reduction of nitrobenzene.(any two)
2. Identification of organic compounds and derivatives (Any Ten)
3. Introduction to the use of stereo models

Biochemistry-II LAB (BSBT- 213)

1. Verification of Beer's Law and Determination of Absorption Maxima
2. Qualitative Estimation of Carbohydrates
3. Quantitative Estimation of Carbohydrates
4. Qualitative Estimation of Amino Acids
5. Quantitative Estimation of Proteins
6. Amino Acid and Carbohydrate Separation by Paper Chromatography
7. Amino Acid and Carbohydrate Separation by Thin Layer Chromatography

Immunology – I Lab (BSBT- 215)

1. Haemagglutination assay
2. Haemagglutination inhibition assay.
3. Separation of serum from blood
4. Separation of T and B cells from PBMC by nylon wool method.
5. Isolation of mononuclear cells from peripheral blood and viability test by dye exclusion methods.
6. Direct and indirect ELISA.
7. Precipitation test
8. Study of Lymph nodes in rats.
- 9 Study of types of inflammation

**(Amended Scheme to be made effective on Students to take admission
2010)**

4th Semester

S. No	Course No	Course Title	L	T	P	Internal marks	External marks	Total marks
1.	BSBT-202	Immunology-II	4			40	60	100
2.	BSBT-204	Molecular Biology	4			40	60	100
3.	BSBT-206	Recombinant DNA Technology	4			40	60	100
4.	BSBT-208	Fundamentals of Industrial Biotechnology	4			40	60	100
5.	BSBT-210	Stem Cell Technology	4			40	60	100
6.	BSBT-212	Immunology-II Lab			3	40	60	100
7.	BSBT-214	Molecular Biology Lab			3	40	60	100
8.	BSBT-216	Recombinant DNA Technology Lab			3	40	60	100
	Total		20		9	320	480	800

Immunology-II (BSBT-202)

UNIT -1

Immune response mechanism, antigen presentation and Processing mechanism of lymphocyte activation

UNIT -II

Immunodeficiency, immune tolerance, autoimmunity, Immune suppression transplantation immunology, tumor Immunology of HIV infection

UNIT -III

Immunization, vaccines and its types with examples, Storage of vaccines.

UNIT -IV

Infection, introduction & types and factors influencing Infection, Hypersensitivity

Recommended Books

1. Immunology Roiu and Roiu
2. Introduction immunology shetty, Nandini
3. Immunobiotechnology Yadav & Tyagi
4. Immunology-Robin IM, Brostoff J and Male DK
5. Principles of Cellular and molecular Immunology- Austyn JM and Wood KJ
6. Immunology and Medical Microbiology-Singh RP
7. Immuno-biotechnology- Naha and Narain.
8. Immunology-Singh and Bharat
9. Medical Immunology- StritesDP, Terr AL Opar TG.
10. Immunology- Kuby.

Molecular Biology (BSBT- 204)

Unit –I

Genome organization : Organization of Chromatin, Histone and Non-histone proteins, Nucleosome. Concept of Gene, Introns and Exons. Nature and Properties of Genetic Code.

Unit –II

DNA Replication and Damage Prokaryotic DNA replication: Enzymes and proteins involved Mechanism of Replication: Initiation, Elongation, synthesis of Leading and lagging strands, Termination. Mutation concept: types: Spontaneous Mutation and Induced Mutation Mutagens: Physical Mutagens and Chemical Mutagens DNA repair mechanisms: Photoreactivation and Dark Excision repair

Unit –III

Central Dogma of Molecular Biology : Transcription: RNA polymerase, Initiation, Elongation and Termination. Translation: Role of Ribosome, Activation of amino acids, Initiation, chain. Elongation and termination of translation. Inhibitors of translation

Unit –IV

Regulation of Gene Expression : Concept of Operon and regulon. Promoter, Operator, Structural and Regulatory genes. Model of Lactose operon: Structure, Positive and Negative regulation.

