



**Department of Biotechnology
Faculty of Science and Humanities
SRM University, Kattankulathur**

Curriculum and Syllabi

**B.Sc., – Biotechnology
(w.e.f 2012)**

REGULATIONS (w.e.f. 2012)

Eligibility

Minimum academic qualification required for students to join Bachelor's Degree in Biotechnology program is Plus Two with biology subjects or equivalent from any recognized Board/Institution recognized by the government.

Duration and Structure of the B.Sc. Programme

The course is organized on semester basis with a total of VI semesters. The minimum period for completion of the B.Sc. programme is VI semesters. The curriculum of B.Sc. programme is designed with twenty theory papers, eleven practical papers, two industrial trainings and one Mini project.

Instruction

Medium of instruction is English and will be imparted through classroom and laboratory sessions as well as on-the-job training. Theoretical instruction will be imparted in the form of lectures and through seminars and discussions. Laboratory Sessions are for imparting practical knowledge of the subjects. On-the-job training will comprise visits to various biotechnology industries where students can study first-hand the various techniques and applications adopted.

Academic Year

The academic year is divided into two semesters: mid-July to December, and January to May. The actual dates of commencement and conclusion of each term of the academic year will be intimated to the students by the University.

Attendance

A minimum of 75 per cent attendance at lectures is compulsory in each term and student falling short of this minimum attendance is liable to be barred from appearing for the final examination.

A candidate who is not permitted to appear for the university examinations due to lack of attendance requirements will have to reregister and do the courses when they are offered subsequently.

Classroom/Laboratory Sessions

Lecture sessions are normally held for five days in a week, Monday through Friday. The timetable for the various lecture sessions will be displayed on the notice board. The teaching faculty will generally provide guidance to candidates in the matter of selection of subjects for the study paper or project work.

Industrial Training

For the benefit of the students, it has been mandatory to attend a minimum of TWO Industrial training programmes. At the end of the second year of the course i.e IV semester the students must attend an industrial training programme for duration of minimum TWO weeks. Similarly, they must attend another industrial training during the third year of the course i.e. V semester for duration of minimum of THREE weeks. By the beginning of the subsequent semester they must submit a report of their training undergone. The report will be evaluated by duly appointed teaching faculty. A maximum of THREE credits will be allotted for successful completion and report submission of the industrial trainings undergone by the student.

Discipline

Every student is required to observe disciplined and decorous behavior both inside and outside the college and not to indulge in any activity which will tend to bring down the prestige of the University.

Revision of Regulation and Curriculum

The University may revise, amend or change the regulations, scheme of examinations and syllabi from time to time if found necessary.

B.Sc BIOTECHNOLOGY

CELL BIOLOGY

Course code	Category	Course Name	L	C	P	TH
BBT12101	Major	Cell Biology	5	4		68

Objective:

The course helps the students to build a sound knowledge in various aspects of the cell and cellular organelles and the mechanism behind the metabolism and various activities of the cell.

UNIT – I

14

An Overview of cells – Origin and evolution of cells. Cell theory, Classification of cells – Prokaryotic cells and Eukaryotic cells. Comparison of prokaryotic and eukaryotic cells. Cell cycle – components in cell cycle control – cyclic- CDKs – check points in cell cycle - abnormalities in cell cycle

UNIT – II

12

Cell Membrane – Fluid mosaic model of membrane structure. Membrane proteins and their properties. Membrane carbohydrates and their role. Transport across membranes – Diffusion - active and passive diffusion.

UNIT – III

16

Endoplasmic reticulum – Types, structure and function. Golgi apparatus – Structure and function. Lysosome– Structure and functions. Morphology and functions of peroxisomes and glyoxisomes. Ribosomes – Types structure and function.

UNIT – IV

12

Nucleus: Structure and function. Chromosomes, chromatin structure. Mitochondria – Structure and functions. Cytoskeleton: Types of filaments and their functions. Microtubules – Chemistry and functions – Cilia and flagella- Cell –cell interactions

UNIT – V

14

Introduction to Necrosis, Senescence, Apoptosis – Programmed cell death. Mechanism of Apoptosis. Oncogenes – Types of cancer

Reference books

1. Molecular Biology of the Cell, 4th edition by Bruce Albert's, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. New York: Garland Science; 2002.
2. Cell and Molecular Biology: Concepts and Experiments, Fourth Edition by Gerald Karp-2004
3. Molecular Cell Biology (Lodish, Molecular Cell Biology) by Harvey Lodish, Arnold Berk, Chris A. Kaiser and Monty Krieger -2007
4. The World of the Cell, 7th Edition by Wayne M. Becker, Lewis J. Kleinsmith, Jeff Hardin and Gregory Paul Bertoni (Feb 29, 2008)

Cell Biology Practicals

Course code	Category	Course Name	L	C	P	TH
BBT12102	Major	Cell Biology Practicals		2	4	

1. Cell Division: Mitosis – onion root tip;
Meiosis – Transdescantia
2. Polytene chromosomes – chironomous larvae
3. microscopic observation of prokaryotic and eukaryotic cell (differential staining)
4. screening of leaf pigments – paper chromatography
5. hemoglobin estimation
6. WBC and RBC count – Haemocytometer
7. Osmotic potential – (sucrose / salt solution)

Permanent Slide observation

1. Meiosis
2. Plant cell
3. Mitochondria
4. chloroplast

CHEMISTRY

Course code	Category	Course Name	L	C	P	TH
BBT12103	Allied	Chemistry	5	4		63

OBJECTIVE

The main objective of the paper is to expose students to basics and advanced chemistry with brief knowledge in industrial production.

UNIT I

12

a) Chemical Bonding

Molecular orbital theory-bonding, antibonding and non-bonding Orbital, Molecular orbital. Molecular Orbital Configuration of H₂, N₂, O₂, F₂. Bond order. Diamagnetism and Para magnetism.

b) Interhalogen Compounds:

ICI, BrF₃, IF₅, -Preparation, Hybridization, structure and shape.

c) Industrial chemistry

Synthesis, Properties and uses of silicones, Fuel gases-natural gas, Water gas, Semi water gas, Carbureted water as, Producer gas, Oil gas

UNIT II

14

a) Coordination Chemistry

Nomenclature, Theories of Werner, Sidge-Wick, Pauling, Chelation Examples, Hemoglobin, Chlorophyll. Applications in qualitative and quantities analysis of EDTA.

b) Fertilizers

Urea, ammonium sulphate, ammonium Nitrate, Potassium Nitrate, NPK fertilizer, Triple Super phosphate, Pollution of air, Water and Sol-sources, remedies.

UNIT III

a) Covalent bond

14

Hybridization and geometry of organic molecules-CH₄, C₂H₄, C₂H₂, C₆H₆ Inductive effect, electrometric, mesomeric, hyperconjugative and Steric effects in properties of compounds.

b) Aromatic Compounds

Electrophilic Substitution in benzene. Mechanism of Nitration, Halogenation, Alkylation, Acylation, Sulphonation.

UNIT IV

12

a) Heterocyclic

Preparation and properties of Furan, Thiophene, Pyrrole and Pyridine.

b) Carbohydrates

Classification, Preparation and properties of glucose and fructose, Discussion of Open Chain, Ring structure of glucose and fructose. Glucose fructose interconvert ion.

UNIT V

10

a) Kinetics

Rate, Order, Molecularity, Pseudo first order, determination of order.
Measurement of reaction. Effect of temperature on the rate. Energy of activation.

1. Electro Chemistry

Kohlraus's law, Measurement of Conductance. pH determination, Conduct metric titrations. Hydrolysis of Salts. pH and buffer in living system.

