

MRSPTU B.Sc. BIOTECHNOLOGY SYLLABUS 2016 BATCH ONWARDS

Total Contact Hours = 27

Total Marks = 800

Total Credits = 25

SEMESTER 1 st		Contact Hrs.			Marks			Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.	Total	
BBOT1-101	Cell Biology	4	0	0	40	60	100	4
BBOT1-102	Genetics	4	0	0	40	60	100	4
BBOT1-103	Organic Chemistry	4	0	0	40	60	100	4
BBOT1-104	Basics of Biosciences	4	0	0	40	60	100	4
BCAP0-195	Computer Applications	4	0	0	40	60	100	4
BBOT1-105	Organic Chemistry Lab.	0	0	2	60	40	100	1
BCAP0-196	Computer Applications Lab.	0	0	2	60	40	100	1
BMAT0-102/BBIO0-103	*Mathematics/Life Sciences	3	0	0	40	60	100	3
Total		23	0	4	360	440	800	25

*Compulsory Deficiency Course for 10+2 students with Mathematics/Biology and to be awarded as satisfactory and non- satisfactory during their final results,

**No credits will be allotted being the deficiency courses

Total Contact Hours = 26

Total Marks = 800

Total Credits = 24

SEMESTER 2 nd		Contact Hrs.			Marks			Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.	Total	
BBOT1-206	Communication Skills	2	0	0	40	60	100	2
BBOT1-207	Fundamentals of Biotechnology	4	0	0	40	60	100	4
BBOT1-208	Microbiology	4	0	0	40	60	100	4
BBOT1-209	Inorganic & Physical Chemistry	4	0	0	40	60	100	4
BBOT1-210	Biochemistry- I	4	0	0	40	60	100	4
BBOT1-211	Techniques in Biotechnology	4	0	0	40	60	100	4
BBOT1-212	Microbiology Lab.	0	0	2	60	40	100	1
BBOT1-213	Inorganic & Physical Chemistry Lab.	0	0	2	60	40	100	1
Total		22	0	4	360	440	800	24

MRSPTU B.Sc. BIOTECHNOLOGY SYLLABUS 2016 BATCH ONWARDS

Total Contact Hours = 22

Total Marks = 700

Total Credits = 19

SEMESTER 3 rd		Contact Hrs.			Marks			Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.	Total	
BBOT1-314	Fundamentals of Industrial Biotechnology	4	0	0	40	60	100	4
BBOT1-315	Fundamentals of Immunology- I	4	0	0	40	60	100	4
BBOT1-316	Biochemistry- II	4	0	0	40	60	100	4
BBOT1-317	Molecular Biology	4	0	0	40	60	100	4
BCAP0-318	Immunology Lab.- I	0	0	2	60	40	100	1
BBOT1-319	Biochemistry- II Lab.	0	0	2	60	40	100	1
BBOT1-320	Molecular Biology Lab.	0	0	2	60	40	100	1
Total		16	0	6	340	360	700	19

Total Contact Hours = 24

Total Marks = 800

Total Credits = 20

SEMESTER 4 th		Contact Hrs.			Marks			Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.	Total	
BBOT1-421	Plant Tissue Culture	4	0	0	40	60	100	4
BBOT1-422	Animal Tissue Culture	4	0	0	40	60	100	4
BBOT1-423	Recombinant DNA Technology	4	0	0	40	60	100	4
BBOT1-424	Fundamentals of Immunology- II	4	0	0	40	60	100	4
BBOT1-425	Plant Tissue Culture Lab.	0	0	2	40	60	100	1
BBOT1-426	Animal Tissue Culture Lab.	0	0	2	40	60	100	1
BBOT1-427	Recombinant DNA Technology Lab.	0	0	2	60	40	100	1
BBOT1-428	Immunology Lab.- I	0	0	2	60	40	100	1
Total		16	0	8	360	440	800	20

MRSPTU B.Sc. BIOTECHNOLOGY SYLLABUS 2016 BATCH ONWARDS

Total Contact Hours = 24

Total Marks = 800

Total Credits = 20

SEMESTER 5 th		Contact Hrs.			Marks			Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.	Total	
BBOT1-529	Bioinformatics	3	1	0	40	60	100	4
BBOT1-530	Bioanalytical tools	4	0	0	40	60	100	4
BBOT1-531	Enzymology and enzyme technology	4	0	0	40	60	100	4
BBOT1-532	Environmental Biotechnology	4	0	0	40	60	100	4
BBOT1-533	Bioinformatics Lab.	0	0	2	60	40	100	1
BBOT1-534	Bioanalytical Tools Lab.	0	0	2	60	40	100	1
BBOT1-535	Enzymology Lab.	0	0	2	60	40	100	1
BBOT1-536	Environmental Biotechnology Lab.	0	0	2	60	40	100	1
Total		15	1	8	400	400	800	20

Total Contact Hours = 28

Total Marks = 600

Total Credits = 20

SEMESTER 6 th		Contact Hrs.			Marks			Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.	Total	
BBOT1-637	IPR, Bioethics and Biosafety	3	1	0	40	60	100	4
BBOT1-638	Food Biotechnology	4	0	0	40	60	100	4
BBOT1-639	Bioprocess Engineering	4	0	0	40	60	100	4
BBOT1-640	Food Biotechnology Lab.	0	0	2	60	40	100	1
BBOT1-641	Bioprocess Engineering Lab.	0	0	2	60	40	100	1
BBOT1-642	Project Work	0	0	12	60	40	100	6
Total		11	1	16	300	300	600	20

CELL BIOLOGY

Subject Code: BBOT1-101

**L T P C
4 0 0 4**

Duration: 45 Hrs.

Course Objectives

To understand the basic concepts related to cell and its functions.

UNIT-1 (9 Hrs.)

Cell as a Basic Unit of Life

Cell theory and detailed classification of cell types within an organism. Different levels of organization of cells and cell organelles.

UNIT-II (12 Hrs.)

Cell Division and Cell Cycles

Cell cycle, Mitosis and Meiosis, binary fission, amitosis, molecular organization of mitotic spindle apparatus, cell cycle regulation and carcinogenesis.

UNIT-III (11 Hrs.)

Biochemical Compositions of Cells

Proteins, lipids, carbohydrates, nucleic acids and metabolic pool and biological membranes.

UNIT-IV (13 Hrs.)

Cellular Interactions

Cell recognition and cell coat; differentiation of cell membrane; inter cellular communication and gap junctions.

Recommended Books

1. E.D.P. De Robertis, E.M.F. Jr. De Robertis, 'Cell and Molecular Biology', 8th Edn., Publisher Lea & Febiger.
2. H.F. Lodish., A. Berk., C.A. Kaiser, M. Krieger, M.P. Scott, 'Molecular Cell Biology', 6th Edn., W.H. Freeman & Co.

GENETICS

Subject Code: BBOT1-102

**L T P C
4 0 0 4**

Duration: 45 Hrs.

Course Objectives

Imparting knowledge about the genetic material, their structure, functions and existence in prokaryotes and eukaryotes.

UNIT-1 (11 Hrs.)

Organization of Chromosomes

The structure of prokaryotic and eukaryotic chromosome, centromere and telomere structure, euchromatin and heterochromatin, special chromosomes: polytene Chromosomes and lampbrush chromosomes, satellite DNA, the supercoiling of DNA, detail structure of chromosome consisting of histones, nucleosomes and scaffold proteins.

UNIT-II (13 Hrs.)

Mendel's Law of Inheritance

Principle of segregation and independent assortment, monohybrid, dihybrid and trihybrid crosses, Back cross and test cross. Interaction of Genes: Incomplete inheritance and CO-dominance, pleiotropism, modification of F₂ ratios: epistasis, complementary genes, supplementary genes, inhibitory genes, duplicates genes, lethality and collaborators genes. Multiple allelism.

UNIT-III (9 Hrs.)

Linkage & Crossing over

Coupling and repletion hypothesis, chromosomal theory of linkage, complete and incomplete linkage, linkage groups and significance of linkage. Introduction, mechanism of meiotic crossing over, type of crossing over, factors affecting it and its significance, Hardy Weinberg Law.

UNIT-IV (12 Hrs.)

Mutation & Microbial Genetics Spontaneous versus induced mutations, types of mutations, mutations rate and frequency, mutagens: physical and chemical, the molecular basis of mutations. Significance & Practical application of mutation. Conjugation, transduction, transformation

Recommended Books

1. S.R. Maloy, J.E. Crown and D. Freifelder, 'Microbial Genetics', 2nd Edn., Jones & Bartlett Publishers, 1994.
2. D.L. Hartl, 'Genetics', 3rd Edn., Jones & Bartlett Publishers, 1994.
3. R.J. Brooker, 'Genetics Analysis and Principles', Jim Green, 1999.
4. A.G. Antherly, J.R. Girton, 'The Science of Genetics', Harcourt College Publishers, 1999.
5. D. Freifelder, 'Microbial Genetics', Narosa Publishing House, 2000.
6. D.L. Hartl, E.W. Jones, 'Genetics; Analysis of Genes & Genomes', 5th Edn., Jones & Bartlett Publishers, 2001.
7. P.K. Gupta, 'Genetics', Rastogi Publications, 2007.
8. Snustad and Simmons (2010) Principles of Genetics: 5th Edn., John Wiley & Sons.

ORGANIC CHEMISTRY

Subject Code: BBOT1-103

**L T P C
4 0 0 4**

Duration: 45 Hrs.

Course Objectives

To learn about the basic of organic chemistry and their role in daily life.