References :-

- 1) Rastogi S.C.; " Concepts in Molecular Biology", New Age International (P) Ltd, New Delhi.
- 2) Verma P.S. and Agrawal V.K.(2001), " Concepts in Molecular Biology", S.Chand and Co.Ltd; New Delhi.
- 3) Pasupuleti Mukesh, "Molecular Biotechnology",MJP (P) Chennai.
- 4) Powar C.B, "Gene Regulation",Himalaya Book Pvt.Ltd, Mumbai.
- 5) Lohar P.S. (ISBN 81-8094-027-6)"Cell and Molecular Biology", MJP Publishers Chennai.
- 6) Friefilder D,"Basics of Molecular Biology",Barlett Publications.
- 7) Strickburger M.W,(1995) "Genetics", Practice hall of India pvt Ltd,new Delhi.
- 8) Upadhyay Avinash and K.Upadhyay (2005),"Basic Molecular Biology", Himalaya Publishing House, Mumbai.

Recombinant DNA Technology (BSBT- 206)

Recombinant DNA technology: Gene cloning- steps in gene cloning, Restriction endonucleases- types, nomenclature, recognition sequence, cleavage pattern, frequency of recognition sites, modification of cut ends, isolation of desired gene Vectors: Properties of good vector, cloning and expression vectors, E. coli vectors,

Plasmids, PSC101, pBR322, pUC8, pGEM3Z and bacteriophage vectors. Cosmid vectors, Phagemid vector and Artificial chromosome vectors, shuttle vectors, yeast vectors, YAC, Vectors for plants and animals.

cDNA Preparation, Isolation of mRNA, Genomic library, construction of genomic library.

Integration of DNA insert into the vector: Integration of DNA inserts through site specific recombination, selection of desired recombinant DNA, Insertion of vector into the suitable host, , multiplication and expression of DNA insert in host genome, production of recombinant proteins in E. coli and other organism.

Chemical Synthesis of Genes and Polymerase Chain Reaction: Introduction, chemical synthesis of gene, gene amplification, procedure of PCR, primers, annealing temperature, Types of PCR- RT PCR, Inverse PCR, real time PCR, nested PCR. Analysis of PCR products, Applications of PCR and its limitations.

Genome maps: Introduction, definitions, genetic maps, genetic markers Application of molecular markers.

Brief introduction to human genome project, automated chromosome-sorting, creation of contigs.

Understanding a gene function: Basic concepts of protein purification using affinity chromatography, SDS PAGE (polyacrylamide gel electrophoresis).

Gene Therapy. Introduction, Types of gene therapy, augmentation gene therapy and targeted gene therapy (general concept).

Recommended Books

1. Biotechnology B D Singh, Kalyani Publication.
2. Gene cloning: T.A. Brown 4th edition Wiley publishers
3. Analysis of genes and Genomes: Richard Reece, John Wiley & Sons
4. From Genes to Genomes: Jereny W dale and Malcolm von Schantz, John Wiley & sons.
5. Gene manipulations by Old and Primrose.
6. Molecular Cloning: A laboratory Manual by Maniatis Cold Spring Harbor Publications
7. Basic Biotechnology by Colin Ratledge (Editor), Bjorn Kristiansen, Cambridge University Press.

Fundamentals of Industrial Biotechnology (BSBT- 208)

Introduction: Industrially important microbes (*E.Coli*, *Bacillus*, *Saccharomyces*)

Role of Yeast in Industry: Transformation procedures, genetic markers for yeast transformation, industrial application.

Fermentation: Large scale fermentation: Design and operation of fermentors, Preparation of ideal growth medium for production of biomass and microbial products

Fermentation reactions: Metabolic groups and pathways, culture preservation

Microbial Products: Microbial production of antibiotics, vitamins, organic acids

Industrial Biocatalyst: Introduction, scope and application, immobilization and its applications

Fermented Beverages: Beer, Whisky, Wine making and Vinegar making.

Role of industrial biotechnology : Introduction to fuel biotechnology, biofertilizers, biocontrol agents, scope and applications of environmental biotechnology and biosafety in industry.