Reference Books

1. Lee, J.D. 2001 Inorganic chemistry. Blackwell science,
2. Negi A.S and Anand. 2001. A text book of physical chemistry. Taj press.
3. Sony, P.L 2000. A text book inorganic chemistry, Sultan Chand and Sons.
4. Mathews, P.1996 Advanced chemistry, Cambridge University Press
5. Voet, D. and Voet, JG.2004 Biochemistry, 4thEdition, John Willey & Sons, Inc

Chemistry Practicals

Course code	Category	Course Name	L	C	P	TH
BBT12104	Allied	Chemistry UG		2	4	

I. VOLUMETRIC ANALYSIS:

1. Estimation of sodium hydroxide using standard sodium carbonate.
2. Estimation of hydrochloric acid- standard oxalic acid.
3. Estimation of oxalic acid- standard sulphuric acid.
4. Estimation of ferrous sulphate- standard Mohr salt solution.
5. Estimation of oxalic acid- standard ferrous sulphate.
6. Estimation of potassium permanganate- standard sodium hydroxide.

II. ORGANIC ANALYSIS:

Systematic analysis

- 1 To distinguish between aliphatic and Aromatic.
2. To distinguish between saturated and unsaturated.
3. Functional group tests for phenols, acids (mono and di), aromatic primary amine, amide, diamide, carbohydrate,

MOLECULAR BIOLOGY & MOLECULAR GENETICS

Course code	Category	Course Name	L	C	P	TH
BBT12201	Major	Molecular Biology& Molecular Genetics	5	4		72

Objective:

The course helps the students to understand the activities of the cell in the genetic and in the molecular level and helps the students in understanding the maintenance and alteration of the cellular activities.

UNIT – I Genome Organization

12

Genome organization – Prokaryotic and Eukaryotic; Chromosome structure and function, chromatin; Chloroplast DNA; Mitochondrial DNA; Gene families; Gene Clusters

UNIT II Central Dogma

16

Prokaryotic and Eukaryotic DNA replication, Transcription, Translation and regulation mechanisms – Post transcriptional modification and splicing mechanism – Post translational modifications - Ribosomes, protein biosynthesis and transportation-Different mechanisms of Signal transduction.

UNIT – III

14

DNA repair mechanisms; Mutagenesis, Mutations, and Mutants-Types of Mutations, Biochemical Basis of Mutants, Mutagenesis, Mutational Hot Spots, Reversion.; Transposable elements (Insertion sequence and transposons, Integrons and Antibiotic-Resistance cassettes; Bacterial Genetics (Conjugation, Transformation, Generalized transduction, Specialized Transduction)

UNIT – IV Gene Regulation mechanisms

14

General aspects of Regulation, The lactose system and the operon model, The Galactose operon, The Arabinose operon, The Tryptophan operon, Relative positions of Promoters and Operators, Feedback Inhibition

UNIT – V: Chromosomal Variations and Mapping

16

Chromosomal variation in Number & Structure – Euploidy, Non-disjunction & Aneuploidy, Polyploidy, Position Effect, and Centromeric & Non-centromeric breaks in chromosomes, chromosomal rearrangements, Chromosomal aberrations & evolution. Chromosome Mapping - Haploid mapping, Diploid mapping - Oncogenesis:Development and causes of cancer, Types of cancer,Oncogenes: Retro viral, proto, tumour suppressor gene.

REFERENCES:

1. Cell Biology. Organelle structure and function, David E Sadava, Jones Bartlett Publishers-1993.
2. Cooper M 1995. The cell molecular approach, ASM Press.
3. Principle of cell and molecular biology 2nd edition – Lewis J Kleinsmith, Valerie M Kish-1995.
4. DeRobertis, EDP, E.M.F Robertis, 7th edition 1980. Cell and molecular biology, Saunders Company.
5. Harvey Lodish, Baltimore. Arnold Berk et al 1995. 3rd edition. Molecular cell biology.
6. Molecular Biology by Freifelder-1987, Jones & Bartlett publications.

Molecular Biology & Molecular Genetics Practicals

Course code	Category	Course Name	L	C	P	TH
BBT12202	Major	Molecular Biology & Molecular Genetics Practicals		2	4	

- Transformation of bacteria
- Purification of plasmid DNA
- Restriction digest of plasmid DNA
- Gel electrophoresis
- Purification of cellular DNA
- Extraction and purification of cellular RNA
- Southern blot / restriction digest
- Southern blot / gel electrophoresis and transfer
- Label probe / hybridization
- Introduction to polymerase chain reaction

BASICS OF COMPUTER

Course code	Category	Course Name	L	C	P	TH
BBT12203	Allied	Basics Of Computer	5	4		66

Objective:

The course helps the students to have initial knowledge in computer applications which can help them to use the statistics in biological field.

Unit I: KNOWING COMPUTER

12

Introduction - Basic Applications of Computer, Components of Computer System- Input devices; Output devices; Computer Memory; Concept of Hardware and Software; Antivirus

Unit II: OPERATING SYSTEM

12

Introduction- Basics of Operating System; Basics of popular operating system (LINUX, WINDOWS); the User Interface; Task Bar; Icons; Menu; Running an Application; Changing Mouse Properties;

Unit III: POWERPOINT & SPREADSHEET

16

Introduction – Basics of PowerPoint presentation; Entering and Editing Text; Preparation of Slides and slideshow; Inserting Word Table or An Excel Worksheet; Adding Clip Art Pictures; Inserting Other Objects; Resizing and Scaling an Object Presentation of Slides; Choosing a Set Up for Presentation; Rehearse timing: Short cut keys

Introduction – Basics of Spreadsheets; Manipulation of Cells; Entering Text, Numbers and Dates; Creating Text, Number and Date Series; Editing Worksheet Data; Formatting spread sheet; Formulas and Function; Short cut keys

Unit IV: Introduction to programming languages:

14

Introduction – Flowcharts – Algorithms - Pseudocodes – Programming languages: data types, variables, constants, operators, input output, expressions, control flow constructs (conditional and loop statements) - functions, arrays, structures and unions - Pointers - Data structures - File handling. Programming languages for Bioinformatics.

Unit V: COMMUNICATION USING THE INTERNET

12

Introduction - Basic of Computer Networks; Local Area Network (LAN); Wide Area Network (WAN); Internet; Concept of Internet; Applications of Internet; Connecting to the Internet; Troubleshooting; World Wide Web (WWW). E-mail Account & Its Functions. Role of computer in Biological field.

REFERENCE BOOKS

1. The complete reference Microsoft Reference access 2007 by Virginia Andersen
2. Microsoft Office 2003: The Complete Reference (Osborne Complete Reference Series) by Jennifer Kettell, Guy Hart-Davis, Curt Simmons and Jennifer Kettell
3. E-Book: Microsoft Office 2010 Ultimate Tips & Tricks

Basics of Computer Practicals

Course code	Category	Course Name	L	C	P	TH
BBT12204	Allied	Basics Of Computer Practicals		2	4	

PowerPoint

Creating a Presentation Using a Template
Entering and Editing Text
Inserting Word Table or an Excel Worksheet;
Adding Clip Art Pictures and Other Objects
Resizing and Scaling an Object Presentation of Slides
Transition and Slide Timings
Using shortcut keys

Spreadsheet

Manipulation of Cells
Entering Text, Numbers and Dates
Creating Text, Number and Date Series
Editing Worksheet Data
Formatting Cells
Formulas and Function
Creating Pivot Tables
Creating graphs
Using multiple spread sheets
Using shortcut keys

BIOCHEMISTRY

Course code	Category	Course Name	L	C	P	TH
BBT12301	Major	Biochemistry	5	4		70

OBJECTIVE

This paper presents the study of identification and quantitative determination of the substances, studies of their structure, determining how they are synthesized metabolized and degraded in organisms, and elucidating their role in the operation of the organism.