UNIT-1 (11 Hrs.)

Structure and Properties of Organic Compounds: Ionic and covalent bonds, atomic orbitals, electronic orbital, molecular orbitals, covalent bond length and angles, hybrid orbitals- double and triple bonds.

UNIT-II (13 Hrs.)

Isomerism: Geometric isomerism, free rotation about single bond, conformational isomers, polarity of bonds and molecules, structure and physical properties of organic compounds, solubility, stereochemistry, optical activity, enantiomers and optical activity, chiral centre, stereoisomers, racemization.

UNIT-III (9 Hrs.)

Different Types of Organic Compounds: Structure and properties of alkanes, alkyl halides, alkenes, alkynes, aliphatic cyclic compounds, aromatic compounds, resonance structures.

UNIT-IV (12 Hrs.)

Functional Groups and Reaction Mechanisms: Free radical reaction mechanism, nucleophilic and electrophilic substitution, organic molecules with different functional groups; alcohols, aldehydes, esters, ethers, primary, secondary and tertiary amines, amides.

Recommended Books

1. R.T. Morrison and R.N. Boyd, 'Organic Chemistry', 6th Edn., Prentice Hall of India, Pvt. Ltd., 2006.

2. I.L. Finar, 'Organic Chemistry', Vol. 1 and 2, 6th Edn., Pearson Education.

BASICS OF BIOSCIENCES

Subject Code: BBOTI-104

L T P C
4 0 0 4

Duration: 45 Hrs.

Course Objectives

To impart basic knowledge about the Bio- world in relation to their types, structure and growth.

UNIT-1 (13 Hrs.)

Diversity in the Living World: Biotechnological values of biodiversity, five kingdom classification of living world, classification of plants & animals in general.

UNIT-II (17 Hrs.)

Structural Organization in Plants & Animals: Morphology of flowering plants (Root, stem, Inflorescence, flower, fruit, seed) Semi-technical description of a flower plant. Anatomy of plants (Tissues, anatomy of dicots & monocots). Structural organisation in animals (Animal tissues, organ & organ system)

UNIT-III (15 Hrs.)

Cell Structure, Functions & Biomolecule: Cell theory, overview of Prokaryotes/Eukaryotes, Plant cell/Animal cell. Bio macromolecules- Proteins, polysaccharides, nucleic acids, nature of bond linking monomers in a polymer, metabolism concept, Cell cycle, Mitosis & Meiosis.

Recommend Books

1. K.N. Bhatia & M. Tyagi, 'Trueman's Elementary Biology', Vol. 1, Trueman Book Publishers.
2. B.B. Arora & A.K. Sabharwal, 'Modern abc of Biology', Modern Publications.

COMPUTER APPLICATIONS

Subject Code: BCAP0-195

L T P C
4 0 0 4

Duration: 45 Hrs.

Course Objectives

To give basic knowledge about the various parts of the computer in terms of their functions.

UNIT-1 (13 Hrs.)

Computer Fundamentals: Block structure of a computer, characteristics of computers, problem solving with computers, generations of computers, and classification of computers, Memory Types; Magnetic core, RAM, ROM, Secondary, Cache, Bubble Memory, Input and Output Units; Keyboard, Mouse, Monitor (CRT, LCD & LED), Light pen, joystick, Mouse, Touch screen; OCR, OMR, MICR, Overview of storage devices; Floppy Disk, hard disk, compact disk, tape, Pen drives, Memory Card and Types, Printers; Impact, non-impact, working mechanism of Drum printer, Dot Matrix printer, Inkjet printer and Laser printer.

UNIT-II (9 Hrs.)

Graphical OS: Operating System and its types, Fundamentals of windows, types of windows, anatomy of windows, windows explorer, customizing windows, control panel, taskbar setting, Network, Internet and its Applications; E-mail, World Wide Web, Search Engines, Web Browsers, Internet, Audio and Video chatting, Video and audio Conferences, uploading and Downloading of files from the web.

UNIT-III (11 Hrs.)

Word Processing: Examine word processing concepts and explore the Microsoft Office Word environment, create a new document, open, save and print a document. Edit and format text. Change the page layout, background and borders. Insert headers and footers. Insert and edit tables. Insert clip art and pictures to documents. Perform a mail merge. Share and review shared document files. Editing features, formatting features, saving, printing, table handling, Graph preparation, page settings, spell-checking, macros, mail-merge, and equation editors.

UNIT-IV (12 Hrs.)

Spreadsheet: Workbook, worksheets, data types, operators, cell formats, freeze panes, editing features, formatting features, Graph preparation, creating formulas, using formulas, cell references, replication, sorting, filtering, functions, Charts & Graphs, Presentation Graphics Software; Introduction to PowerPoint, what is PowerPoint? Create new presentations from scratch, using beautiful template, working with Shapes and Pictures, Adding Objects and Effects, Outlining Proofing and Printing, Delivering Your Presentation.

Recommended Books

1. Sunita Goel, 'Computer Fundamentals', Pearson.
2. Anupam Jain and Avneet Mehra, 'Computer Fundamental MS Office: Including Internet & Web Technology'.
3. P.K. Sinha, 'Introduction to Computers', BPB Publications.
4. Raymond Greenlaw, 'Fundamentals of the Internet & the World Wide Web'.
5. Sunjay Saxsena, 'Introduction to Computers and MS office'.

ORGANIC CHEMISTRY LAB.

Subject Code: BBOT1-105

L T P C

0 0 2 1

1. Synthesis of organic compounds (Aspirin / para-bromoacetanilide / anthraquinone)
2. Determination of melting points (Naphthalene / Benzoic acid / Urea / Succinic acid / Salicylic acid / Aspirin)
3. Determination of boiling points (Ethanol / Cyclohexane / Toluene)
4. Crystallization of Phthalic acid from hot water
5. Complete identification including derivation of following organic compounds: Aromatic hydrocarbons, Aldehydes, Ketones, Carbohydrates, Amides, Amines, Carboxylic acids and phenols.

Recommended Books

1. W. Moor, A. Winston, 'Laboratory Manual for Organic Chemistry: A Microscale Approach', Publishers Mc- Graw Hill Science.
2. D.L. Pavia, G.M. Lampanana, G.S. Kriz Jr., 'Introduction to Organic Laboratory Techniques', 3rd Edn., Pubs: Thomson Brooks/Cole, **2005**.
3. A.I. Vogel, A.R. Tatchell, B.S. Furnis, A.J. Hannaford, P.W.G. Smith, 'Vogel's Text Book of Practical Organic Chemistry', 5th Edn., Pubs: ELBS.

COMPUTER APPLICATION LAB.

Subject Code: BCAP0-196

L T P C

0 0 2 1

Introduction to Personal Computing:

1. Introduction to Computer Hardware and Peripherals.

2. Familiarization with Windows Operating System
3. Working with Files and Folders (Cut, Copy, Paste etc.)
4. Desktop Personalization using Control Panel (Changing wallpaper, Screen Saver, Screen Resolution, Mouse Pointer, speed etc.)
5. Working with Notepad, Calculator, Paint and utilities programs.

Introduction to Word:

1. Introduction to Word and its basic editing
2. Text Formatting, Copying and moving text and objects
3. Working with tables and its formatting
4. Working with paragraph and Clipboard
5. Send Emails using Mail Merge and create hyperlinks in it.
6. Printing documents with header and footers

Introduction to Spreadsheets:

1. Introduction to Spread Sheets and its basic editing
2. Modifying Spreadsheets, formatting cells
3. Working with formula and functions,
4. Working with Charts and Graphs
5. Sorting and filtering with different Conditions
6. Printing selected cells and sheets

Introduction to Power Point:

1. Introduction to PowerPoint and its basic Features
2. Working with slides, adding template and contents to slides
3. Working with charts, Graphs and Tables in Slides
4. Adding animations, Videos and Audio to slides
5. Printing of Presentation
6. Creating a full Presentation with all features of PowerPoint.

Introduction to Internet:

1. Introduction to Internet and its Benefits
2. Browsing Internet with Internet Explorer, Firefox and Chrome with Bookmarks
3. Creating and Using Email, Text, Audio and Video Messages/ chat. Placing Video and PC to PC Calls.
4. Downloading files using Different Web Browsers such as Rar, ZIP. docs, exe etc.,
5. Printing of Web Pages

Recommended Books

1. Sunita Goel, 'Computer Fundamentals', Pearson.
2. Anupam Jain and Avneet Mehra, 'Computer Fundamental MS Office: Including Internet & Web Technology'.
3. P.K. Sinha, 'Introduction to Computers', BPB Publications.
4. Raymond Greenlaw, 'Fundamentals of the Internet & the World Wide Web'.
5. Sunjay Saxena, 'Introduction to Computers and MS Office'.

MATHEMATICS

Subject Code: BMAT0-102

**L T P C
3 0 0 3**

Duration: 36 Hrs.

Course Objectives

1. The knowledge of Mathematics is necessary for a better understanding of almost all the Engineering and Science subjects.

2. Here our intention is to make the students acquainted with the concept of basic topics from Mathematics, which they need to pursue their Engineering degree in different disciplines.

UNIT-1 (7 Hrs.)

Algebra: Arithmetic and Geometric progression, Linear and quadratic equations, complex numbers, polar representation of a complex number, square root of a complex number.

UNIT-II (10 Hrs.)