Books Recommended

1. Pelczar and E.C.S. (Jr.) Chan, 2000 : Microbiology, Tata McGraw Hill Pub. Co., New Delhi.
2. D.D. Bernard, R. Dulbecco, H.N. Eisen, and H.S. Ginsberg , 1990: Medical Microbiology, Harper and Row, New York.
3. M.K.J. Waites et al ., 2001 : Industrial Microbiology, Blackwell Science Ltd., London.
4. Nicklin et al., 2001: Instant Notes in Microbiology, BIOS Scientific Publishers Ltd, U.K.
5. G.J. Tortora et al 1995: Microbiology : An introduction, Benjamin/Cummings Pub Co., Inc. B.T.
6. Principles of fermentation Technology : By Stanbury and Whittakar, Orgamon Press
7. Industrial biotechnology by Cruger & Cruger , Tata McGraw Hill

Stem Cell Technology (BSBT-210)

(To be made effective on students to take admission in 2010)

Introduction: Differentiation, Dedifferentiation, Maturation, Proliferation, Totipotency, transit cells, commitment & lineage, stem cells plasticity, stem cells models (clonal succession, Deterministic method, stochastic mode), problem of stem cell biology.

Hematopoietic stem cells:- Properties of hematopoietic stem cells, role of Haemopoietic Microenvironment, Differentiation of stem cells, Principles and concepts of stem cells assay (LFU-5, MRA, LTC-IC, HPP-CFC, LTR).

Primordial germ cells:- Introduction and Basic concepts of Embryonic stem cells, embryonal carcinoma cells as embryonic stem cells, Trophoblast stem cells.

Epidermal stem cells:- Introduction and Basic concepts of Liver stem cells, pancreatic stem cells, stem cells in the epithelium of the small intestine and colon.

Stem cells for gene therapy:- Large animal models for gene therapy, stromal support, Xenograft systems, human gene therapy, new vector delivery system (Adeno associated virus, Adenovirus).

Ethical Issues pertaining to Stem cell.

Recommended Books

Stem cells by CS Potten, 1997 Academic Press

Molecular Biology of the Cell, 5th Edition, Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, James D. Watson, . 2008.

Stem cell biology by Marshak 2001, Cold spring Harbar symposium Publication.

Immunology-II Lab (BSBT-212)

LIST OF PRACTICALS

1. ELISA Test
2. Precipitation Test
3. Study of Lymph nodes in rats
4. Study & understanding of Bacterial, fungal & viral infection in human prepared models
5. Study of type of inflammations.

Molecular Biology Lab (BSBT-214)

(Amended Syllabus made effective from 2008 Batch)

LIST OF PRACTICALS

Isolation of Bacterial DNA

Silver staining of proteins

Analysis of DNA by fluorescent and spectroscopical method

PCR

Isolation and analysis of RNA

Preparation of Competent E.coli cells

Recombinant DNA Technology Lab (BSBT-216)

LIST OF PRACTICALS

1. Demonstration of purification of genomic DNA from bacterial cells using chemical methods
2. Demonstration of purification of extra chromosomal DNA (plasmid DNA using chemical method)
3. Purification of isolated DNA using a premade assay kit.
4. Demonstration of Agarose Gel Electrophoresis: preparing an agarose gel and visualizing both genomic and plasmid DNA
5. Demonstration of DNA digestion with restriction enzymes, agarose electrophoresis
6. Visualization proteins – polyacrylamide gel electrophoresis

5th Semester

S. No	Course No	Course Title	L	T	P	Internal marks	External marks	Total marks
1	BSBT-301	Animal Cell Culture and Biotechnology	4	-	-	40	60	100
2	BSBT-303	Food Biotechnology	4	-	-	40	60	100
3	BSBT-305	Environmental Biotechnology	4	-	-	40	60	100
4	BSBT-307	Agricultural Biotechnology	4	-	-	40	60	100
5	BSBT-309	Intellectual Property Rights & Biosafety	4	-	-	40	60	100
6	BSBT-311	Animal Cell Culture and Biotechnology Lab	-	-	3	40	60	100
7	BSBT-313	Food Biotechnology Lab	-	-	3	40	60	100
8	BSBT-315	Environmental Biotechnology Lab	-	-	3	40	60	100
	Total		20		9	320	480	800

Animal Cell Culture and Biotechnology (BSBT 301)

Introduction: History of animal tissue culture, organ culture: techniques, advantages, limitations and applications.

