

Syllabus for B.Sc., Biotechnology

2010 - 11



Since 1951

**P.G and Research Department of Biotechnology
Jamal Mohamed College
(Autonomous)
(Accredited at Five Star Level by NAAC)
Tiruchirappalli – 620 020.**

**JAMAL MOHAMED COLLEGE (AUTONOMOUS)
TIRUCHIRAPPALLI – 620020.**

**Department of Biotechnology
B.S. Biotechnology Degree Course Structure From 2010 - 11**

SEM	Subject Code	Course	Title of the Paper	Hrs / Week	Credits	Int. Marks	Ext. Marks	Max. Marks
I	10 BSBT 1LT1 10 BSBT 1L BT1	Language I	Language for Science – I/ Basic Tamil	5	4	25	75	100
	10 BSBT 1LE1	English I	English for Science – I	5	4	25	75	100
	10 BSBT 1401	Core I	Basic Mathematics and Biostatistics	5	4	25	75	100
	10 BSBT 1402	Core II	Bioresources	5	4	25	75	100
	10 BSBT 1403	Core III	General Chemistry	5	4	25	75	100
	10 BSBT 1404P	Core IV	Biostatistics, Bioresources and General Chemistry - Practical	5	3	40	60	100
Total				30	23	165	435	600

SEM	Subject Code	Course	Title of the Paper	Hrs / Week	Credits	Int. Marks	Ext. Marks	Max. Marks
II	10 BSBT 2LT2/ 10 BSBT 2LT2	Language II	Language for Science – II	5	4	25	75	100
			Basic Tamil– II					
	10 BSBT 2LE2	English II	English for Science – II	5	3	25	75	100
	10 BSBT 2405	Core V	General Physics and Biophysics	4	3	25	75	100
	10 BSBT 2406	Core VI	Cell Biology	5	4	25	75	100
	10 BSBT 2407	Core VII	Biochemistry	4	3	25	75	100
	08 U 29	Part IV	Environmental Studies	2	2	25	75	100
10 BSBT 2408P	Core VIII	Cell Biology, Biochemistry and Biophysics - Practical	5	3	40	60	100	
Total				30	23	190	510	700

SEM	Subject Code	Course	Title of the Paper	Hrs / Week	Credits	Int. Marks	Ext. Marks	Max. Marks
III	10 BSBT 3409	Core IX	Molecular Biology	5	4	25	75	100
	10 BSBT 3410	Core X	Principles of Genetics	5	4	25	75	100
	10 BSBT 3411	Core XI	Immunology and Immunotechnology	5	4	25	75	100
	10 BSBT 3412	Core XII	General Microbiology	5	4	25	75	100
	10 BSBT 3413P	Core XIII	Molecular Biology and Genetics - Practical	5	3	40	60	100
	10 BSBT 3414P	Core XIV	Immunology and Microbiology - Practical	5	3	40	60	100
Total				30	22	180	420	600

SEM	Subject Code	Course	Title of the Paper	Hrs / Week	Credits	Int. Marks	Ext. Marks	Max. Marks
IV	10 BSBT 4415	Core XV	General Physiology	5	4	25	75	100
	10 BSBT 4416	Core XVI	Enzymology and Enzyme Technology	5	3	25	75	100
	10 BSBT 4417	Core XVII	Recombinant DNA Technology	4	3	25	75	100
	10 BSBT 4418	Core XVIII	Bioinstrumentation	4	3	25	75	100
	08 U 410	Part IV	Value Education	2	2	25	75	100
	08 U 411	Part V	Extension Activates NSS, NCC, etc.,	-	1	-	-	-
	10 BSBT 4419P	Core XIX	General Physiology and Enzymology - Practical	5	3	40	60	100
	10 BSBT 4420P	Core XX	rDNA Technology and Bioinstrumentation - Practical	5	3	40	60	100
Total				30	22	205	495	700

SEM	Subject Code	Course	Title of the Paper	Hrs / Week	Credits	Int. Marks	Ext. Marks	Max. Marks
V	10 BSBT 5421	Core XXI	Bioprocess Technology	5	5	25	75	100
	10 BSBT 5422	Core XXII	Bioinformatics	5	5	25	75	100
	10 BSBT 5423	Core XXIII	Environmental Science and Ecobiotechnology	5	5	25	75	100
	10 BSBT 5424P	Core XXIV	Bioprocess Technology and Ecobiotechnology - Practical	5	3	40	60	100
	10 BSBT 5425P	Core XXV	Bioinformatics - Practical	5	3	40	60	100
	10 BSBT 5501	Core Based Elective - I	General Pharmacology	5	4	25	75	100
Total				30	25	180	420	600

SEM	Subject Code	Course	Title of the Paper	Hrs / Week	Credits	Int. Marks	Ext. Marks	Max. Marks
VI	10 BSBT 6426	Core XXVI	Plant Biotechnology	5	5	25	75	100
	10 BSBT 6427	Core XXVII	Molecular Diagnostics	5	4	25	75	100
	10 BSBT 6428	Core XXVIII	Genomics and Proteomics	5	5	25	75	100
	10 BSBT 6429P	Core XXIX	Plant Biotechnology and Molecular Diagnostics - Practical	5	3	40	60	100
	10 BSBT 6430P	Core XXX	Genomics and Proteomics - Practical	5	3	40	60	100
	10 BSBT 6502	Core Based Elective - II	Nanobiotechnology	4	3	25	75	100
	08 U 612	Part V	Gender Studies	1	1	25	75	100
Total				30	24	205	495	700

SEM	Subject Code	Course	Title of the Paper	Hrs / Week	Credits	Int. Marks	Ext. Marks	Max. Marks
VII	10 BSBT 7431	Core XXXI	Animal Biotechnology	5	5	25	75	100
	10 BSBT 7432	Core XXXII	Biotechnology Management	5	4	25	75	100
	10 BSBT 7433	Core XXXIII	Research Methodology	5	4	25	75	100
	10 BSBT 7434P	Core XXXIV	Animal Biotechnology - Practical	5	3	40	60	100
	10 BSBT 7503	Core Based Elective - III	IPR, Biosafety and Bioethics	5	4	25	75	100
	10 BSBT 7504	Core Based Elective - IV	Frontiers in Biotechnology	5	4	25	75	100
Total				30	24	165	435	600

SEM	Subject Code	Course	Title of the Paper	Hrs / Week	Credits	Int. Marks	Ext. Marks	Max. Marks
VIII	10 BSBT 88	Project Work	Project	30	22	240	360	600

Total credits for the entire course (For 8 semesters)	185 Credits
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	Nos.	Credits	Total Credits
Language	: 04	04	16
Core Courses	: 23	05/04 /03	93
Elective Courses	: 04	04/03	15
Lab	: 11	03	33
Project Work	: 01	22	22
Part IV	: 02	02	04
Part V	: 02	01	02

185

Semester I

Core : I
Code : 10 BSBT 1401
Hours : 5
Credits : 4

BASIC MATHEMATICS AND BIOSTATISTICS

- UNIT I** Matrix – algebra of matrices, determinants – adjoint – inverse of matrix, system of linear algebraic equations – Cramer’ s rule.
- UNIT II** Sequence and series – limit – differentiation – L” Hospital rule, integration - some methods.
- UNIT III** Mathematical modeling – ordinary differential equations – first order linear equations – methods of solving, second order differential equations with constant coefficients – methods of solving.
- UNIT IV** **STATISTICAL ANALYSIS: Introduction to Statistics – Mean, Standard deviation, coefficient of variation, correlation and regression. Probability Theories - Conditional Probability, Poisson Distribution, Binomial Distribution**
- UNIT V** **STATISTICAL APPLICATIONS: Properties of Normal Distributions, Point and Interval Estimates of Means and Proportions; Hypothesis Tests, One Sample Test - Two Sample Tests / Chi-Square Test, Association of Attributes - t-Test. Analysis of Variance - ANOVA.**

REFERENCES:

1. Introduction to Mathematics for Life Scientist, E. Batschelet, Springer. 2003
2. Mathematical Modeling, J.N. Kapur, Wiley Eastern Ltd., 1988.
3. Ordinary and Partial Differential Equations, M.D. Raisinghania, R.S.Aggarwal, S.Chand & Company Ltd., 1981.
4. Programming in ANSI C, E. Balagruswamy, Tata Mc Graw-Hill publishing company Ltd.2000.
5. Jerrold H. Zar. Biostatistical Analysis (4 th edition).

Semester I

Core : II
Code : 10 BSBT 1402
Hours : 5
Credits : 4

BIORESOURCES

- UNIT I** **BIORESOURCES: Characters, organization and diversity of living organisms - Microbes, Plants and Animals. Levels and patterns of organization – Basic concepts - Organic evolution. Evolutionary adaptations and diversification. Population dynamics - Reduction of Biodiversity and Web Interaction.**
- UNIT II** **MICROBIAL BIODIVERSITY: Diversity of prokaryotes, lower eukaryotes with emphasis on their evolution and symbiosis. Role of fungi in colonization of land by plants. Anthropogenic impact on fungal and plant diversity. Role of soil microbiota in plant protection and ecosystem restoration. Morphological, physiological, life-history of primary producers, consumers and predators. Microbial food webs and their interactions with metazoans. Mixotrophy and symbiosis with prokaryotes. Spatial and temporal distribution of protists. Microecosystems in laboratory experimentation.**
- UNIT III** **PLANT BIODIVERSITY: Major groups of algae, fungi, bryophytes, pteridophytes, angiosperm and gymnosperm. Modification of the plant form as adaptation to the environment. Ecology of pollination. Sexual and apomictic reproduction in plants. Medicinal plants & their bioactive potentials.**
- UNIT IV** **ANIMAL BIODIVERSITY: Invertebrata – Protozoa- amoeba. Porifera – sponges. Platyhelminthes - *Taenia solium*. Annelida - Round worms. Arthropoda – insect-ants, flies, arachnida- spiders and crustacean- prawn, Mollusca - apple snail, Echinodermata - star fish - general characters and body plan. Vertebrata – protochordata and Urochordata - Pisces, amphibians, Reptiles, Aves and Mammals – general characters. Animals as a source for food & other applications.**
- UNIT V** **CONSERVATION: Hotspots in Biodiversity. Loss of Biodiversity, its causes and threats. Biodiversity and its conservation – *insitu* and *exsitu* conservation. National parks and sanctuaries - political and legal aspects of Biodiversity. Conservation and resurrection of extinct animals – Big panda and the Tasmanian tiger. Bio diversity convention - RIODEGENERO- 1992. *DNA Barcoding* – Principles, Methods and Applications.**

REFERENCES:

1. **Biology – Raven, Johnson, Losos, Singer, TATA Mc Graw-Hill publishing company Limited, New Delhi**
2. **Integrated Principles of Zoology – 9th edition – Hickmen, Roberts & larson, 1995 Wim C.Bnun Publishers, Oxford, England.**
3. **Invertebrate Zoology. 7th edition. E.E. Ruppert, R.S. Fox & R.D. Barnes. Thomson Brook/Cole.U.K.**
4. **Vertebrate Life 4th edition. Pough, F.H., Heiser, J.B. and Mc Farland, W.N Prentice – Hall of India Pvt. ltd., New Delhi**
5. **Prasad B.N., “Biotechnology in Sustainable Biodiversity and Food Security” (2003), Oxford & IBH, New Delhi.**
6. **Foster C.F. John Ware D.A. Environmental Biotechnology, Ellis Horwood Ltd. 1987.**
7. **Sasson A, “Biotechnologies in developing countries present and future”, UNESCO Publishers, 1993.**

Semester I

Core : III
Code : 10 BSBT 1403
Hours : 5
Credits : 4

GENERAL CHEMISTRY

- UNIT I** **ORGANIC CHEMISTRY:** Basic concepts of bonding in organic chemistry. Hybridization and geometry of molecules - methane, ethane, ethylene, acetylene and benzene. Electron displacements effects - Inductive, electromeric, mesomeric, resonance, hyper conjugation and steric effects. Free radicals and their stability.
- UNIT II** **NOMENCLATURE OF ORGANIC COMPOUNDS:** IUPAC recommendations for naming - simple aliphatic, alicyclic and aromatic compounds. Elements of symmetry – symmetry and asymmetry, cause of optical activity, isomerism of lactic acid and tartaric acid – racemization and resolution. Geometrical and isomerism of maleic acid and fumaric acid. Keto-enol tautomerism.
- UNIT III** **PERIODIC TABLE:** Atomic orbitals, quantum numbers and its significance. Pauli's exclusion principle, Hund's rule, Aufbau Principle, (n+/-) rule, stability of half-filled and fully filled orbitals. Periodic table classification as s, p, d & f block elements, Periodic properties of elements. Factors influencing the periodic properties. Avogadro's Number.
- UNIT IV** **AQUEOUS SOLUTIONS AND ACID-BASE CHEMISTRY:** Aqueous solutions- Concentration based on volume, Weight, Degree of Saturation, Equilibrium constants, Acid and Bases – Various definitions of acids and bases. ionization of Water, weak acids, weak bases, pH of solutions, hydrolysis of salts of weak acids and bases, Handerson-Hasselbalch equation, Buffer concepts, Laboratory Buffers, pH Changes in buffers. Buffer capacity.
- UNIT V** **CHEMICAL KINETICS AND ELECTROCHEMISTRY:** Chemical Reaction – rate and factors influencing. Pseudo First Order Reaction, Temperature Dependence of the Rate of a Reaction, Surface chemistry, adsorption, catalysis, colloids, classification of colloids, Emulsions, and biological colloids. Electrochemistry - electrochemical cells, Galvanic cells, Nernst Equation, Conductance of Electrolytic Solutions, Biological significance of Nernst equation.