Coordinate Geometry and Trigonometry: Rectangular Coordinate system, Straight lines, Circles. Trigonometric functions, sum and product formulae for trigonometric functions, trigonometric equations and C- D formulae for trigonometric functions, identities related to $\sin(2x)$, $\cos(2x)$ and $\tan(2x)$.

UNIT-III (8 Hrs.)

Determinants and Matrices: Matrices, Operations on Matrices, Determinants and its properties, singular and non-singular matrices, Adjoint and inverse of a matrix and its properties, Solution of system of linear equations using Cramer's rule and inverse of a matrix.

UNIT-IV (11 Hrs.)

Calculus (Differentiation & Integration): Differentiation, review of sets, relations and functions, limit, continuity and differentiability, differentiation of standard functions (polynomials, trigonometric, inverse trigonometric exponentials and logarithmic); product rule, quotient rule, applications of derivatives in Graphing, maxima and minima. Integration - Integral as anti-derivative, integration by substitution, partial fractions and by parts. Definite integral and its properties, areas of bounded regions.

Recommended Books

1. 'Mathematics, A Text Book', (Parts I & II), NCERT, New Delhi, 2011.
2. G.B. Thomas and R.L. Finney, 'Calculus and Analytical Geometry', 10th Edn., Pearson Education, 2007.
3. S. Narayan, 'Differential and Integral Calculus', S. Chand, 2005.
4. N.P. Bali, 'Engineering Mathematics', Laxmi Publications.

LIFE SCIENCES

Subject Code: BBIO0-103

**L T P C
3 0 0 3**

Duration: 36 Hrs.

Course Objectives

To understand the real concepts of biology in relation to study of the various body parts and their role.

UNIT-1 (8 Hrs.)

Biological Diversity: Diversity in the living world, Outline classification of plants, animals & microorganisms: Important criteria used for classification in each taxon. Classification of plants, animals and microorganisms. Evolutionary relationships among taxa.

UNIT-II (10 Hrs.)

Plant Physiology: Structural organization in plants, Anatomy of plants. Flower structure; Development of male and female gametophytes; Pollination-types, agencies and examples; Outbreeding devices; Pollen-Pistil interaction; Double fertilization; Post fertilization Events-Development of endosperm and embryo, Development of seed and formation of fruit; Special modes-apomixes, parthenocarpy, polyembryony; Significance of seed and fruit formation.

UNIT-III (8 Hrs.)

Chemical Structures and their role in Biology: Structure of atoms, molecules and chemical bonds. Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins; Structural organization in animals. Structural organization in animals – animal tissues, morphology and anatomy of animals.

UNIT-IV (10 Hrs.)

Cellular Organization: Membrane structure and function (Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes). Structural organization and function of intracellular organelles (Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility). Cell division and cell cycle (Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle). Microbial Physiology (Growth yield and characteristics, strategies of cell division, stress response).

Recommended Books

1. Rastogi and Dubey, 'Life Sciences', S. Chand and Co., N. Delhi, 2001.
2. Sobti and Sharma, 'Basics of Bio-Tech.: Introduction to Life Sciences', Vishal Publishing Co. Jalandhar, 2005.
3. R.C. Sobti, 'Animal Physiology', Narosa Publishings, N. Delhi.
4. Bhatia and Tyagi, 'Trueman's Elementary Biology', Trueman Book Company Publishers.
5. Arora and Sabharwal, 'Modern Biology'.

COMMUNICATION SKILLS

Subject Code: BBOT1- 206

**L T P C
2 0 0 2**

Duration: 24 Hrs.

Course Objectives

The objective of this course is to make students understand that both oral & written communication is equally important.

UNIT-I (6 Hrs.)

Basics of Technical Communication

Meaning, Internal & External functions, Shannon & weaver's model of Communication, Importance of Communication Barriers to communication & ways to improve these barriers, Essentials (7c's & other principles)

UNIT-II (4 Hrs.)

Writing Skills

Writing styles of applications, resume & CV, Personal letters, Official/Business letters, Memo, Notice, Report writing, Project writing, Quotation & Tender.

UNIT-III (6 Hrs.)

Speaking Skills

Presentation Techniques, Principles of Presentation, Types of Interview, G.D, Extempore speaking, Speech Mechanism, Organs of speech, Production & Classification of Speech sounds, skills of effective speaking.

UNIT-IV (8 Hrs.)

Tech Communication & Listening Skills

MS Word, Excel, PowerPoint, Process, Types of listening, Barriers to effective listening, Barriers to effective listening & ways to improve these Barriers

Recommended Books

1. Loveleen Kaur, 'Communication Skills', Satya Prakashan Publication.
2. Narinder Kumar Bodhraj, 'Business Communication', Kalyani Publishers, 2011.
3. S.P. Dhanavel, 'English & Communication Skills for the Students of Science & Engineering', (with audio C.D) Orient Blackswan Publication, 2009.
4. Indrajit Bhattacharya, 'An Approach to Communication Skills'.
5. Wright, Chissie, 'Handbook of Practical Communication Skills'.

FUNDAMENTALS OF BIOTECHNOLOGY

Subject Code: BBOT1- 207

L T P C
4 0 0 4

Duration: 45 Hrs.

Course Objectives

1. Students will learn the basics and applied areas of biotechnology.

UNIT- I (11 Hrs.)

Role of Microbes in Biotechnology

Advent, scope and basis of biotechnology. Bacteria as work horses of biotechnology, E-coli as the model bacteria. Role of yeast, viruses and bacteriophages in biotechnology.

UNIT- II (13 Hrs.)

Introduction to Bioinformatics & Biotechnological Techniques

Introduction to genomics, transcriptomics, proteomics and metabolomics; bioinformatics and its role in biotechnology. Introduction to basic techniques like sterilization, centrifugation, electrophoresis, chromatography, sonication, lyophilisation, basic microscopy, radioscopy, spectroscopy. Fundamentals of recombinant DNA technology: restriction enzymes, vectors and their properties.

UNIT-III (12 Hrs.)

Applications of Biotechnology

Biotechnology in fermentation and pharmaceutical processes. Green technology to control pollution. Role of biotechnology in diagnostics, introduction to gene therapy.

UNIT-IV (9 Hrs.)

Biotechnology and Society

Genetically modified organisms (GMOs)-transgenic plants and animals and their applications in biotechnology. Public concern and risks associated with genetic engineering: bioterrorism and biowarfare. Ethical, social and legal implication of biotechnology.

Recommended Books

1. Murray Moo-Young, 'Comprehensive Biotechnology', 2nd Edn., Pergamon Press, 2011.
2. William J. Thieman and Michael A. Palladino, 'Introduction to Biotechnology', 3rd Edn., Benjamin Cummings.
3. B.D. Singh, 'Biotechnology Expanding Horizons', 4th Edn., Kalyani Publishers, 2012.
4. Jonathan Morris, 'The Ethics of Biotechnology (Biotechnology in the 21st Century)', 1st Edn., Chelsea House Publication (L), 2005.
5. Sandy B. Primrose, 'Molecular Biotechnology', 2nd Edn., Blackwell Scientific Publications, 1991.
6. Bourgaize, Thomas R. Jewell and Rodolfo G. Buiser, 'Biotechnology: Demystifying the concepts', 1st Edn., Benjamin Cummings, 1999.
7. Richard Sherlock and John D. Merrey, 'Ethics issues in Biotechnology', 1st Edn., Rowman and Littlefield Publishers, 2002.

MICROBIOLOGY

Subject Code: BBOT1- 208

**L T P C
4 0 0 4**

Duration: 45 Hrs.

Course Objectives

1. Discovery origin and evolution of different forms of bacteria, fungi, protozoa and viruses constitute the basics of biotechnology.

UNIT-I (12 Hrs.)

History of Microbiology

Spontaneous Generation versus Biogenesis, Germ Theory of Fermentation and diseases. Applied areas of Microbiology. Microscopy: Bright field, dark field, phase contrast, fluorescent and electron microscopy.

UNIT-II (13 Hrs.)

Morphology and Fine Structures

Bacteria: size, shape, internal and external structures, cell wall of Gram positive and Negative bacteria, sporulation, Fungi and viruses.

UNIT-III (9 Hrs.)

Microbial Nutrition and Growth

Nutritional requirements and types, culture media preparation and sterilization, growth patterns, growth curve, generation time, synchronous growth and chemostat. Culture collection, purification and preservation. Microbes in extreme environments.

UNIT-IV (11 Hrs.)

Control of Microorganisms and Normal Micro Flora

Physical agents, chemical agents, antibiotics and other chemotherapeutic agents. Normal micro flora of the soil, microbial interactions (positive and negative). Nitrogen cycle, Carbon Cycle, Sulphur cycle, Phosphorus cycle.

Recommended Books

1. M.J. Pelczar Jr., Chan E. C.S., and R. Krieg, 'Microbiology', Mac Graw Hill.
2. G.J. Tortora, B.R. Funke, and C.L. Case, 'Microbiology-An Introduction', Benjamin Cummings.
3. B.D. Davis, R. Dulbecco, H.N. Eisen and H.S. Ginsber, 'Microbiology', Harper & Row Publisher.
4. R.Y. Stainer, J.L. Ingraham, M.L. Wheelis and P.R. Palmer, 'General Microbiology', MacMilan Press Ltd.
5. M.T. Madiga, J.M. Martinko, D.A. Stahl, D.P. Clark, 'Brock Biology of Microorganisms', Benjamin Cummings
6. R.P. Gupta, A. Kalia, S.K. Kapoor, 'Bioinoculants: A Step towards Sustainable Agriculture', New India Publishers.

