



Scheme of Instruction & Syllabi

of

B.Sc Biotechnology (3 Years)

JIS UNIVERSITY,
81, Nilgunj Road, Agarpara
Kolkata -700109

Course structure and syllabus

SEMESTER - I:

Sl. No.	Paper Code	Title of the Paper	L	T	P	No. of Credits	No of Hrs./Week
1	BBT 101	Biological Macromolecule - I	3	1	0	4	4
3	BBT 102	Biophysics and Instrumentation	3	1	0	4	4
4	BCH 101	Inorganic Chemistry - I	3	1	0	4	4
5	BBT 103	Mathematics - I	3	0	0	3	3
6	BCH 191	Chemistry Lab	0	0	3	3	3
7	BBT 191	Biological Macromolecule Lab I	0	0	4	4	6
8	BBT 192	Biophysics and Instrumentation Lab I	0	0	3	3	3
TOTAL						25	27

SEMESTER - II:

Sl. No.	Paper Code	Title of the Paper	L	T	P	No. of Credits	No of Hrs./Week
1	BBT 201	Biological Macromolecule - II	3	1	0	4	4
3	BBT 202	Microbiology	3	1	0	4	4
4	BCH 201	Organic Chemistry - I	3	1	0	4	4
5	BBT 203	Mathematics - II	3	0	0	3	3
6	BCH 291	Chemistry Lab II	0	0	3	3	3
7	BBT 291	Biological Macromolecule Lab II	0	0	3	3	3
8	BBT 292	Microbiology Lab	0	0	3	3	6
9	BSD 282	Project and Seminar	0	0	2	1	-
TOTAL						25	27

SEMESTER - III:

Sl. No.	Paper Code	Title of the Paper	L	T	P	No. of Credits	No of Hrs./Week
1	BBT 301	Cell Biology	3	1	0	4	4
3	BBT 302	Molecular Biology	3	1	0	4	4
4	BCH 303	Physical Chemistry - III	3	1	0	4	4
5	BBT 304	Mathematics - III	3	0	0	3	3
6	BCH 391	Chemistry Lab III	0	0	3	3	3
7	BBT 391	Cell Biology Lab	0	0	3	3	3
8	BBT 392	Molecular Biology Lab	0	0	3	3	6
9	BSD 381	Skill Development	1	0	0	1	-
TOTAL						25	27

SEMESTER - IV:

Sl. No.	Paper Code	Title of the Paper	L	T	P	No. of Credits	No of Hrs./Week
1	BBT 401	Immunology	3	1	0	4	4
3	BBT 402	Genetics	3	1	0	4	4
4	BCH 402	Organic Chemistry - III	3	1	0	4	4
5	BBT 403	Mathematics - IV	3	0	0	3	3
6	BCH 491	Chemistry Lab IV	0	0	3	3	3
7	BBT 491	Immunology Lab	0	0	3	3	3
8	BBT 492	Genetics Lab	0	0	3	3	6
9	BSD 482	Project and Seminar	0	0	2	1	-
TOTAL						25	27

SEMESTER - V:

Sl. No.	Paper Code	Title of the Paper	L	T	P	No. of Credits	No of Hrs./Week
1	BBT 501	Recombinant DNA Technology	3	1	0	4	4
3	BBT 502	Bioprocess Engineering	3	1	0	4	4
4	BBT 503	Animal Biotechnology	3	1	0	4	4
5	BBT 504	Plant Biotechnology	3	1	0	4	4
6		Environmental Science	2	0	0	2	2
7	BBT 591	Recombinant DNA Technology Lab	0	0	3	3	4
8	BBT 592	Bioprocess Engineering Lab	0	0	3	3	6
9	BSD 581	Skill Development	1	0	0	1	-
TOTAL						25	27

SEMESTER - VI:

Sl. No.	Paper Code	Title of the Paper	L	T	P	No. of Credits	No of Hrs./Week
1	BBT 601	Environmental Biotechnology	3	1	0	4	4
3	BBT 602	Industrial Biotechnology	3	0	0	3	4
4	BBT 603	Medical Biotechnology	3	0	0	3	4
5	BBT 604	Virology	3	0	0	3	3
6	BBT 691	Project and Viva Voce	0	0	10	12	12
TOTAL						25	27

BBT 101 Biological Macromolecule I

(3-1-0)

Unit I: Introduction: Biochemical basis of life. Significance of macromolecules Carbohydrates, proteins, lipids and nucleic acids.

Unit II: Chemistry and Metabolism of Carbohydrates: Structure and function of monosaccharides, Oligosaccharides and Polysaccharides. Chemical reactions of carbohydrates.

Unit III: Classification and chemistry Lipids: Structure and functions of triglycerides, phospholipids, glycolipids, Significance of PUFA, Cholesterol and its derivatives. Metabolism of fatty acids oxidation, fatty acid biosynthesis, endogenous synthesis of triacylglycerols, phospholipids cerebrosides, gangliosides, cholesterol.

Unit IV: Classification of Proteins and their functions: Essential and nonessential Amino acids structure and properties of amino acids, general degradation of amino acids transamination, oxidative deamination, decarboxylation, disposal of ammonia Urea cycle, structure of proteins primary secondary and tertiary structures. Biocatalysts: Enzymes classification, Mechanism of action / allosteric enzymes / Isoenzymes / Coenzymes and cofactors.