REFERENCES:

1. J.Clayden, N. Greeves, S. Warren, P. Wothers, "Organic chemistry" Oxford University Press, 2001.
2. R.T.Morrison and R.N. Boyd, "Organic Chemistry" ed., prentice Hall of India Pvt Ltd., 2004.
3. I.L Finar, "Organic Chemistry Vol I & II" 5th ed., ELBS, 1975.
4. B.S. Bhal and Arun Bhal, "Text Book of Organic Chemistry", 14th ed., S Chand and Company Ltd., 1997.
5. R.A.Alberty and R.J. Silbey, Physical Chemistry, Jhon Wiley & Sons, Inc., Newyork, 1995.
6. P.W. Atkins, Physical Chemistry, ELBS and Oxford University Press, 1998.
7. G.M. Barrow, Physical Chemistry, Tata McGraw Hill, New Delhi, 1994.
8. James E. Huheey, Eleen A. Keiter, Richard L. Leiter, "Inorganic Chemistry", 4th ed., Pearson Education, Inc., 2002.
9. Irvin H. Segel, Biochemical Calculations, 2nd Edition, John Wiley and Sons., 2004.

Semester I

Core : IV
Code : 10 BSBT 1404P
Hours : 5
Credits : 3

BIOSTATISTICS, BIORESOURCES AND GENERAL CHEMISTRY - Practical

BIORESOURCES

1. Bioresources – biodiversity, terrestrial, avian and marine–microbe, plants, animals & Birds (Field visit).
2. Microscopic observation of bacteria, microalgae, fungi, lichen and protist
3. Identification of Plants up to species level - algae, fungi, bryophytes, pteridophytes, angiosperm and gymnosperm
4. Identification of animals – Vertebrates & Invertebrates.
5. Endangered / Rare plant, animal, fossil - observation (Field visit)

GENERAL CHEMISTRY

1. Volumetric analysis
 - a. Complexometric titration
 - b. Acidimetric alkalimetric
 - c. Redox titrations
2. Colorimetric estimation of metals – Cu^{2+} , Ni^{2+} , Fe^{2+} ,
3. Dissolved Oxygen, TDS, water quality parameters
4. Conductometric titration / potentiometric titration
5. Quantitative salt analysis
 - a. Simple inorganic analysis
 - b. Simple organic compound analysis
6. Quantitative salt analysis
 - a. Titrimetry
 - b. Conductometric
 - c. Potentiometric
 - d. Colorimetric
 - e. Chromatography
 - i. Paper and TLC

BIOSTATISTICS

1. Relevant exercises on Presentation Graphics – bar, line, pie graphs, MS-Excel – statistical application usage with appropriate problems in a computer system.
2. SPSS packages – statistical problem solving – mean, median, mode, T-testing, ANOVA, DMRT.

Reference:

1. Vogel's text book of chemical analysis
2. Practical chemistry - A.O. Thomas-Scientific hook center, Cannanore
3. Practical chemistry - S.Sundaram -- 3 Volumes - S.Viswanathan
4. Vogel's text book of practical organic chemistry - Lorigman
5. Ganguli, B.B., Sinha, A.K. and Adhikari, S., 2001, Biology of Animals, (Vol. I and III), New Central Book Agency, Calcutta.
6. Kotpal, R.L., 1990, Modern Text Book of Zoology, Invertebrates, 8th Edition, Rastogi Publication, Meerut.
7. Jordan, E.L., P.S. Varma, 2001, Invertebrate Zoology, S. Chand & Co., New Delhi.

Semester II

Core : V
Code : 10 BSBT 2405
Hours : 5
Credits : 4

GENERAL PHYSICS AND BIOPHYSICS

- UNIT I** **MECHANICS AND ELASTICITY:** Newton's laws of motion – Applications – Collision – Impulse – Projectile motion Centrifugal force – Centripetal force – Applications. Elasticity – Stress – Strain – Elastic modulus: Young' s modulus – Bulk modulus – Modulus of rigidity – Relation between elastic constants – Bending of beams – Cantilever.
- UNIT II** **FLUID STATICS AND DYNAMICS:** Surface tension – Capillary rise – Water rise in tall trees – Variation of surface tension with temperature – Osmosis – Laws of osmosis –Berkeley experiment – Viscosity – Viscosity of liquid – Poiscuilles formula- Viscosity of blood – Flow of liquid through tubes Bernoulli' s equation – Venturimeter.
- UNIT III** **ATOMIC, MOLECULAR AND RADIATION PHYSICS:** Electromagnetic spectrum – Rotation and vibration of molecules – Absorption and emission spectra – Basic elements of practical spectroscopy – Absorption and emission Spectrophotometer (block diagram) – NMR spectroscopy. Atomic nucleus – Isotopes – Radioactivity. Radioactive decay - Biological traces–Detection of radiation. Biological effect of Radiation – Dosimetry – Basic definitions and units of radiation. Biological tracers in metabolic studies radioactive mapping.
- UNIT IV** **BIOMACROMOLECULES:** Proteins: Amino acids – Peptide bond – Cis and Trans configurations – Torsion angles – Phi and Psi – Steric hindrance – Conduct criteria – Ramachandran diagram, Maps for glycine and alanine residues. Classification of proteins into globular and fibrous – Levels of structural organization. Nucleic Acids: Nucleosides and nucleotides – Structure of DNA–Polymorphism Carbohydrates: Classification – L and D sugars. Types of linkages in polysaccharides – structure of maltose, cellobiose and lactose – Ramanchandran plot.
- UNIT V** **THERMODYNAMICS:** Laws of thermodynamics, statements, heat content of foods, free energy and entropy, free energy released role of adenosine triphosphate and mechanism of ATP synthesis in mitochondria and chloroplast, measurement of H, F and TS membrane potentials, negative entropy change in living systems, equilibrium vs. steady-state, rate controlling steps, diffusion-co-efficient - permeability constant.

REFERENCES

1. R. Murugesan, *Modern Physics*, S. Chand & Company Ltd (1998) New Delhi.
2. A. Mookerjee & Sukhendu B. Bhattacharjee, *Aspects of Radiation Biophysics*, Interprint, New Delhi.
3. C.N. Banwell, *Fundamentals of Molecular Spectroscopy* (Mc Graw Hill, New York, 1981).
4. Brij Lal, N. Subramanmian, Jivan Seshan *Mechanics and Electrodynamics*, Eurasia Publishing House (PVT.) Ltd. 1980.
5. A. I. Lehninger, D. L Nelson and M. M. Cox. *Principles of Biochemistry*, CBS Publishers, New Delhi (1993).
6. Lubert Stryer, *Biochemistry*, W. H. Freeman and Co., New York (1995).
7. V. S. R. Rao, P. K. Qasba, P. V. Balajil and R. Chandrasekaran *Conformation of Carbohydrates* Harwood Academic Publishers, Amsteerdam(1998)

Semester II

Core : VI
Code : 10 BSBT 2406
Hours : 5
Credits : 4

CELL BIOLOGY

- Unit I** **THE CELL: Origin of cell. Cell Theory. Cell membrane - physiochemical properties; Molecular Organization- asymmetric distribution of biomolecules: Biogenesis and Functions, Transport of small molecules across cell membranes: types and mechanisms of transport. Transport of proteins into Mitochondria and Chloroplast.**
- Unit II** **STRUCTURE AND ORGANELLES: Prokaryotic and Eukaryotic cell structure and Intracellular organelles. Chromosomes structure. Morphology and functional elements of eukaryotic chromosomes – lampbrush chromosomes, polytene chromosome, Giant chromosomes, Barr bodies, DNA banding patterns – karyotyping – Idiogram.**
- Unit III** **INTRACELLULAR DIGESTION: Ultra structure and function of lysosomes. cytoskeleton structures – types, function, role in motility. Transport of proteins into and out of Nucleus. Transport of proteins into Endoplasmic Reticulum. Transport by Vesicle formation: Endocytosis and Exocytosis. Molecular mechanisms of Vesicular transport.**
- Unit IV** **INTRA CELLULAR COMMUNICATION THROUGH CELL JUNCTIONS: Occluding Junctions, Anchoring Junctions and Communicating Junctions. Molecular Mechanisms of Cell-Cell Adhesions: Ca⁺⁺ dependent cell-cell adhesions. Ca⁺⁺ independent cell-cell adhesions. Extracellular Matrix of animals: Organization and Functions. Extracellular Matrix Receptors on animal cells: Integrins.**
- Unit V** **CELL SIGNALING: Signaling via G-Protein linked and enzyme linked cell surface receptors, MAP kinase pathways, Interaction and Regulation of signaling pathways. Eukaryotic Cell Division Cycle: Different Phases and Molecular Events. Control of Cell Division Cycle: In yeast and mammalian cells. Overview of Apoptosis: Phases and significance, Morphological and Biochemical changes associated with apoptotic cells, Apoptotic Pathways and regulators**

Reference Books

1. **Molecular Biology of the cell (2002) Alberts, et al**
2. **Molecular Cell biology (2004) Lodish, et al**
3. **Working with Molecular Cell Biology: A study companion (2000), Stories et al**
4. **Cell and Molecular Biology: concepts and Experiments (3rd Ed.,2002), Gerald Karp**
5. **The cell: A Molecular Approach, G.M.Cooper**
6. **The world of Cell (1996), Becker et al**
7. **Cell proliferation and apoptosis (2003), Hughes and Mehnet**
8. **Essential Cell Biology (1998), Alberts et al**
9. **Biochemistry and Molecular Biology of Plants (2000) Buchanan et al**
10. **Harpers biochemistry Murray et al**

Semester II

Core : VII
Code : 10 BSBT 2407
Hours : 5
Credits : 4

BIOCHEMISTRY

- UNIT I** **BIOENERGETICS:** Thermodynamics and Molecular basis for evolution - Principles of bioenergetics - free energy functions - ATP as main carrier of free energy. Energy molecules. Biological oxidation - reduction reaction. Biomolecular Interactions - Structure and properties of H₂O. Solute – Solvent Interactions - Bonding; strong and weak interactions – hydrogen bonding – hydrophobic - hydrophilic interactions and ionic interactions.
- UNIT II** **CARBOHYDRATES:** Classification, structure, functions; homo and hetero polysaccharides, animal, plant and microbe specific polysaccharides. Lipids: Classification, structure, functions; Lipids with specific biological functions, Lipoproteins and biological membrane, micelles and liposomes. Amino acids – structure, functions, types of classification.
- UNIT III** **PROTEINS:** Classification, Primary, Secondary, tertiary and quaternary structure, Separation, purification and criteria of homogeneity, End group analysis. Nucleic acids: Structure, Properties of purines and pyrimidine bases, DNA : Structure, conformation, Nucleic acid metabolism: biosynthesis and breakdown of purine and pyrimidine nucleotides by de novo and salvage pathways.
- UNIT IV** **OVERVIEW OF METABOLIC PATHWAYS:** Glycolysis - citric acid cycle. Oxidative phosphorylation. Photophosphorylation Glyoxalate cycle - Carbohydrate biosynthesis - C₂ - C₃- C₄ cycles. Lipid metabolism - chemical nature of fatty acids and acylglycerols - sources and storage of fatty acids - utilization fatty acids for energy production. Triacylglycerols - cholesterol - Phospholipids - sphingolipids.
- UNIT V** **AMINO ACID METABOLISM:** an over view - incorporation of nitrogen to amino acids - transport of nitrogen to liver and kidney - urea cycle - synthesis and oxidation of amino acids. Vitamins and cofactors: Structure, distribution, interaction and biological properties. Hormonal integration of mammalian metabolism.

REFERENCES:

- 1. Outlines of Bio-chemistry by E.E. Conn and P.K. Strumpf (Wiley Eastern Limited);**
- 2. Review of physiological chemistry by H.A. Harper (Lange).**
- 3. Textbook of Biochemistry by West, Todd, Mason and Bruygen (Macmillan);**
- 4. Biochemistry by A.L. Lehninger (Worth).**
- 5. Principles of Biochemistry by White, handier and Smith (Tata Mc Graw Hill)**
- 6. The Chemical Analysis of foods by Pearson David (Churchill)**
- 7. Clinical Biochemistry by Cantorow & Trumper (Saunders) Biochemistry by L. Stryer (Freeman-Toppan).**

Semester II

Core : VIII
Code : 10 BSBT 2408P
Hours : 5
Credits : 3

CELL BIOLOGY, BIOCHEMISTRY AND BIOPHYSICS - Practical

CELL BIOLOGY

1. Microscopy- bright field
2. Cell division- mitosis (Onion root tip) and Meiosis (Tradescantia)
3. Chromosome preparation: Meiosis- Rat/mouse testis, Grasshopper testis.
4. Polytene chromosome (chironomous larvae)
5. Determination of leaf water potential
6. Determination of osmotic potential
7. Chromosome preparation: Mitosis-Onion root tip, rat/mouse cornea, rat mouse bone marrow, human lymphocytes
8. Identification of tissue typing: Histological preparation of tissues
9. Identification of different biomolecules in different tissues by histochemical techniques.

BIOCHEMISTRY AND BIOPHYSICS

1. Verification of Beer's law
2. Determination of absorption maxima
3. Electrophoresis of proteins-native and under denaturing conditions
4. Amino acid and carbohydrate separations by paper & thin layer chromatography
5. Gas Chromatography
6. Ion Exchange and gel filtration chromatography
7. Titration of amino acids
8. Colorimetric determination of pK
9. Reactions of amino acids, sugars and lipids
10. Quantitation of proteins and sugars by different methods

REFERENCES:

1. C.H. Collins, P.M. Lyne (1985) Microbiological
2. Collins and Lyne's microbiological methods. 7th ed. C.H. Collins. Butterworth- Heinemann,1994.
3. Microbiology a laboratory manual, P. Gunasekaran
4. Microbiology, A Laboratory Manual, Cappuccino, J.G. & Sherman, N., Addison Wesley.