INORGANIC & PHYSICAL CHEMISTRY

Subject Code: BBOT1- 209

**L T P C
4 0 0 4**

Duration: 45 Hrs.

Course Objectives

To understand the basic concepts of inorganic and physical chemistry in terms of their utilization in various applications.

UNIT-I (12 Hrs.)

Atomic Structure and Periodic Properties

Atomic spectra of hydrogen, Bohr theory and its refinement, dual nature of electrons, Heisenberg uncertainty principle, Schrödinger wave equation, Pauli's exclusion principle,

Hund's rule, energy levels, arrangement of elements in groups in periodic table, types of bonds - ionic, covalent, coordinate bonds, oxidation number, metallic bonds, conductivity, melting point, solubility.

UNIT-II (11 Hrs.)

Periodic Table and Properties

Long form of periodic table, alkali and alkaline earth metals and their biological properties, ionization and electronegativity, p-block elements, oxidation states, halogens and noble gases, transition elements, variability in oxidation state, complex formation, f-block elements.

UNIT-III (9 Hrs.)

Thermodynamics

Properties of gases, perfect gas, gas laws, kinetic theory of gases, mole concept, real gases, van der Waals equation, laws of thermodynamics, enthalpy, relation between C_v and C_p , entropy, Gibbs energy, phase rule and phase diagrams.

UNIT-IV (13 Hrs.)

Chemical Equilibrium

Spontaneous chemical reaction, Gibbs energy minimum, effect of pressure and temperature on equilibria, acids and bases, biological activity, thermodynamics of ATP, thermodynamic properties of ions in solution, ion activities, electrochemical cells, electrochemical series, solubility constants, measure of pH and pK, potentiometric titrations.

Recommended Books

1. J.D. Lee, 'Concise Inorganic Chemistry, 5th Edn., Blackwell Science.
2. P.W. Atkins, 'Physical Chemistry' ELBS Oxford University Press.

BIOCHEMISTRY- I

Subject Code: BBOT1- 210

**L T P C
4 0 0 4**

Duration: 45 Hrs.

Course Objectives

To aware students about the different types of biomolecules, their structure, functions and metabolism.

UNIT-I (13 Hrs.)

Carbohydrate Metabolism and Energy Production

Biosynthesis and degradation of carbohydrates, glycolysis, pentose pathway, Kreb's cycle (enzymes, regulation), substrate level, oxidative and photo- phosphorylation, mitochondrial electron transport chain, regulation of ATP synthesis.

UNIT-II (11 Hrs.)

Lipids and Vitamins

Classification and functions of lipids and fatty acids, digestion, absorption, biosynthesis and degradation of fatty acids, metabolism of triacyl glycerol, cholesterol, ketone bodies, structure of water soluble & fat soluble vitamins and their functions.

UNIT-III (12 Hrs.)

Proteins

Structure of amino acids and their chemical reactions, biosynthesis and degradation of amino acids, classification and functions of protein, enzyme classification, properties and factors affecting enzyme activity, regulation of enzyme activity.

UNIT-IV (9 Hrs.)

Nucleic Acids

Sugar (ribose, deoxyribose), nucleoside, nucleotide, DNA structure, types of DNA, Chargaff's rule, RNA structure and its types, replication, transcription, translation.

Recommended Books

1. U. Satyanaryana, U. Chkrapani, 'Biochemistry', 4th Edn., Elsevier
2. D.L. Nelson, L.A. Lehninger, M. Cox, Lehninger, 'Principles of Biochemistry', 5th Edn., W.H. Freeman.
3. J.M. Berg, J.L. Tymoczko, L. Stryer, 'Biochemistry', 5th Edn., W.H. Freeman.
4. D. Voet, J.G. Voet, 'Biochemistry', 4th Edn., John Wiley & Sons.

TECHNIQUES IN BIOTECHNOLOGY

Subject Code: BBOT1-211

**L T P C
4 0 0 4**

Duration: 45 Hrs.

Course Objectives

To impart knowledge about the various techniques used in biotechnology in terms of their principle, working and applications.

UNIT-I (13 Hrs.)

Chromatography

Distribution coefficient, stationary and mobile phases, paper chromatography, thin layer chromatography, column chromatography, packing a column, loading a sample, chromatographic development, elution of separated analytes, detector and fraction collector, normal phase and reverse phase chromatography, ion exchange chromatography, gel exclusion chromatography, affinity chromatography.

UNIT-II (12 Hrs.)

Electrophoresis

Agarose gel electrophoresis, separation of DNA and RNA by electrophoresis, polyacrylamide gel electrophoresis, native PAGE, SDS-PAGE, Isoelectric focusing and 2D gel electrophoresis, separation of DNA and proteins using PAGE, Southern blot, northern blot and western blot analysis urea PAGE for DNA sequencing. Apparatus for casting/polymerizing gels and carrying out electrophoresis, power supply. Visualizing methods such as ethidium bromide, coomassie brilliant blue, acridine orange and silver staining.

UNIT-III (11 Hrs.)

Spectroscopy, Radioactive Isotopes & Microscopy

Source of monochromatic light, UV and visible spectroscopy, Beer-Lambert law, applications of UV and visible spectrophotometry in biotechnology, spectrofluorometry, Infra-red spectroscopy. Radioactive decay, half-life, ionizing radiations, their energy and penetration, application of radioactive isotopes in biotechnology, detection and quantification of radioactivity. Simple and compound microscopes, parts of a microscope, magnification and resolution of a microscope, staining procedures, introduction to electron microscopy.

UNIT-IV (9 Hrs.)

Centrifugation

Centrifugal force and RCF, rotors of centrifugation machines, types of centrifuges, ultracentrifuge, applications of centrifugation in biotechnology, precautions and safety guidelines for operating centrifuges.

Recommended Books

1. K. Wilson and J. Walker, 'Principles and Techniques of Biochemistry and Molecular Biology', Cambridge University Press.
2. A. Pingoud, C. Urbanke, J. Hoggett and A. Jeltsch, 'Biochemical Methods', Wiley-VC.

MICROBIOLOGY LAB.

Subject Code: BBOT1-212

**L T P C
0 0 2 1**

1. Introduction to the instruments use in the microbiology, aseptic techniques.
2. Cleaning of glass wares, Preparation of media, Cotton plugging and sterilization.
3. Isolation of microorganisms from air, water and soil samples.
4. Preparation of Serial dilution, colony purification.
5. Staining: Methylene blue, Gram, Negative and Spore.
6. Growth curve of bacteria.
7. Testing of water quality.

Recommended Books

1. James G. Cappuccino and Natalie Sherman, 'Microbiology: A Laboratory Manual', Benjamin Cummings.
2. K.R. Aneja, 'Experiments in Microbiology, Plant Pathology and Biotechnology', New Age Publishers.

INORGANIC & PHYSICAL CHEMISTRY LAB.

Subject Code: BBOT1-213

**L T P C
0 0 2 1**

Inorganic Chemistry

1. Volumetric Analysis: Iodimetry, Iodometry, Redox titrations using $K_2Cr_2O_7$ and $KMnO_4$. Complexometric titration using EDTA, Ca^{2+} and Mg^{2+}
2. Four ions (Two cations two anions)
3. Preparation of copper tetra-ammine complex. $[Cu(NH_3)_4]SO_4$

Physical Chemistry

1. Determination of surface tension of a given liquid by Stalagmometer (number of drops and weight of drops methods)
2. Determination of coefficient of viscosity of a pure liquid (Acetone, Ethanol, Propanol, Butanol, Glycol)
3. Verification of Lambert beer's law for solution of $CoCl_2 \cdot H_2O$ (in water) and $K_2Cr_2O_7$ (in water)
4. pH of buffer solution
5. Acid base titration HCl vs. NaOH
6. Determination of ionization constant of a weak acid (CH_3COOH)

Recommended Books

1. S. Rattan, 'Engineering Chemistry', S.K. Kataria & Sons.
2. G. Svelha, S. Mittal, 'Vogel's, Qualitative Inorganic Chemistry', Pearson Education.

FUNDAMENTALS OF INDUSTRIAL BIOTECHNOLOGY

Subject Code: BBOT1-314

**L T P C
4 0 0 4**

Duration: 45 Hrs.

Course Objectives

1. To make the students aware of the overall industrial bioprocesses, so as to help them to manipulate the process to the requirement of the industrial needs.

UNIT- 1

Introduction to Industrial important microbes (9 Hrs.)

Role of Yeast in biotechnological based processes: improvement through genetic manipulation. Role of other microbes like *E. coli*, *Bacillus* and *Aspergillus* in industrial applications.

UNIT- 2

Fermentation process and production media (10 Hrs.)

Design and operation of fermenter & criteria for selection and preparation of ideal media for production of biomass and microbial products.

UNIT- 3

Microbial products (14 Hrs.)

Microbial production of vitamins, organic acids; fermented beverages: Beer, whisky, wine and vinegar.

UNIT- 4

Microbes in Agro farming (12 Hrs.)

Production of bio-fertilizers: Rhizobium, Azotobacter, Blue green algae; Bio-control agents: bacteria, viruses and fungi; role of microbes in Bio-fuel production.

Recommended Books

1. L.E. Casida, 'Industrial Microbiology', New Age International Publishers, 1996.
2. Prescott and Dunn, 'Industrial Microbiology', **1991.**
3. W. Crueger and A. Crueger. 'Biotechnology', 2nd Edn., Panima Publishers, 1992.
4. Peppler and Perlman, 'Microbial Technology', Vol. I and II, Academic Press, 1979.