Unit V: Nucleic acids: Structure and function of DNA and RNA Purine and Pyrimidine bases structure, degradation and synthesis, inborn errors of nucleotide metabolism.

Text Books:

1. Lehninger AL, Nelson DL and Cox MM (2002), Principles of Biochemistry. Mac Millan Worth Publishers Inc.(CBS Pub. & Distributors, New Delhi)
2. Martin DW, Jr., Mayer, PA and Rodwell, VW (2002). Harper's Review of Biochemistry 25th Edition, Maruzen Asian Ed: Lange Med. Pub.
3. Stryer L (2002). Biochemistry, Freeman & Co.

BBT 102 Biophysics and Instrumentation

(3-1-0)

Unit I: Biophysical Method: Molecular analysis using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy Molecular structure determination using X-ray diffraction and NMR, Molecular analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.

Unit II: Radiolabeling techniques: Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines.

Unit III: Microscopic techniques: Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze- fracture methods for EM, image processing methods in microscopy.

Unit IV: Electrophysiological methods: Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT.

Unit V: Electrophoresis- General principles, horizontal & vertical gel electrophoresis, capillary electrophoresis, isoelectric focusing, 2D, pulse-field and immuno, electrophoresis. Disc gel electrophoresis; Gradient electrophoresis; SDS PAGE.

Text Books

1. Separation methods in biochemistry by S.J. Morris and P. Morris (Pitman)
2. The tools of Biochemistry by Terrance G. Cooper (Wiley)
3. Biochemical research technique (A practical introduction by Ed. John M. Wriggles worth
4. Analytical biochemistry by David J. Holmes and Hazel peck
5. A Biologist's guide to principles and techniques of practical biochemistry, 2nd edition Ed. by BL. Williams and K. Wilson (Edward Arnold)
6. Biophysical chemistry D. Freifelder, W.H. Freeman
- 7 Experimental techn. Ex ques in biochemistry by Drewer Pesec, AJ. And As worth, R.B.

8. Principles of Physical Biochemistry by K.E. Vanholdem W.C. Johnson, P.S. Ho, (Prentice Hall), 1998.

BCH 101 Inorganic Chemistry – I

(3-1-0)

Refer Chemistry Department Syllabus

BBT 103 Biomathematics I

(3-0-0)

Unit I: Determinant and Matrix: Determination up to the third order : Properties, Cofactor and Minor. Product of two determinants. Adjoint, Symmetric and Skew-symmetric determinants. Solutions of linear equations with not more than three variables by Cramer's Rule. Basic conception of matrix and its properties. Minor, Co-factor, Jaccobi's theorem. Complementary Minor and Algebraic Complement of a matrix. Orthogonal matrix and its important properties. Row and column operations, row (column) equivalency, row (column) reduced form, Echelon form of a matrix. Rank of a matrix. Trace of a matrix. System of linear equations (Homogeneous, Non-Homogeneous), consistency and inconsistency of system and their solutions by Crammer's rule and matrix inversion method. Eigen values and Eigen vectors of a matrix. Cayley-Hamilton theorem. Diagonalisable matrix.

Unit II: Differential Calculus: Natural numbers(N), Integers(Z), Rational numbers(Q), Irrational numbers(R-Q), Real numbers(R) and some properties. Definition of function. Study of the functions e^x (where e is exponential function), x^a , x^n , $\log_e x$, $\sin x$, $\cos x$, $\tan x$, $\sinh x$, $\cosh x$, $\tanh x$ and their properties. Boundedness, limit and continuity of function. Monotonic function. Periodic function. Differentiation of function. Properties of differentiation. Rules for finding higher order derivatives. . Leibnitz's theorem. Statement of Rolle's theorem and its geometrical interpretation. Mean Value Theorems of Lagrange and Cauchy. Statements of Taylors and Maclaurin's Theorems with Lagrange's and Cauchy's form of remainders. Taylor's and Maclaurin's Infinite series for functions like e^x , $\sin x$, $\cos x$. $(1+x)^n$, $\log(1+x)$ [with restrictions wherever necessary]. Indeterminate Forms : L'Hospital's Rule : Statement and problems only. . Functions of two and three variables : Partial

derivatives . Limit and Continuity (definitions only) for functions of two variables. Relation between limit and continuity. Harmonic function. Laplace's equation. Knowledge and use of Chain Rule. Exact differentials (emphasis on solving problems only). Statement of Schwarz's Theorem on commutative property of mixed derivatives. Euler's theorem on homogeneous function of two and three variables. Jacobian and Maxima and minima of functions of not more than three variables – Lagrange's Method of undetermined multiplier – Problems only. Implicit function in case of function of two variables (existence assumed) and derivative.

Unit III: Sequence and Series: Definition of sequence. Bounded sequence, convergent sequence, divergent sequence. Series of positive terms. Test for convergence: Comparison test, Cauchy's root test, D'Alembert's ratio test and Raabe's test (statement and related problems on these tests). Alternative series. Leibnitz test (statement and related problems on these test). Absolute convergence and conditional convergence.

Unit IV: Set Theory: Definition of set. Examples. Union, Intersection, Complement, \square operator and some more important properties of set. D Morgan's law (statements and proof). Venn diagram of set. Type equation here. Cartesian product of two sets. 5. Definition of Relation. Properties of relation.. Equivalence relation and examples. Mapping (Function). Injective mapping, Surjective mapping and Bijective mapping. Examples. Composition of mappings. Inverse of mapping. Cardinality of a set. Cardinality theorem.