Cell cultures: Substrate and suspension cultures, natural and artificial media, gas phase, initiation of cell cultures, preparation and sterilization of substrate and media, isolation of explants, subcultures, precautions to avoid contamination.

Cell lines: maintenance, large scale production, monolayer culture, suspension culture, immobilized culture, media and other considerations.

Cell culture products and Hybridoma technology: Recombinant proteins, interferons, Hybrid antibodies, production of monoclonal antibodies

In vitro fertilization and embryo transfer: Overview of in vitro fertilization, embryo transfers in cattle, application and limitations, Test tube baby, Animal cloning.

Transgenic animals: Transfection methods-Embryonic stem cell transfer, electroporation, microinjection, macro injection, biolistic gun method and Transgenic animals.

Bioethics: Importance of ethical committee, guidelines and role in animal research.

Recommended Books:

1. Manual of animal cell culture by Freshney
2. Animal Cell culture by Butler
3. Animal Cell culture by Griffith and Smith
4. Molecular Biotechnology by Glick and Pasternick

Food Biotechnology (BSBT-303)

Historical Background and Introduction

Composition of food, Improvement of food resources through biotechnology i.e., (golden rice, potato etc.) Traditional fermented foods – meat, fish, bread, sauerkraut, soybean, coffee, cocoa and tea.

Fermented food

Solid substrate fermentation- methods, advantages and limitations. Fermented milk, yoghurt, pickles, cheese production – coagulum formation, separation of curd, ripening, types of cheese, value addition products like high fructose syrup and invert sugar

Role of enzymes

Use of protease, glucose oxidase and catalase in food processing. Role of lactase in dairy technology. Enzymes in fruit juice and brewing industry. Production of fruit juices, wine and beer and hard liquor.

Food additives

Coloring, flavoring, vitamins. Microbiology of pickling, color and flavor changes in pickling.

Mushroom production

Advantages and scope of mushroom production. Different types of substrates, conditions and types of mushrooms. Harmful mushrooms.

Single cell Protein

Microorganisms, substrates, production of SCPs, biomass recovery, safety evaluation and nutritional evaluation. Advantages.

Recommended Books:

1. Food microbiology by Frazier
2. Food chemistry by Shakuntlamanay
3. Food processing technology P.J. Fellows, published by Ellis Horword Ltd

Environmental Biotechnology (BSBT 305)

Wastes and Pollutants

Introduction, sources of wastes and pollutants, role of biotechnology in minimizing pollutants.

Waste Treatment

Biofilters, treatment of solid and liquid wastes, contribution of biotechnology to waste management.

Aerobic and Anaerobic Waste Water Treatment

Measurement of level of pollution, digesters

Biodegradation

Types of recalcitrant xenobiotics compounds, hazards from xenobiotic compounds, hydrocarbon degradation, co-metabolism and gratuitous metabolism, use of mixed microbial population and practical approach to xenobiotic degradation.

Bioremediation

Microbial remediation and phyto-remediation, advantages, limitations and scope

Water quality parameters

Introduction, methods, quality parameters.

Recommended Books

1. Biotechnology by B.D.Singh, Kalyani Publishers
2. Microbiology by Tortora
3. Microbial Ecology by Odum

Agricultural Biotechnology (BSBT-307)

1. Introduction: Plant biotechnology, Biological Control, Diagnostics in agriculture, Bioremediation.
2. Transformation techniques: Physical methods, *Agrobacterium* mediated transformation.
3. Transgenics: basic concept and essential steps of the process, Use of suitable promoters and reporters, Gene silencing and measures to overcome it, Commercial aspects of the technology. Production of transgenic plants for fungal, bacterial and viral disease resistance; herbicide resistance, drought and other abiotic stress resistance.
4. Environmental genetics: Degradative plasmids, release of genetically engineered microbes in environment.
5. Microbial inoculants: Biofertilizers, biopesticides, bioinsecticides, bioherbicides.
6. Nitrogen fixation: Basic concepts, nif genes and their regulation, potential scope in crop improvement, Modification of nitrogen fixing capabilities
7. Introduction to Biosensors: Concepts and applications. Applications of biosensor to environmental samples, Introduction to Biochips and their application in modern sciences