FUNDAMENTALS OF IMMUNOLOGY- I

Subject Code: BBOT1- 315

**L T P C
4 0 0 4**

Duration: 45 Hrs.

Course Objectives

1. To learn the fundamental working knowledge of the basic principles of immunology and immunological techniques in prognosis/diagnosis.

UNIT- 1

Overviews of the Immune system (10 Hrs.)

Historical perspectives, Innate and acquired immunity, Clonal nature of immune response; Hematopoiesis and differentiation; lymphocyte trafficking; B lymphocytes, T-lymphocytes, macrophages, dendritic cells, Natural killer cells and lymphocyte activated killer cells, eosinophils, neutrophils & mast cells.

UNIT- 2

Organs of Immune System, Antigen & Antibodies (14 Hrs.)

Primary, secondary and tertiary lymphoid organs; Immunogenicity Vs. antigenicity, factors affecting immunogenicity, nature of immunogen, epitopes, heptans and antigenicity, pattern recognition receptors; Structure of antibody, antibody effector function, antibody classes and biological activities, antigenic determinants on

Immunoglobulins, Immunoglobulins super-families, Production of Monoclonal Antibodies, applications of polyclonal and monoclonal antibodies.

UNIT- 3

Antigen–Antibody Interactions & Major Histocompatibility Complex (12 Hrs.)

Strength of interaction: cross reactivity, antibody affinity, avidity. Antigen-antibody interactions as tools for research and diagnosis: precipitation and agglutination reactions, immunodiffusion, immune-electrophoresis, immunoassays, Enzyme linked immunosorbent assay (ELISA), Radioimmunoassay (RIA), western blot, Immunofluorescence; General organization and inheritance, MHC molecules, regulation of MHC expression and disease susceptibility, antigen presentation.

UNIT- 4

Cytokines & Cell- Mediated Effector Response (9 Hrs.)

Properties of cytokines, cytokine receptor, cytokine secretion by T_H1 and T_H2 subsets; General properties of effector T cell, cytotoxic T cell, Natural killer cell, Antibody-dependent cell- mediated cytotoxicity.

Recommended Books

1. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby 'Kuby Immunology', W.H. Freeman, 2006.
2. Ivan Maurice Roitt, Jonathan Brostoff, David K. Male 'Immunology', Mosby, 2001.

BIOCHEMISTRY- II

Subject Code: BBOT1-316

**L T P C
4 0 0 4**

Duration: 45 Hrs.

Course Objectives

1. To learn the basic principles of enzymology to know how enzymes functions in the biological systems and strategies/ applications of enzyme technology.

UNIT- 1

Introduction to Enzyme (10 Hrs.)

Enzyme nomenclature & classification, Enzyme Kinetics, effect of substrate concentration on Michaelis – Menten equation, determination of K_m & its significance, Introduction to enzymes & coenzymes, units of enzymes activity.

UNIT- 2

Mechanism of Enzyme Action (12 Hrs.)

Nature of active site: identification of functional groups at active site; enzyme substrate complex; Factors responsible for catalytic efficiency of enzymes; Covalent catalysis, Acid base catalysis; Strain and distortion theory, Induced fit hypothesis.

UNIT- 3

Enzyme Inhibition (14 Hrs.)

Reversible and irreversible inhibition, Kinetics of competitive, uncompetitive and non-competitive inhibition; Effect of pH and temperature on rate of enzyme catalyzed reactions; Reversible covalent modification; zymogen activation; Isozymes as well as their importance.

UNIT- 4

Nucleic Acid Metabolism (9 Hrs.)

Biosynthesis of purine and pyrimidine nucleotides; salvage reactions; Catabolism of purines and pyrimidines, urea cycle.

Recommended Books

1. 'Principles of Biochemistry', 3rd Edn., Lehninger, Nelson & Cox.

2. Luberts Stryer. 'Biochemistry', 4th Edn., W.H. Freeman and Company, New York, 1995.
3. K. Rangnathan Rao, 'Text Book of Biochemistry', 3rd Edn., 1986.
4. J.L. Jain, Fundamentals of Biochemistry, 5th Edn., Chand and Co., New Delhi.

MOLECULAR BIOLOGY

Subject Code: BBOT1- 317

L T P C
4 0 0 4

Duration: 45 Hrs.

Course Objectives

1. To know about the genetic material and basic genetic molecular mechanisms to develop analytical and quantitative skills.

UNIT- 1

Genetic Material and Replication (12 Hrs.)

Structure and properties of nucleic acids, double helical structure DNA and its alternate structures, superhelical DNA, semi-conservative replication of double stranded DNA, DNA polymerases, Initiation of DNA replication, origin of replication, semi-discontinuous replication, DNA replication in bacteria, phages and eukaryotes, DNA damage, DNA repair, mismatch repair, excision repair, recombination repair.

UNIT- 2

Transcription (14 Hrs.)

Bacterial and eukaryotic promoters, transcription initiation, elongation and termination in prokaryotes and eukaryotes, structure and function of RNA polymerases in prokaryotes and eukaryotes, regulation of transcription, regulation of lac and trp operons, regulatory elements, activators and repressors, general transcription factors in eukaryotes, PRE, NRE, enhancers, insulators and regulatory *trans*-factors, RNA interference.

UNIT- 3

Post-translational Modification and Genetic Code (10 Hrs.)

Classes of RNA molecules, 5' capping and polyadenylation of mRNA, splicing and spliceosome; Genetic code, open reading frame, degeneracy of codon system, wobble concept.

UNIT- 4

Translation (9 Hrs.)

Ribosome structure and role in polypeptide synthesis, tRNA structure and function in translation, start and termination codons, initiation, elongation and termination of translation, post translational modifications.

Recommended Books

1. G.M. Malacinski, 'Freifelder's Essentials of Molecular Biology', 4th Edn., Narosa Publishing House.
2. B. Lewin, 'Genes VIII', International Edition, Pearson Education International.
3. S.B. Primrose and R.M. Twyman, 'Principles of Gene Manipulation and Genomics, Blackwell Publishing', 7th Edn., ISBN 1-4051-3544-1, 2006.

IMMUNOLOGY LAB.- I

Subject Code: BBOT1- 318

L T P C
0 0 2 1

1. Differential leucocytes count.
2. Total leucocytes count.
3. Separation of serum and plasma from blood.

4. Agglutination (Blood group testing).
5. Radial and double immuno diffusion test using specific antibody and antigen.

Recommended Books

1. Arti Nigam, Archana Ayyagri, 'Lab. Manual in Biochemistry, Immunology and Biotechnology', McGraw Hill Education (India), **2008**.
2. G.P. Talwar, S.K. Gupta, 'Hand Book of Practical and Clinical Immunology', CBS, 2nd Edn., **2006**.

BIOCHEMISTRY LAB.- II

Subject Code: BBOT1-319 **L T P C**
0 0 2 1

1. Estimation of α -amylase activity from saliva.
2. Effect of temperature on enzyme activity.
3. Purification of protein using salt precipitation.
4. Paper chromatography for separation of macromolecules.
5. Verification of Beer's Law and Determination of Absorption Maxima.
6. Qualitative Estimation of Carbohydrates.
7. Qualitative Estimation of Amino Acids.
8. Quantitative Estimation of Proteins.
9. Amino Acid and Carbohydrate Separation by Paper Chromatography.

Recommended Books

1. Arti Nigam, Archana Ayyagri, 'Lab. Manual in Biochemistry, Immunology and Biotechnology', McGraw Hill Education (India), **2008**.
2. David T. Plummer, 'An Introduction to Practical Biochemistry', 3rd Edn., Tata McGraw Hill Education, **2006**.

MOLECULAR BIOLOGY LAB.

Subject Code: BBOT1-320 **L T P C**
0 0 2 1

1. Transformation of bacterial cells with plasmid DNA.
2. Agarose gel electrophoresis.
3. Plasmid isolation.
4. Genomic DNA isolation.
5. Quantification of DNA and protein samples using UV spectrophotometer.
6. Qualitative analysis of DNA sample using UV spectrophotometry ($Q_{260/280}$).

Recommended Books

1. J. Fritsch and E.F. Maniatis, 'Molecular Cloning, A laboratory Manual', Cold Spring Harbor Laboratory, **1999**.
2. G.M. Malacinski, 'Freifelder's Essentials of Molecular Biology', 4th Edn., Narosa Publishing House.

PLANT TISSUE CULTURE

Subject Code: BBOT1-421 **L T P C** **Duration: 45 Hrs.**
4 0 0 4

Course Objectives

1. To teach set of in vitro techniques, methods and strategies related to plant tissue culture.

2. Students will learn how to create genetic variability for the improvement of crops and secondary metabolite products.

UNIT- 1

Micropropagation (12 Hrs.)

Methods of micropropagation (axillary bud, shoot-tip and meristem culture), Stages of micropropagation, Factors affecting micropropagation, Applications of micropropagation, Acclimatization of tissue culture raised plants. Modes of regeneration: somatic embryogenesis and organogenesis, Types of somatic embryogenesis and their applications.

UNIT- 2

Haploid and Triploid Plants Production (9 Hrs.)

Production through tissue culture; ovary and ovule culture; embryo culture and rescuing hybrid embryos; somaclonal variations, selection of variant cell lines and its applications.

UNIT- 3

Concept of Protoplast (10 Hrs.)

Protoplast isolation and culture, viability of protoplasts, protoplast fusion, selection of somatic hybrids and cybrids, applications of somatic cell hybridization.