Unit V: Groupoid, Semigroup, Monoid ,Quasigroup and Group with examples.

BBT 191 Biomacromolecule Lab 1**(0-0-3)**

1. Qualitative tests of carbohydrates: Glucose, fructose (Benedict's Test); sucrose (Acid hydrolysis & Benedict's Test);
2. Qualitative tests of proteins (Biuret method);
3. Qualitative tests of lipids (TLC & detection by Iodine vapor).
4. Separation of aminoacids (Lysine, glycine, tryptophan, proline) by Thin Layer Chromatography.
5. Estimation of amino acid (glycine) by formol titration.

BBT 192 Biophysics and Instrumentation Lab**(0-0-3)**

1. Microscopy – Light microscopy : principles, parts & function, Operation.
2. Image analysis of different classes of Microbes.
3. Preparation of Microbial media (bacteria, yeast, mold, algae, protozoa)
4. Sterilization: principles & operations – Autoclave, Hot Air Oven, Filtration, Laminar Air Flow
5. Principles & operations of Incubators & Shakers
6. Principle & operation of Centrifuge
7. Principle & operation of pH meter
9. Principle & operation of Spectrophotometer
10. Electrophoresis techniques

Unit I: Carbohydrate metabolism: Glycolysis, TCA cycle – and its function and regulation. Electron transport chain, Glyoxylate cycle, Gluconeogenesis and its regulation, HMP shunt and its significance, Uronic acid pathway, Glycogen metabolism and its regulation with special reference to phosphorylase and glycogen synthase, Metabolism of fructose, galactose and lactose, cori cycle - outline.

Unit II: Metabolism of essential and non-essential amino acids: General metabolic reactions of amino acids. Biosynthesis and regulation of branched chain amino acids, aromatic amino acids, histidine and methionine. Metabolic breakdown of individual amino acids. Ketogenic and glycolytic amino acids. Urea cycle.

Unit III: Fats as energy stores: Oxidation of fatty acids, Formation and utilization of ketone bodies. Biosynthesis of fatty acids and regulation. Biosynthesis of triglycerides.. Biosynthesis of cholesterol and its regulation, Formation of bile acids.

Unit IV: Biosynthesis of purines and pyrimidines: Degradation of purines and pyrimidines and their regulation. Structure and regulation of ribonucleotide reductase. Biosynthesis of ribonucleotides, deoxyribonucleotides and polynucleotides. Inhibitors of nucleic acid biosynthesis. Biosynthesis and degradation of heme.

Unit V: Metabolic disorders-In born errors of Carbohydrate metabolism: Lactose intolerance, Diabetis mellitus, Cori's disease, Inborn errors of amino acid metabolism- Alkaptonuria, Tyrosinemia, In born errors of lipid metabolism- Gaucher disease, Hyper and hypo cholesterolemia. In born errors of Nucleic acid metabolism – Gout, Hyper uricemia, Lesch – Nyhan syndrome.

Text Books

1. Lehninger AL, Nelson DL and Cox MM (2002), Principles of Biochemistry. Mac Millan Worth Publishers Inc.(CBS Pub. & Distributors, New Delhi)
2. Martin DW, Jr., Mayer, PA and Rodwell, VW (2002). Harper's Review of Biochemistry 25th Edition, Maruzen Asian Ed: Lange Med. Pub.
3. Stryer L (2002). Biochemistry, Freeman & Co.

Unit I: Air Microbiology: Different types of microorganisms in the air, aerosols, sampling techniques, airborne pathogens, techniques of room sterilization.

Unit II: Microbiology of water: Microbiological analysis of water (total count, indicative organism), B.O.D. & C.O.D. - determination and implication. Coliform test - detection of faecal and non-faecal coliform); IMViC test; determination of MPN microbiological treatment of sewage and industrial waste water. Anaerobic Treatment (safety tank).

Unit III: Food Microbiology: Milk as a growth medium of bacteria, Normal microflora in milk, undesirable microbes in milk and normal microflora of meat, poultry, eggs, fruits and vegetable; Fresh food, Fresh milk, canned food and stored grains; Microscopic examination and Culture, phosphatase test of pasteurized milk.

Unit IV: Preservation of food: High temperature (Boiling, Pasterurization. Appertization) Low temperature (Freezing): Dehydration. Osmotic Pressure. Chemical Preservations. Radiation.

Unit V: Microbiologically Fermented food: Curd. Cheese. Idli. Yogurt. Acidophilic Milk Microorganisms as food-SCP : Food borne diseases - Salmonellosis. shigellosis.

Text Books

1. Stainer R.Y. Adelberg, E.A., Ingrham J.L. General Microbiology. 4th ed. Macmillan, 1976.
2. Davis, B.D. Dulbecco, R.Eisen, H.N., Ginsberg H.S Microbiology Harper & Row publishers 1980.
3. Pelczar, M.L.Chan, E.C.S. Krieg, N.R. Microbiology, Mc Graw-Hill Book Company, 1986.
4. Freeman B.A. Burrows Text book of Microbiology Saunders HB Company, 1985.
5. Joklik, W.K., Willet H.P., Amos, D.B. and Wilfert C.M. Zinssers Microbiology, 19th ed. Prentice- Hall International Inc. 1988.
6. Paul J. Vandemark, Barry L. Batzing th microbes. The Benjamin/ cummings publishing company, Inc.1987.
7. Lansing M. Prescott, John P.Harley, Donald. A.Kleein, Microbiology, 3rd edition brown publishers, 1996.