Semester III

Core : IX
Code : 10 BSBT 3409
Hours : 5
Credits : 4

MOLECULAR BIOLOGY

- Unit 1** **NUCLEIC ACIDS:** Introduction to DNA and RNA - as genetic material – properties, structure and function. Prokaryotic and eukaryotic genome organization. Nature of Gene Concept and Chemical Nature of Gene. DNA super coiling.
- Unit 2** **REPLICATION:** Enzymes in DNA replication - modes of replication. Prokaryotic and eukaryotic replication – Events. Regulation of DNA replication. DNA methylation. Plasmids – Types and Replication.
- Unit 3** **TRANSCRIPTION:** Prokaryotic and Eukaryotic transcription - RNA polymerase - Prokaryotic and Eukaryotes transcription factors - mechanism of transcription - Post Transcriptional modifications - Transcription in eukaryotes- enhancers- silencers. Export of mRNA - Si RNA- SnRNA.
- Unit 4** **TRANSLATION:** Genetic code - Elucidation of Codons - mRNA- ribosomes - aminoacyl tRNA synthetase. Prokaryotic and eukaryotic translation. Translational control and gene expression- post – translational regulatory mechanisms.. **Regulation of gene expression - Operon concepts – Lactose –** Constitutive - inducible and repressible gene expression. Operon systems – lactose operon – induction- catabolite repression. Tryptophan operon - Repression- attenuation. Arabinose operon - positive and negative controls.
- Unit 5** **DNA REPAIR and PROTEIN LOCALIZATION:** DNA repair and recombination- Chaperons and protein folding - nuclear localization signals for nucleus – mitochondria – chloroplast – Golgi - endoplasmic reticulum- membrane and secretory proteins and targeting.

Reference:

- 1. Genes IX Benjamin Lewin**
- 2. Molecular Biology, turner et al**
- 3. Cell and Molecular Biology: Concepts and Experiments, Gerald Karp**
- 4. Translational regulation in eukaryotes (2000), Carey and Smale**
- 5. Translational control of Gene Expression (2000), Sonenberg et al**
- 6. Chromatin and Gene Regulation (2001), Turner**
- 7. An Introduction to Genetic Analysis, Griffiths et al**
- 8. Genome (1999), Brown**
- 9. Concepts of Genetics, Klug and Cummings**
- 10. Proteins, Creighton**
- 11. Molecular Cell Biology, Lodish et al**
- 12. Biochemistry and Molecular Biology of Plants (2000), Buchanan**
- 13. Plant Biochemistry and Molecular Biology, Lea and Leegood**
- 14. Plant Biochemistry (1997), Dey and Harborne**

Semester III

Core	: X
Code	: 10 BSBT 3410
Hours	: 5
Credits	: 4

PRINCIPLES OF GENETICS

- UNIT I MENDELIAN ANALYSIS AND INHERITANCE:** Genotype and phenotype, Experiments of Mendel: Sutton - Boveri theory, Sex determination in plants and animals, Sex linkage, Linkage; mapping genes; interference; coincidence in pro and eukaryotes.
- UNIT II CHROMOSOMAL ABERRATIONS AND GENE REGULATION:** Structural changes in chromosomes – deficiencies, Induction and transcriptional activity by environmental and biological factors – temperature - molecular control and Cytoplasmic control of mRNA stability. Chloroplast and Apicoplast DNA. Mitochondrial control DNA - Epigenetic regulation- RNA mediated regulation.
- UNIT III CROSS OVER AND RECOMBINATION:** Linkage mapping techniques in eukaryotes - Ordered and un-ordered Tetrad analysis in *Neurospora crassa*. Genetics of Bacteria and virus - Conjugation, discovery, $F^+ \times F^-$ matings, Hfr conjugation, sexduction, Determining linkage from interrupted mating experiments. Determining gene order from the gradient of transfer. Transduction –Transformation - the process and competency. Bacterial viruses – discovery, genetic fine structure. Phage cross, rII System, Selection in genetic crosses of bacteriophages. Elucidation of fine Structure of genes by Benzer's experiment- Cis-Trans complementation. HIV genome regulation.
- UNIT IV MUTATION AND DNA REPAIR:** Mutation – Genetic variability required for evolution. Mutation types – basic features of the process – Molecular basis of mutation – physical, chemical and biological. Transposable genetic elements- origin of spontaneous mutations. Mutations – phenotypic effects – effect of mutation in human hemoglobin genes- blocks in metabolic pathways. Conditional lethal mutations and their uses. Ames Test suppression of mutation – inter and intra gene suppression- nonsense- missense suppression.
- UNIT V TRANSPOSABLE GENETIC ELEMENTS:** IS Elements- composite transposons-medical significance. Eukaryotes – Ac and Ds elements in maize- P elements in drosophila. Retro transposons. Genetic and evolutionary significance of transposable elements. Genetic basis of cancer – benign - malignant - metastatic cancer. Oncogenes and tumour suppressor genes- Ras protein signaling and cancer. Apoptosis.

REFERENCES

1. Brown, T.A., 1998, Genetics, A Molecular Approach, Chapman Hall, London.
2. Gardner, E.J., Simmons, M.J., and Snusted D.P., 1991, Principles of Genetics, John Wiley and Sons, New York.
3. Gupta, S.P. 1985, Elementary Statistical Methods, S. Chand and Co., New Delhi.
4. Gurumani, N. 2004, An Introduction to Biostatistics, MJP Publishers, Chennai.
5. Hotter, P, 2002, Textbook of Genetics, IVY Publishing House, New Delhi.
6. Strickberger, M.W., 1996, Genetics, Macmillan publishing Co., New York.
7. Verma, P.S. and Agarwal, V.K. 2003, Genetics, S.Chand & Company Ltd, New Delhi.
8. Weaver, R.F. and Hedrick, P.W., 1997, Genetics, W.M.C. Brown Publishers, London.

Semester III

Core : XI
Code : 10 BSBT 3411
Hours : 5
Credits : 4

IMMUNOLOGY AND IMMUNOTECHNOLOGY

- UNIT I** **IMMUNE RESPONSE:** Innate, adaptive immune responses, Hematopoiesis. Anatomical organization of Immune System: Primary Lymphoid Organs, Secondary Lymphoid Organs, Ontogeny and Phylogeny of lymphocytes, Cell of immune system Antigens, Heptanes: Factor affecting immunogenecity, Super antigen. Inflammation.
- UNIT II** **MAJOR HISTOCOMPATIBILITY SYSTEMS:** Antigen processing, Role of MHC molecules in Antigen presentation and co stimulatory signals. T-Cell receptor complex, T- Cell accessory membrane molecules, activation of T –cells, organization and arrangement of T-receptor genes. B-cell receptor complex, activation of B-cells, Immunoglobulins: molecular structures, types and function. Antigenic determinants on immunoglobulins.
- UNIT III** **MOLECULAR MECHANISM OF ANTIBODY DIVERSITY:** Organization of genes coding for constant and variable regions of heavy chain and light chain. Mechanism of antibody diversity, Class Switching. Antigen-Antibody interaction avidity and affinity measurement. Monoclonal antibodies: production, characterization and application in diagnosis, therapy and basic research. Compliment System, components, Activation pathway and regulation of activation pathway, complement deficiency, role of complement system in immune responses.
- UNIT IV** **CYTOKINES:** Structure and functions, cytokine receptors, Cytotoxic T-cell and their mechanism of action, NK cell and mechanism of target cell destruction. Antibody dependent cell mediated cytotoxicity, delayed type hypersensitivity. Techniques of Cell-mediated immunity. Hypersensitivity: definition, and types.
- UNIT V** **AUTOIMMUNITY:** Organ specific diseases, systemic disease, mechanism of autoimmunity. Immunodeficiency Syndrome: Primary Immunodeficiencies and Secondary Immunodeficiencies and their diagnosis and therapeutic approaches. Vaccines: Active and passive immunization, whole organism vaccines, macromolecules as vaccines, Recombinant vector Vaccines, DNA Vaccines, synthetic peptide Vaccines and sub-unit Vaccines.

REFERENCES :

1. Benjamini E, Coico R and G. Sunskise (2000). Immunology -A short course. IV edn. (Chapters 1-13) .Wiley – Liss publication, NY.
2. Brown, F, Chanock, R. M., Lerner R.A. (Editors) (1986) Vaccines 86: New approaches to Immunization.
3. Fathman, C. G. Fitch, F.W (1982) Isolation, characterization and utilization of T-lymphocytes clones, Academic Press, London.
4. Goding, J. W (1998) Monoclonal antibodies: Principles and practice, Academic Press, London.
5. Goldsby R.A. Kindt T.I and Osborne B.A (2000) Kuby Immunology IV edn WH Freeman &Co, NY.
6. Janeway, C.A. Travers P. Wolport M and Capra J.D (1999) .Immunology IV edn. Current Biology, NY.
7. Kuby, J (1997) immunology, III edn, WH Freeman &Co, NY.
8. Roitt, Male and Brostoff (1998). Immunology 4th edn. Pub. Mocby, New York pp 28.14.
9. Roitt, I (2000). Essential Immunology, IV edn. Blackwell Sci NY.
10. Springer T. A (Editor) (1985). Hybridoma technology in Biosciences and Medicine, Plenum Press, New York.

Semester III

Core : XII
Code : 10 BSBT 3412
Hours : 5
Credits : 4

GENERAL MICROBIOLOGY

- UNIT I** **INTRODUCTION:** Scope and History of Microbiology. Classification of microorganisms - bacterial and fungal. Morphology and fine structure of eubacteria, archeobacteria, fungi and virus - Bacteriophage. Properties of Light - Light microscopy - Phase contrast - Interference - Fluorescence and Electron microscopy (SEM - TEM) - principles - applications and limitations. Specimen preparation for Light and Electron Microscopy.
- Unit II** **MICROBIAL NUTRITION:** Nutritional requirements and nutritional types of microorganisms. Uptake of nutrients: passive and facilitated diffusion - active transport - group translocation and membrane function. Microbial growth - culture media - isolation of pure culture. Cultivation of Bacteria, moulds and yeast. Measurement of microbial growth. Growth curve - Diauxy, continuous culture, chemostat, Turbidostat and synchronized growth. Factors affecting microbial growth. Oxygen toxicity. Taxonomic classification of microbes using molecular markers - 16s rRNA typing.
- Unit III** **CONTROL OF MICROORGANISMS:** Physical and chemical methods of microbial control. Antimicrobial chemotherapy, determination of levels of antimicrobial activity, mechanisms of action of antimicrobial agents. Antifungal and antiviral drugs. Principles of antimicrobial resistance. Maintenance and preservation of microorganism. Bacterial spores - endo and exo - structure, function. Dormancy.
- UNIT IV** **HOST PARASITE INTERACTION:** Infection and disease. Mechanism of pathogenesis of bacterial and viral diseases - recognition and entry processes of different pathogens into host cells, alteration of host cell behavior by pathogens. Food poisoning. Hyphae vs yeast forms and their significance.
- UNIT V** **DISEASES:** Elementary account of most common diseases caused by bacteria, virus and fungi in humans - respiratory tract - and skin infections - diseases of nervous system - digestive system and sexually transmitted diseases. Mycoplasma and diseases caused by them.

REFERENCES:

1. **Handbook of Medical Laboratory Technology – V.H. Talib**
2. **Medical Microbiology - Murray**
3. **Prescott LM- Harley JP- Klein DA. – 1996 Microbiology- Wm.C. Brown Publishers.**
4. **Davis BD- Dulbecco R- Eisen HN- Ginsberg HS. 1980 Microbiology- Harper Intl. Edition..**
5. **Pelczar MJ Jr.- Chan ECS- Krieg NR. 2001 Microbiology- TataMcGraw Hill Publishing Co.-**
6. **Tortora- Funke- Case- 1995 Microbiology – An Introduction- Benjamin-Cummings Publications.**

Semester III

Core : XIII
Code : 10 BSBT 3413: P
Hours : 5
Credits : 3

MOLECULAR BIOLOGY AND GENETICS - Practical

1. Isolation of Genomic DNA of microbial, fungal, plant and animal source
2. DNA Quantification, UV-studies – hyperchromic effect, T_m determination
3. Isolation of Plasmid
4. Gel electrophoresis of DNA and analysis by Gel Documentation System
5. SDS-PAGE, staining (quick, CBB and Silver Staining) and analysis of Gel Documentation System
6. Western blotting
7. Experiments with lac operon- induction and assay of beta-galactosidase.
8. Preparation of competent cells and transformation- Transduction- Conjugation

REFERENCE BOOKS:

1. J.H. Miller (1992), A short course in Bacterial Genetics by Cold Spring Harbor Laboratory.
2. DM. Glover & BD. Hames (1995), DNA cloning I & II by IRL Pres.
3. MA. Innis- DH- Gelfand & D JJ Sninsky (1995), PCR strategies by Acadmi Press.
4. Molecular cloning Volume I- Volume II and Volume III- Academic Press.
5. Grierson and S.N. Covey (1988), Plant Molecular Biology by Blackie
6. S.Ignacimuthu S.J. (1996), Applied Plant Biotechnology- Mc Graw Hill publications Co. Ltd.- New Delhi.

Semester III

Core : XIV
Code : 10 BSBT 3414: P
Hours : 5
Credits : 3

IMMUNOLOGY AND MICROBIOLOGY- Practical

1. Preparation of Liquid and Solid media for growth of microorganisms.
2. Isolation and maintenance of organisms by plating, streaking and serial dilution method, slant and stab cultures, storage of microorganisms.
3. Isolation of pure cultures from soil and water.
4. Growth: Growth curve; Measurement of bacteria population by turbidometry and serial
5. Dilution methods. Effect of temperature, pH and carbon and nitrogen sources on growth.
6. Microscopic examination of bacteria, Yeast and mold and study of organism by Gram's stain, acid fast stain and staining for spores.
7. Study of mutation by Ame's Test.
8. Assay of antibiotics and demonstration of antibiotic resistance
9. Analysis of water for potability and determination of MPN.
10. Bacterial transformation.
11. Biochemical Characterization of selected microbes.
12. Media preparation- Sterilization.
13. Culture transfer techniques- Isolation of pure cultures.
14. Bacterial staining (Simple- Negative- Gram's- Acid fast- spore)
15. Bacterial growth curve.
16. Isolation of Antibiotic producing organism and determination of antimicrobial spectrum of isolates
17. Extracellular activities of micro organisms
18. Acid fast Bacilli Staining.
19. Hanging drop Method.
20. Confirm of E-Coli by Indole-Catalase Test, Agar Tests.
21. Antibiotic sensitivity testing
22. Skin scrap staining for Fungi (by KOH)
23. Fungal Culture and Fungal Staining
24. Blood & Chocolate agar preparation
25. Blood Specimen screening for bacteria.
26. Preparation of Ag - Protocols of immunization- methods of bleeding- Routes of administration of antigen.
27. Blood group - typing. - lymphocyte subset identification and enumeration, Immunoelectrophoresis- immunodiffusion and rocket electrophoresis. ELISA Western blotting
28. Separation of mononuclear cell by Ficoll-paque.