Recommended Books

1. Agricultural Biotechnology by Arie Altman. Marcel Dekker, Inc. 2001.
2. Biochemistry and Molecular Biology of Plants: Edited by Buchanan B.B., Gruissem W and Jones RL (2000) American Society of plant Biologists, USA.
3. Comprehensive Biotechnology Vol. 1-4: M.Y. Young (Eds), Pergamon Press.
4. Microbial Biotechnology: Channarayaapa, University press, Hyderabad, 2003.
5. Commercial Biosensors: Graham Ramsay, John Wiley and Sons, INC (1998).
6. Various research and review journals like nature biotechnology, current opinion, Trends and Annual Reviews.

Intellectual Property Rights And Biosafety (BSBT-309)

1. Introduction: History of IPR in India, Protection of IPR, International intellectual property dispute and resolution
2. Choice of IPR protection, management, benefits and problems
3. Brief overview of patents, Copyrights, trademarks and designs, Plant Breeders rights (PBR).
4. Patent application, procedures for patent application, Indian patent acts, TRIPS. WTO, Budapest treaty, Appropriate case study.
5. International harmonization of Patent Laws, Protection of Biotechnological inventions.
6. Patent Litigation: Substantive aspect of patent litigation., Procedural aspects of patent litigation, Recent developments in patents, Patentability of biotechnology, IPR issues in the Indian context, Current patent laws.
7. Biosafety- introduction, History, definition, objectives, Risk assessment, risk regulation, Biosafety during industrial production, Biosafety guidelines in India.
8. Good safety practices, GLP standards, Lab contaminants
9. The Cartagena protocol on Biosafety

Recommended Books

1. International Intellectual property- Doris Estelle Long, Anthony D Amato.
2. International civil dispute resolution by Charles S Balswin
3. Biotechnology- PK Gupta
4. Biotechnology- BD Singh
5. Good Laboratory and Clinical practices by PA Carson and NJ Dent.

Animal Cell Culture and Biotechnology Lab (BSBT-311)

LIST OF PRACTICALS

1. Preparation of Media
2. Lymphocyte culturing
3. Passaging and cell line maintenance
4. Epidemiological analysis
5. Preparation of immobilized culture

Food Biotechnology Lab (BSBT-313)

LIST OF PRACTICALS

1. To check the quality of milk by MBRT test
2. Preparation of yoghurt and curd.
3. Preparation of cheese, pickles and sauerkraut
4. To prepare the spawn for white butter mushroom
5. Estimation of different enzymes (protease, catalase, lactase etc)

Environmental Biotechnology Lab (BSBT-315)

LIST OF PRACTICALS

1. To measure the level of pollutants from air by Hansen method
2. To measure the level of Pollutant from water by Dilution method
3. To measure the level of pollutants from soil by Dilution method
4. To check the presence of microorganisms from different water sources in the region
5. Isolation of xenobiotic bacteria.

(Scheme and Syllabus made effective on students taken admission in 2010)

6th Semester

S. No	Course No	Course Title	L	T	P	Internal marks	External marks	Total marks
11.	BSBT-302	Bioinformatics	3	1		40	60	100
12.	BSBT-304	Plant Biology	3	1		40	60	100
13.	BSBT-306	Fermentation Technology	3	1		40	60	100
14.	BSBT-308	Bioinformatics lab			3	40	60	100
15.	BSBT-310	Fermentation Technology lab			3	40	60	100
16.	BSBT-312	Plant Tissue Culture Lab			3	40	60	100
17.	BSBT-314	*Drug Designing and Drug Delivery system	4			40	60	100
18.	BSBT-316	*Total Quality Management and Entrepreneurship	4			40	60	100
19.	BSBT-318	*Major Project			8	80	120	200
	Total		17	3	9	320	480	800

*-The institute will offer either two courses (BSBT-314 and BSBT-316) or major project work (BSBT- 318) to the students depending upon the facilities in the department

Bioinformatics (BSBT-302)

Unit-I

Scope of Bioinformatics and internet basics. Database management system: Data life cycle, Database architecture, Data format, Database abstraction, relational database system. Database searching: Protein sequence databases, genome databases, protein structure databases, conserved sequence databases, literature databases, BLAST and its types.