BCH 201 Organic Chemistry – I

(3-1-0)

Refer Chemistry Department Syllabus

BBT 203 Biomathematics II

(3-0-0)

Unit I: Ordinary differential Equation : First order and first degree: Existence condition and uniqueness of a differential, necessary and sufficient condition of exactness of a first order and first degree ODE (statement only). Integrating factor. Rules for finding integrating factors. Linear equation. Bernoulli's differential equations. First order and Higher degree ODE Clairaut's form, singular solution, Equations solvable for p , x , y respectively. Higher order ODE. General linear ODE (2nd order) with constant coefficients, CF and PI. Methods for finding PI. Variation of parameters.

Unit II: Vector Calculus and Vector Analysis: Definition of scalar and vector fields. Collinear and co-planar vectors. Dot product and cross product and their properties. Box function. Directional derivatives, gradient, divergence and curl. Solenoidal and irrotational vectors. Green's theorem. Stokes' theorem. Gauss's theorem and their applications. Orthogonal curvilinear co-ordinates of gradient, divergence and curl in curvilinear co-ordinates.

Unit III: Integral Calculus: Indefinite integration. Integration by parts. 3. Integration by substitution. Definite integration. Reduction formulae of $\int \sin m x dx$, $\int \cos n x dx$, $\int \sin n x \cos m x dx$, $\int \tan x dx$ and associated problems (m and n are non-negative integers). Definition of Improper Integrals : Statements of (i) μ -test, (ii) Comparison test (Limit form excluded) – Simple problems only. Use of Beta and Gamma functions (convergence and important relations being assumed). Application of integration.

BBT 291 Biomacromolecule Lab II**(0-0-3)**

1. Assay of chymotrypsin and trypsin.
2. Isolation and partial purification of enzymes, amylases and cellulases.
3. Localization of enzymes – mitochondrial (SDH) and cytosolic (GSH)
4. Determination of characteristics of enzyme-catalyzed reaction (V_{max} , K_m and K_{cat}).
5. Effect of temperature on the rate of enzyme catalysed reaction.
6. Effect of pH on the rate of enzyme catalysed reaction
7. Effect of inhibitors on enzyme catalyzed reactions.
8. Effect of Activators on enzyme catalyzed reactions.
9. Immobilization of enzymes.
10. Characterisation of immobilised enzymes.

BBT 292 Microbiology Lab II**(0-0-3)**

1. Preparation of culture media: (Complex media (Nutrient Broth; NA slant; Lactose broth); Chemically defined, Synthetic media (Czapekdox broth / agar). YPD / select media which will be used for the experiments specified.
2. a) Cultivation of Microorganisms: on agar-slant/agar-plate streak culture: Bacteria (*Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli*); Yeast (*Saccharomyces cerevisiae*) Moulds (*Penicillium notatum*, *Aspergillus niger*).
b) Pure-culture: by streak-plate/pour plate methods
3. Sampling and quantification of microorganisms in air.
4. Sampling and quantification of microorganisms in soil.
5. Sampling and quantification of microorganisms in water.
6. Isolation of bacteria [Streak plate, spread plate, pour plate, serial dilution]
7. Identification of microorganisms from the habitats [simple staining, differential staining, acid fast staining, capsule staining, spore staining and motility]
8. Observation of morphology - shape and arrangement of cells.
9. Methods of inoculation of different microbes in selective media.
10. Microscopic measurements, micrometer (ocular andstage), haemocytometer.
11. Microscopic study of phytoplanktons & zooplanktons.

Unit I: Basic properties of cell: Different classes of cell: Prokaryotic, animal and plant cell, their characteristics, cell wall, composition, function of bacterial cell wall. Plasma membrane, structure, function, fluid mosaic model, membranes, lipids and proteins transport across the membranes- passive, active; phagocytosis, endocytosis.

Unit II: Cell organelles: Endoplasmic reticulum, golgi complex- exocytosis; Lysosomes: phagocytosis, endocytosis; Plant cell vacuoles; Structure of mitochondria and organization of respiratory chain; Structure of chloroplast and photophosphorylation; Structure of nucleus, nucleolus, nuclear membrane, transport across nuclear membrane.

Unit III: Cell Cycle: Molecular aspects of cell division and cell cycle, Regulation of cell cycle events, apoptosis, necrosis.

Unit IV: Different components of cell: Water, inorganic, organic constituents of cell, minerals, polysaccharides, proteins lipids, nucleic acids, vitamins, enzymes.

Unit V: Cellular communication: Extracellular matrix, collagen, proteoglycans, fibronectin, laminins, integrins, selectin, cadherins, role of tight junctions and gap junctions, Role of G-proteins coupled receptors, cAMP, Tyrosine kinase in cell signal transductions.

Text Books

1. Cell Biology - De Robertes & De Robertes
2. Cell and Molecular Biology - Baltimore.L
3. The Cell - Hooper
4. Cell and Molecular Biology - P.K.Gupta
5. Cell Biology- Verma and Agarwal
6. Cell Biology- Rastogi
7. Cell Biology-twyn

Unit I: Replication: DNA replication, repair and recombination (Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination).

