

B.Sc. I Year, Paper -1

BIOCHEMICAL TECHNIQUES AND BIOPHYSICS

UNIT-I		
1.	Nature of biological material	01
2.	General properties of organic compounds for generation of structure, storage of energy and information	02
3.	Hydrophilic and hydrophobic groups in biological molecules	01
UNIT-II		
1.	Classification of biomolecules based on their role in bioprocesses i. Molecules involved in generation of mechanical stability-peptidoglycans, polysaccharides and membrane lipids ii. Molecules involved in information storage and retrieval –the nucleic acids iii. Molecules executing mediator and catalytic functions- the proteins iv. The signal molecules	
2.	Perspectives of biological macromolecules: the repeating units in nucleic acids and proteins. Helicity, bending, looping, pleats, salt bridges etc. and their determinants. The basis for intermolecular interactions eg. enzyme-substrate and antigen-antibody recognition.	
UNIT-III		
1.	Nature of biochemical reactions underlying biosynthesis and degradation. Tool of enzymes in such reactions. Protein and non-protein enzymes. Kinetics of enzyme catalyzed reactions.	05
2.	<i>In vitro</i> activity of purified enzymes and their applications in industry. Various uses of enzymes-enzymes in food processing, medicine, diagnostics and production of new compounds.	05
3.	Enzymes as research tool- ELISA methods, modification of biological compounds with the help of enzymes.	03
UNIT-IV		
1.	Energetics of living body. Sources heat limits to temperature. Heat dissipation and conservation.	02
2.	Lambert-Beer law. Spectrophotometry and colorimetry. Primary events in photosynthesis.	02
3.	Strategies of light reception in microbes, plants and animals.	01
4.	Correction of vision faults.	01
5.	Electrical properties of biological compartments. Electricity as a potential signal.	01

6.	Generation and reception of sonic vibrations. Hearing aids	02
UNIT-V		
1.	Intra and intermolecular interactions in biological systems. Spatial and charge compatibility as determinant of such interactions.	02
2.	Physical methods applied to find out molecular structures -X ray crystallography and NMR	05
3.	General spectroscopy-Uv vis, fluorescence, atomic absorption, IR, Raman spectra	05
4.	Physical methods of imaging intact biological structures <ul style="list-style-type: none"> - Ultrasound - Optical filters - X-ray - CAT scan - ECG - EEG - NMR imaging 	10

Practicals Paper-I

Quantitative estimation of the following in biological samples

Sugar in given solutions	1 x 3hrs
Sugar in biological samples	1 x 3 hrs
Extraction and separation of lipids	2 x 3 hrs
Estimation of proteins	2 x 3 hrs
Estimation of DNA/ RNA	2 x 3 hrs
Assay of enzyme activity	2 x 3 hrs
Kinetic studies on enzymes	5 x 3 hrs
Chromatographic methods for separation of macromolecules	5 x 3 hrs

B.Sc. I Year Paper-II

MICROBIAL TECHNIQUE AND RECOMBINANT TECHNIQUE

M.M.50

UNIT-I		
1.	Development of microscope (Optical, TEM and SEM)	01
2.	Pasteur's experiments disapproving spontaneous generation	01
3.	The concept of sterilization. Methods of sterilization (Dry heat, wet heat, radiation, chemical and filtration etc.)	02
4.	The various forms of microorganisms- <i>PPLOs, cocci, bacill and spirila</i>	01
5.	Concept of microbial species and strain	01
6.	Genetic homogeneity in clonal population	01
7.	Nature of the microbial cell surface. Gram positive and gram negative bacteria, kinds of flagella, serotypes	04
8.	Spontaneous and induced variation arising in microbial population	03
UNIT-II		
1.	Prokaryotic and eukaryotic microbial cells	02
2.	Gene transfer in microorganisms	01
3.	Nutritional classification of microorganisms	01
4.	Microbes in extreme environments- the thermophiles and alkalophiles	01
5.	Symbiosis and antibiosis among microbial population	02
6.	Photogenic microorganisms. Defence mechanism against microorganisms	02
UNIT-III		
1.	Microbial metabolism, Fermentation products. A survey of products from microorganisms. Strain improvement by enrichment, selection and recombinant DNA methods. production of heterologous proteins of interest in miroorganisms	04
2.	N ₂ fixing microbes in agriculture	02
UNIT-IV		
1.	What is gene cloning and why do we need to clone a gene?	02