REFERENCE BOOKS

1. Rodney Boyer (2003), An Introduction to Practical Biochemistry, Pearson Education.
2. J. G. Cappuccino and N. Sherman (2004), Microbiology. A laboratory manual, Pearson Education.
3. J. Sambrook and D. W. Russell (2001), Molecular Cloning, Cold Spring Harbour Lab. Press.
4. J.Jayaraman (1988), Laboratory Manual of Biochemistry, Wiley Eastern
5. Wilson and Walker (1994), Practical Biochemsitry by Cambridge University Press
6. J.H. Miller (1992), A short course in Bacterial Genetics Cold Spring Harbor Laboratory.
7. Ed. RGF Murray- WA. Wood & NB krieg (1994), Methods for Genetics and molecular Bacteriology American society for Microbiology.
8. N. Kannan (2003), Handbook of Laboratory culture media- Reagents- Stains and Buffers - Panima Publishers- New Delhi.

Semester IV

Core : XV
Code : 10 BSBT 4415
Hours : 5
Credits : 4

GENERAL PHYSIOLOGY

- Unit I** **MICROBIAL PHYSIOLOGY:** Biosynthesis of peptidoglycan – outer membrane, teichoic acid – exopolysaccharides. Electron carriers – artificial electron donors – inhibitors – uncouplers – energy bond – phosphorylation. Bioluminescence – mechanism – advantages. Photosynthetic bacteria and green algae – Brief account of photosynthetic and accessory pigments. Carbon assimilation – types. Fermentation of carbohydrates – homo and heterolactic fermentations.
- Unit II** **PLANT WATER RELATIONS:** Importance of water to plant life. Movement of water in plants in relation to water potential, osmotic potential, pressure potential and metric potential. Ascent of sap: mechanism of water absorption, Guttation and transpiration, Physiology of stomatal opening and closing, Significance of transpiration. Phototropism: Phototropic signal perception, Gravitropism: Gravisensing, Growth response. Nastic movements. Nyctinasty, Seismonasty. Photoperiodism. Biological clock. Vernalization. Dormancy: Significance, Seed dormancy Bud dormancy.
- Unit III** **PHOTOSYNTHESIS AND NITROGEN METABOLISM:** Historical summary of early photosynthesis research. Photosynthesis and photorespiration. Nitrogen Metabolism: Uptake and assimilation of various forms of nitrogen by plants. Nitrogen fixation: Nonsymbiotic and symbiotic nitrogen fixation. Translocation of photoassimilates, tissues - Mechanisms of phloem transport. Plant growth regulators. Mechanism of action of plant growth regulators.
- Unit IV** **CIRCULATORY AND DIGESTIVE SYSTEM:** General and cellular basis of Animal Physiology. Body fluid compartments; transport across cell membrane, Homeostasis. Digestive system. Circulatory system, components – function, Blood coagulation – mechanism and regulation. Respiration- Mechanism of breathing, transport of Oxygen and carbon dioxide, O₂ dissociation curve. Role of kidney in the regulation of water, salt and acid base balance.
- Unit V** **NEUROENDOCRINE SYSTEM:** Muscle, types and movement- mechanism of muscle contraction. Nervous system and nerve cells, nerve impulses, action potential, all or none response, synaptic transmission. Sensory organs-structure and functions. Endocrinology – major endocrine organs, hormones and functions. Reproduction- Reproductive mechanisms, functional morphology of reproductive organs, Gametogenesis.

References

1. Guyton, A.C. and Hall, J.E., 2000, A Text Book of Medical Physiology, Xth Edition, W.B. Saunders Company.
2. Ganong, H, 2003, Review of Medical Physiology, 21st Edition, McGrawHill.
3. Strand Fluer, 1978, Physiology (a regulatory system approach) McMillan Pub. Co.
4. David Shier, Jakie, Butler & Lewis, 1996, Human Anatomy & Physiology, WCB, USA.
5. Salisbury, F.B. & Ross, C.W., 1992, Plant Physiology, (4th Edition) Wadsworth Publishing co. California, USA.
6. Taiz, L & Zeiger, E, 1998, Plant Physiology (2nd Edition) Sinauer Associates Inc. Publishers, Massacher setts USA.
7. Hopkins, W.G., 1999, Introduction to Plant Physiology, John Wiley & Sons, Inc. New York, USA.
8. Bhojwane, S.S. and Razdan, M.K., 1996, Plant Tissue Culture : Theory and Practice (a rev. ed), Elsevier, Science Publishers, New York, USA.

Semester IV

Core : XVI
Code : 10 BSBT 4416
Hours : 5
Credits : 3

ENZYMOLGY AND ENZYME TECHNOLOGY

- UNIT I** ENZYME CLASSIFICATION AND NOMENCLATURE: General properties of enzymes like effect of pH- Temperature- Ions etc. Extraction- assay and purification of enzymes. Kinetics of enzyme action – Concept of ES complex, active site, specificity, derivation of Michaelis-Menten equation for uni- substrate reactions. Different plots for the determination of K_m & V_{max} and their physiological significances. Importance of K_{cat}/K_m . Kinetics. Significance and evaluation of energy of activation. Collision and transition state theories.
- UNIT II** MULTI SUBSTRATE REACTIONS: Ping Pong, random and ordered Bi-Bi mechanisms. Reversible and irreversible inhibition. Competitive, non-competitive, uncompetitive, linear-mixed type inhibitions. Suicide inhibitor.
- UNIT III** MULTIENZYME SYSTEM: Occurrence, isolation and their properties: Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthase complexes. Enzyme-enzyme interaction, multiple forms of enzymes with special reference to lactate dehydrogenase.
- UNIT IV** MECHANISM OF ENZYME ACTION: Acid-base catalysis, covalent catalysis, proximity, orientation effect. Strain and distortion theory. Chemical modification of active site groups. Site directed mutagenesis of enzymes. Mechanism of action of chymotrypsin, lysozyme, carboxypeptidase, triose phosphate isomerase and alcohol dehydrogenase.
- UNIT V** ENZYME REGULATION: General mechanisms of enzyme regulation, product inhibition. Reversible (glutamine synthase and phosphorylase) and irreversible (proteases) covalent modifications of enzymes. Allosteric enzymes, qualitative description of “concerted” and “sequential” models for allosteric enzymes. Hill and Scatchard plots. Enzyme Engineering.

Reference

1. Dixon and Webb, Enzymes
2. Glick and Pasternack (1994), Molecular Biotechnology by. ASM Press.
3. Alan Fersht (1995), Enzyme structure and Mechanisms. W.H.Freeman and Company New York.
4. Trevor Palmer - Enzymology
5. Enzymology, Nicholas Price and Stevens.

Semester IV

Core : XVII
Code : 10 BSBT 4417
Hours : 4
Credits : 3

RECOMBINANT DNA TECHNOLOGY

- UNIT I INTRODUCTION TO RDNA TECHNOLOGY: DNA modifying enzymes and their uses.** Restriction enzymes – Discovery, types, use of type II restriction enzymes, elucidation of restriction site, restriction mapping. DNA polymerases – Klenow fragments, DNA polymerase I, thermostable DNA polymerases used in PCR, T4 / T7 DNA Polynucleotide kinases and alkaline phosphatases. RNA polymerases. Ligases. Nucleases - DNase I, SI Nuclease, Mung Bean Nuclease, RNAases and Exo III.
- UNIT II CLONING VECTORS AND THEIR APPLICATIONS:** Plasmid vectors for gram positive and gram negative bacteria. Plasmid - copy number, incompatibility and curing. Bacteriophage vectors - Lambda and M13 virus based vectors, cosmids and phagmids. Yeast vectors. Expression vectors- vectors facilitating protein purification, gene fusion and Shuttle vectors. Artificial chromosomes - BAC-YAC-HAC. Inteins (protein introns) and Exteins.
- UNIT III PCR AND SEQUENCING:** Maxxam and Gilbert, Sanger method and Automated DNA sequencing. Protein sequencing. PCR technology – concepts, types, primer construction/design, analysis of products and applications. DNA-finger printing. Chromosome walking and jumping. In vitro mutagenesis and deletion techniques.
- UNIT IV DNA CLONING:** Generation of rDNA molecules - cutting and joining DNA molecules - sticky ends- blunt ends- homopolymer tailing- use of adaptors and linkers. PCR based cloning. Preparation of radiolabelled / fluorescent labeled DNA & RNA probes. Chemical synthesis of oligo-nucleotides. Methods of introducing rDNA in microbes. Selection and screening of recombinants - alpha complementation, Blue – white selection, blotting and hybridization. cDNA arrays and Micro array technology.
- UNIT V STRATEGIES FOR THE PRODUCTION OF RECOMBINANT PROTEINS;** Insulin, human growth hormone, interferons and industrially important proteins. Construction of genomic library and cDNA library.

REFERENCE BOOKS:

1. Ernst-L. Winnacker (2003), Genes to Clones- Panima Publishing House- New Delhi.
2. T. A. Brown (2001), Gene Cloning Blackwell Science.
3. Bernard R. Glick and Jack J. Pasternak (2002), Molecular Biotechnology Panima Publishing House New Delhi.
4. S. B. Primrose (2001), Molecular Biotechnolgy, Panima Publishing House- New Delhi.
5. DM. Glover & BD. Hames (1995), DNA cloning I & II by IRL Pres..
6. MA. Innis- DH- Gelfand & D JJ Sninsky (1995), PCR strategies by Acadmic Press.

Semester IV

Core : XVIII
Code : 10 BSBT 4418
Hours : 4
Credits : 3

BIOINSTRUMENTATION

- UNIT I** **SPECTROSCOPIC TECHNIQUES:** Spectroscopy – Concepts of spectroscopy, Visible and UV spectroscopy, Laws of photometry. Beer-Lambert's law, Principles and applications of colorimetry. Principles of UV-Vis- IR- NMR-spectroscopy. CD – ORD and X – Ray Diffraction (XRD). Principles of Microscopy - phase contrast- fluorescence- confocal- scanning and Electron microscopy. ID and 2D gel electrophoresis of proteins. Mass spectrometry-MALDI-TOF.
- UNIT II** **SEPARATION TECHNIQUES:** Chromatography – Principles of partition chromatography, paper, thin layer, ion exchange and affinity chromatography, gel permeation chromatography, HPLC and FPLC. Electrophoretic techniques – Principles of electrophoretic separation. Continuous, zonal and capillary electrophoresis, different types of electrophoresis including paper, cellulose, acetate/nitrate and gel. Electroporation, pulse field gel electrophoresis.
- UNIT III** **CENTRIFUGATION:** Principles of centrifugation, concepts of RCF, different types of instruments and rotors, preparative, differential and density gradient centrifugation, analytical ultra-centrifugation, determination of molecular weights and other applications, subcellular fractionation.
- UNIT III** **TRACER TECHNIQUES:** Radioactive isotope and half life and isotope; Assessing the metabolic pathways - Meselson and Stahl experiment - autoradiography. Counting techniques: Liquid scintillation counting- Photomultiplier tubes- Chemiluminescence and bioluminescence. Green fluorescent protein. Fluorescence activated cell sorting.
- UNIT V** **MICROSCOPY AND MICROTOME TECHNIQUES:** Viscosity – Viscosity of macromolecules, relationship with conformational changes. Electron microscopy – Transmission and Scanning. Scanning Tunneling Microscopy. Specimen preparation for Electron Microscopy - freeze, fracture techniques, specific staining of biological materials. Microtome: types, principle and applications.

REFERENCE

1. Canter & Canter (1996), Biophysical Chemistry
2. Dixon and Webb, Enzymes
3. Glick and Pasternack (1994), Molecular Biotechnology by. ASM Press
4. P.L. Soni, Physical chemistry, S. Chand publications
5. Puri & Sharma, Physical chemistry- David Freifelder, Biophysical chemistry-

Semester IV

Core : XIX
Code : 10 BSBT 4419P
Hours : 5
Credits : 3

GENERAL PHYSIOLOGY AND ENZYMOLOGY- Practical

1. Estimation of rate of O₂ consumption in fish
 2. Estimation of Blood sugar in human
 3. Estimation of Blood urea in human
 4. Total Blood Cell Count
 5. Estimation of Haemoglobin level in Blood sample
 6. Estimation of Ammonia in human urine
 7. Recording of Blood Pressure during Stress condition
 8. Chlorophyll Estimation
 9. Calculation of Stomatal Index
 10. Plasmolysis
 11. Proline Estimation
 12. Calculation of Leaf Surface Area
 13. Water Potential of potato Tuber
 14. Extraction and quantification of DNA from onion
 15. Determination of water quality
 16. Assay of enzyme activity
 17. Isolation and purification of urease
 18. Time course of enzymatic reaction
 19. Influence of substrate concentration on the rate of enzymatic reaction
 20. Effect of pH and temperature on the rate of enzyme reaction
 21. Specificity of enzyme action
 22. Inhibition of enzyme activity. Determination of K_i values
 23. Molecular weight determination of enzyme by gel filtration
 24. Isozyme detection
 25. Isolation and purification of Acid phosphatases
 26. Immobilization studies:
 - (a) Preparation of urease (or any enzyme of interest) entrapped in alginate beads and determination of percent entrapment
 - (b) Study of the kinetics of the rate of urea hydrolysis by urease entrapped alginate beads
 - (c) Study of reusability and storage stability of urease entrapped alginate beads
 - (d) Immobilization of urease by covalent attachment to solid support.
- Sub cellular fractionation of rat liver and marker enzyme assays

REFERENCE:

1. **Enzyme Assays: A Practical approach by Eisenthal and Danson**
2. **Enzyme Biotechnology by G.Tripathi**
3. **Practical Biochemistry by Plummer**
4. **Practical biochemistry by sawhney and R.Singh**
5. **MA. Innis- DH- Gelfand & D JJ Sninsky (1995), PCR strategies by AcadmiPress.**
6. **Molecular cloning Volume I- Volume II and Volume III- Academic Press.**
7. **Grierson and S.N. Covey (1988), Plant Molecular Biology by Blackie**

Semester IV

Core : XX
Code : 10 BSBT 4420:P
Hours : 5
Credits : 3

RECOMBINANT DNA TECHNOLOGY AND BIOINSTRUMENTATION - Practical

1. Titration of a weak acid using a pH meter, preparation of buffers
2. Verification of Beer-Lambert's law and determination of absorption coefficients
3. Paper chromatography – Separation of amino acids and carbohydrates in a mixture
4. Thin layer chromatography of fatty acids
5. Column chromatography – Separation of a mixture of proteins and salt using Sephadex column
6. Agarose Gel Electrophoresis
7. Measurement of pH, Temperature and Electrical Conductivity;
8. Estimation of total solids, Total-dissolved solids, Total-suspended solids.
9. Restriction digestion of DNA
10. Ligation of DNA fragments.
11. Demonstration of gene transfer techniques - Cloning a gene
12. Agarose gel electrophoresis- resolution and purification of DNA fragments.
13. PCR amplifications- RFLP- RAPD

References:

1. Molecular cloning Volume I- Volume II and Volume III- Academic Press.
2. J.H. Miller (1992), A short course in Bacterial Genetics by Cold Spring Harbor Laboratory.
3. DM. Glover & BD. Hames (1995), DNA cloning I & II by IRL Pres.
4. MA. Innis- DH- Gelfand & D JJ Sninsky (1995), PCR strategies by AcadmiPress.