Unit II: Transcription: RNA synthesis and processing (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport).

Unit III: Translation: Protein synthesis and processing (Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins).

Unit IV: Gene Regulation: Control of gene expression at transcription and translation level (regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing).

Text Books

1. Molecular Biology of the Gene (4th Edn) JD Watson, NH Hopkins, JW Roberts, JA Steitz and AM Weiner, The Benjamin/Cummings Publ, Co. Inc, California.
2. Molecular Cell Biology (2nd Edn) J.Darnell, H.Lodish and D. Baltimore, Scientific American Books, Inc. USA 1994
3. Molecular Cloning: A Laboratory manual, J. Sambrook, E.Ffrisch and T. Maniatis, Old Spring Harbor Laboratory Press New York, 2000
4. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & Sons Ltd,
5. Molecular Biology, TA Brown (Ed) Bios Scientific Publishers Ltd.,Oxford, 1991

BCH 303 Physical Chemistry – III

(3-1-0)

Refer Chemistry Department Syllabus

BBT 303 Mathematics III

(3-0-0)

Unit I: Probability: Random Experiment, Outcome, Event, Mutually exclusive events, Equality like and exhaustive, Classical definition of probability, conditional probability and statistical independence. Sequential definition of probability. Baye's theorem and related problems. Axiomatic approach of probability. Exercise.

Unit II: Random variable. Probability space .Expectation. Theorems on Expectation. Joint distribution of two random variables. Probability distribution- Continuous and Discrete. Probability Density function. Probability Mass function. Binomial , Poisson, Normal and Rectangular distributions and their properties.

Unit III: Geometry 2 Dimension: Co- Ordinates, Straight Line, Circle.

BBT 391 Cell Biology Lab**(0-0-3)**

1. Osmofragility of RBC
2. Isolation of plasma membrane from erythrocyte
3. Chloroplast isolation from mung beans leaves
4. Extraction and estimation of chlorophyll
5. Extraction of Acid phosphatase from potato to study the effect of pH, temperature.
6. Effect of substrate concentration and inhibitor on the efficiency of the enzyme.
7. Extraction of tyrosinase from potato
8. Preparation of Competent cell by calciumchloride method and checking its efficiency
9. Preparation of slides from onion root tip for mitosis

BBT 392 Molecular Biology Lab**(0-0-3)**

1. Isolation of genomic DNA from bacteria
2. Determination of purity of the isolated DNA by UV spectrophotometry
3. Colorimetric method (Diplhenylamine reagent) to measure DNA purity.
4. Thermal denaturation of DNA and demonstration of hyperchromic effect.
5. Isolation of plasmids from E.coli and separation of CCC, Open circular and linear forms of plasmids
6. Agarose gel electrophoresis – Separation and molecular size determination of DNA
7. Isolation and separation of proteins by SDS- PAGE
8. Western blot.
9. Purification of DNA fragment from agarose gels

Unit I: Introduction and overview: Types of Immunity, Innate and Acquired Immunity. Organs of the immune system. Cells of the immune system -B and T Lymphocytes, NK cells, macrophages, monocytes, granulocytes, mast cells and dendritic cells. The Antigen Presenting Cells. Antigens - Immunogenicity versus antigenicity, factors that influence immunogenicity, epitopes, haptens, adjuvants.

Unit II: Immunoglobulins: Classification, structure and functions. Antibody diversity. Antigen-antibody reactions, Complement system. Major Histocompatibility Complex (MHC), the role of HLA typing in organ transplantation. T Cell maturation, activation, differentiation. The structure and functions of T cell receptors, TCR-peptide-MHC Tri molecular complexes. B cell generation, activation and differentiation. Cytokines.

Unit III: The Humoral and Cell-mediated Immune Responses: B-cell activation and proliferation by Thymus independent and Thymus dependant antigens in vivo sites for induction of humoral response; B-cell differentiation, class-switching and generation of plasma cells and memory cells; Cell-mediated immune response: General properties of effector T-cells; Direct cytotoxic response; experimental assessment of cell-mediated cytotoxicity; Hypersensitivity – classification, mechanism, types, consequences of hypersensitive reactions.

Unit IV: Vaccines: Classification and types. Production of vaccines and sera- conventional and biotechnological. Autoimmunity and autoimmune diseases (Rheumatoid arthritis, multiple sclerosis and SLE). Cancer and Immune system-Tumor induced cell signaling. Immune tolerance and immune suppression.

Text Books

1. Coleman, Lombard and Sicard. Fundamental Immunology, WCB publishers 1992.
2. Goldsby RA, Kindt TJ, Osborne BA. Kuby Immunology, Fourth Ed, W.H. Freeman and company, New York, 2000.

Unit I: Mendelian principles: Dominance, segregation, independent assortment.

Unit II: Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests

Unit III: Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

Unit IV: Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants.

Unit V: Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.

Unit VI: Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.

Unit VII: Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.

Unit VIII: Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.

Text Books

1. Freidfelder, D. Molecular Biology. Jones & Bartlett Pub, Second Edition. 1986.
2. Strickberger, MW., Genetics, 3rd edition, Macmillan Publishing Company, 1985
3. Basic Genetics by Daniel L. Hartl, David Freifelder, Leon A. Snyder Jones & Bartlett Pub. 1988.
4. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A., and A.M. Weiner.
5. Molecular Biology of the Gene, Volume I & II (4th Edition). Benjamin Cummings Publications, 1987.