2.	Tools and techniques, plasmids and other vehicles genomic DNA, handling of DNA, RNA, cDNA, RT enzymes and other reagents, techniques, Laboratory reagents	03
3.	Safety measures and regulations for recombinant DNA work	01
4.	Choice and selection of the tools and the techniques	02
5.	Vehicles: Plasmids and bacteriophages, available phagemids, cosmids, viruses	04
6.	Purification of DNA from bacterial, plant and animal cells	02
7.	Manipulation of purified DNA	03
8.	Introduction of DNA into living cells	02
9.	Cloning vectors for <i>E.coli</i>	
10.	Cloning vectors for organisms other than <i>E.coli</i> , yeast, fungi, plant-agrobact, plant virus, animal viruses	02
UNIT-V		
1.	Applications of cloning in gene analysis -How to obtain a clone of specific gene -Studying gene location and structure -Studying gene expression	03
2.	Gene cloning and expression of foreign genes in research and Biotechnology -Production of proteins form cloned genes	03
3.	Gene cloning in medicine -Phamaceutical compounds -Artificial insulin gene -Recombinant vaccine -diagnostic reagents	04

Practicals
Aseptic Techniques

Cleaning of glasswares	2x3 hrs
Preparation of media, cotton plugging and sterilization	2x3 hrs
Personal hygiene-Microbes from hands, tooth-scum and other body parts	2x3 hrs
Isolation of microorganisms from air, water and soil samples. Dilution and pour plating, Colony purification	2x3 hrs
Enumeration of microorganisms. Total vs viable counts	2x3 hrs
Identification of isolated bacteria. Gram staining, other staining methods metabolic characterization (eg IMVic test)	2x3 hrs

Growth curve of microorganisms	3x3 hrs
Antibiotic sensitivity of microbes, use of antibiotic discs	2x3 hrs
Testing of water quality	4x3 hrs
Test for antibodies against given bacteria	3x3 hrs
One step growth of bacteriophage	3x3 hrs
Culture from body fluids (Stool, Urine, Blood)	3x3 hrs
Alcoholic and mixed-acid fermentation	2x3 hrs

B.Sc. II Year, Paper-I

METHODS IN MOLECULAR & CELL BIOLOGY & ANIMAL CELL CULTURE

MM.50

UNIT-I		
1.	Molecular basis of life	02
2.	Structure of DNA	01
3.	DNA replication in both prokaryotes and eukaryotes	04
4.	DNA recombination-molecular mechanisms prokaryotic and eukaryotic	02
UNIT-II		
1.	Insertion elements and transposons	03
2.	Structure of prokaryotic genes	01
3.	Prokaryotic translation	03
4.	Prokaryotic gene expression (lac, his, trp, catabolic repression)	10
5.	Gene expression in yeast	02
6.	Gene expression in protozoan parasites	02
UNIT-III		
1.	Structure of eukaryotic genes	02
2.	Eukaryotic transcription	02
3.	Eukaryotic translation	02

4.	Eukaryotic gene expression, transcription factors etc.	10
5.	Gene organization and expression in mitochondria, chloroplasts	06
6.	Post translational regulation of gene expression	02
7.	Development and environmental regulation of gene expression	03
UNIT-IV		
1.	History of development of cell cultures	01
2.	The natural surroundings of animal cells	01
3.	Simulating natural conditions for growing animal cells	01
4.	Importance of growth factors of the serum	01
5.	Primary cultures. Anchorage dependence of growth. Non-anchorage dependent cells.	01
6.	Secondary cultures. Transformed animal cells-Established/ continuous cell lines	02
7.	Commonly used animal cell lines-their origin and characteristics	02
UNIT-V		
1.	Growth kinetics of cells in culture	01
2.	Applications of animal cell culture for studies on gene expression	01
3.	Organ culture	01
4.	Transfection of animal cells : Selectable markers, HAT selection, antibiotic resistance etc.	02
5.	Cell fusion	02
6.	Transplantation of cultured cells	01
7.	Differentiation of cells	02

Practicals

Cytological preparation -Fixation, dehydration and staining -Squash in stain -Embedding and sectioning	03x3 hrs 02x3 hrs 03x3 hrs
Cell counting methods -The haemocytometer and other ideas	02x2 hrs

Measurement with the help of light microscope -Calibration of ocular micrometer -Finding our average cell size -Chromosome lengths	01x3 hrs 01x3 hrs 01x3 hrs
Separation of cell types (from blood)	01x3 hrs
Separation of cell organelles -Methods for cell lysis: Rupture, osmotic/ chemical/ enzymatic/ lysis of cells Followed by centrifugation. Monitoring of cell lysis by release of cellular Material and by change in light scattering etc.	02x3 hrs
Extraction of cellular material -Extraction in saline buffer -Extraction in solvents -Precipitation from extracts	02x3 hrs 02x3 hrs 02x3 hrs