UNIT – I

14

Carbohydrates: Definition, classification, stereochemistry, cyclic structures and anomeric forms, Haworth projections. Monosaccharide, Disaccharides, Polysaccharides. Homopolysaccharides - starch, glycogen, cellulose, chitin, dextrin and inulin. Heteropolysaccharides-hyaluronic acid, chondroitin sulphate and heparin.

UNIT – II

16

Lipids; Definition, classification of lipids, simple compound and derived. Simple lipids-Physical and chemical properties of fats. Characterisation of fat – Saponification number, acid number, Iodine number and Compound lipids-Structure and function of phospholipids, glycolipids and lipoproteins. Derived lipids-Fatty acids-saturated and unsaturated. Essential fatty acids. Steroids-Structure of cholesterol.

UNIT- III

14

Amino acids and peptides.

Definition, amino acids as ampholytes. Structure and classification of amino acids based on chemical nature, Essential amino acids, Peptides; Structure and properties.

UNIT- IV

12

Nucleic acids; Structure of Purines and Pyrimidines; Nucleotides and Nucleosides. DNA: double helix: A, B and Z forms

UNIT- V

14

Vitamins: Definition, Classification. Fat soluble vitamins- sources, structure and physiological functions; Water soluble vitamins-sources, structure and physiological functions. Minerals: Mineral requirement, essential macro minerals and essential micro minerals, sources and functions.

REFERENCES

1. Ambika Shanmugam, Fundamentals of Biochemistry for Medical Students-2001.
2. Deb, A.C., Fundamentals of Biochemistry, New Central Agency, Calcutta, 3rd Edition, 1989.
3. Lehninger, A.L., Nelson, D.L., Cox, M.M., Principles of Biochemistry, CBS Publishers, 2nd Edition, 1993.
4. Lubert stryer, Biochemistry, Freeman and company, 4th Edition, 1995.
5. Rastogi S.C, V.N. Sharma, Anuradha Tanden, Concepts in molecular biology, 1993.
6. Jain J.L, Fundamentals of biochemistry, S.Chand Publication 6th Edition, 2005.

Biochemistry Practicals

Course code	Category	Course Name	L	C	P	TH
BBT12302	Major	Biochemistry Practicals		2	4	

QUALITATIVE ANALYSIS

1. ANALYSIS OF SUGARS

- a) Monosaccharide-Glucose, Fructose, Galactose, Mannose, Pentose.
- b) Disaccharides-Sucrose, Maltose and Lactose.
- c) Polysaccharides-Starch and Dextrin.

2. ANALYSIS OF AMINO ACIDS

- a) Histidine b) Tyrosine c) Tryptophan
- d) Methionine e) Cysteine f) Arginine

3. LIPID ANALYSIS [GROUP EXPERIMENTS]

- a) Determination of Saponification number.
- b) Determination of Acid number.
- c) Determination of Iodine number.

4. DEMONSTRATION EXPERIMENTS

- a) Separation of amino acids by TLC.

REFERENCES

- 1. David T. Plummer, An introduction to practical bio-chemistry, Mc Graw Hill publication-1971
- 2. Pattabiraman, Laboratory manual in bio-chemistry, 1987- ASM publications.
- 3. J.Jayaraman, Practical bio-chemistry-2001, New Age International.

BIOINSTRUMENTATION

Course code	Category	Course Name	L	C	P	TH
BBT12303	Major	Bioinstrumentation	5	2		64

Objective:

This course provides a sound knowledge to the students, the details about the various techniques and their applications in the biological field.

UNIT-I: Centrifugation:

12

Sedimentation Principle, Types of rotors, Preparative and Analytical Centrifuges, Density Gradient Centrifugation, Differential centrifugation.

UNIT-II: Chromatography Techniques:

12

Theory and Application of Paper Chromatography, TLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, GLC and HPLC.

UNIT-III: Electrophoresis Techniques:

12

Theory and Application of PAGE, Agarose Gel Electrophoresis 2DE, Iso-electric Focusing, Immuno diffusion, Immuno Electrophoresis, ELISA, RIA, Southern, Northern and Western Blotting.

UNIT-IV: Spectroscopic Techniques:

14

Theory and Application of UV and Visible Spectroscopy, Fluorescence Spectroscopy, MS, NMR, ESR, Atomic Absorption Spectroscopy.

UNIT-V: Radio-isotopic Techniques:

14

Introduction to Radioisotopes and their Biological Applications, Radioactive Decay – Types and Measurement, Principles and Applications of GM Counter, Solid and Liquid Scintillation Counter, Autoradiography, RIA.

RECOMMENDED BOOKS:

1. Physical Biochemistry: Application to Biochemistry and Molecular Biology – Freilder-1982.
2. Biochemical Technique: Theory and Practice, - Robyt & White-1990, waveland press
3. Principle of Instrumental Analysis – Skoog & West , 1998, saunders college publications
4. Principle & Technique – Practical Biochemistry 5th Ed. (2000) - Walker J. & Wilson.
5. Biochemical Technique Theory & Practical- White, R. -1990, waveland press
6. Principle of Instrumental Analysis – Skoog *et al* 2006.
7. Biophysical Chemistry – Upadhyay & Nath, 2010.

MICROBIOLOGY

Course code	Category	Course Name	L	C	P	TH
BBT12304	Major	Microbiology	5	4		70

Objective:

The course helps in understanding the microbial world in various aspects of structure, growth, industrial and medicinal applications.

Unit-1 Basics of Microbiology

14

Microbiology - definition, history and scope – Prokaryotes and eukaryotes – Microorganisms- bacterial cell – size, shape and arrangement - General structure – functions of microbial cellular compounds (viruses, bacteria, algae, fungi, protozoa) – Microscopy – Principles of Light, dark field and Phase contrast microscopy.

Unit-2 Principles & classification of microbes

14

Principles & classification of microbes – binomial nomenclature Whittaker five kingdom classification– sterilization and disinfection - Physical and chemical methods of sterilization – MIC: Disc Diffusion, Well Diffusion; Stain and staining methods – principles of staining - simple, differential, capsule, nuclear and spore staining methods.

Unit-3 Microbial media & Inoculum preparation

16

Microbial media – Types of Media, Reviving, culturing and sub culturing of microbes; Isolation and enumeration of microorganisms in soil, water and air – methods of obtaining Pure cultures – Inoculum preparation- methods for microbial identification. Microbial growth – Phases of growth curve, Factors influencing the growth of microbes- classification based on that. (Temperature, pH, Nutrition) and nutritional types of microorganisms.

Unit -4 Food and Industrial Microbiology

12

Food and Industrial Microbiology - Microbiology of fermented food and dairy products – cheese, yogurt, Alcoholic beverages-beer, wine etc. Food spoilage and Preservation processes. Microbes as source of food - single cell protein, Application of Microbes in industries production of antibiotics (penicillin, streptomycin), amino acids (Glutamic Acid) organic Acids (citric acid and Lactic acid)

Unit-5 Medical microbiology

14

Medical microbiology – pathogenesis, lab diagnosis, biological specimen diagnosis, prevention and control of important microbial diseases, Pathogenic bacteria diseases (E.coli, Leprosy, Tuberculosis, Salmonella typhi, Staphylococcus aureus, Vibrato cholera), Fungal diseases- Mycotoxicoses (Candida sp, Aspergillus, Cryptococcus), Viral Diseases (HIV,Rabies,Hepatitis and Polio Virus) and Protozoan diseases (Plasmodium, Trypanosoma)

Reference Books

1. **Microbiology** -Principles and Explorations, Jecquelyn G.Black, Wiley publications-2008.
2. **Microbiology** – Pelczar, Chan, Klieg Tate McGraw Hill Publications-1993.
3. **Microbiology** – concepts and application by Paul A. Ketchum, Wiley publications-1988.
4. Prescott, Harley and Klein, ‘Microbiology’, McGraw Hill publications, Fifth edition 2003.ents of Microbiology – Furbisher, Saunders & Toppan publications.
5. **Microbiology** – Ronald M. Atlas, 1997, William C Brown Publishers.
6. **Introductory Biotechnology** – R.B. Singh C.B.D India(1990)
7. **Industrial Microbiology** – casual. Dewily Eastern Ltd-2002.
8. **Fundamentals of Biotechnology** – Sally-2011, CRC Press.
9. **Biotechnology: International Trends of perspectives** A.T.Bull, G.Holl M.D.Lilly Oxford & TBH Publishers-1987.
10. **General Microbiology** – C.B.Powar, H.F.Daginawala, Himalayan Publishing House-1965.
11. **Microbial physiology** – Albert G. Moat and John W. Foster- Wiley-interscience publication-2003.
12. **Food microbiology**-W.C. Frazier and D.C. Westhoft, tata Mcgra Hill publication-1995.
13. **Microbial Biotechnology** – Alexander N. Glazer, Hiroshni – Kaido, W.H. Freeman and Co. 1995.