Semester V

Core : XXI
Code : 10 BSBT 5421
Hours : 5
Credits : 5

BIOPROCESS TECHNOLOGY

- UNIT I INTRODUCTION TO WHITE BIOTECHNOLOGY:** Isolation and screening of industrially important microbes. Strain improvement - mutation and recombination. Media/substrates for industrial fermentation/process - typical media, media formulation, factors, buffers, precursors, inhibitors, inducers and antifoams. Media formulation/optimization. Preservation of industrially important microorganisms.
- UNIT II FERMENTATION AND FERMENTOR/BIOREACTOR:** Concepts of basic modes of fermentation - Batch, Fed batch and Continuous fermentation. Fermentor/Bioreactor design and operations - basic function, design, components and body construction. Sterilization of Fermentor/Bioreactor - air and media sterilization. Bioprocess control and monitoring - control and monitoring of variables such as temperature - pH - aeration - agitation - pressure - online measurement - on / off control - PID control - computers in bioprocess control system.
- UNIT III TYPES OF FERMENTORS / BIOREACTORS:** Mechanical - Stirred tank bioreactors, pneumatic - Airlift fermentors, Hydrodynamic - jet fermentors, enzymatic membrane reactors, photo bioreactors, solid state fermentors, anaerobic solid stage silage fermentors, bed fermentors, tower fermentors, rotating disc fermentor, bubble cap fermentor, animal cell culture reactors and plant cell culture reactors, and cylindro conical vessel.
- UNIT IV DOWNSTREAM PROCESSING:** Objectives and criteria - foam separation - precipitation methods. Filtration - filtration devices and filter aids. Centrifugation - industrial scale centrifugation and cell disruption. Liquid - liquid extraction, solvent recovery. Chromatography - two-phase aqueous extraction, super - critical fluid extraction, ultra filtration, membrane process, drying devices, crystallization and whole broth processing. Effluent treatment - disposal, treatment process and by - products.
- UNIT V BIOPROCESS ECONOMICS AND INDUSTRIAL PRODUCTION:** Bioprocess economics. Production of enzymes-amylases and proteases. Acetone - Butanol - Ethanol (ABE) fermentation. Antibiotic production - penicillin, streptomycin and tetracycline. Amino acid - Lysine, proline and glutamic acid. Vitamin production - vitamin B12. Organic acid production - citric acid. SCP production. Cell and enzyme immobilization. Biotransformations.

REFERENCE BOOKS:

1. Glazer, A N. and Nikaldo, H.1995 Microbial Biotechnology -W H Freeman and company network.
2. Prescott, L M., Harley, J P and Klein, D A.1999. Microbiology 4th edition Mc Graw Hill.
3. Stainer, R Y, Ingrtham, J L., Wheels, M.L and Painter P.R.1987 - General Microbiology. Maomillan.
4. Stanbury P.F., Whitaker A., Hall S.J. (1995) Principles of Fermentation Technology, Butterwoth Heinemann.
5. Casida L.E. (1968) Industrial Microbiology, John Wiley & Sons.
6. Flickinger M.C., Drew S.W. (1999) Encyclopedia of Bioprocess Technology – 5 Volumes, John Wiley & Sons.
7. Arnold L. demain & Julian E. Davis. (2004) Industrial Microbiology & Biotechnology ASM Press.
8. Emt.el - Mansi & CFA. Bryce (2004). Fermentation Microbiology & Biotechnology Taylor & Francis Ltd.
9. P.F. Stanbury - A. Whitaker & S.J. Hall (1997) - Principles of fermentation technology Oxford.
10. Gungalus- I.C. and Stainer. RY. (Eds.) The Bacterial Vol. III Academic press. New York.
11. Sala Teh JR -Bacterial physiology and metabolism Academic press- New York.
12. J.M. Coulson and J.F. Richardson (1984) Chemical Engineering Pergamon Press.

SEMESTER V

Core : XXII
Code : 10 BSBT 5422
Hours : 5
Credits : 5

BIOINFORMATICS

- UNIT-I INTRODUCTION TO BIOINFORMATICS:** Definition, Use of information technology for studying Biosciences, Emerging areas in Bioinformatics, Future prospects of Bioinformatics. Introduction to Genomics, Introduction to Proteomics, Human Genome Project, Biological Software, Public Database, Gene Bank, Using Public Database.
- Unit II BIOLOGICAL DATABASES:** Open access bibliographic resources and literature databases, Structure databases: PDB and NDB- Structural classification databases: SCOP, CATH- Metabolic pathways database: KEGG – Biodiversity databases: World Biodiversity Database (WBD).
- Unit III COMPUTATIONAL METHODS:** Gene Prediction, Sequence alignment and Sequence searching, Multiple sequence alignment, Phylogenetic analysis, Protein sequence analysis, Protein structure prediction. Genome Database: GOLD – Genome Features of Prokaryote and Eukaryote – Genome annotation – Gene finders: GLIMMER and GENSCAN - Genome browser: UCSC –Genome projects: E.coli, A. thaliana and Human – Genomic Variations (SNP) – Genome Expressions (Microarray) – Computational approaches in Comparative Genomics: CMR, MUMMER and ACT Features of Protein Sequence and Structure – Proteomics tools in ExPASy Server- Protein Identification Programs: Mascot, PeptideIdent and Protein prospector – Secondary structure Prediction: GOR and Chou nFasman – Tertiary structure prediction: Homology modeling – Interactomics – Protein structure Visualization tools: RasMol Swiss PDB Viewer.
- UNIT- IV GENOMICS AND PROTEOMICS:** Genome Database: Genome annotation – Gene finders: - Genome browser: UCSC –Genome projects: E.coli, A. thaliana and Human – Genomic Variations (SNP) – Genome Expressions (Microarray) – Computational approaches in Comparative Genomics: CMR, MUMMER and ACT Features of Protein Sequence and Structure – Proteomics tools in ExPASy Server- Protein Identification Programs: Mascot, PeptideIdent and Protein prospector – Secondary structure Prediction: GOR and Chou nFasman –Tertiary structure prediction: Homology modeling – Interactomics – Protein structure Visualization tools: RasMol Swiss PDB Viewer
- UNIT –V PHYLOGENETIC ANALYSIS:** Sequence –based taxonomy – From Multiple Alignment to Phylogeny – Orthologs, Paralogs and Xenologs – Phylogenetic tree representation – Construction of dendrogram – Computer Tools for Phylogenetic analysis: PAUP and PHYLIP .

REFERENCES

1. Arthur M.Lesk, Introduction to Bioinformatics, Oxford University press, New Delhi, 2003.
2. A.Baxevanis and B.F. Ouellete. Bioinformatics: A practical Guide to the Analysis of Genes and proteins, Third edition, Wiley –Interscience (Wiley Student Edition), 2005.
3. D.W.Mount, Bioinformatics – Sequence and Genome Analysis, Second edition, CBS Publishers, New Delhi, 2005.
4. D.Higgins and W.taylor (Eds), Bioinformatics - Sequence, Structure and Databanks, Oxford University Press, New Delhi, 2000. 5. A.M.Campbell & L.G. Heyer , Discovering Genomics , Proteomics & Bioinformatics, Pearson Education ,New Delhi , 2003.
5. S.R.Pennington and M.J.Dunn, Proteomics –from Protein sequence to function, Viva Books Pvt. Ltd, New Delhi, 2002.

Semester V

Core : XXIII
Code : 10 BSBT 5423
Hours : 5
Credits : 5

ENVIRONMENTAL SCIENCE AND ECOBIOTECHNOLOGY

- Unit I** **ECOLOGY: Basic Ecological Concepts and Principles Our Environment: Geological Consideration, and Homeostasis; Biological control of chemical environment; Energy transfer in an ecosystem; Food chain, food web; Energy budget; Production and decomposition in a system; Ecological efficiencies; Trophic structure and energy pyramids; Ecological energetics; Principles pertaining to limiting factors; Biogeochemical cycles (N, C, P cycles). Over view of Freshwater Ecology; Marine Ecology; Estuarine Ecosystem; and Terrestrial Ecosystem.**
- Unit II** **POLLUTION: Concept of Environmental Pollution: Origin of pollution; Classification and nature of Environmental Pollutants; Industrial pollutions. Overview of Noise pollution. Radiation Pollution Types and possible hazards of radioactive substances; Soil Pollution - Waste land formation - Deforestation, Shifting cultivation. Impact of Dams, Loss of soil fertility. Global environmental changes; Green house effect. Over view of Water pollution - oil spills.**
- UNIT III** **EFFLUENT TREATMENT: Microbiology of waste water treatment, aerobic process – activated sludge, oxidation ponds, trickling filter, towers, rotating discs, rotating drums, oxidation ditch. Anaerobic process: Anaerobic digestion, anaerobic filters, up-flow anaerobic sludge blanket reactors. Biotechnology in tannery, dairy, distillery, textile, pulp, paper and Antibiotic industries effluent treatment.**
- UNIT IV** **APPLICATION AND TECHNOLOGY: Remote sensing and its applications in resource management and pollution monitoring - IRS satellites & their sensors. Biosensors, Bioremediation (Mycorrhizae - in restoration of soil fertility) and pollution abatement: Biotechnological applications for Xenobiotics degradation, hydrocarbons, oil pollutants, surfactants and pesticides. Bioleaching. Phytoremediation. Recycling of metallic waste;**
- UNIT V** **ENVIRONMENTAL QUALITY ASSESSMENT AND MONITORING: Quality of environment for life on earth and man - Deterioration of environmental quality with reference to anthropogenic impact. Methods of assessment of environmental quality; Short term studies/surveys. Environmental Impact Assessment (EIA) - The Environmental Protection Act, 1986. Green peace friendly concept.**

Reference:

1. Kudesia V P & R Kudesia (1979) - Environmental Health and Technology Me Graw Hill Publications Co. Ltd., New Delhi.
2. Harvinder Sohal & A K Srivastava (1982) - Environment and Biotechnology, Black Well publishers. New Delhi.
3. Kumar H D (1982) - Modern Concepts of Ecology - Vikas Publishing House Pvt. Ltd.
4. Environmental Chemistry A.K. De, Wiley Eastern Ltd.
5. Environmental Biotechnology and Clean air Bioprocess by E.J. Olguin, G. Sanchez and E. Hernandez (2003) Taylor& Francis.
6. Kumaraswamy.K. Algappa Moses A, Vasanthi M: Environmental Studies-Bharathidasan University Publication, Trichy.
7. Agarwal. K.C, 2001. Environmental Pollution: Causes, Effects and Control-Nidhi Publishers (India) Bikaner.
8. Environmental Biotechnology 1995, S.N.Jogdand Himalaya Publishing House.
9. Waste water engineering – treatment, disposal and reuse. Metcalf and Eddy Inc., Tata McGraw Hill, New Delhi.
10. Introduction to Biodeterioration. D.Allsopp and K.J. Seal, ELBS / Edward Arnold. Selected Papers from Applied and Environmental Microbiology

Semester V

Core : XXIV
Code : 10 BSBT 5424: P
Hours : 5
Credits : 3

BIOPROCESS TECHNOLOGY AND ECOBIOTECHNOLOGY - Practical

1. Isolation of Industrially important microorganisms for microbial processes.
2. Microbial production of citric acid using *Aspergillus niger*
3. Production and estimation of Alkaline protease
4. Biomass SCP from Algae and Fungi
5. Organic Solvent production
6. Bio-fertilizer production
7. Use of alginate for cell immobilization
8. Parts of Bioreactor and production kinetics using yeast or *E.coli*.
9. Water Analysis: Determination of Total Hardness.
10. Estimation of Calcium and Magnesium.
11. Estimation of Dissolved Oxygen.
12. Analysis of Carbonates and Bicarbonates.
13. Testing of drinking water for *E.coli* MPN analysis
14. Soil Analysis: Estimation of Available Nitrogen.
15. Estimation of Calcium and Magnesium.
16. Quantitative estimation of Nitrates.
17. Qualitative determination of Nitrates.
18. Analysis of Carbonates and Bicarbonates.
19. Determination of dissolved oxygen concentration of water sample
20. Determination of biological oxygen demand (BOD) of sewage sample
21. Determination of Chemical oxygen demand (COD) of sewage sample
22. Isolation of xenobiotic degrading bacteria by selective enrichment technique
23. Study on biogenic methane production in different habitats.

REFERENCES:

1. V. Subramanian (2002) A text book of Environmental Science, Narosa Publishing House.
2. P.K. Sharma, Environmental Chemistry.
3. David HF, Bela G. Liptak, Paul A. Bouis (1997) Environmental Engineers Handbook (2nd Ed) Lewis Publishers, New York.
4. Stanley E. Marahan Environmental Chemistry (4th edition) Environmental Chemistry
5. Dara SS. (2000) A text book of Environmental Chemistry and Pollution Control (1st edition) S. Chand & Company Ltd. New Delhi.
6. S. S, Saxena , Air, water and Soil analysis , Agro Botanica Publications.