BCH 402 Organic Chemistry - III

(3-1-0)

Refer Chemistry Department Syllabus

BBT 403 Mathematics IV

(3-0-0)

Unit I: Elements of Statistical methods: Primary data and secondary data. Population and sample. Sample survey. Chart and diagram. Frequency distribution. Measure of central Tendencies- Mean , Median and Mode. Standard Deviation, Variance. Moment , Skewness and Kurtosis.

Unit II: Sampling distribution: Fundamental distributions- Standard normal distribution, Chi-square Distribution.

Unit III: Bivariate Frequency Distribution: Correlation and Co-efficient. Regression lines. Curve fittings.

BBT 491 Immunology Lab**(0-0-3)**

1. Simple immunodiffusion
2. Radial immuodiffusion
3. Immuno-electrophoresis
4. Spot ELISA
5. Blood group and Rh typing
6. Rocket electrophoresis
7. Ag-Ab agglutination reaction

BBT 492 Genetics Lab**(0-0-3)**

1. DNA Isolation from peripheral blood lymphocytes
2. Polymerase Chain Reaction (PCR)
3. Fluorescence In-Situ Hybridization (FISH)
4. Chromosomal Analysis
5. Culture of Human, Plant & Animal cells
6. Preparation of Slides
7. Staining of Slides
8. Image analysis & Karyotyping
9. Estimation of serum protein content
10. Estimation of blood glucose.

BBT 501 Recombinant DNA Technology

(3-1-0)

Unit I: Vectors for cloning: Plasmids, phages, ssDNA phages, cosmids, YACs. Enzymes used in gene manipulation-restriction enzymes, DNA polymerases, reverse transcriptase, ligases, polynucleotide kinase, alkaline phosphatase and nucleases.

Unit II: Transfer of DNA into cells: transformation, transduction, electroporation, microinjection. Agrobacterium mediated gene transfer.

Unit III: Cloning strategies: Genomic libraries, cDNA Cloning subcloning, shot gun cloning. Cloning in E. coli, Bacilli and yeast. Yeast two hybrid system. cDNA phage display library. Recombinant clones: Detection of recombinant DNA and its Products.

Unit IV: Site-directed mutagenesis of cloned genes. DNA sequencing: Oxy, deoxy chemical methods, Pyrosequencing, Nanosequencing. PCR: Design of PCR primers, RT-PCR, RACE, AP-PCR, PAF. Antisense and ribosome technology: siRNA, miRNA, Ras, Dicer. Applications of PCR.

Unit V: Applications of genetic engineering: In medicine, agriculture, veterinary and industry. Safety aspects of recombinant DNA technology; Intellectual property rights (IPR) and patents. DNA forensics. Somatic cell gene therapy.

Text Books

1. Primrose, S.B., Twyman, R.M., and R.W. Old. Principles of Gene Manipulation. Sixth Edition. Blackwell Science, 2001.
2. Genes IV, 1990. B. Lewin. Oxford University Press. PP 857. Microbial genetics. 1994. Freifelder, D. Springer.
3. Genetics : A molecular approach. 2nd ed. 1992. T.B. Brown. Panima Publications. PP 496. Principles of Gen
4. Lodish, H., Baltimore, D., and A. Berk. Molecular Cell Biology. W H Freeman & Co (Sd); 3rd edition, 1995.
5. Sambrook, J., Fritsch, E.F., and T. Maniatis. Molecular Cloning. A Laboratory Manual. 2nd Ed. Cold Spring Harbor Laboratory Press, New York, 1989.
6. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., and P. Walter. Molecular Biology of the Cell, Fourth Edition. Garland & Co. 2002.

BBT 502 Bioprocess Engineering

(3-1-0)

UNIT I: History of bio processing, industrial applications, chemical technology vis a vis biotechnology, commercial evolution, potential

Unit II: Mechanism of enzyme reactions, Michaelis Menten kinetics, inhibition, factors affecting rate, parameter estimations, growth characteristics of microbial cells, Monod model, batch culture.

Unit III: Agitation and mixing, transport in cells, transfer resistances, mass transfer coefficients, enhancement of oxygen transfer, heat transfer correlations, batch and continuous sterilisation

Unit IV: Ideal bioreactors, Batch, fed batch, CSTR, PFR, Multiphase bioreactors, packed bed, bubble column fluidized trickle bed, immobilization. Aseptic, septic and anaerobic fermentors.

Unit V: Filtration, centrifugation, sedimentation, extraction, sorption, reverse osmosis, ultrafiltration, electrophoresis, waste water treatment.

Text Books

1. Bioprocess Engineering by M.Shuler & F.Kargi (2002)Prentice Hall (I) Ltd., N.Delhi.
2. Bioprocess Engineering Principles by P. M. Doran (1995)Academic Press
3. Biochemical Engineering fundamentals" 2nd ed. by J E Bailey and D F Ollis, McGraw-Hill (1986).

Unit I: Gene transfer methods in Animals: Microinjection, Embryonic Stem cell gene transfer, Retrovirus & Gene transfer.

Unit II: Transgenic Animals: Mice, Cow, Pig, Sheep, Goat, Bird, Insect.

Unit III: Animal diseases need help of Biotechnology: Foot-and-mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis.

Unit IV: Animal propagation: Artificial insemination, Animal Clones.