Microbiology Practicals

Course code	Category	Course Name	L	C	P	TH
BBT12305	Major	Microbiology Practicals		2	4	

Sterilization techniques – demonstration of microbial culture — hanging drop – simple staining - -differential staining –capsular staining – spore staining – inoculation techniques – pour plate – spread plate –dilution techniques – biochemical tests for bacterial identification – catalase test –oxidase test – IMVIC test – TSI testy – Gelatin liquefaction – starch degradation –carbohydrate fermentation – viable bacteria – haemocytometer – morphological identification of fungi.

BIOSTATISTICS

Course code	Category	Course Name	L	C	P	TH
BBT12306	Allied	Biostatistics	5	4		76

OBJECTIVE

This part of the curriculum helps the students to understand the statistical approach of biology and its applications in the biological field.

UNIT I

14

Statistics – definition, functions and its limitations Collection, classification, tabulation of data, diagrammatic and graphical representation of data

UNIT II

15

Measures of central tendency - mean, median, mode, geometric mean, harmonic mean - Merits and demerits

UNIT III

16

Measures of dispersion – range, quartile deviation, decile, percentile mean deviation, standard deviation, variance, coefficient of variation, skewness – kurtosis

UNIT IV

15

Correlation - Types, scatter diagram - Karl Pearson's method, Spearman's Rank method, concurrent deviation method, Regression equations and their properties (simple problems)

UNIT V

16

Probability, Definitions of various terms used in probability, Addition and multiplication rule, Conditional probability, Independence of events, Baye's theorem (simple problems)

Test of significance for small samples - Students't' test - to test the significance of sample mean, difference between two sample mean, Analysis of variance –meaning and assumptions - one way and two way classification

TEXT BOOKS:

1. Fundamentals of biostatistics, Khan and Khanum, Ukaaz Publications (2004)
2. Statistical methods, S.P.Gupta, S.Chand & Sons, 1997

REFERENCE BOOKS

- 1.S.C.Gupta & V.K.Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi, 2003
2. An introduction to biostatistics, N.Gurumani, MJP Publishers-2004
3. Fundamentals of biostatistics , Bernard Rosner-2011
- 4.Stanton A & Clantz, Primer of Biostatistics — The McGraw Hill Inc., New York-2001.
- 5.Arora PN & Malhon PK, (1996) Biostatistics. Imalaya Publishing House, Mumbai.
- 6.Zar, J.H. (1996). Biostatistical analysis. Prentice Hall, Upper saddle River, New Jersey, USA

BIOPHYSICS

Course code	Category	Course Name	L	C	P	TH
BBT12401	Major	Biophysics	5	4		74

OBJECTIVE

The course helps the students to understand the macromolecules with the knowledge of physics and helps in understanding the structural conformations

UNIT I - Macromolecular structure – protein 15

Peptide bond - Structural organization of protein - primary, secondary, tertiary and quaternary levels, super secondary structures, domains.
Torsion angles, Ramachandran plot

UNIT II – Macromolecular structure - Nucleic Acids 14

Nucleosides and nucleotides - Watson and Crick model of DNA - Polymorphism of DNA - Unusual structure of DNA- Structure of tRNA.

UNIT III - Applications of physical methods in biology 16

Diffusion - Sedimentation - Electrophoresis - SDS, PAGE, Agarose .Separation techniques - HPLC-Mass spectrometry, Southern blotting, Northern blotting, Western blotting, Dot blotting and hybridization

UNIT IV - Biomolecular structure determination 15

Crystal - unit cell - seven crystal systems - Bravais Lattices - X-ray diffraction - Bragg's law - Principle, instrumentation and applications of NMR - ESR - Atomic force microscopy, Transmission electron microscope, Scanning electron microscope

UNIT V - Conformational Analysis 14

Van der waals radii of atoms (equilibrium separation between non covalently bonded atoms) - contact distance criteria - Noncovalent forces determining biopolymer structure – dispersion forces - electrostatic interactions - van der waals interactions - hydrogen bonds - hydrophobic interactions - distortional energies - potential functions

TEXT BOOKS

1. Biophysics by Vasantha Pattabhi and N. Gautham, Narosa Publishing House, New Delhi, 2002.
2. Essentials of Biophysics by P. Narayanan, New Age International (P) Ltd. Publishers, New Delhi 2000.
3. Biochemistry , D.Voet & J.G.Voet, John Wiley & Sons, New York (1995).
4. Introduction to Protein Structure by C. Branden and J. Tooze, Garland Publishing, 1991.
5. Statistical methods ,S.P.Gupta,S.Chand & Sons,1997
- 6.Fundamentals of biostatistics, Khan and Khanum, Ukaaz Publications(2004)

REFERENCE BOOKS

1. Cantor C.R. and Schimmel P.R. (1980), Biophysical chemistry, W.A.Fremman and Co.
2. Lehninger A. (1981), Biochemistry, Butter Worth Publication
3. Radiation Biophysics, E. L. Alpen, Prentice-Hall, New Jersey, USA, (1990).
- 4.X-ray Structure Determination, G.H. Stout and L.H. Jensen, John Wiley and Sons Inc., New York (1989).
- 5.Biophysical Chemistry, C.R. Cantor & P.R. Schimmel, W.H. Freeman & Co.1980,
6. Principles of Protein Structure by G. Schulz and R.H. Schirmer, Springer - Verlag, 1984.
- 7.Proteins Structure and Molecular Properties Thomas E. Creighton, W.H. freeman and Company, New York, 1993.
8. Principles of Nucleic acid Structure, W. Saenger, Springer verlag, 1984.
9. An introduction to biostatistics, N.Gurumani, MJP Publishers-2009.
10. Fundamentals of biostatistics , Bernard Rosner,2006-Cengage Learning.

BIOINFORMATICS

Course code	Category	Course Name	L	C	P	TH
BBT12402	Major	Bioinformatics	5	4		66

Objective:

The course provides the details of dry lab conditions and analysis of macromolecules and genetic material and help the students to have a brief knowledge about analysis of sequences of the same.

UNIT- I

12

Introduction to bioinformatics, Biological data formats. Application of bioinformatics in various fields.

Unit II

14

Biological databases – Nucleotide databases – Genbank, EMBL, DDBJ; Protein Sequence Databases – Swiss Prot, Trembl, PIR, UNIPROT, Various Data retrieval formats in biological databases – ENTREZ, SRS

UNIT- III

14

Sequence Analysis: sequence similarity, identity and homology - Definitions of homologues, orthologues and paralogues
Pairwise Sequence Alignment: Dot matrix, Dynamic programming alignment, BLAST and FASTA. Scoring matrices: PAM and BLOSUM.