Semester V

Core : XXV
Code : 10 BSBT 5425
Hours : 5
Credits : 3

BIOINFORMATICS - Practical

BIOINFORMATICS

1. Computer basic knowledge; hardware, connection cables, typing, Windows
2. 98/XP, Internet browsers, search engines.
3. LAN connections, setting up the IP address, network security.
4. Internet surfing and searching information, downloading and installing software(Acrobat Reader, etc).
5. Program to store a DNA sequence
6. Program to concatenate DNA fragments
7. Program to convert DNA to RNA
8. Program to calculate reverse complement of DNA sequence
9. Program to read protein sequence data from a file
10. Program to print the elements of an array
11. Program to take an element off the end of an array
12. Program to take an element off the beginning of an array
13. Program to put an element at the beginning of an array
14. Program to put an element at the end of an array
15. Program to reverse an array
16. Program to get the length of an array
17. Program to insert an element at a random position in an array
18. Program to find motif in a protein sequence
19. Program to count nucleotide in a sequence
20. Program to find the percentage of G and C in a DNA sequence
21. Program to find the percentage of type of amino acid in a sequence
22. Program to append ATGC to a DNA sequence using subroutines
23. Program to concatenate two strings using subroutines
24. Program to count the number of given motifs
25. Program to convert DNA to RNA using subroutines
26. Program to find is a DNA is stable or not.

REFERENCES

1. E. Balaguruswamy-1992 Programming in ANSI C- TataMcGraw Hill.
2. Attwood TK- Parry Smith DJ-2001 Introduction to bioinformatics- Pearson Education Asia.
3. Kutti- 1995 C and Unix programming: a conceptual perspective- Tata McGraw Hill-.
4. Gibas C- Jambeck P. 2001 Developing bioinformatics in computer skills. Oreilly & Associates Inc. Shroff Publishers.
5. David W. Mount- 2001-Bioinformatics- Cold Spring Harbor Laboratory Press.

Semester V

Elective : I
Code : 10 BSBT 5501
Hours : 5
Credits : 4

CORE BASED ELECTIVE – I: GENERAL PHARMACOLOGY

- UNIT I** **BASIC PHARMACOLOGY:** Introduction to Pharmacology, Sources of Drugs, Dosage forms and routes of administration and drug delivery system; Mechanism of action, drug receptors and cellular signaling systems ;Combined effect of drugs, Factors modifying drug action, tolerance and dependence; Pharmacogenetics.
- UNIT II** **PHARMACOKINETICS:** Absorption – Structure of cell membrane, Gastro-intestinal absorption of drugs, Mechanism of drug absorption, Absorption of drug from non-per oral routes. Distribution, Metabolism – Phase-I, and Phase-II reactions, Excretion of drugs, Principles of basic and clinical Pharmacokinetics.
- UNIT III** **CHEMOTHERAPY:** General principles of chemotherapy, Chemotherapy of tuberculosis and leprosy; Chemotherapy of cancer; General mechanism of action of chemotherapeutic agents. Bioassay of drugs and Biological standardization, Discovery and development of new drugs. Evaluation of New Drugs -Acute, sub-acute and chronic toxicity tests, Teratogenicity and Carcinogenicity; Clinical trials. Tablets – Formulation of different types, physiological availability and coating. Capsules – Advantages and disadvantages, dosage form, gelatin shell.
- UNIT IV** **DRUGS ACTING ON CNS, CARDIOVASCULAR AND RESPIRATORY SYSTEM:** Synaptic transmission in the CNS, General anaesthetics, Dissociative and neuroleptanaesthesia. Hypnotics and sedatives, Alcohol, Antiepileptics, Psychopharmacological agent, Antiparkinsonian drugs; Non-steroidal analgesics, anti-inflammatory and anti-pyretic agents, drugs used in gout; Narcotic analgesics, opioid poisoning and treatment; CNS stimulants and Nootropic agents, Local anaesthetics. Cardiac glycosides and positive inotropic agents; Antiarrhythmic drugs, Antihypertensive drugs.
- UNIT V** **PHARMACOGNOSY:** Definition, history and scope of Pharmacognosy including indigenous system of medicine. Classification of drugs of natural origin. Occurrence, distribution, organoleptic evaluation, microscopical evaluation, chemical constituents and therapeutic efficacy of the following categories of drugs - Laxatives: Aloes, Cardiotonics - Digitalis, Enzymes - Papaya, diastase yeast; Vitamins - Shark liver oil and Amla; Antimalarials – Cinchona; Antitumour – Vinca; Antihypertensives – Rauwolfia. Reverse Pharmacology.

REFERENCES:

1. Rang, M.P. Dale M.M. Reter JM – Pharmacology
2. Pharmacology and Therapeutics – Satoskar
3. Goodman and Gilman “s, The Pharmacological basis of therapeutics
4. Kulkarni S.K., Handbook of Experimental Pharmacology
5. Chronppharmacology by B. Lammer
6. Topicss of Molecular Pharmacology I & II by Nurger and Roberts
7. Medical Pharmacology by K.D. Tripathi
8. Essential of Pharmacotherapeutics by F.S.K. Barar
9. Pharmacology & Pharmacotherapeutics by Das & Dutta
10. Lippincotts Pharmacology

Semester VI

Core : XXVI
Code : 10 BSBT 6426
Hours : 5
Credits : 5

PLANT BIOTECHNOLOGY

- UNIT I INTRODUCTION TO TISSUE CULTURE:** Objectives, roles and landmarks in plant breeding; special breeding techniques: Mutational breeding and distant hybridization. History of plant cell, tissue and organ culture – laboratory organization – aseptic techniques – nutritional requirements and culture media. Micro propagation – Somatic embryogenesis and artificial seeds – induction of multiple shoots – Totipotency.
- UNIT II *IN-VITRO* PROPAGATION:** Production of virus free plants – production and exploitation of haploids and triploids – techniques of overcoming incompatibility barriers – embryo rescue – protoplast culture and parasexual hybridization – exploitation of Somaclonal and Gametoclonal variations. cryopreservation – germplasm conservation and establishment of gene banks.
- UNIT III GENE TRANSFER TECHNIQUES:** Genetic Engineering in Plants - Molecular biology of Agrobacterium mediated DNA transfer- Ti plasmid Vectors- Physical method of transfer-Biolistics –Electroporation. Transposons in transgenic plants – their uses – Terminator gene technology.
- UNIT IV MOLECULAR MARKERS:** Selectable Markers, reporter genes- Promoters used in Plant vectors genetic engineering for - heat, drought and saline tolerance (Osmogenes) - Virus resistance - Pest resistance – Bt genes, Non-Bt like protease inhibitors, alpha amylase inhibitors - Herbicide resistance - Delayed fruit ripening - Fungal and bacterial resistance - Secondary metabolite production . Production of therapeutic proteins - antibodies, vaccines - edible vaccines- hormones- Golden Rice.
- UNIT V PLANT GENOME MAPPING:** Physical and molecular maps, gene tagging –Seed production techniques, release of new varieties and plant breeders right: UPOV 369, 370, 372. Plant DNA finger printing: Hybridization and PCR based markers (RFLP, SSR's, RAPD, QTLs, SCARS, AFLP etc.). Green House Technology - Molecular aspects of nitrogen fixation. Management aspect of plant Genetic Engineering.

REFERENCE:

1. R.A Dixon And R.A. Gonzales (2004).Plant cell culture, IRL press.
2. G.W. Lycett and D. Grierson (1990) Genetic Engineering of crop plants- (Eds)
3. M.J. Chrispeels and D.F. Sadava (1994) Plants- Genes and Agriculture Jones and Bartlett.
4. Glick and Paster mark (2002) Molecular Biotechnology by Panima.
5. S.S. Bhojwani and M.K. Razdan (2004) Plant Tissue culture: theory and practice a revised edition Elsevier science.
6. F.H.Erbisch and K.M.Maredia (2000). Intellectual property in agricultural Biotechnology, Edited by, University Press.
7. Bernard R.Glick and Jack J.Pasternak (2001). Molecular Biotechnology, Principles and applications of recombinant DNA technology. ASM Press Washington DC.
8. J.Hammond, P.McGarvey and V.Yusibov (eds) (1999). Plant Biotechnology – New products and Applications. By Springer Publication.
9. Kalyankumar De. (2007). An Introduction to Plant Tissue Culture Techniques. New Central Book Agency, Kolkata.

Semester VI

Core : XXVII
Code : 10 BSBT 6427
Hours : 5
Credits : 4

MOLECULAR DIAGNOSTICS

- UNIT I** **MOLECULAR TECHNIQUES:** Approaches, methods and tools for molecular diagnostics - blotting techniques, RFLP, RAPD and PCR. *In situ* hybridization - FISH and fluorescent methods. Microarray technique: principle of global screening and diagnosis. Application of ELISA, ELISPOT, FACSCAN, Immunofluorescence and RIA in molecular diagnostics. Fluorescence tag chromophore-tagged DNA and protein probes, chip-based molecular diagnostics.
- UNIT II** **IMMUNODIAGNOSTICS:** Overview of Humoral and cellular immunity - Hematopoiesis -Stem cell markers. Antibodies and MHC molecules - allotypes and isotypes. Serodiagnostics: agglutination, immunodiffusion, immunoelectrophoresis and immunoprecipitation. HLA typing. Diagnostic and therapeutic implications of cytokines. Immunoinformatics and vaccine designing.
- UNIT III** **MICROBIAL DIAGNOSTICS:** Overview of microbial pathogens types. Molecular epidemiology. Type study of *Mycobacterium tuberculosis*, HIV, HBV, H5N1, Chikungunya and Dengue – Detection and molecular epidemiology. Conventional Vs Molecular diagnostics - merits and demerits. Environmental molecular diagnostics – Pathogens of importance in aqua culture (WSSV) and agriculture- plant molecular genetic markers.
- UNIT IV** **DIAGNOSTICS FOR HUMAN DISEASES:** Genetic testing - Practice of genetic testing - for carrier detection, predict disorders, presymptomatic testing and disease-susceptibility testing. Detection of genetic defects-mutation. Gene polymorphism: candidate genes approach. Metabolic and genetic disorders - diabetes, cardiac disorders, DNA analysis in Duchene Muscular Dystrophy, Sickle cell anemia and beta thalassemia: molecular aetiology and detection. Prenatal molecular diagnosis: CVS and amniocentesis, preimplantation - test methods and applications. Molecular Forensics - Contributions of Alec Jeffrys - DNA as evidence. DNA fingerprinting - Paternity dispute, Personal identification and identity of descent by molecular methods.
- UNIT V** **CANCER DIAGNOSTICS:** Cancer types and Diagnosis of cancer. Tumor markers, tumor imaging and staging –p53 and its role. Monoclonal and engineered antibodies and fluorescent antibodies in cancer diagnosis. Antigen specific therapy, cytokine therapy and gene therapy.

Reference

1. Benjamini E, Coico R and G. Sunskise (2000) Immunology a short course. IV edn. Wiley – Liss publication, NY.
2. Kuby, J (2005) immunology, III edn, WH Freeman &Co, NY.
3. Goldsby R.A. Kindt T.I and Osborne B.A (2000) Kuby Immunology IV edn. S WH Freeman And Co, NY.
4. Roitt, I (2006). Essential Immunology, IV edn. Blackwell Sci NY.
5. Strachan, T. and A.P. Read. 2004. Human Molecular Genetics. 3rd Edition. Garland b Science, UK.
6. Clinical chemistry-Principles, Procedures and correlations 5th edn/. Michael L. Bishop, Edward P. Fody, Larry Scoeff – Lipincott Williams and Wilkins – Indian Reprint 2005.
7. Julian Little, Muin J. Khoury, Wylie Burke 2003. Human Genome Epidemiology: A Scientific Foundation for Using Genetic Information to Improve Health and Prevent Disease, Oxford University Press.
8. BROCK Biology of Microorganisms. Eleventh Ed., Michael T. Madigan, John M. Martinko. Pearson-Prentice Hall, 2006. 68
9. A Practical Guide to Clinical Virology. 2nd Ed. L.R. Haaheim., J.R. Pattison. R.J.Whitley. John Wiley & Sons, 1994.
10. Biomedical Methods Hand Book- John M. Walkser, Ralph Raplay. Humana Press, 2005.
11. Tietz Textbook of Clinical Chemistry & Molecular Diagnostics – 4th Ed. Carl A. Burtis, Edward R. Ashwood, David E. Bruns. Saunders – Elsevier, 1999.
12. CDC epidemiology manuals.
13. Medical Genetics at a Glance. Dorian J. Pritchard & Bruco R. Korf, Blackwell publishers.
14. An introduction to Human Molecular Genetics Mechanisms of Inherited Diseases. IInd Ed. Jack J. Pasternak, Wiley-Liss & Sons Inc., 2005. N J, USA.
15. Elements of Medical Genetics. II th edition-Muller, Young – Churchill Livingstone, 2002.