B.Sc. II Year, Paper II

IMMUNOLOGY & IMMUNOLOGICAL METHODS

M.M.50

UNIT-I		
1.	The immune system and immunology along with historical perspective	02
2.	The organs and the cells of the immune system and their function	06
UNIT-II		
1.	Antigen-antibody and their structure	03
2.	Antigen-antibody interaction	03
UNIT-III		
1.	Humoral and cell mediated immunity (role of MHC and genetic restriction)	06
UNIT-IV		
1.	Origin of diversity in the immune system	02
2.	Effectors mechanisms	04
UNIT-V		
1.	Immunity to infectious diseases, vaccines	04

Practicals

Purification of antigens	04
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Raising polyclonal antibodies	Spread over 8 weeks
Purification of antibodies	02
Conjugation and labeling of antibodies	02
Enzyme-linked immunoassay (ELISA)	03
Radioimmunoassay (RIA)	03
Radial immunodiffusion analysis	02
Generation of ascetic fluid	03
Diagnosis of an infectious disease by an immunoassay	03
Separation of the constituent molecules of the extract in aqueous buffer -Gel filtration chromatography -Ion exchange chromatography	03x 3 hrs 03x 3 hrs
Thin layer chromatography of extracted material	02x 3 hrs
Isolation of chromosomal and plasmid DNA from bacteria	04x 3 hrs
Making competent <i>E.coli</i> cells	02x 3 hrs
Transfection of plasmid DNA and selection for transformants	03x 3 hrs

B.Sc. III Year, Paper-I

ANIMAL CELL BIOTECHNOLOGY & PLANT BIOTECHNOLOGY

M.M.50

UNIT-I		
1.	General metabolism	02
2.	Special secondary metabolites/ products (Insulin, Growth hormone, Interferon, t-plasminogen, activator factor-VIII etc.)	02
3.	Expressing cloned proteins in animal cells, over production and processing of chosen protein	02
4.	The need to express in animal cells	01
UNIT-II		
1.	Production of vaccines ion animal cells	01
2.	Production of monoclonal antibodies	02

3.	Growth factors promoting proliferation of animal cells (EGF, FGF, PDGF, IL-I, IL-II, NGF, erythropoietin etc.)	04
4.	Bioreactors for large scale culture of cells	04
5.	Transplanting cultured cells	04
UNIT-III		
1.	Introduction to <i>in vitro</i> methods. Terms and definitions. Use of growth regulators.	02
2.	Beginning of <i>in vitro</i> cultures in our country (ovary and ovule culture, <i>in vitro</i> pollination and fertilization)	01
3.	Embryo culture, embryo rescue after wide hybridization and its applications	01
4.	Introduction to the processes of embryo genesis and organ genesis and their practical applications	02
5.	Clonal multiplication of entire species (Micropropagation) axillary bud, shoot-tip and meristem culture	02
6.	Haploids and their applications. Somaclonal variations and applications (Treasure your exceptions)	02
7.	Endosperm culture and production of triploids	01
8.	Practical applications of tissue and organ culture (summarizing the practical applications of all the above mentioned techniques)	01
UNIT-IV		
1.	Single-cell suspension cultures and their applications in selection of variants/ mutants with or without mutagen treatment (of haploid cultures preferably)	02
2.	Introduction to protoplast isolation: Principles and applications	01
3.	Testing of viability of isolated protoplasts	01
4.	Various steps in the regeneration of protoplasts	01
5.	Somatic hybridization-an introduction	02
6.	Various methods for fusing protoplasts. Chemical, electrical	01
7.	Use of markers for selection of hybrid cells	01
8.	Practical applications of somatic hybridization (hybrids vs cybrids)	01
UNIT-V		
1.	Use of plant cell protoplasts and tissue culture for genetic manipulation of plants. Introduction to <i>A. tumefaciens</i>	02

2.	Tumor formation on plants using <i>A. tumefaciens</i> (Monocots vs. Dicots)	01
3.	Root formation using <i>A. rhizogenes</i>	01
4.	Practical application of genetic transformation	01