UNIT – IV

14

Multiple Sequence Alignments (MSA): various approaches for MSA - Progressive, Hierarchical and Iterative – Clustal W, clustal X , TCOFFEE and their application for sequence analysis

UNIT – V

12

Evolutionary analysis: distances - clustering methods - rooted and un-rooted tree representation - Bootstrapping strategies – phylogenetic trees – PHYLIP, PAUP

Reference Books

1. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by Andreas D. Baxevanis and B. F. Francis Ouellette -2002
2. Bioinformatics: Sequence and Genome Analysis, Second Edition by David W. Mount-2004
3. Introduction to Bioinformatics by Teresa Attwood and David Parry-Smith-2001
4. Essential Bioinformatics by Jin Xiong -2006
5. Introduction to Bioinformatics by Arthur M. Lesk-2008

Bioinformatics Practicals

Course code	Category	Course Name	L	C	P	TH
BBT12403	Major	Bioinformatics Practicals		2	4	

1. Study of Internet resources in Bioinformatics.
2. Searches on MEDLINE, PubMed and CDROM bibliographic databases.
3. Introduction to sequence databases
 - Protein sequence databank – UNIPROT
 - Nucleic acid sequence databank – Gene bank, EMBL, DDBJ
4. Sequence alignment
 - BLAST, FASTA
 - Pair wise alignment- Needleman-Wunsch and Smith-Waterman algorithms
 - Multiple alignment- CLUSTALW, CLUSTAL X, T-COFFEE
5. Evaluation of protein structure by Swiss PDB viewer and visualization tools – RASMOL
6. Homology modeling of a given protein sequence

ENZYMOLGY

Course code	Category	Course Name	L	C	P	TH
BBT12404	Major	Enzymology	5	4		66

Objective:

The course helps the student to learn in detail about the enzymes which are the main components in any metabolic activity and helps in determining the various kinetics and dynamic studies.

UNIT-I: Enzymes

12

Classification - IUB system, rationale, overview and specific examples. Characteristics of enzymes, enzyme substrate complex. Concept of active centre, binding sites, stereo specificity and ES complex formation. Effect of temperature, pH and substrate concentration on reaction rate. Activation energy. Transition state theory. Enzyme activity, international units, specific activity, turnover number.

Unit II Enzyme catalysis

12

Enzyme catalysis-Factors affecting catalytic efficiency - proximity and orientation effects, distortion or strain, acid - base and nucleophilic catalysis. Isoenzymes and multiple forms of enzymes. Mechanism of action chymotrypsin, ribonuclease.

Unit III Enzyme Kinetics

14

Michaelis - Menten Equation - form and derivation, steady state enzyme kinetics. Significance of V_{max} and K_m . Bisubstrate reactions. Graphical procedures in enzymology - advantages and disadvantages of alternate plotting. Enzyme inhibition - types of inhibitors - competitive, noncompetitive and uncompetitive, their mode of action and experimental determination.

Unit IV Allosteric interactions:

14

Protein ligand binding including measurements, analysis of binding isotherms, cooperativity and kinetics of allosteric enzymes. Enzyme regulation: Product inhibition, feedback control, enzyme induction and repression and covalent modification. Allosteric regulation.

Unit V Immobilized enzymes:

14

Relative practical and economic advantage for industrial use, effect of partition on kinetics and performance with particular emphasis on charge and hydrophobicity (pH, temperature and K_m). Various methods of immobilization - ionic bonding, adsorption, covalent bonding (based on R groups of amino acids), microencapsulation and gel entrapment.

RECOMMENDED BOOKS:

1. Enzyme Kinetics (1995) – Palmer, London: Portland Press
2. Enzyme Kinetics - Dixon , 1972, wiley publishers
3. Fundamental of Enzymology – Price & Steven , 1999-Bowker company
4. The Enzymes Vol. 1 & 2 – Boyer, 1983
5. Enzyme Structure & Mechanism – Alan Fersht, 1985, W.H. Freeman
6. Enzyme Biotechnology – Tripathi, G, 2009- ABD Publishers.
7. Industrial Enzyme & their Application (1998) –Uhlig, H.
8. Enzyme 3rd Ed. (1979) – Dixon M. & Webb, E.C.

BIOPROCESS TECHNOLOGY

Course code	Category	Course Name	L	C	P	TH
BBT12405	Allied	Bioprocess technology	5	4		70

Objective:

The course curriculum helps in the understanding of the bioreactors and the kinetics and dynamics behind the bioprocess technology and helps the students to understand about the industrial processes.

Unit I: Bioreactor and Types

12

Introduction to Bioprocess Technology: History and Scope- Bioreactor: Design, parts and accessories, functions- Modes of Operation of fermenter- Batch, fed batch, Continuous, Semi continuous, Perfusion- Types of reactors CSTR, Tower, Jet loop, Airlift, Bubble column, Packed bed- Applications of Bioprocess Technology

Unit II: Microbial Kinetics and Bioreactor Instrumentation 12

Microbial growth kinetics: Batch and continuous reactors- Immobilized cell systems- Bioreactor instrumentation, control and monitoring variables such as Temperature, agitation, pressure, pH - On line measurement. On/off control. PID control. Computers in bioprocess control systems. Transport phenomena in bioprocess – Mass transfer and Mass transfer coefficient for gases and liquids.

Unit III: Strain Improvement and Media Formulation 14

Isolation and screening of microbes: primary and secondary metabolites, new metabolites- Preservation of microbes- Strain improvement: General, mutation and recombination- Media formulation and sterilization of gases and nutrient solutions- Inocula preparation – Immobilized cells- Enzyme co-immobilization

Unit IV: Downstream Processing 16

Downstream processing- Cell disruption: Mechanical and non-mechanical methods - Recovery and purification of products: Separation of insoluble products-filtration – Micro to Nano filtration, centrifugation, flocculation and coagulation-Separation of soluble products- liquid-liquid extraction, precipitation, adsorption, dialysis, reverse osmosis, chromatography- purification-crystallization and drying

Unit V: Industrial Biotechnology 16

Industrial Bioprocesses: Anaerobic processes-ethanol, lactic acid production- Aerobic processes-Citric acid, yeast, penicillin- Organic acid (acetic acid)- antibiotics(Streptomycin)- malt beverages-enzymes (Amylase and protease), vitamins, biopolymers, biofertilizers, biopesticides, recombinant products-insulin and hepatitis B – Waste water management

REFERENCES:

1. Instrumentation, measurement and analysis, II edition (2004), Nakra BC and Chaudhry KK, Tata McGrawHill Publishing Co. Ltd., New Delhi.
2. Fermentation Microbiology and Biotechnology (2002), Mansi El-Mansi and Charlie Bryce, Taylor and Francis Ltd., London (Replika Press Pvt. Ltd., Kundli – 131 028)
3. Manual of Industrial Microbiology and Biotechnology, III edition (1999), Arnold L. Demain and Julian Davies, ASM press, Washington DC
4. Principles of Fermentation technology, Stanbury PF and Whitaker A. Pergamon Press, Oxford 5. Biochemical Engineering, Aiba, S., Humphrey, A.E. and Millis, N.F. Univ. Of Tokyo Press, Tokyo.
5. Bioprocess Technology: Fundamentals and Applications, KTH, Stockholm 2004 McGraw-Hill Book.
6. Process Engineering in Biotechnology, Jackson, A.T., Prentice Hall, Engelwood Cliffs. 1991
7. Bioprocess Engineering: Basic Concepts, Shuler, M.L. and Kargi, F., Prentice Hall, Engelwood Cliffs, 1991.
8. Bioreaction Engineering Principles, Neilson, J. and Villadsen, J., Plenum Press, 1994.
9. Industrial microbiology – Casida (1997)
10. Industrial microbiology – A.H. Patel, 2000, Macmillan Publishers India

Bioprocess Technology and Enzymology Practical

Course code	Category	Course Name	L	C	P	TH
BBT12406	Allied	Bioprocess Technology And Enzymology Practicals		2	4	

1. Growth kinetics
2. Effect of pH and temperature on enzyme kinetics
3. Media formulation for a industrial important microbe
4. Optimization of culture conditions for amylase production
5. Downstream process – purification of any one protein / enzyme from fermented broth using chromatography
6. Cell/Enzyme immobilization
7. Production of cheese/yoghurt
8. Bread making
9. Production of wine
10. Production of citric acid
11. Mushroom cultivation
12. Colourant production – *Serratia*
13. Flavorant production
14. Identification of food pathogens
15. Qualitative analysis of any one industrial effluent
16. Adsorption kinetic studies in any one metal removal process
17. Vermicomposting
18. Demonstration of any one pesticide degradation process

rDNA TECHNOLOGY

Course code	Category	Course Name	L	C	P	TH
BBT124501	Major	rDNA Technology	5	4		70

Objective:

The course helps the students to understand about the recombinants from the basics to advanced techniques, giving in detail about each factor during construction of recombinants.