Unit V: Conservation Biology: Embryo transfer techniques.

Unit VI: Genetic modification in Medicine: gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics.

Text Books

1. Animal Biotechnology (1989): Comprehensive Biotechnology First Supplement: (Ed.)L.A. Babink and J.P.Phillips. Pregamon press, Oxford,
2. Experimental approaches to Mammalian Embryonic Development. (1986) Rossant,J. and R.A.Pederson Cambridge University Press, Cambridge
3. Animal cell culture A practical approach. (1992) Ed. R.I.Freshney .IRL press.
4. Future Developments in the Genetic Improvements of Animals. Ed. J.S.F. Barrer, K. Hammond and A.E. Mc Clintock, Academic Press, 1992.
5. Human Genetics : Concept and Applications. Ricki Lewis . McGraw Hill. 2003.

Unit I: Plant Tissue Culture applications: Micropropagation, from Callus to plant, somatic embryogenesis, somaclonal variation, valuable germplasm, chemicals from plants, genetically engineered plants.

Unit II: Applications of Plant Genetic Engineering: crop improvement, herbicide resistance, insect resistance, virus resistance, plants as bioreactors.

Unit III: Genetic modification in Agriculture: transgenic plants, genetically modified foods, application, future applications, ecological impact of transgenic plants.

Unit IV: Genetically modified foods: organic foods, types of organic foods, identifying organic foods, organic food & preservatives.

Unit V: Genetic modification in Food industry: background, history, controversies over risks, application, future applications.

Text Books

1. Plant Molecular Genetics - Monica A. Hughes. Harlow, England: Addison Wesley Longman, 1996.
2. Plant Biotechnology and Transgenic Plants. Editors: Kirsi-Marja, Wolfgang Barz. Marcel Dekker, 2002.
3. Plant Biochemistry and Molecular Biology, Lea, PJ, Leegood, RC, eds. John Wiley and Sons, Chichester and New York , 1993.
4. Plant development and Biotechnology. Editors: Robert N. Trigiano, Dennis J. Gray. CRC press, 2004.

BBT 591 Recombinant DNA Technology Lab**(0-0-3)**

1. UV mutagenesis and percent survival
2. Photoreactivation of UV irradiated *E. coli*.
3. Development of auxotrophic mutants employing EMS
4. Screening of multiple antibiotic resistant mutants of *E. coli*
5. Plasmid curing in bacteria
6. Replica plating technique
7. Determination of purity and estimation of DNA
8. Transfection by single burst experiment
9. Blue and white colony selection employing X-gal-IPTG

BBT 592 Bioprocess Engineering Lab**(0-0-3)**

1. Determine the growth patterns and specific growth rate of *E. coli*
2. Determine the effect of peptone concentration on *E. coli* growth
3. Determination of specific thermal death rate constant (kd) for *E. coli*
4. Determine the effects of temperature & pH on the growth of bacteria
5. Upstream and Downstream of bioprocess for the production of Citric acid by *Aspergillus niger*
6. Citric acid production from whey with glucose as supplementary carbon source by *Aspergillus niger*
7. Upstream and Downstream of bioprocess for the production of α -amylase by *Aspergillus nudulans*
8. Preparation of immobilized enzymes & cells and evaluation of kinetic parameters.

Unit I : Components of Environment: Hydrosphere, lithosphere, atmosphere and biosphere – definitions with examples; Interaction of man and environment; Environmental Studies as a multidisciplinary subject.

Unit II: Global Environmental Problems: Green House Effect, Acid rain, El Nino, Ozone depletion, deforestation, desertification, salination, biodiversity loss; chemical and radiation hazards.

Unit III: Environmental pollution and degradation: Pollution of air, water and land with reference to their causes, nature of pollutions, impact and control strategies; noise pollution; environmental damage by agriculture, perspectives of pollution in urban, industrial and rural areas. Habitat Pollution by Chlorinated Hydrocarbons (DDT, PCBs, Dioxin etc), Organophosphates, Heavy Metals, Die-offs, Endocrine disrupting chemicals, Nutrient pollution.

Unit IV: Environmental Management: Concept of health and sanitation, environmental diseases – infectious (water and air borne) and pollution related, spread and control of these diseases, health hazards due to pesticide and metal pollution, waste treatment, solid waste management, environmental standards and quality monitoring.

Unit V: Environmental Protection Act: Environmental Laws, national movements, sustainable development, environmental policies, environmental economics, environmental ethics – holistic approach of environmental protection and conservation, IUCN – role in environmental protection. Concept with reference to UN – declaration, aim and objectives of human right policies with reference to India, recent north-south debate on the priorities of implementation, Environmental Protection Agency (EPA).

Unit VI: Bioremediation: Oil spills, Wastewater treatment, chemical degradation, heavy Metals.

Text Books

1. Comprehensive Biotechnology (All volumes) Ed. Young, M.Y. Pub: Pergmon Press
2. Environmental Microbiology. Grant, WD and Long PE. Publ: Blakie, Glasgow
3. Biotreatment systems Vol. 22. Ed. Wise, DL.
4. Microbial Ecology: Principles, Methods and Applications by Lavin, Seidler, Rogul,

Unit I: Commercial Production of Microorganisms: Industrial Fermenters, Single-cell Protein.