B.Sc. III Year, Paper-II

MATHS & COMPLETE ENVIRONMENTAL BIOCHEMISTRY & CULTURE METHODS

M.M. 50

UNIT-I		
1.	Methods of sampling, confidence level	01
2.	Measurement of deviations	02
3.	Probability calculations	01
4.	Measurement of central tendencies	02
UNIT-II		
1.	Computers : General introduction to computers, organization of computers, digital and analogue computers, computer algorithm	03
2.	Application of computers in co-ordination of solute concentration, pH and temperature etc. of a fermenter in operation	02
3.	Demonstration of the above utilities (along with the above lectures)	02
UNIT-III		
1.	Renewable and non-renewable resources	02
2.	Renewable should be inassimilable/ biodegradable	02
3.	Major consumer items: Food, fuel and fibers	01
4.	Conventional fuels and their environmental impacts <ul style="list-style-type: none"> - Firewood - Plant and animal waste - Coal - Gas - Animal oils 	02
5.	Modern fuels and their environmental impacts <ul style="list-style-type: none"> - Methogenic bacteria and biogas - Microbial hydrogen production - Conversion of sugars to ethanol. The gasohol experiment - Solar energy converters-Hopes from the photosynthetic pigments 	05

	<ul style="list-style-type: none"> - Plant based petroleum industry - Cellulose degradation for combustible fuel 	
UNIT-IV		
1.	Biotechnological inputs in production of good quality natural fiber - Transgenic sheep and transgenic plants	03
2.	Microbiological quality of food and water	02
3.	Treatment of municipal waste and industrial effluents	03
4.	Degradation of pesticides and other toxic chemicals by microorganisms	02
5.	Thurigiensis toxin as a natural pesticide	01
6.	Biological control of other insects swarming the agricultural fields	02
7.	Enrichment of ores by microorganisms	02
8.	Biofertilizers. Enrichment of the soil with assimilable nitrogen by nitrogen fixing microorganisms	03
9.	Initiation of plant tissue culture (Dedifferentiation of explants)	01
UNIYT-V		
1.	Growth of plant cells into undifferentiated mass	01
2.	Large scale cultivation of plant cells in suspension	02
3.	Induction of differentiation by modulating the hormonal balance	01
4.	Culture of lymphocytes from blood samples. Preparation of media, Filter sterilization, monitoring microbial contamination (Bacteria, fungi and micoplasma). Cloning of animal cells by cell and colony purification	05
5.	Fusion of cultured cells with myeloma cells	01
6.	Production of monoclonal antibodies at a large scale	01
7.	Demonstration/ operation of large scale fermenters	02

B.Sc. III Year

Practicals and Project

The students will be assigned to generate data on available information from literature on a given topic of biotechnological relevance.

ENTREPRENEURSHIP

The students will be delivered lectures on how to select for a product line design and development processes, economies on material and energy requirement, stock and product and release the same for marketing etc. The basic regulations of excise also should be appraise on the candidates. In parallel, the students will be assigned to survey the demand for a given product, feasibility of its production under the given constraints of raw material, energy input, financial situations, export potential etc. Procedural details on how to select process, how to move for loans in aphasic manner should also be highlighted during the lectures. The semester should end with submission of a draft project by the students.

B.Sc in Biotechnology

2008-11

SYLLABUS

Structure of B.Sc. Programme with Specialization in Biotechnology

Year	Semester	Paper
I Year	I Semester	BT 101 : Biomolecules
		BT 102 : Enzymology, Biochemical Techniques and Biophysics
		BT 103 : Laboratory I
	II Semester	BT 201 : Microbial Techniques
		BT 202 : Recombinant DNA Technology
		BT 203 : Laboratory II
II Year	III Semester	BT 301 : Molecular Biology
		BT 302 : Molecular Biology, Cell Biology and Animal Cell Culture
		BT 303 : Laboratory III
	IV Semester	BT 401 : Immunology
		BT 402 : Immunological methods
		BT 403 : Laboratory IV
III Year	V Semester	BT 501 : Animal Cell Biotechnology
		BT 502 : Techniques and Applications of Animal Cell Biotechnology & Plant Biotechnology
		BT 503 : Literature survey, Internet surfing and preparation of project report on given topic
	VI Semester	BT 601 : Biostatistics, Computers and Bioinformatics
		BT 602 : Environmental Biotechnology
		BT 603 : Project Work

B.Sc. Biotechnology
I Year
I Semester

BT 101 : Biomolecules

UNIT I

1. Nature of biological material
2. Central properties of organic compounds for generation of structure, storage of energy and information