UNIT I: Introduction to rDNA technology **12**

rDNA technology- tools of rDNA technology - Discovery of RE - its nomenclature and classification - role of endonucleases- DNA modifying enzymes- methylases, ligases, alkaline Phosphatase, terminal transferase, reverse transcriptase, Klenow polymerase, topoisomerase. Linkers, adaptors, Homopolymer tailing.

UNIT II: Vector Biology **16**

Ideal cloning vehicle - alteration, promoters, control circuits, upstream and downstream element - markers and reporters. Bacterial Plasmids - features and biology- construction of plasmid vectors and its maintenance & uses- Bacteriophage vectors- λ vectors, M13 vector- Cosmids- Yeast Vectors- Specialized vectors - expression vectors, gene fusion & shuttle vectors, BAC, YAC-Ti plasmid, Ri plasmid, SV40, CaMV.

Unit III: Gene transfer mechanism **12**

Gene transfer mechanism - physical, chemical and biological methods. Gene Recombination and Gene transfer: Bacterial Conjugation, Transformation, Transduction, Microinjection, Electroporation, Microprojectile, Shot Gun method, Ultrasonication, Liposome fusion, Microlaser

UNIT IV: Cloning Strategies **14**

Screening and selection of recombinants- blue-white, antibiotic and immunochemical methods. Hybridization techniques – southern, northern, western, PCR- primer designing- amplification of DNA – types of PCR – RT, real-time, LA, Nested, inverse & its applications.

UNIT V: Techniques of rDNA technology **16**

Limitation and advantages and novel technologies generation of transgenic plants and animals - Gene silencing and siRNA techniques- micro RNA, construction of

siRNA vectors, applications of gene silencing - Gene knockouts-DNA finger printing – Molecular markers

REFERENCES:

1. Principles of gene manipulation – Old and Primrose, 1981
2. Molecular biotechnology – Glick-2010, ASM Press
3. Recombinant DNA technology – James D. Watson, 1992, Scientific American Books
4. From genes to clones – Winnacker, VCH, 1987
5. Genomes – T.A. Brown, Wiley-Liss, 2002
6. Gene cloning - T.A. Brown, Chapman and Hall, 1995
7. Molecular cloning - a laboratory manual – Manniatus, Cold Spring Harbor Laboratory, 1989
8. Biotechnology fundamentals and applications – Purohit, 2009, Student Edition
9. Biotechnology – U. Sathyanarayana, 2009, Books and allied (p) Ltd
10. Textbook of Biotechnology – R.C. Dubey-2001, S.Chand & Company

rDNA Technology Practicals

Course code	Category	Course Name	L	C	P	TH
BBT12502	Major	rDNA Technology Practicals		2	4	

1. Agarose gel electrophoresis
2. Isolation of bacterial genomic DNA
3. Isolation of Plasmid DNA by Alkali-lysis method
4. Determination of T_m of DNA
5. Determination of purity of DNA
6. Restriction digestion of λDNA
7. Ligation by T4 DNA ligase
8. SDS-PAGE
9. Preparation of competent cells
10. Transformation – Calcium chloride method
11. Blue-white and antibiotic selection and screening
12. Southern blotting

Demonstration:

13. RFLP
14. PCR
15. RAPD

BASICS OF IMMUNOLOGY

Course code	Category	Course Name	L	C	P	TH
BBT12503	Major	Basics of Immunology	5	4		70

Objective:

This helps the student to understand about the immune system of the body and its response to variety of external factors and changes happening in the host during infection.

Unit – 1 Basics of Immune System 12

Historical perspectives and overview of immune system – introduction to immune system –Immune responses -innate immune response, adaptive immune response, overlap of innate and adaptive immunity - Cells of immune system – lymphoid organs – structure, functions - Antigens – types, structure and properties –Antigenecity and immunogenicity

Unit – 2 Components of Immune System 16

Antibodies- structure – types – function of immunoglobulins - Antigen presenting cells – Major histo-compatability complex – Class 1 & 2.- Cytokine and cytokine receptors - Complement – structure -properties – functions of complement components and pathways.

Unit – 3 Antigen-Antibody Interactions 12

Antigen-antibody reactions – types – Invitro methods – agglutination – precipitation – ELISA – RIA – IF – HA & HI –CFT – blood grouping and Rh typing – Invivo methods – Skin tests- immune complex tissue demonstrations.

Unit – 4 Response of Immune system 16

Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of recognition, inactivation of host-immune effector mechanisms - Hypersensitivity – IgE mediated – antibody mediated – immune complex mediated and delayed type hypersensitivity - Tumor immunology – tumor associated antigens. Immune response to tumor - Transplantation immunology – Graft rejection

Unit – 5 Advancements of Immunology 14

Hybridoma technology – monoclonal antibodies production – significance and applications - Vaccines –Immunization types – Vaccine types – live attenuated vaccines, killed vaccines, purified polysaccharide vaccines – toxoid vaccines – recombinant vaccines and DNA vaccines - Production and isolation of various bacterial and viral antigen – purification of antigen – Adjuvants and haptens – Toxins – toxoids – antitoxins- production and purification of antitoxins and toxoids.

References :

1. J. Kuby, 2003, Immunology 5th edition, W.H. Freeman and Company, Newyork..
2. C.V.Rao. 2002, An Introduction to Immunology, Narosa Publishing House, Chennai.
3. K.M.Pavri. 1996, Challenge of AIDS, National Book Trust, India.
4. I.R.Tizard, 1995, Immunology: An Introduction, 4th edition, Saunders College Publishers, New York.
5. I.Roitt, 1994, Essential Immunology, Blackwell Science, Singapore. 6. A. Bul and K.Abbas, 1994, Cellular and Molecular immunology, W.D. Saunders and Co, Philadelphia

Basics of Immunology Practicals

Course code	Category	Course Name	L	C	P	TH
BBT12504	Major	Basics Of Immunology Practicals		2	4	

1. Blood smear preparation.
2. RBC and WBC enumeration.
3. Total count and differential count.
4. Blood grouping and Rh typing.
5. Separation of Lymphocytes from blood.
6. Ochterlony double immunodiffusion
7. Agarose gel immunodiffusion and counter Immunodiffusion.
8. Immunoelectrophoresis and serum electrophoresis.
9. Single radial immunodiffusion.
10. CRP test.
11. RPR test
12. Widal test
13. ELISA – dot ELISA, sandwich ELISA.
14. Demonstration of detection of Hbs Ag by ELISA.
15. Selection of animals, Preparation of antigens, Immunization and methods of bleeding, Serum separation, Storage (Demo)
16. Methods of injection and bleeding (Demo)

MEDICAL BIOTECHNOLOGY

Course code	Category	Course Name	L	C	P	TH
BBT12505	Major	Medical Biotechnology	5	4		72

Objective:

The course provides the students about the medicinal approach of Biotechnology and helps in understanding the various techniques and advancements of biotechnology in medicinal field.