Unit-II

Sequences and their alignment: Meaning of sequence, sequence similarity, homology. Pairwise Sequence Alignment: Different scoring models, Substitution matrices (PAM and BLOSUM), Concept of Global and Local Alignment, Dot matrix method, Dynamic programming (Needleman-Wunsch algorithm, Smith-Waterman algorithm), Choosing of best scoring matrix, gap penalties, BLAST (Word) algorithms.

Unit-III

Multiple Sequence alignment: Multiple Sequence Alignment methods (MSA), Progressive, Iterative and Hidden Markov Model (HMM) methods of MSA. Phylogenetic Analysis

Unit-IV

Electronic journals: importance of E-journals and their features like electronic submission, downloading, reference and citations.

Text books

1. **D.W. Mount** *Bioinformatics: Genome and Sequence Analysis: (2001)*
Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.
2. **D. Higgins and Willie Taylor.** *Bioinformatics: Sequences, structures and databanks.* Oxford.
3. **A.D. Baxevanis and B.F. Francis Ouellette.** *Bioinformatics: A practical guide to the analysis of genes and proteins.*

Plant Biology (BSBT-304)

(To be made effective on students having taken admission in 2008)

Unit –I

Introduction: Large scale cultures, agar cultures, suspension cultures, and problems in large scale cultures of plant cells. Micropropagation: Proliferation of axillary buds, induction of adventitious buds, bulbs and protocorms, somatic embryo genesis, somaclonal variations, advantages and limitations. Virus Free Plants: Shoot meristem culture, cryotherapy, chemotherapy, virus indexing, and maintenance of virus free stock, applications and limitations.

Unit –II

Haploid Plants: Homozygous lines, gametoclonal variations, analytical breeding, production of all male populations, advantages and limitations. Somaclonal variations: Isolation, molecular basis, induced mutations and somoclonal variations, advantages and limitations.

Unit –III

Embryo Rescue: Recovery of interspecific hybrids, propagation of orchids, shortening of breeding cycle. Overcoming dormancy.

Unit –IV

Germplasm conservation: Freeze preservation, slow growth cultures, DNA clones, desiccated somatic embryos and artificial seeds. Advantages and limitations.

Recommended Books :

1. J.Hammond, P. McGarvey and V.Yusibov (Eds) Plant Biotechnology Springer Verlag, 2000.
2. T-J Fu. G. Singh and W.R. Curtis (Eds) : Plant Cell and Tissue Culture for the production of Food Ingredients kluwer Academics/Plenum Press 1999.
3. H.S. Chawla : Biotechnology in crop Improvement . International Book Distributing Company, 1998
4. R.J. Henry; Practical Application of Plant Molecular Biology, Chapman and Hall, 1997.
5. P.K. Gupta: Elements of Biotechnology , Rastogi and C. Meerut , 1996
- 6 Bhojwani Rajdan: Plant tissue Culture: Theory and practice, a revised edition
- 7 Biotechnology B D Singh, Kalyani Publication

Fermentation Technology (BSBT-306)

Unit-I

Microbial Growth Kinetics : Batch culture, continuous culture, Comparison of batch & continuous culture, fed-batch culture, Variable volume, Fixed volume, cyclic fed batch culture, applications & uses

Unit-II

Media for Industrial Fermentation : Different types of media, Medium formulation, Carbon sources, Nitrogen sources, Minerals, chelators, precursors, inducers, inhibitors, buffers, Antifoam, Medium optimization. Sterilization : Sterilization of Medium – batch and continuous, Sterilization of fermenter, Sterilization of feed, Filter Sterilization – medium, air, exhaust air, depth filters Aeration and agitation : Design of sparger and agitator, Oxygen requirement, Determination of $K_L a$ value - Sulphite oxidation tech, Gassing out tech, Oxygen Balance tech, Factors affecting $K_L a$ value - effect of air flow rate, degree of agitation, medium and culture rheology

Unit-III

Downstream Processing: Recovery of microbial cells, foam separation, precipitation, Filtration, Centrifugation, cell disruption, extraction, chromatography, Membrane separation process, drying, crystallization.