UNIT II

Classification, structure and roles of biomolecules in bioprocesses

1. Carbohydrates
2. Proteins
3. Lipids

UNIT III

Classification of biomolecules based on their role in bioprocess

1. Molecules involved in generation of mechanical stability: Peptidoglycans, polysaccharides and membrane lipids
2. Molecules involved in information storage and retrieval –the nucleic acids
3. Molecules executing mediator and catalytic functions- the proteins
4. The signal molecules

UNIT IV

Amino acids

1. Classification based on solubility, shape, structure and R-groups
2. Physical and Chemical properties
3. Separation of amino acids

UNIT V

1. Protein structure-Primary, secondary, tertiary and quaternary
2. Denaturation and renaturation of proteins
3. Structure and functions of fibrous proteins, globular proteins, lipoproteins, metalloproteins, glycoproteins and nucleoproteins

BT 102 : Enzymology, Biochemical Techniques and Biophysics

UNIT I

1. Enzymes : Historical perspective, classification, nomenclature, E.C. number
2. Mechanism of enzyme action and properties of enzymes as catalyst
3. Subcellular localization and organization of enzymes

UNIT II

1. Methods of enzyme assay
2. Expression of velocity of enzyme catalyzed reactions, activity, specific activity, turn over number and catalytic centre activity
3. Enzyme purification techniques: Objective and strategy, methods of homogenization, methods of isolation

UNIT III

1. Enzyme kinetics : Rate equation and determination of K_m and V_{max}
2. Effect of pH, temperature and pressure on enzyme activity
3. Enzyme inhibition

UNIT IV

1. Energetics of living body, sources of heat limits of temperature, heat dissipation and conservation
2. Lambert Beer's, Spectrophotometry and colorimetry, primary events in photosynthesis
3. Strategies of light reception in microbes, plants and animals.
4. Correction of vision fault
5. Electrical properties of biological compartments, electricity as a potential signal.
6. Generation and reception of sonic vibrations, hearing aids

UNIT V

1. Intra and intermolecular interactions in biological systems. Spatial and charge compatibility as determinant of such interactions.
2. Physical methods applied to find out molecular structure-X ray crystallography and NMR
3. General spectroscopy-Uv vis, fluorescence, atomic absorption, IR, Raman spectra
4. Physical methods of imaging intact biological structures
 - o Ultrasound
 - o Optical filters
 - o X-ray
 - o CAT scan
 - o ECG
 - o EEG
 - o NMR imaging

PRACTICALS FOR I SEMESTER

BT 103 : Laboratory I

1. Qualitative estimation of carbohydrates
2. Qualitative estimation of lipids
3. Qualitative estimation of proteins
4. Qualitative estimation of RNA
5. Qualitative estimation of DNA
6. Extraction and separation of lipids
7. Assay of enzyme activity
8. Kinetic studies on enzymes
9. Chromatographic methods for separation of macromolecules

B.Sc. Biotechnology
I Year
II Semester

BT 201 : Microbial Techniques

UNIT I

1. Development of microscope (Optical, TEM and SEM)
2. Pasteur's experiments disproving spontaneous generation
3. The concept of sterilization, Methods of sterilization (dry heat, wet heat, radiation, chemical and filtration etc.)
4. The various forms of microorganisms-*PPLOs, cocci, bacilli and spirilla*

UNIT II

1. Concept of microbial species and strain
2. Genetic homogeneity in clonal populations
3. Nature of the microbial cell surface. Gram positive and gram negative bacteria, kinds of flagella, serotypes
4. Spontaneous and induced variation arising in microbial population

UNIT III

1. Prokaryotes
2. Eukaryotic microbial cells
3. Gene transfer in microorganisms
4. Nutritional classification of microorganisms

UNIT IV

1. Microbes in extreme environments-the thermophiles, alkalophiles.
2. Symbiosis and antibiosis among microbial populations
3. Photogenic microorganisms and defense mechanism against microorganisms

UNIT V

1. Microbial metabolism, fermentation products, a survey of products from microorganism, strain improvement by enrichment, selection and recombinant methods. Production of heterologous proteins of interest in microorganisms
2. Nitrogen fixing microbes in agriculture

BT 202 : Recombinant DNA Technology

UNIT I

1. Cloning vectors for recombinant DNA
 - Plasmids as vectors
 - Cosmids as vectors
 - Phagemids as vectors
 - Plant and animal viruses as vectors
2. RNA, cDNA, RT enzymes and other reagents techniques
3. Purification and manipulation of DNA from bacteria, plants and animal cells