UNIT- 4

Metabolites Production (14 Hrs.)

Cell suspension culture, production of secondary metabolites (Flavonoids, Terpenoids) by plant tissue culture, immobilized plant cell culture, use of bioreactors in secondary metabolite production, transgenic approaches in secondary metabolite production.

Recommended Books

1. S.S. Bhajwani & M.K. Razdan, 'Plant Tissue Culture. Theory and Practice', Elsevier, 1996.
2. M.K. Razdan, 'Introduction to Plant Tissue Culture', Science Publishers, 2003.
3. B.D. Singh, 'Biotechnology Expanding Horizons', Kalyani Publishers, New Delhi, 2004.

ANIMAL TISSUE CULTURE

Subject Code: BBOT1-422

**L T P C
4 0 0 4**

Duration: 45 Hrs.

Course Objectives

1. To introduce the students to Animal cell-culture its advantages and disadvantages.

UNIT- 1

Concepts of Animal Tissue Culture (12 Hrs.)

Historical background, advantages & disadvantages of animal tissue culture, Design and layout of ATC Lab, Equipment used in ATC Lab, Aseptic Techniques in ATC- Sterilization of culture media, glassware & tissue culture laboratory. Growth and viability of cells in culture, cryopreservation and retrieval of cells from frozen storage, transportation of cells. Characteristics of normal and transformed cells.

UNIT- 2

Contamination and Safety (10 Hrs.)

Sources, Types, monitoring and eradication of contamination, Cross Contamination. Safety considerations in ATC laboratory, Clean Environment – P1, P2, P3 facility and their applications.

UNIT- 3

Culture Media (9 Hrs.)

Types of cell culture media, physiochemical properties, balanced salt solution, constituents of serum, serum free media (SFM), design of SFM, advantages and disadvantages of serum supplemented and serum free media, conditioned media.

UNIT- 4

Cell Culturing Process (14 Hrs.)

Primary culture and Established cell line Culture (Finite & continuous cell lines), Isolation of Cells-Enzyme digestion, perfusion and mechanical disaggregation. Culture of anchorage dependent cells and cells in suspension, phases of cell growth and determination of cell growth data (calculation of *in vitro* age, multiplication rate, population doubling time, cell counting, phases of cell cycle).

Recommended Books

1. E.J. Gareth, 'Human Cell Culture Protocols', Humara Press, 1996.
2. M. Butler, 'The Animal Cell Culture and Technology', IRL Oxford Univ. Press, 1996.
3. E. Julio, Celis, 'Cell Biology-A Laboratory Hand Book, Vol. I-IV, 2nd Edn., Academic Press, New York, 1998.'
4. R.T. Freshney, 'Culture of Animal Cells 5th Edn., John Wiley and Sons, New York, 2006.

RECOMBINANT DNA TECHNOLOGY

Subject Code: BBOT1-423

L T P C
4 0 0 4

Duration: 45 Hrs.

Course Objectives

1. To teach the students about the different techniques used in rDNA Technology.

UNIT- 1

Molecular Cloning (14 Hrs.)

Cutting and joining DNA using restriction enzymes and DNA ligase, other enzymes used in recombinant DNA technology such as, DNA polymerase I, Taq DNA polymerase, Klenow fragment, reverse transcriptase, terminal transferase, RNaseH, DNaseI, alkaline phosphatase and polynucleotide kinase. Cloning vectors based on plasmids, phasmids, phages, cosmids and artificial chromosomes, expression vectors, host systems for cloning and recombinant protein expression.

UNIT- 2

Library Construction and Recombinant Protein Expression (10 Hrs.)

Genomic library construction and screening, cDNA synthesis, conversion into double stranded cDNA, cDNA library construction and screening, merits of the two libraries, cDNA expression library.

UNIT- 3

PCR and other Techniques (9 Hrs.)

Polymerase chain reaction, concept and applications, DNA labelling (end labelling and body labelling), DNA sequencing, Southern blot, northern blot.

UNIT- 4

Site Directed Mutagenesis (12 Hrs.)

Basic principle of site directed mutagenesis and its comparison with random mutagenesis, oligonucleotide based mutagenesis, cassette mutagenesis, application of PCR in site directed mutagenesis, applications of site directed mutagenesis.

Recommended Books

1. S.B. Primrose and R.M. Twyman, 'Principles of Gene Manipulation and Genomics', Blackwell Publishing, **2006**.
2. J.E. Krebs, E.S. Goldstein and S.T. Kilpatrick, 'Lewin's GENES X', Jones and Bartlett Publishers, **2011**.
3. J. Fritsch and E.F. Maniatis, 'Molecular Cloning, A laboratory Manual', Cold Spring Harbor Laboratory, **1999**.

FUNDAMENTALS OF IMMUNOLOGY- II

Subject Code: BBOT1-424

L T P C
4 0 0 4

Duration: 45 Hrs.

Course Objectives

1. To teach the students regarding importance of immune system, its disease and vaccines.

UNIT- 1

Antigen Processing and Presentation & Complement System (10 Hrs.)

Role of antigen processing T cells, cytosolic and endosytic pathway, presentation of nonpeptidated antigens; functions of complement, components of complement, classical, alternative and lectin pathways.

UNIT- 2

Hypersensitivity & Immune Response to Infectious Diseases (14 Hrs.)

Gell and Coombs classification, Type I, II, III and IV hypersensitivity; viral, bacterial infections, protozoan disease and emerging infectious diseases.

UNIT- 3

Vaccines & Immuno-deficiencies (12 Hrs.)

Active and passive immunization, types of vaccines, Immunization Programme schedule; Primary and secondary immune-deficiencies.

UNIT- 4

Autoimmunity & Cancer (9 Hrs.)

Organ- specific autoimmune and systemic autoimmune diseases; Cancer: origin and terminology, malignant transformation of cell, tumor antigens, immune response to tumors.

Recommended Books

1. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby 'Kuby Immunology', W.H. Freeman, **2006**.
2. Ivan Maurice Roitt, Jonathan Brostoff, David K. Male, 'Immunology', Mosby, **2001**.

PLANT TISSUE CULTURE LAB.

Subject Code: BBOT1-425

L T P C
0 0 2 1

1. Micropropagation and its different steps.
2. Significance of growth hormones in culture medium.
3. Induction of callus from different explants.
4. To study regeneration of shoots/embryos.
5. Raising of cell suspension cultures.
6. Anther Culture, Ovary culture and embryo rescue.

Recommended Books

1. Santosh Nagar, Madhavi Adhav, 'Practical Book of Biotechnology & Plant Tissue Culture', Kindle edition, S. Chand, **2010**.

2. C.C. Giri, Archana Giri, 'Plant Biotechnology Practical Manual', I.K. International, 2007.

ANIMAL TISSUE CULTURE LAB.

Subject Code: BBOT1-426 **L T P C**
0 0 2 1

1. Sterilization techniques: Theory and Practical - Glassware Sterilization-Media sterilization -Laboratory Sterilization.
2. Sources of contamination and decontamination measures.
3. Preparation of Hanks Balanced salt solution.
4. Preparation of Minimal Essential Growth medium.
5. Isolation of lymphocytes for culturing.
6. Isolation of macrophages from blood for culturing.

Recommended Books

1. Sudha Gangal, 'Principles and Practice of Animal Tissue Culture', 2nd Edn., Universities Press, 2010.

RECOMBINANT DNA TECHNOLOGY LAB.

Subject Code: BBOT1-427 **L T P C**
0 0 2 1

1. Preparation of competent cells.
2. Transformation of bacterial cells using plasmid DNA.
3. Ethanol precipitation of DNA.
4. Plasmid isolation.
5. Genomic DNA.
6. Restriction digestion of plasmid DNA and genomic DNA.
7. RNA degradation by RNase A after plasmid isolation.
8. Molecular cloning.
9. PCR amplification.

Recommended Books

1. J. Fritsch and E.F. Maniatis, 'Molecular Cloning, A Laboratory Manual', Cold Spring Harbor Laboratory, 1999.
2. S.B. Primrose and R.M. Twyman, 'Principles of Gene Manipulation and Genomics', Blackwell Publishing. 2006.

IMMUNOLOGY LAB.-II

Subject Code: BBOT1-428 **L T P C**
0 0 2 1

1. Performing enzyme linked immunosorbent assay.
2. Rocket immuno-electrophoresis for antigen antibody interaction.
3. Isolation of mononuclear cells from peripheral blood.
4. Study of Lymph nodes in rats.

Recommended Books

1. Arti Nigam, Archana Ayyagri, 'Lab Manual in Biochemistry, Immunology and Biotechnology', McGraw Hill Education (India), 2008.
2. G.P. Talwar, S.K. Gupta, 'Hand Book of Practical and Clinical Immunology', CBS, 2nd Edn., 2006.

BIOINFORMATICS

Subject Code: BBOT1-529

**L T P C
3 1 0 4**

Duration: 45 Hrs.

Objectives:

To introduce bioinformatics concepts, principles, and techniques to students with life science background. To impart knowledge about the existing tools for storage, retrieval, sharing and use of biological data.

Unit-I

History, scope and importance of bioinformatics.

Introduction to Genomics and proteomics – information flow in Biology, DNA sequence data,

experimental approach to genome sequence data, genome information resources, protein sequence and structural data, protein information resources.

Bioinformatic-biological data analysis and application, sequence data bases, NCBI model, File format.