Unit-IV Microbial enzymes- Isolation, Production of Microbial enzymes, & purification of enzymes, Production of heterologous enzymes, Immobilization of enzymes, Enzyme Engineering, large scale Application of Microbial enzymes. Microorganisms for bioenergy production, Biomass Degradation of Lignocelluloses Ethanol Production. Microbial Insecticides, *Bacillus thuringiensis*, *Bacillus Spharicus Baculoviruses*. Microbial Production of Biosurfactants & their importance. Oilgeanous microbes

Text books :

1. Principles of fermentation technology by Stanberry and Whitaker
2. Biochemical engineering fundamentals by Bailey and Ollis

Bioinformatics(BSBT-308)
List of Practicals

1. To locate an article in midline database
2. To identify the family of a protein through BLAST using non redundant Database
3. Multiple deference alignment using cluster w
4. To convert the data format of structure file of protein
5. To perform point mutations us a protein & obtain its stable structure
6. To generate a packed crystal structure using ist unit all model in silicon

Fermentation Technology Lab (BSBT-310)
List of Practicals

1. To study different parts of fermentor
2. To determine growth rate of unicellular organism in Batch culture
3. To study the release of cellular contents by cell disruption method
4. To study the separation of fermented product by chromatography
5. Purification of protein by salt precipitation
6. To study the enzyme immobilization.
7. Isolation of UV- induced auxotrophic mutants by the replica plating technique
8. Fermentative production of Amylase
9. To determine the nodulation by Rhizobium by plant infection test.

Lab in Plant Tissue Culture (BSBT-312)

1. To prepare media for culturing.
2. To study the sterilization of explant.
3. To study the Meristem and node culture of potato.
4. Preparation of callus from a leaf explant.
5. Sub-culturing of callus.
6. Micropropagation of rose and its subculturing.
7. To study embryogenesis in rose plant.
8. To study seed germination.

Drug Designing and Drug Delivery system(BSBT-314)

Unit-I

Cell culture basics: cell lines, media, growth and culture characteristics, animal cell culture products and their therapeutic potential: human biologicals, recombinant proteins, viral vaccines, monoclonal antibodies.

Unit-II

Newtonian basis of Molecular Modeling, Structure modification of natural therapeutic agents, Chemical approaches to site-specific delivery of therapeutic entities.

Unit-III

Biotechnological Pharmaceutical products: FDA approved, marketed and in clinical trials.

Unit-IV

Transdermal Drug Delivery, Drug Delivery Technologies: Nanoparticles, microspheres and liposomes.

Recommended Books:

Burger's Medicinal Chemistry, John Wiley & Sons, Inc., New York, 1994, Vol 1-3
Applied Biopharmaceutics and Pharmacokinetics 4th Edition Leon Shargel and Andrew Yu, Appleton & Lange.
Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry.

Total Quality Management and Entrepreneurship (BSBT-316)

Unit I

Total Quality Management: Introduction, Concept, Role and its Impotence, Contribution of management Thinker in Quality Delivery Market

Core Concept of Total Quality Management: Quality of Profit, Cost and Economics of Quality, Competiting Branch Market and Quality Delivery Market

Unit II

Tools and Techniques of Total Quality Management: Technique for Analyzing Quality Process, Statistical Process Control, Problem Solving Tools.

Information System and Technology: Basic concept, Types, Information System Organization, Information Management and decision making

Total Quality Management:-ISO-9000-2000, 9001-9004, ISO-14000,. HACCP
Role of regulatory agencies -FDA FAO, TFA, BIS

Unit III

Entrepreneurship: Concept, nature, scope and philosophy of entrepreneurship - Distinction between self-employment and entrepreneurship. Importance of entrepreneurship and self-employment in India. Context, entrepreneurial traits, Small business strategic planning, Pricing and promotion, Franchising.

Unit IV

Concept of various Types of business organization - sole proprietorship, partnership, cooperation society, private and public limited companies, institutions support for establishment of self-employment and entrepreneurial ventures, role of various agencies.

Recommended Books

1. Total Quality Management by Feighan Baun.
2. Total Quality Management by Duncan.