Semester VI

Core : XXVIII
Code : 10 BSBT 6428
Hours : 5
Credits : 5

GENOMICS AND PROTEOMICS

- UNIT I GENOMICS: NUCLEOTIDE SEQUENCE DATABASES, ANALYSIS GENE IDENTIFICATION** - Goals of the Human Genome Project, cloning vectors, concept of maps, physical maps, shotgun libraries, DNA polymorphism, nucleotides, DNA sequences. Sequence databases: GeneBank, EMBL Nucleotide sequence databank, DNA Data Bank of Japan (DDBJ), database formats. Recombinant DNA technology, restriction enzymes, resource for restriction enzyme (REBASE), similarity search. Polymerase chain reaction, primer selection for PCR, BLASTn, application of BioEdit; Genome information and special features, coding sequences (CDS), untranslated regions (UTR's), cDNA library, expressed sequence tags (EST). Approach to gene identification; masking repetitive DNA, database search, codon-bias detection, detecting functional sites in the DNA. Internet resources for gene identification, detection of functional sites, gene expression.
- UNIT II FUNCTIONAL GENOMICS AND DNA MICROARRAY**-Introduction, Basic steps for gene expression, concept of microarrays; spotted arrays, oligonucleotide arrays, designing the experiment, Two-color microarray experiments, Clustering gene expression profiles; Agglomerative, Hierarchical, Nearest neighbour (Single-linkage), complete-linkage, average-linkage, weighed pair-group average, k-means clustering, self-organizing maps (SOM) clustering, Tools for microarray analysis; soft-finder, xCluster, MADAM, SAGE, Microarray design, microarray experimentation, fabrication computational analysis of Microarray data, Applications of microarray technology.
- UNIT III PROTEOMICS**- Protein Sequence Databases And Analysis-Protein sequence information, composition and properties, physicochemical properties based on sequence, sequence comparison; Primary databases, Secondary databases. Pair-wise sequence alignment, gaps, gap-penalties, scoring matrices, PAM250, BLOSUM62, local and global sequence alignment, multiple sequence alignment, useful programs, ClustalW, BLASTp. Protein Microarray- Proteomics classification; Tools and techniques in proteomics; 2-D gel electrophoresis, gel filtration, PAGE, isoelectric focusing, affinity chromatography, HPLC, ICAT, fixing and spot visualization, Mass spectroscopy for protein analysis, MALDI-TOF, Electrospray ionization (ESI), Tandem mass spectroscopy (MS/MS) analysis; tryptic digestion and peptide fingerprinting (PMF), Protein Micro array *in protein* expression, profiling and diagnostics, drug target discovery. Database searching- 3-dimensional structure determination by X-ray and NMR.
- UNIT IV PHYLOGENETIC ANALYSIS**-Evolution, elements of phylogeny, methods of phylogenetic analysis, Phylogenetic tree of life, comparison of genetic sequence of organisms, phylogenetic analysis tools-Phylip, ClustalW; Comparative Transcriptomics- Differential Gene expression, Transplastomics.

UNIT V

PHARMACOGENETICS: High Throughput Screening for Drug Discovery-Identification of Drug targets, Pharmacophore, Pharmacogenetics and Drug development. ADME Properties, Metabolome and Metabolomics. Systems Biology-Model systems. Global databases and analysis and statistical Modelling; Drug Discovery And Computer-Aided Drug Designing:Introduction, drug discovery area, pharmacogenetics and pharmacogenomics applications, SNPs, parameters in drug discovery identification of drug target molecules,drug design and its approaches, computer-aided drug designing methods; computer aidedmolecular design (CAMD), Quantum CAChe and project leader, ligand design methods,docking programs; De novo design.

References:

1. Introduction to Bioinformatics, (Atwood, T. K. and Parry-Smith, D. J).
2. An introduction to Computational Biochemistry. (C. Stain Tsai, A. John Wiley and Sons, Inc., publications).
3. Genomics: The Science and technology behind the human genome project (2000.) Edited by C. Cantor and C.L Smith, Wiley-Interscience. NewYork
4. Genome Analysis- A practical Approach(19995)by J.M Davis, Oxford University press, Oxford
5. Genome Mapping A practical Approach(1997) by P.H Dear, Oxford University press, Oxford
6. DNA microarrays: A practical Approach(1999) Edited by M.Schena, Oxford University press, Oxford
7. TWYMAN, R.M. (2004) Principles of proteomics. Bios Scientific Publishers, New York ISBN 1859962734
8. Westerneir.R&T.Navn.2002 Proteomics in practice: A laboratory manual of proteome analysis. Wiley-vch,weinheim.ISBN3527303545 liebler.D.C.2002
9. Introduction to proteomics: Tools for the New Biology. Humana Press Tottava, NJISBN0585418799
10. Proteome Research: New frontiers in functional genomics (1997). Edited by M.R. wilkins, K.L.Wiliams, R.D.Appel and D.F. Hochstrasscr- Springrt Vereag, New York
11. Bioinformatics; Methods and applications; Genomics, Proteomics and Drug Discovery; (Rastogi, S. C. and Mendiratta and Rastogi, P.

Semester VI

Core : XXIX
Code : 10 BSBT 6429 P
Hours : 5
Credits : 3

PLANT BIOTECHNOLOGY AND MOLECULAR DIAGNOSTICS - Practical

1. Sterilization- media preparation- hormones.
2. Seed Germination,
3. Explant preparation,
4. Micropropagation- Shoot induction- multiplication- root induction and hardening.
5. Callus induction
6. Cell suspension cultures
7. Regeneration
8. Suspension culture
9. Haploid culture- anther culture
10. Protoplast isolation and culture
11. Agrobacterium-mediated transformation- GUS expression- extraction of DNA from transformed plants.
12. Plant DNA isolation
13. RAPD analysis
14. Western Blotting
15. ELISA
16. HLA Class typing
17. PCR diagnosis of Mycobacterium tuberculosis
18. Serodiagnostics for microbial and viral pathogens
19. DNA fingerprinting – Forensic analysis based on VNTR
20. White spot syndrome virus (WSSV)
21. PCR based detection of Cancers

References

1. Benjamini E, Coico R and G. Sunskise (2000) Immunology a short course. IV edn. Wiley – Liss publication, NY.
2. Kuby, J (2005) immunology, III edn, WH Freeman &Co, NY.
3. Goldsby R.A. Kindt T.I and Osborne B.A (2000) Kuby Immunology IV edn. S WH Freeman &Co, NY.
4. Roitt, I (2006). Essential Immunology, IV edn. Blackwell Sci NY.
5. Strachan, T. and A.P. Read. 2004. Human Molecular Genetics. 3rd Edition. Garland Science, UK.
6. Clinical chemistry-Principles, Procedures and correlations 5th edn/. Michael L. Bishop, Edward P. Fody, Larry Scoeff – Lipincott Williams and Wilkins – Indian Reprint 2005.
7. Sambrook, (2001), Molecular Cloning : A laboratory manual Vol. I - III Cold Spring Harbor Laboratory.

8. F.M. Abubel (1987), Current Protocols in Molecular Biology Vol. & II, John Wiley Publishers- New York.
9. Weir- D.M. (1986), Hand Book of Experimental Immunology Vol. I & II by Blackwell Scientific Publications.
10. Hudson- L and Hay. H.C. (1980), Practical Immunology by Blackwell Scientific Publications.
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Semester VI

Core : XXX
Code : 10 BSBT 6430 P
Hours : 5
Credits : 3

GENOMICS AND PROTEOMICS - Practical

1. Study of Internet resources in Bioinformatics- Eg. NCBI, ICGB, EMBL-EBI.
2. Searches on NCBI- Pub Med bibliographic databases and Genome annotation.
3. Expert protein Analysis System (ExPASy)- Primary & Secondary structure tools-analysis & prediction
4. Multiple alignment- Domain/Motif databases-BLOCKS, PRINTS, SBASE and PFAM
5. Protein Structure and classification databases-PDB, SCOP,CATH, FSSP,PDBSUM
6. Phylogenetic analysis using web tools.
7. Protein Structure Prediction (Homology Modeling) using SPDBV
8. Evaluation of protein structure by Swiss PDB viewer or by any other suitable programs like Insight-II.
9. Calculation of Phi-Psi angles and Ramachandran plot for given protein structure.
10. Familiarisation with use of peptide fingerprint and Tandem MS search engines, (MS-Fit, Mascot)
 - a. Analysis and interpretation of peptide and protein identification results
11. Multiple alignment-CLUSTALW
12. Phylogenetic Trees-PHYLIP
13. Molecular Docking and Drug designing by using Chimera

Semester VI

Elective : II
Code : 10 BSBT 6502
Hours : 4
Credits : 3

CORE BASED ELECTIVE II: NANO BIOTECHNOLOGY

- UNIT I** **NANOTECHNOLOGY: Introduction to Nanoworld, Nanoscience and Nanotechnology** - nanoparticles, nanowires, thin films and multi-layers; Applications in various fields viz. Physical and Chemical, Materials, Life Sciences.
- UNIT II** **BIOMOLECULAR STRUCTURE DETERMINATION:** Structure determination through X-ray crystallography, NMR spectroscopy, Electron microscopy, Atomic force microscopy. Biomolecules as nanostructures and their applications in nanotechnology viz. Biosensors, separation of cells and cell organelles, drug delivery, gene therapy.
- UNIT III** **SYNTHESIS OF NANOSTRUCTURES - PHYSICAL:** Physical methods for synthesis of nanomaterials: mechanical methods, vapour deposition, cluster beam deposition, laser vaporization, laser Pyrolysis, sputter deposition, chemical vapour deposition, electric arc deposition, ion implantation, molecular beam epitaxy.
- Unit IV** **SYNTHESIS OF NANOSTRUCTURES - CHEMICAL:** Chemical methods for synthesis of Nanomaterials: colloids and colloids in solutions, colloids in vacuum, colloids in medium, synthesis of colloids, growth of nanoparticles, synthesis of metal nanoparticles, synthesis of semiconductor nanoparticles, langmuir-blodgett method, micro emulsions, sol-gel method.
- Unit V** **SYNTHESIS OF NANOSTRUCTURES - BIOLOGICAL:** Biological synthesis of Nanomaterials: synthesis using microorganisms, synthesis using plant extracts, synthesis using proteins and DNA templates Review of axioms of quantum mechanics, states and the bra / ket notation, rudiments of quantum theory of the process of measurement, relationship between quantum and classical concepts. Recent trends in Nanobiotechnology - Applications in life Sciences and ethical issues

REFERENCES:

1. Cotterill RMJ (2002). Biophysics. John Willey & Sons Ltd, England.
2. Chandra R (2004). Nuclear Medicine Physics. The Basics. Lippincott Williams & Wilkins, New York.
3. Buchholy K, Kasche V, Bornschever VT (2005). Biocatalysts and Enzyme Technology. Willey- VCH Verlag Gm bh & Co. KGaA Weinheim.
4. Renugopalakrishnan V, Lavis RV (2006). Bionanotechnology- proteins to nanodevices, Springer, Dordrecht.
5. Goodsell D.s.(2004). Bionanotechnology, Lessons from Nature. Willey – Liss, New Jersey.

Semester VII

Core : XXXI
Code : 10 BSBT 7431
Hours : 5
Credits : 5

ANIMAL BIOTECHNOLOGY

- Unit I** **GAMETOGENESIS AND EMBRYO DEVELOPMENT:** Overview of Endocrine regulation of oestrous cycle. Molecular biology of animal development - Oogenesis and fertilization- Blastula - gastrulation and morphogenesis. Genetic analysis of development in drosophila - a model system. Sex determination in drosophila. Maternal gene activity - zygotic gene activity- vertebrate homologues of invertebrate genes.
- Unit II** **MANIPULATION OF REPRODUCTION:** Pharmacological control of eostrous and ovulation, superovulation and embryo transfer, immunological methods to manipulate reproduction. Invitro embryo production and manipulation – production of multiple embryos invitro. Asexual multiplication of embryos. Evaluation of embryo quality. Embryo sexing, Cryopreservation of embryos, microinjection of embryos.
- Unit III** **GENE TRANSFER TO A WHOLE ANIMAL:** Gene transfer methods and target cells, design of a transfer vector, production of transgenic livestock and applications. Somatotropins in animal production – Somatotropin, regulation of somatotropin production and release, Endocrinology of somatotropin, Practical applications – alternative approaches to manipulation of production, recombinant-DNA bovine somatotropin, application of recombinant-DNA bovine somatotropin, Effects of ST-treatment on milk-and carcass quality. Profitability of application of bST to dairy cows.
- Unit IV** **ANIMAL CELL CULTURE:** Primary cell culture - transformed cell lines - cell culture media – components and their function. Serum and serum free media. Flask culture and passage of cells. CO₂ incubator. Organ culture. DNA insertion methods – microinjection, calcium phosphate transfection, lipofection and electroporation. Reporter gene systems – luciferase and green fluorescent protein. CAT assay. Preservation of animal cells. American type culture collection.
- Unit 5** **ADVANCED CONCEPTS:** Gene knock out technology - generation knockout and insertional mutants in mice. Stem Cells – types and Gene therapy – somatic versus germline therapy, Targets for gene therapy- inborn errors of metabolism, multifactorial and somatic genetic disease, cancer, hematopoietic system as a target for gene therapy. Cloning of animals - reproductive cloning. Biotechnology of silkworms and aquaculture.

Reference:

1. A. J. Griffiths- J.H. Miller- D.T. Suzuki- R.C. Lewontin and W.M. Gelbart (2000), An introduction to Genetic analysis, W. H. Freeman and Company.
2. J.R.W. Masters (2000), Animal Cell culture, Oxford University Press.
3. M.M. Ranga (2003), Animal Biotechnology, Student Edition- Jodhpur.
4. Bernard R. Glick and Jack J. Pasternak (2002), Molecular Biotechnology, Panima Publishing House- New Delhi.
5. Biotol Series: Biotechnological innovations in Animal Productivity, (1992), Butterworth-Heinemann.
6. R. A. Goldsby- T.J. Kindt- B. A. Osborne and J. Kuby. (2003), Immunology, W.H. Freeman and company.
7. T. A. Springer (1985), Hybridoma Technology in Biosciences and Medicine by Plenum Press- New York.
8. C. Garrison Fathman- F. W. Fitch (1982), Isolation- Characterization and utilization of T – Lymphocyte clones by Academic Press
9. J.D. Watson- N.H. Hopkins- J.W. Roberts- JA. Steitz and A.M. Weiner (2002), Molecular Biology of gene by Benjamin / cummings 4th Ed. Vol. 1 &2-
10. J.D. Watson- M. Gilman- J. Witkowski and M. Zoller (1992), Recombinant DNA 2nd, Scientific American Books- New York.
11. A. Puher (1993), Genetic Engineering of animals by (Ed.) VCH Publishers- Weinheim- FRG.