Unit I: ART and ACC

12

Manipulation of assisted reproductive technology- artificial insemination and storage-isolation and *in vitro* maturation of Oocytes- IVF- Embryo transfer technique- Pregnancy diagnosis - Animal cell culture-media, maintenance and culture of primary, secondary and continuous cell lines- organ culture- applications- cancer cell lines- apoptosis

Unit II: Chromosomal Disorders

16

Chromosomal disorders – Gene controlled diseases –Identification of disease genes-Functional cloning(Haemophilia) – Positional cloning(DMD) – Candidate gene approach(Alzheimer's) – Molecular basis of human diseases :Pathogenic mutations (Gain of function mutations: Oncogenes-Loss of function - Tumour Suppressor Genes-Immunopathology: Hepatitis, Autoimmune Disorders)

Unit III: Diagnostics Methods

16

Prenatal diagnosis - Invasive techniques and Non-invasive techniques – Diagnosis of pathogenic microbes: Classical and modern methods- Diagnosis using protein and enzyme markers, monoclonal antibodies.DNA/RNA based diagnosis- Molecular markers- Microarray technology- genomic and cDNA arrays

Unit IV: Prevention and Treatment

14

Vaccines-conventional, recombinant, synthetic peptide, anti-idiotypic, DNA vaccines- Deletion mutant and vaccinia vector vaccine- Prophylaxis - Antibiotics-mode of action- antibacterial, antifungal, antiviral, antitumor antibiotics- synthetic chemotherapeutic agents- development of microbial resistance to antibiotics

Unit V: Advanced Medical Biotechnology

14

Hybridoma technique for Monoclonal Ab production and applications- Gene therapy:Ex vivo, In vivo, In situ- Cell and tissue engineering- Stem cell therapy- Nanomedicines- Gene products in medicine – Humulin, Erythropoietin, Growth Hormone/Somatostatin, tPA, Interferon

Reference Books

1. Jogdand, S. N. 2000. Medical Biotechnology, Himalaya Publishing house, Mumbai.
2. Click, B. R. and Pasternak. 2002. Molecular Biotechnology: Principle and applications of recombinant DNA. ASM Press.
3. Ramasamy, P.2002. Trends in Biotechnology, University of Madras, Pearl press.
4. Trevan. 2001. Biotechnology. Tata McGraw-Hill.
5. Jenkins, N (Ed) 1999. Animal cell biotechnology: Methods and Protocols. Humana press, New Jersey.

GENOMICS AND PROTEOMICS

Course code	Category	Course Name	L	C	P	TH
BBT12506	Major	Genomics And Proteomics	5	4		68

Objective:

The course helps the students to understand the molecular biology in terms of detailed genes and protein level approach.

Unit – I

12

Genomic and c DNA sequence: gene prediction rules – gene prediction softwares – human and Arabidopsis genome projects – mutations

Unit – II

12

Gene therapy - applications of genome – transgenic animals and plants – Pathway regulatory networks

Unit – III

16

Introduction, Serial Analysis of Gene Expression, Microarray, Types of Microarrays, Microarray Fabrication, Microarray hybridization and detection, Microarray Image Processing and analysis, Expression ratios, Transformations of the Expression ratio, Data Normalization

Unit – IV

14

Proteomics – protein separation - 2DE, protein identification – mass spectrometry. Protein chips. Applications of proteomics – Medical proteomics in disease diagnosis, pharmaceutical proteomics in drug development.

Unit – V

14

Discovering a drug - target identification and validation - identifying the lead compound - optimization of lead compound - chemical libraries.

Reference Books

1. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by Andreas D. Baxevanis and B. F. Francis Ouellette, 2004-Wiley Interscience
2. Discovering Genomics, Proteomics and Bioinformatics (2nd Edition) by A. Malcolm Campbell and Laurie J. Heyer , 2009, Pearson Education.
3. Principles of Proteomics by R.M.Twyman, Taylor & Francis group , 2004 BIOS Scientific Publishers.
4. Introduction to Bioinformatics by Arthur M. Lesk ,2008, Oxford University
5. Essential Bioinformatics by Jin Xiong, Cambridge, 2011

PLANT AND ANIMAL BIOTECHNOLOGY

Course code	Category	Course Name	L	C	P	TH
BBT12601	Major	Plant and animal Biotechnology	5	4		72

Objective:

The course helps the students to know about the plant tissue culture and animal cell culture techniques and applications from basics to advanced level.

PLANT BIOTECHNOLOGY

Unit – 1 Genome organization 12

Plant genomic organization – nuclear, organelle genomes – mitochondria and chloroplast – inheritance pattern. Arabidopsis thaliana – a model plant for genome analysis – Genomic studies in rice and maize.

Unit – 2 Plant tissue culture 14

Plant tissue culture – basic of plant tissue culture, plant hormones – their role in development of plant – micropropagation - callus induction, organogenesis, embryogenesis, somatic embryogenesis, somaclonal variation, artificial seeds and embryo rescue, plant cell suspension culture - secondary metabolites production and uses.

Unit – 3 Plant genetic engineering 16

Plant genetic engineering – gene transfer methods – plant cloning vectors, Agrobacterium technology, Nitrogen fixation – Molecular biology, Applications of plant biotechnology- Techniques in crop improvement, molecular breeding, commercialization of plant biotechnology, plant pharmaceuticals, Plant cell bioreactors – Bt cotton, Bt corn, Golden rice, Genetic Use Restriction Technology – terminator seeds.

ANIMAL BIOTECHNOLOGY

Unit – 4 Cell culture techniques 16

Animal cell culture – basis, materials and methods - animal cell lines, biology of cultured cells – types of culture - Organ culture – Stem cells - basics of stem cells – ASC, ESC – applications – transplantation. Pharmaceuticals from animal systems – humanized pharmaceuticals. Animal cell bioreactors, Animal systems as bioreactors.

Unit – 5 Animal genetic engineering 14

Animal genomes – Animal breeding and molecular farming. Animal transgenesis - methods and applications. Assisted reproduction techniques – Artificial insemination, in vitro fertilization and embryo implantation, germplasm preservation, methods of cryopreservation. Animal cloning – case studies, Applications of animal biotechnology in medicine - Prenatal diagnosis and gene therapy.

Reference Books

1. Plant Molecular Biology – Grierson and S N Covey, Blackie, 1988.
2. Plant Biotechnology – S Ignacimuthu, S J Oxford and IBH, New Delhi, 1996.
3. Applied Biotechnology and Plant Genetics – M Sudhir, Domain publishers & distributors, 2000
4. Plant Biotechnology: Recent Advances – P C Trivedi, Panima publishing corporation, 2000
5. Inducible gene expression in plants - Reynolds, P H S (Ed), Cabi publishing, UK, 1999.
6. Applied Plant Biotechnology – Ignacimuthu, Tata McGraw – Hill, 1996
7. Recombinant DNA and Biotechnology: A guide for teachers, 2nd edition – H Kreuzer & A Massey, ASM Press, Washington, 2001.
8. Molecular biology and Biotechnology, 3rd edition– J M Walker & E B Gingold, Panima publishing corporation, 1999.
9. Animal cell Biotechnology: Methods and protocols – Nigel Jenkins (Ed), Humana press, New Jersey, 1999.
10. Recombinant DNA (2nd edition) – J S Watson, M Gillman, J Witkowski and M Zoller, Scientific American Books, NY , 1992.