Unit II: Bioconversions: Biomining and bioleaching of ores (Use of thermophilic microorganisms in industrial microbiology Bio-gas, Bio-leaching, Bio-diesel.

Unit III: Microorganisms & Agriculture: Microorganisms in Agricultural Waste water treatment, Vermiculture, Microbial pesticides.

Unit IV: Products from Microorganisms: Metabolites, Enzymes, Antibiotics.

Unit V: Bioremediation: Petroleum prospecting and formation of oil spills,, Wastewater treatment, chemical degradation, heavy Metals.

Unit VI: Principles of Microbial growth: introduction, the ways of growing microorganisms, ways to increase yield of microbes, Batch, fed-batch and continuous cultures (definition and kinetics).

Unit VII: Downstream processing: extraction, separation, concentration, recovery & purification, operations (Insulin, Vitamins, Metabolites), Industrial production of Ethyl alcohol, Acetic Acid (Vinegar), Citric acid, lactic acid, α -amylase, protease penicillin, tetracycline and vitamin B12, with reference to easily available raw materials, Production of herbal drugs. .

Unit VIII: Biological fuel generation: photosynthesis, sources of biomass, ethanol from biomass, methane from biomass, hydrogen, microbial recovery of petroleum.

Text Books

1. Industrial Microbiology (1992): 4th edition-Prescott & Dunn.,CBS
2. Perspectives in Biotechnology and applied Microbiology. Elsevier Publication, Alani,D.I., and Murray Moo-Young (1986):
3. Applied Microbiology (1968)Cassida Jr. Tata McGraw hill. Microbiology- Concepts and applications (1994): Paula A.Ketchun
4. Fermentation Technology -(1998) Staneberry et al.
5. Molecular Biotechnology -Principles & applications of Recombinant DNA - Bernad R.Glick and JackJ.Pasternak.

Unit I: Gene therapy: Background, types of gene therapy (ex vivo & in vivo), choosing targets for gene therapy, vectors in gene therapy, retroviruses, adenoviruses, adeno-associated viruses, types of gene delivery, Weismann barrier (soma-to-germ line barrier), epigenetic inheritance, problems & ethics.

Unit II: Gene Delivery methods: Viral delivery (through Retroviral vectors, through Adenoviral vectors), Non-viral delivery, Antibody engineering.

Unit III: Gene therapy Models: Liver diseases, Lung diseases, Hematopoietic diseases, Circulated gene products, Cancer & Auto-immune diseases.

Unit IV: Vaccines: Vaccine vectors, nucleic acid vaccines, immuno-enhancing technology.

Unit V: Synthetic therapy: synthetic DNAs, therapeutic Ribozymes, synthetic drugs.

Unit VI: Tissue Engineering: Skin, Liver, Pancreas.

Unit VII: Xenotransplantation: terminology, technology behind it, organ donors, social & ethical issues.

Unit VIII: Cell Adhesion-based therapy: integrins, inflammation, cancer & metastasis.

Unit IX: Drug delivery: conventional & new approaches to drug delivery.

Test Books

1. Albert Sasson. Medical Biotechnology: Achievements, Prospects and Perceptions. United Nations University Press, 2005.
2. Lee Yaun Kun. Microbial Biotechnology Principles and applications. World Science publications, 2004
3. Michels et al., Genetic techniques for Biological Research. Wiley Publications, 2002.
4. Glazer AN, Nikaido H. Microbial Biotechnology Fundamentals of Applied Microbiology WH Freeman, New York 1994.
5. Vyas. Methods in Biotechnology and Bioengineering, CBS publications, 2003.
6. Marshak et al., Stem cell Biology. CSHL publications, 2002.

Unit I: History of Virology and Biosafety: History and principles of virology, virus taxonomy. Structures of animal and plant viruses and their morphology. Principles of biosafety, containment facilities, maintenance and handling of laboratory animals, and requirements of virology laboratory.

Unit II: Virus Replication: Structure and replication strategies of bacteriophages – T7, λ , Φ X174, and plant viruses – ss RNA virus (TMV) and ds DNA virus (CaMV). Structure and replication strategies of animal viruses – Influenza virus, Adeno virus and Retro virus.

Unit III: Interferon and Antiviral Agents: Viral Interference and Interferons. Nature and source of interferons, Classification of interferons. Induction of interferon. Antiviral agents (chemical and biological) and their mode of actions.

Unit IV: Cultivation of Viruses and Viral Vaccines: Cultivation of viruses in embryonated egg, tissue culture and laboratory animals. Conventional vaccines – Killed and attenuated. Modern vaccines – Recombinant proteins, subunits, DNA vaccines, peptides, immunomodulators (cytokines). Vaccine delivery and adjuvants, large-scale manufacturing.

Unit V: Virological Methods: Methods for purification of viruses with special emphasis on ultracentrifugation methods. Quantitative diagnostic methods – Haemagglutination, complement fixation, neutralization, Western blot, flowcytometry. Nucleic acid based diagnosis – PCR, microarray and nucleotide sequencing. Application of Microscopic techniques – Fluorescence, confocal and electron microscopic techniques.

Text Books

General Virology - Luria and Darnel

Virology and Immunology - Jokli

Text book of Virology - Rhodes and Van Royen

Plant Virology - Smith

Genetics of bacteria and their viruses - W. Hayes

Molecular Biology of the gene - Watson, Roberts, Staitz and Weiner

A laboratgory guide in virology - Charles H. Lunningham