Unit-II

Sequence Alignment and Database: Information retrieval systems and Data submission, Entrez, SRS; BankIt, Database Scanning and Sequence similarity searches, algorithm BLAST, BLAST programs (BLASTP, BLASTN), FASTA, multiple sequence alignment.

Unit-III

Nucleotide Sequence Databases: Composition, organization and structure of data entries, INSDC, Genbank, EMBL,

Primary and Secondary Protein Databases: Composition, organization and structure of data entries, IPSCD, Swiss-Prot, TrEMBL PIR, UniProt, PDB, CATH, SCOP, PROSITE, Pfam.

Unit-IV

Phylogenetic Analysis: Multiple sequence alignment tools - clustalW; Phylogenetic analysis and methods - overview of Maximum Parsimony method, Tree confidence; Analysis tools – Phylip.

Genome Annotation: Pattern and repeat finding, Gene identification tools, Detecting Open Reading Frames.

Recommended Books

1. P. Baldi, S. Brunak, 'Bioinformatics: The Machine Learning Approach', 2nd Edn., Cambridge, Mass: MIT Press, 2001.
2. A.D. Baxevanis, B.F.F. Ouellette, 'Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins', 3rd Edn., N.J. Hoboken: Wiley Interscience, 2005.
3. R.F. Doolittle, 'Computer Methods for Macromolecular Sequence Analysis', San Diego: Academic Press, 1996.
4. D. Higgins, W.R. Taylor, 'Bioinformatics: Sequence, Structure and Databanks: A Practical Approach', Oxford; NY: Oxford University Press, 2000.

BIOANALYTICAL TOOLS

Subject Code: BBOT1-530

**L T P C
4 0 0 4**

Duration: 45 Hrs.

Objectives:

To understand the various tools used in modern day biotechnological processes.

Unit-I

Microscopy: Simple, compound, phase contrast microscopy, fluorescence, electron microscopy (TEM and SEM), and atomic force microscopy.

Spectroscopy: Absorption and emission spectra- UV, Visible, IR, NMR, ORD/CD, atomic absorption and plasma emission spectroscopy, X-ray diffraction.

Unit-II

Centrifugation Techniques: Basic principle of centrifugation, different types of centrifuges and their uses, preparative and analytical ultra-centrifuges, types of rotors: swing bucket and fixed angle rotors, separation by differential and density gradient centrifugation.

Unit-III

Chromatography Techniques: principle of chromatography, Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC.

Unit-IV

Separation and Analysis by Electrophoresis: General principle, support media, types of electrophoresis, Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, isoelectric focusing, 2D-PAGE, Western blotting.

Radioisotopy: Principles and applications of tracer techniques in biology, radioactive isotopes and half-life of isotopes, Autoradiography, Liquid scintillation counters.

Recommended Books

1. G. Karp, 'Cell and Molecular Biology: Concepts and Experiments', 6th Edn., John Wiley & Sons. Inc., 2010.
2. D. Freifelder, 'Physical Biochemistry. Applications to Biochemistry & Molecular Biology', W.H. Freeman & Co., 1982.
3. E.D.P. De Robertis and E.M.F. De Robertis, 'Cell and Molecular Biology', 8th Edn., Lippincott Williams and Wilkins, Philadelphia, 2006.
4. G.M. Cooper and R.E. Hausman, 'The Cell: A Molecular Approach', 5th Edn., ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA, 2009.
5. W.M. Becker, L.J. Kleinsmith, J. Hardin and G.P. Bertoni, 'The World of the Cell', 7th Edn., Pearson Benjamin Cummings Publishing, San Francisco, 2009.
6. K. Wilson and J. Walker, 'Practical Biochemistry: Principles and Techniques', Cambridge University Press, U.K., 1995.

ENZYMOLGY AND ENZYME TECHNOLOGY

Subject Code: **BBOT1-531**

L T P C
4 0 0 4

Duration: 45 Hrs.

Unit-I

Introduction to Enzymes: Structure, evolution and its basis, Nomenclature, Classification and Characteristics of enzymes, Enzyme specificity, Cofactors, Co-enzyme and Prosthetic group.

Unit-II

Mechanism of Enzyme Action: Nature of active site, identification of functional groups at active site, enzyme substrate complex, Activation of enzymes, covalent modification, allosteric interaction, multienzyme complexes.

Unit-III

Kinetic Characterization: Kinetics of single and bi-substrate enzyme catalysed reactions, Michaelis Menten equation and determination of K_m and V_{max} values, Lineweaver-Burk plot, Hanes Plot. Enzyme inhibition kinetics.

Unit-IV

Pharmaceuticals: Role of soluble and immobilized enzymes in production of antibiotics, steroids, and other important intermediates of biotechnological industry.

Applications in Food Industry: Soluble and immobilized enzymes - food production and processing, amylases, pectinases, proteases, lipases,

Enzyme Engineering: *In vitro* approaches to improve functional efficiency; Recombinant enzymes.

Recommended Books

1. N.C. Price and L. Stevens, 'Fundamentals of Enzymology: The cell and Molecular Biology of Catalytic Proteins', Oxford University, 2000.
2. P.C. Engel, 'Enzymology Lab Fax', Academic Press, 2003.
3. A. Fersht, 'Enzyme Structure and Function', W.H. Freeman and Co., NY, 1999.
4. Rehm, Reed and A. Phuler, 'Enzymes, Biomass, Food and Feed (Biotechnology) 2nd Edn., Vol. 9, Wiley VCH, Berlin, 2001.
5. H. Bisswanger and L. Bubenheim, 'Enzyme Kinetics: Principles and Methods', 2002.
6. T. Godfrey and S. May, 'Industrial Enzymology: The Application of Enzymes in Industry', McMillan Publishers, 2001.

ENVIRONMENTAL BIOTECHNOLOGY

Subject Code: BBOT1-532

L T P C
4 0 0 4

Duration: 45 Hrs.

Unit-I

Introduction to Environmental Pollution: Nature of pollutants, Types of pollution: air, water, soil, Marine Pollution, Noise Pollution, Thermal Pollution, Nuclear Hazards, Electronic Waste.

Unit-II

Environmental Treatment Technologies for Waste Water and Air: Physical and chemical methods, aerobic, activated sludge treatment, aerated ponds, lagoons, trickling filters, rotating biological contactors. Up flow anaerobic sludge blanket bioreactor (UASB), Anaerobic filter reactor, contact reactor.

Unit-III

Solid waste management by composting, vermicomposting, sanitary landfills, treatment of hazardous and biomedical waste, management of E-waste, Methanogenesis
Biodegradation of organic pollutants (organic solvents, pesticides) and Bioremediation technology for environmental pollutants.

Unit-IV

Biogas technology: biogas technology raw materials, biochemistry, microbiology, biogas plant, factors affecting biogas production and its status in India. Agri-waste and plastic waste management, Biomining and bioleaching, Plastic menace, biodegradable plastics. Biosafety levels.

Recommended Books

1. R.C. Dubey, 'A Text Book of Biotechnology', S. Chand & Company Ltd., New Delhi, 2002.

2. P.K. Goel, 'Advances in Industrial Waste Water Treatment', Technoscience Publications, **1999**.
3. E. Bruce Rittmann and L. Perry, 'Environmental Biotechnology: Principles and Applications', Mc. Corty, McGraw Hill Publications, New York, 2000.
4. Hans-Joachim Jordening and Josef Winter, 'Environmental Biotechnology: Concepts and Applications', Wiley-VCH Verlag, 2005.

BIOINFORMATICS LAB.

Subject Code: BBOT1-533

L T P C

0 0 2 1

1. Sequence information resource
2. Understanding and use of various web resources: EMBL, Genbank, Entrez, Unigene,
3. Protein information resource (PIR)
4. Understanding and using: PDB, Swissprot, TREMBL
5. Using various BLAST and interpretation of results.
6. Retrieval of information from nucleotide databases.
7. Sequence alignment using BLAST.
8. Multiple sequence alignment using Clustal W and other programs
9. Phylogenetic analysis
10. Gene finder tools (Genscan GRAIL etc)
11. Protein structure prediction, protein modelling and docking.

Recommended Books

1. Z. Ghosh and M. Bibekanand, 'Bioinformatics: Principles and Applications'. Oxford University Press. ISBN 13: 9780195692303, **2008**.
2. J. Pevsner, 'Bioinformatics and Functional Genomics', 2nd Edn., Wiley Blackwell, ISBN: 978-0-470-08585-1, **2009**.
3. A.M. Campbell, L.J. Heyer, 'Discovering Genomics, Proteomics and Bioinformatics', 2nd Edn., Benjamin Cummings. ISBN-13: 978-0805382198, **2006**.

BIOANALYTICAL TOOLS LAB.

Subject Code: BBOT1-534

L T P C

0 0 2 1

1. Determine the absorption spectra of a biological sample with single/double beam spectrophotometer & verification of Beer's Lambert law.
2. Introductory microscopy experiments. Working of light, phase contrast, fluorescence and inverted microscope. Demonstration of TEM and SEM.
3. Differential centrifugation for separation of biomolecules.
4. To study separation of bio-molecules by paper chromatography.
5. To study separation of bio-molecules by thin layer chromatography.
6. Separation of proteins by ion-exchange column chromatography
7. Separation of proteins by affinity column chromatography.
8. Qualitative and quantitative analysis of DNA sample
9. Preparation of standard curve of protein
10. Preparation of standard curve of DNA.
11. Casting of vertical and horizontal gels for electrophoresis.
12. Separation of bio-molecules by vertical and horizontal gel electrophoresis

ENVIRONMENTAL BIOTECHNOLOGY LAB.