Plant and Animal Biotechnology Practicals

Course code	Category	Course Name	L	C	P	TH
BBT12602	Major	Plant and Animal biotechnology Practicals		2	4	

1. Sterilization techniques – glasswares, media and laminar air flow chamber
2. Preparation of plant tissue culture media – MS, B5
3. Callus induction
4. Organogenesis – caulogenesis and rhizogenesis
5. Hardening and green house transfer
6. Isolation of plant genomic DNA .
7. Isolation of mt and cp/ct DNA
8. Isolation of RNA from plant leaf tissue.
9. Isolation of plant protoplasts by mechanical and enzymatic method
10. Protoplast fusion by fusogen - polyethylene glycol
11. Agrobacterium mediated tumor induction
12. Preparation of animal cell culture medium.
13. Preparation of single cell suspensions from animal tissue
14. Preparation of Animal cell monolayer
15. Subculturing of cell lines
16. Cell counting – Quantitation of cells in culture
- 17.** Cell viability assay
- 18.** Chick embryo fibroblast culture.

NANOBIOTECHNOLOGY

Course code	Category	Course Name	L	C	P	TH
BBT12603	Major	Nanobiotechnology	5	4		66

Objective:

This helps the students to understand the various nanomaterials, their construction and biological approach of the same in medical field.

UNIT I: Introduction 14

Nanotechnology – definition and scope, nanobiotechnology- recent development and applications, Biocompatibility and cytotoxicity studies of Nanomaterials, carbon nanotubes, Bioconjugation mediated drug delivery. General medicine is changing into personalized nanomedicine.

UNIT II: Biopolymer 14

Biopolymer- polymer nanofibers - electrospinning method and their biomedical applications, polymer nanocomposite- bone and dental restorations, polymer controlled drug delivery for the treatment of cancer and other diseases. Biodegradable polymer derived from amino acid.

UNIT III: Liposphere in drug target and delivery 14

Liposome - liposomes in sensor technology, polymeric Micelles – Production of Lipospheres for Bioactive compound delivery – Melt dispersion technique, Solvent evaporation technique and InVitro drug release - Polymeric biodegradable liposphere for vaccine delivery.

UNIT IV: Nucleic acid based nanomaterials: 12

Nucleic acid engineered nanomaterials and their applications. Protein patterning for applications in biomaterials. DNA lipoplexes – Lipofection efficiency In Vitro and In Vivo, Polymer controlled delivery of therapeutic nucleic acid.

UNIT V: Biocompatible nanomaterials: 12

PLA and PLGA Based nanoparticulate delivery system. Metal Microbes interaction, Biological metal nanoparticle synthesis and biomedical application – Dendrimers, quantum dots, Biodegradable optical nanoparticles for tumor diagnosis and treatment.

Reference Books:

1. Challa S.S.R. Kumar (Ed). 2006. Biological and pharmaceutical nonmaterial's. Wiley-VCH Verlag GmbH & Co., KgaA.
2. K.K. Jain 2006 Nanobiotechnology in Molecular Diagnostics: Current Techniques and Application Horizon Biosciences.
3. Niemeyer, C.M. Mirking C.A., (Eds.) 2004 . Nano biotechnology concepts.
4. Applications and Perspectives, 2004 Wiley- VCH, Weinheim
5. Claudio Nastruzzi – 2005 (Ed) Liposphere in drug targets and delivery, CRC press.

ENVIRONMENTAL BIOTECHNOLOGY

Course code	Category	Course Name	L	C	P	TH
BBT12604	Major	Environmental Biotechnology	5	4		66

Objective:

The course deals with the study of ecosystem, bioremediation and metal mining. This ensures the students in better understanding of environmental crisis and its remediation.

Unit -1 Ecosystem

14

Limiting factors, energy transfer and biogeochemical cycling in ecological systems; Response of microbes, plant and animals to environmental stresses; Concept of ecosystems and ecosystem management, Environmental problems- ozone depletion, green house effect, water, air and soil pollution, land degradation.

Unit 2 Bioremediation – I

14

Introduction, constraints and priorities of Bioremediation, Biostimulation of Naturally occurring microbial activities, Bioaugmentation, in situ, ex situ, intrinsic & engineered bioremediation.

Unit3 Bioremediation – II

14

Solid phase bioremediation - land farming, prepared beds, soil piles, Phytoremediation. Composting, Bioventing & Biosparging; Liquid phase bioremediation - suspended bioreactors, fixed biofilm reactors. Biological method of sewage treatment, WHO standards.

Unit 4 Metal biotechnology

12

Mining–heavy metals, Microbial transformation, accumulation and concentration of metals, metal leaching, extraction and future prospects.

Unit 5 Biofuels

12

Microorganisms and energy requirements of mankind; Production of nonconventional fuels - Methane (Biogas), Hydrogen, Alcohols and algal hydrocarbons, Use of microorganisms in augmentation of petroleum recovery.

TEXT BOOKS:

1. Environmental Biotechnology by S. K. Agarwal, APH Publishing Corporation, 2001
2. Biodegradation & Bioremediation (1999), Martin Alexander, Academic press.

REFERENCES:

1. Stanier R. Y., Ingram J.L., Wheelis M.L., Painter R.R., General Microbiology, McMillan Publications, 1989.
2. Foster C.F., John Ware D.A., Environmental Biotechnology, Ellis Horwood Ltd., 1987.
3. Karrely D., Chakrabarty K., Omen G.S., Biotechnology and Biodegradation, Advances in Applied Biotechnology Series, Vol.4, Gulf Publications Co. London, 1989.
- 4 Bioremediation engineering; design and application 1995 John. T. cookson, Jr. Mc Graw Hill, Inc.
- 5 Environmental Biotechnology by A.K. Chatterjee, 2004 Prentice-Hall Of India Pvt. Limited
- 6 Environmental Biotechnology by 1995, S.N.Jogdand Himalaya Publishing

BIOETHICS, BIOSAFETY AND IPR

Course code	Category	Course Name	L	C	P	TH
BBT12605	Major	Bioethics, Biosafety And IPR	5	4		72

OBJECTIVE

This part of the syllabus helps the students to understand the ethical, social, legal aspects in biology and biocontainment

UNIT I – BIOETHICS **14**

Bioethics - legal and socioeconomic impacts of biotechnology- ethical concerns of biotechnology research and innovation, Bioethics committees

UNIT II - INTELLECTUAL PROPERTY RIGHTS **14**

Intellectual property rights-patent, copyright, trade mark, TRIP- GATT and PBR, WTO

UNIT III - PATENTS AND PATENT LAWS **15**

Patent system – patenting laws-Legal development-Patentable subjects and protection in biotechnology-The patenting living organisms.

UNIT IV – BIOSAFETY **14**

GLP - Containment facilities – Biosafety levels - Genetically modified organisms and its release - Genetically modified foods, Biosafety guidelines in India - International guidelines

UNIT V – BIODIVERSITY **15**

Basic concepts of Biodiversity - Elements of Biodiversity - Ecosystem Diversity, Genetic Diversity, Species Abundance & Diversity

TEXT BOOKS:

1. Sasson A, *Biotechnologies and Development*, UNESCO Publications, 1988.
2. Sasson A. *Biotechnologies in developing countries present and future*, UNESCO publishers, 1993.

REFERENCE:

1. Singh K, *Intellectual Property rights on Biotechnology*, BCIL, New Delhi, 2010
2. Shaleesha A. Stanley, *Bioethics*, Wisdom educational service, 2008, Wisdom Educational Service
3. Beier, F.K., Crespi, R.S. and Straus, T. *Biotechnology and Patent protection*-Oxford and IBH Publishing Co. New Delhi, 1985
4. *Biotechnology* by U.Sathyanarayana, 2009 , Books and allied (p) Ltd
5. *Biotechnology* by B.D.Singh, kalyani publishers, 2009