Semester VII

Core : XXXII
Code : 10 BSBT 7432
Hours : 5
Credits : 4

BIOTECHNOLOGY MANAGEMENT

- Unit I** **BASICS OF MARKETING:** Marketing concepts, approaches, marketing process and functions of marketing. Marketing Planning-Nature and Process – Contents of Marketing Plan-Analyzing need and trends in Macro Environment, Economic Environment, Technical Environment, Political Environment and Socio-cultural Environment. Consumer Behaviour-Factors influencing buyer behaviour-Buyer decision process- Consumer Psychology-Industrial Buyer behaviour vs. domestic buyer behaviour-Customer satisfaction vs. customer delight. Market Segmentation-Bases for market segmentation of consumer goods, industrial goods and services-targeting and positioning strategies. Market Evaluation and Control-Types, process, obstacles to marketing control-marketing. Market Research, Impact of Govt. policies on marketing and Ethics.
- Unit II** **SETTING UP OF A LABORATORY:** Laboratory organization – inventories – equipment and manuals - methods – protocols and standard operating procedures. Laboratory administration – personnel – finances – public expectations – leaving the laboratory – collaborations. Good Laboratory practices and current manufacturing practices – definition of GLP and cGMP, documentation procedures, validation. Collaboration – steps to facilitate collaboration. Closing a laboratory – inventories, clean up and inspections, equipment, personnel.
- Unit III** **TOTAL QUALITY MANAGEMENT:** Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs – Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures.
- Unit IV** **ENTREPRENEURSHIP:** Entrepreneur - definition & characters. Definition of science and technology. Common examples of bioproducts and their market values. Knowledge economy. Definition of tiny, small and large scale industry. Biotechnology parks in India. Roles of district industrial centers. Small industries service institutes and National small industries corporation in promoting entrepreneurship. Self help groups. Govt. regulations for biotech products. Public policy, regulatory and ethical challenges facing the biotechnology entrepreneurship. Business development for medical products. Business development for consumable products.

Unit V

QUALITY SYSTEMS: Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits. Barriers to TQM Implementation. Personnel Management skills: Recruiting, Hiring, Mentoring, Promoting and Terminating. Personal Life: Child care, Family and friends, Micromanaging, Leadership training, Managing projects and building teams, communicating and fostering creativity.

REFERENCES:

1. Dale H.Besterfield, et al., Total Quality Management, Pearson Education Asia, 1999. (Indian reprint 2002).
2. James R.Evans & William M.Lindsay, The Management and Control of Quality, (5th Edition), South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).
3. Feigenbaum.A.V. “Total Quality Management, McGraw-Hill, 1991.
4. Oakland.J.S. “Total Quality Management Butterworth – Heinemann Ltd., Oxford. 1989.
5. Narayana V. and Sreenivasan, N.S. Quality Management – Concepts and Tasks, New Age International 1996.
6. Zeiri. “Total Quality Management for Engineers Wood Head Publishers, 1991.

Semester VII

Core : XXXIII
Code : 10 BSBT 7433
Hours : 5
Credits : 4

RESEARCH METHODOLOGY

- UNIT I** RESEARCH CONCEPTS AND DATA COLLECTION: Definition of Research, Qualities of Researcher, Components of Research Problem, Various Steps in Scientific Research, Types of Research; Hypotheses Research Purposes - Research Design - Survey Research - Case Study Research. Sources of Data: Primary Data, Secondary Data; Procedure Questionnaire - Sampling Merits and Demerits.
- UNIT II** RESEARCH REPORTS: Structure and Components of Research Report, editing and evaluation of final draft, evaluating the final draft; Good Research Report, observation and research report. Pictures and Graphs; Research proposal/ Grant-definition, structure, budget allocation, specific aims, background and significance. Hierarchy of funding agencies in India and their operations.
- UNIT III** MODEL ORGANISMS IN BIOLOGY: definition of model organism and research resources – classification of model organisms. Non-human mammalian models – mouse (*Mus musculus*); Guinea pigs (*Cavia porcellus*). Non-mammalian models – Bacteria (*Escherichia coli*), Viruses (T4 and Lambda Bacteriophage), Yeast (*Saccharomyces cerevisiae*), Amoeba (*Dictyostelium discoideum*), Round worm (*Caenorhabditis elegans*), Fruit fly (*Drosophila melanogaster*), Zebra fish (*Danio rerio*), Mouse Ear cress (*Arabidopsis thaliana*), Maize (*Zea mays*) – rationale of model organism, comparative physiology, life cycle, scope and research preferences. Repositories- ATCC, NCCS, Pune. Culture collection and submission.
- UNIT IV** INTRODUCTION TO COMPUTER BASICS: concept of hardware, Windows XP and Linux. Hardware concepts- parts, devices-types, assembly, Installation of OS, Installation of Windows XP and Drivers. Various languages - C Language, loops, control flow, arrays and pointers, Memory allocation, Basic ideas of C++ and Java based object oriented programming (no programming in Java or C++). Concept of file, folders, directories and their management by Windows XP and Linux. Office applications: MS-Office, MS Word, MS-Excel and MS-Power point. Open Office on Linux: Word Processor, Spread Sheets.
- UNIT V** INTERNET TECHNOLOGY: Internet and world wide web, Client- server organization, FTP, HTTP, Telnet, Gopher, and other protocols, POP mails, Concepts of mail servers and clients, Browsers and mail managers, Netscape and Internet explorer, Internet domain. Searching the web, Search engines, Web indexes, Meta search engines, Internet security. Concepts of firewall, digital signature, remote login, Java applets and servelets, Scripting, Basic ideas of CGI and pearl (only the working principles).

REFERENCES

1. Wilkinson & Bhandarkar: **METHODOLOGY AND TECHNIQUES OF SOCIAL RESEARCH.**
Pauline Vyoung: **SCIENTIFIC SOCIAL SURVEYS AND RESEARCH.**
2. Panneerselvam, R., **RESEARCH METHODOLOGY**, Prentice Hall of India, New Delhi, 2004.
3. Kothari: **RESEARCH METHODOLOGY.**
4. Festinger. L & D. Katz: **RESEARCH METHODS IN BEHAVIORAL SCIENCE.**
5. Sellitz, et al: **RESEARCH METHODS IN SOCIAL RELATIONS.**
6. Jerrold H. Zar. **Biostatistical Analysis (4 th edition).**
7. Janet Buttolph Johnson and Richard A. Joslyn, *Political Science Research Methods* (Washington D.C.: CQ Press, 2001), pp. 131-145.

Semester VII

Core : XXXIV
Code : 10 BSBT 7434: P
Hours : 5
Credits : 3

ANIMAL BIOTECHNOLOGY - Practical

1. Media preparation, Primary Cell culture, chick embryo fibroblast culture.
2. Trypsinization of monolayer and subculturing.
3. Cryopreservation and thawing of cell lines.
4. Preparation of metaphase chromosomes from cultured cells.
5. DNA isolation from cultured cells, MTT assay
6. Cell counting and viability measurement.

REFERENCE:

1. Sambrook, (2001), Molecular Cloning: A laboratory manual Vol. I - III Cold Spring Harbor Laboratory.
2. F.M. Abubel (1987), Current Protocols in Molecular Biology Vol. & II, John Wiley Publishers- New York.
3. Weir- D.M. (1986), Hand Book of Experimental Immunology Vol. I & II by Blackwell Scientific Publications.
4. Hudson- L and Hay. H.C. (1980), Practical Immunology by Blackwell Scientific Publications.
5. Ian Freshney, Animal Cell Culture – A Manual of Basic Techniques, Wiley Liss Publications.

Semester VII

Elective : III
Code : 10 BSBT 7503
Hours : 5
Credits : 4

CORE BASED ELECTIVE – III: IPR, BIOSAFETY AND BIOETHICS

- UNIT I** **BIOSAFETY:** Introduction – biosafety issues in biotechnology - historical background. Biological Safety Cabinets, Primary Containment for Biohazards. Biosafety Levels - Levels of Specific Microorganisms, Infectious Agents and Infected Animals.
- UNIT II** **BIOSAFETY GUIDELINES:** Guidelines and regulations (National and International including Cartagena Protocol) – operation of biosafety guidelines and regulations of Government of India; Definition of GMOs & LMOs. Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture. Environmental release of =GMOs - Risk - Analysis, Assessment, management and communication.
- UNIT III** **INTELLECTUAL PROPERTY RIGHTS:** Introduction to IPR, Types of IP - Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge and Geographical Indications. Importance of IPR – patentable and non patentables, patenting life, legal protection of Biotechnological inventions. Agreements and Treaties - History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments. IPR and WTO regime - Consumer protection and plant genetic resources.
- UNIT IV** **PATENTS AND PATENT LAWS:** Objectives of the patent system - Basic, principles and general requirements of patent law. Biotechnological inventions and patent law - Legal development - Patentable subjects and protection in Biotechnology. Patent Filing Procedures - National & PCT filing procedure, Time frame and cost, Status of the patent applications, Precautions while patenting, disclosure/ nondisclosure, financial assistance for patenting, introduction to existing schemes. Patent licensing and agreement. Patent infringement - meaning, scope, litigation, case studies.
- UNIT V** **BIOETHICS:** Introduction to ethics and bioethics, framework for ethical decision making. Ethical, legal and socioeconomic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research. Ethical implications of GM crops, GMO's, human genome project, human cloning, designer babies, biopiracy and biowarfare. Eugenics and its possible approaches. Animal right activities - Blue cross in India- society for prevention of cruelty against animals. Ethical limits of Animal use. Green peace - Human Rights and Responsibilities.

REFERENCES:

1. **Beier- F.K.- Crespi- R.S. and Straus- T. Biotechnology and Patent protection-Oxford and IBH Publishing Co. New Delhi.**
2. **Sasson A- Biotechnologies and Development- UNESCO Publications.**
3. **Jeffrey M. Gimble- Academia to Biotechnology- Elsevier- Academic Press.**
4. **Biosafety and Bioethics related book. Rajmohan Joshi (Ed.) 2006. Biosafety and Bioethics. Isha Books, Delhi.**

Semester VII

Elective : IV
Code : 10 BSBT 7504
Hours : 5
Credits : 4

CORE BASED ELECTIVE – IV: FRONTIERS IN BIOTECHNOLOGY

- UNIT I** **FOOD BIOTECHNOLOGY:** Origin, scope and development. Fruits: Preservation vegetables, cereals, pulses, nuts, oils and fats in foods. Processing of beverages: Coffee, tea, cocoa, soft drinks, fruit juices. Fermented products: Dairy products. Fermented vegetable products-Regulatory and social aspects of biotechnology of foods, safety assessment of nutritionally improved foods and feeds developed through the application of modern biotechnology. Food borne illness, quality control, case studies on biotechnology in the evaluation of food quality, contamination and spoilage of fruits, vegetables, cereals, legumes, milk products, egg, meat, poultry, sea foods.
- UNIT II** **CANCER BIOLOGY:** Introduction: cancer cell and its properties, Classification of cancer (carcinoma, sarcoma, leukemia, lymphoma), Clonal nature of cancer, Cell cycle (Phases of cell cycle, cyclins and CDKs G2/M checkpoint). Mechanisms: Chemical carcinogenesis (initiation, promotion and progression), Radiation and cancer, genetic effects of ionizing radiation, oncogene activation (c-MYC, RAS superfamily, BCL-2 family) Apoptosis (Extrinsic and intrinsic pathways). Risk factors (oncogenes, tumor suppressor genes). Diagnosis and Treatment: Methods in cancer cytogenetics (Karyotyping, FISH). Tumor markers, genetic markers of cancer predisposition, Chemotherapy and Radiotherapy.
- UNIT III** **STEM CELLS:** Definition, classification and sources. Need for stem cell research. Role of stem cell in basic research. Human Embryonic Stem cells: Maintenance – culture - sub cloning - spontaneous and controlled differentiation. Clinical applications of hESCs. Haemopoietic stem cells: Definition, isolation, Clinical applications of Hematopoietic stem cells. Ethical implications of National Policies governing ES cells research for Science and the Scientist. Umbilical Cord blood stem cells – harvesting - treating brain injury, diabetes, stroke, earing loss and cardiovascular. Ethics and moral values related to stem cell research.
- UNIT IV** **BIOTECHNOLOGY IN TEXTILES:** Fibre preparation – retting process, enzymes in retting process, carbonization-enzyme application; Fabric preparation – desizing of fabric- Enzymes in fabric preparation - amylase, cellulase, pectinase, Catalase, lipase; oxidoreductases in fabric preparation – laccase, peroxidases, Fabric finishing – using enzymes, Wool processing applications – degumming of silk; textile after-care –enzymes in laundry detergents – alternative to sodium perborate. Bacterial cellulose, Genetically modified microorganisms – spider DNA-into bacteria for proteins – use in bullet proof vests. Biotechnology for tissue engineering and medical textiles – vascular prosthetics, heart valves, sutures – use in surgeries, controlled revascularization-matrix for growth of biological tissues.

UNIT V

CLINICAL RESEARCH: The History of the Legislation and Regulations, which Govern the Clinical Research Process; which Protect the Rights, Safety, and Well-Being of Human Subjects. Drug Discovery and Pre-Clinical Research: The Clinical Research and New Drug Application Approval Process; The Biologics Research, Development, and Licensing Process; Medical Device Research and Development. Clinical Trial Development and Management: Protocol Design and Development; Principals of Data Management and the Query Resolution Process; The Study Types Providing Expanded Access to Investigational Products; Essentials of Source Documentation: Maintaining and Managing Essential Documents; Recording and Reporting Non-Serious and Serious Adverse Events.

REFERENCES:

1. **Cancer Biology, 2nd edition, Ruddon R.W., Oxford University Press, 1987.**
2. **The molecular biology of Cancer. Ed. Stella Pelengaries and Michael Khan. Blackwell Publishing, 2006.**
3. **Stem Cells (Bench to Bedside) Ariff Bongso, Eng Hin Lee (editors)-2005-world Scientific Publishing Co.**
4. **Retim H.J and dRed G., Biotechnology**
5. **T. Ramachandran and T. Karthik Journal. TX 84, 32. (2004)**
6. **Angelina Georgiewa: Borislav, Industrial Fabrics Bulletin. (9), 58, (2003).**
7. **Hayavadana J. and Renuka G., Tissue Engineering, Asian Textile Journal 12, (9), 107, (2003).**

Semester VIII

Code : 10 BSBT 88
Hours : 30
Credits : 22

Project Work