Subject Code: BBOT1-535

**L T P C
0 0 2 1**

1. Estimation of dissolved oxygen in water samples
2. Determination of BOD in polluted water sample
3. Determination of COD in polluted water
4. Estimation of Chlorine in water samples
5. Detection of coliform bacteria in water samples
6. Estimation of NOX concentration.
7. Estimation of SOX concentration.
8. Isolation of pesticide degrading microorganisms from soil
9. Biosorption of dyes from effluents by biomass and its recycling

ENZYMOLGY LAB.

Subject Code: BBOT1-536

**L T P C
0 0 2 1**

1. Estimation of α -amylase activity from saliva.
2. Assay of acid phosphatase activity.
3. Effect of temperature on enzyme activity.
4. Effect of pH on enzyme activity
5. Effect of substrates concentration on the activity of enzyme and determination of K_m and V_{max} of enzyme.
6. Demonstration/practical on competitive, non-competitive, uncompetitive enzyme inhibition using LB plot.
7. Screening of microorganisms producing industrial enzymes.
8. Immobilization of enzyme by different methods and their reuse.

Books Recommended

1. D.T. Plummer, 'An Introduction of Practical Biochemistry', 3rd Edn., Tata McGraw Hill, Publishers Co. Ltd., New Delhi, 1998.
2. D.D. Bansal, R. Khardori & M.M. Gupta, 'Practical Biochemistry', Standard Publication, Chandigarh, 1985.
3. S.K. Sawhney and Randhir Singh, 'Introductory Practical Biochemistry', Narosa Publishing House, New Delhi, 2001.

IPR, BIOETHICS AND BIOSAFETY

Subject Code: BBOT1-637

**L T P C
3 1 0 4**

Duration: 45 Hrs.

Objectives: This course will also make the students aware of the a) law pertaining to biotechnology, how to apply for national/international patent, Biotech agreements between various countries etc.(b) ethical issues concerned with the field of Biotechnology, (c) bioterrorism and (d) ways to handle/dispose-of biohazard material.

UNIT-I

Ownership of Tangible and Intellectual Property. Basic requirements of patentability, patentable subject matter, novelty and the Public Domain; Non obviousness. Introduction to Indian Patent Law. World Trade Organization and its related intellectual property provisions. WTO agreement and TRIPS, Patent Cooperation treaty, Intellectual/Industrial property and its legal protection in research, design and development.

UNIT-II

Patenting in Biotechnology, economic, ethical and depository considerations. Compulsory licensing, Patent infringements and revocation, Patents: Disclosure Requirements, Collaborative research, competitive research, Patent Litigation: Substantive Aspects of Patent Litigation, Procedural Aspects of Patent Litigation, Recent Development in Patent System, Budapest treaty.

UNIT-III

Biosafety – Introduction to biosafety and health hazards concerning biotechnology, The Cartagena protocol on biosafety. Introduction to the concept of containment level and Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).

UNIT-IV

Bioethics – Necessity of Bioethics, different paradigms of Bioethics – National & International. Ethical issues against the molecular technologies. Bioterrorism, Social and ethical implication of biological weapons

Recommended Books

1. P.K. Gupta, 'Elements of Biotechnology', Rastogi Publications, Meerut, ISBN- 978-81-7133-937-2, **2004**.
2. N. Subbaram, 'What Everyone should know about Patents?', Pharma Book Syndicate, Hyderabad, ISBN 13: 9788188449101, **2003**.
3. J. Watal, 'Intellectual Property Rights in the WTO and Developing Countries', Oxford University Press, New Delhi, **2001**.
4. M.K. Sateesh, 'Intellectual Property Bulletin', 'Bioethics and Biosafety', I.K. International Pvt. Ltd., ISBN-13: 978-8190675703, **2010**.
5. Sree Krishna V. 'Bioethics and Biosafety in Biotechnology', New Age International Publishers, ISBN- 9788122422481, **2007**.

FOOD BIOTECHNOLOGY

Subject Code: BBOT1-638

L T P C

Duration: 45 Hrs.

4 0 0 4

Objectives: This course enlightens the students about the role of biotechnology in the Food Sector. The major emphasis is on a) the role of microbes in the preparation of traditional food, alcoholic beverages and single cell proteins; b) microbial diseases spread through foods and their detection techniques c) various strategies used for preservation of foods.

Unit-I

History background of food technological advances, Composition of food, Growth of microorganisms in food: Intrinsic and extrinsic factors affecting food quality, Traditional fermented foods: Bread, cocoa, coffee, tea, sauerkraut, cheese, butter, yoghurt, meat, fish, etc.

Unit-II

Alcoholic Beverages: Beer, wine and whisky, Value addition products: production of high fructose syrup, invert sugars etc., Edible fungus: different types of edible mushrooms and their food value

Unit-III

Nutraceutical application of Spirulina, yeast etc. as food supplements, Improvement of food resources: Golden rice, Potato etc., Food and water borne disease: Gastroenteritis, Diarrhoea, Shigellosis, Salmonellosis, Typhoid, Cholera, Polio, Hepatitis etc.

Unit-IV

Food Borne Intoxications: Staphylococcal, Bacillus, Clostridium etc., Detection of food borne pathogens, techniques in food preservation and storage

Recommended Books

1. G.F.P. Lopez, G. Canas, E.V. Nathan, 'Food Sciences and Food Biotechnology', CRC, **2003**.
2. M. Ruse, D. Castle, 'Genetically Modified Foods', Prometheus Book Publication, ISBN-13: 978-1573929967, **2002**.
3. H.G. Schwartzberg, M.A. Rao, 'Biotechnology and Food Process Engineering', Marcel Dekker, **1990**.
4. James M. Jay, M.J. Lossner, D.A. Golden, 'Modern Food Biotechnology', 7th Edn., **2005**.
5. N.N. Potter, J.H. Hotchkiss, 'Food Science', 5th Edn., ISBN 978-0-8342-1265-7, **2005**.

BIOPROCESS ENGINEERING

Subject Code: BBOT1-639

L T P C
4 0 0 4

Duration: 45 Hrs.

Unit-1

Fundamental principles of biochemical engineering. Applications of physical and chemical laws on biological samples, Principles of upstream and downstream processing; Unit operations involved in bioprocesses. *Bioreactors:* Designing and development of a bioreactor; Aeration and agitation systems for bioreactors; Bioreactor configurations; Mode of operation-batch, fed batch and continuous; Scale-up of bioprocess.

Unit-II

Simple kinetics of microbial growth, yield coefficient, doubling time, specific growth rate, substrate inhibition kinetics, product inhibition kinetics, metabolic and biomass productivities.

Transport Phenomenon in Bioreactors: Mass transfer coefficient (KLa) for gases and liquids, determination of KLa, factors affecting KLa value in bioprocesses; Heat transfer-general considerations; Dimensionless groups; Fluid rheology.

Unit-III

Thermal death kinetics of batch and continuous sterilization of media; air and media sterilizations, design of batch sterilization process, Del factor, sterilization cycle, continuous sterilization process, sterilization of fermenters.

Unit-IV

Growth and product formation by recombinant cells, thermodynamics and stoichiometric aspects of microbial processes. Finishing techniques in bioprocesses: Distillation; Electrodialysis; Evaporation; Drying; Crystallography.

Recommended Books

1. P.F. Stanbury, A. Whitaker and S.J. Hall, 'Principles of Fermentation Technology', 2nd Edn., Pergamon Press, Oxford, **2001**.
2. M.Y. Young, 'Comprehensive Biotechnology', Vol. 1-4), Pergamon Press, Oxford, **2000**.
3. M.Y. Young, 'Environmental Biotechnology, Principles & Applications', Kluwer Academic Publications, New Delhi, **1996**.
4. J.E. Bailary and D.F. Ollis, 'Biochemical Engineering Fundamentals', McGraw Hills, N.Y., **1986**.
5. S.J. Pirt, 'Principles of Microbes and Cell Cultivations', Blackwell Scientific Publication, London, **1985**.

FOOD BIOTECHNOLOGY LAB.

Subject Code: BBOT1-640

L T P C

0 0 2 1

PRACTICALS

1. Preparation and estimation of casein content of milk
2. Estimation of lactose concentration in milk
3. Determination of pasteurization of milk by Alkaline phosphatase test
4. To check the microbial load in milk by Methylene blue dye reduction test
5. To enumerate microorganisms in food samples by Direct Microscopic Count
6. Isolation of Lactic Acid Bacteria from curd
7. Study of microflora associated with fresh and spoilt fruits and vegetables.

BIOPROCESS ENGINEERING LAB.

Subject Code: BBOT1-641

L T P C

0 0 2 1

1. To study the growth curve of microorganism.
2. To determine the specific growth rate and generation time of a bacterium during
3. submerged fermentation.
4. Demonstration of sterilization of fermenter and other accessories.
5. To study the effect of temperature, pH and aeration on growth of microbes.
6. Production of an enzyme in a Bioreactor/shaking flask.
7. Determination of thermal death kinetics of batch sterilization

Recommended Books

1. J.G. Cappuccino, N. Sherman, 'Microbiology: A Laboratory', Pearson Benjamin Cummings, 2007.
2. D.T. Plummer, 'An Introduction to Practical Biochemistry', Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2004.
3. D.D. Bansal, R.K. Hardori, M.M. Gupta, 'Practical Biochemistry', Standard Publication Chandigar, 1985.