UNIT II

1. Introduction of DNA into living cells
2. Cloning vectors for *E.coli*, yeast, fungi
3. Cloning vectors for plants, plant viruses and animal viruses

UNIT III

1. Application of cloning in gene analysis

- How to obtain clone of specific gene
 - Studying gene location and structure
 - Studying gene expression
2. Gene cloning and expression of foreign gene in research and biotechnology
 - Production of proteins from cloned genes

UNIT IV

1. Application of gene cloning in agriculture
2. Application of gene cloning in industries

UNIT V

1. Polymerase chain reaction
2. DNA chip technology
3. Mass spectroscopy

PRACTICALS FOR II SEMESTER

BT 203 : Laboratory II

1. Cleaning of glassware
2. Preparation of media, cotton plugging and sterilization personal hygiene- microbes from hands, tooth-scum and other body parts
4. Isolation of microorganism from air, water and soil samples
5. Dilution and pour plating, colony purification
6. Enumeration of microorganisms, total vs viable counts
7. Identification of isolated bacteria, Gram staining, other staining methods
8. Metabolic characterization (eg. IMVic test)
9. Growth curve of microorganisms
10. Antibiotic sensitivity of microorganisms
11. Testing of water quality
12. Test for antibodies against given bacteria
13. One step growth for bacteriophage
14. Culture from body fluids (stool, urine, blood)
15. Alcoholic and mixed acid fermentation
16. Isolation of DNA from tissues
17. Determination of absorption maxima
18. Isolation of plasmid DNA
19. Competent cell preparation

B.Sc. Biotechnology
II Year
III Semester

BT 301 : Molecular Biology

Unit I

1. Molecular Basis of life
2. Structure of DNA- Evidence as genetic materials, composition of DNA and RNA
3. Generalized structure plan of nucleic acids, features of double helix, denaturation and annealing of DNA

Unit II

1. Insertion elements and transposons
2. Structure of prokaryotic genes
3. Structure of eukaryotic genes

Unit III

1. DNA Replication ; Replication machinery in prokaryotes and eukaryotes
2. Enzymology of DNA replication
3. Regulation of DNA replication

Unit IV

Transcription

1. Transcription in prokaryotes
2. Modes of termination
3. Regulation by small RNA molecules and cleavage of mRNA

Unit V

1. Genetic code, Wobble hypothesis, adaptors and amino acyl tRNA synthetases
2. Operon : definition, structure (trp, ara, lac, gal) and regulation

BT 302 : Molecular Biology, Cell Biology and Animal Cell Culture

Unit I

1. Transcription in eukaryotes
2. Post-transcriptional modification and processing in eukaryotes

Unit II

1. Translation in prokaryotes and its comparison with eukaryotes
2. Post translational modifications
3. Regulation of gene expression in eukaryotes

Unit III

1. History of development of Cell Culture
2. The natural surroundings of animal cells
3. Simulating natural conditions for growing animal cells
4. Importance of growth factors of the serum

Unit IV

1. Primary cultures, anchorage dependence of growth, non-anchorage dependent cells
2. Secondary cultures, transformed animal cells, established-continuous cell lines
3. Commonly used animal cell lines, their origin and characteristics

Unit V

1. Growth kinetics of cells in culture
2. Applications of animal cell culture for studies of gene expression
3. Organ culture
4. Transfection of animal cells, selectable markers, HAT selection, antibiotics resistance etc.
5. Cell fusion
6. Transplantation of cultured cells
7. Differentiation of cells

PRACTICALS FOR III SEMESTER BT 303 : Laboratory III

1. Cytological preparations : Fixation, dehydration and staining
2. Squash in stain
3. Embedding and sectioning, cell counting methods
4. The haemocytometer and other ideas
5. Measurement with the help of light microscope
6. Finding our average cell size
7. Chromosome lengths
8. Extraction of cell types (from blood)
9. Extraction of cell organelles
10. Methods for cell lysis: Rupture, osmotic/ chemical/ enzymatic/ lysis of cells followed by centrifugation.
11. Monitoring of cell lysis by release of cellular material and by change in light scattering etc.
12. Extraction of cellular materials
13. Extraction in saline buffers
14. Extraction in solvents
15. Precipitation from extracts

B.Sc Biotechnology
II Year
IV Semester

BT 401 : Immunology

Unit I

1. The immune system and immunity
2. Immune response

Unit II

1. Anatomical organization of immune system
2. Cells of immune system and their functions
3. Organs of immune system and their functions

Unit III

1. Antigen
2. Antigen-antibody and their structure

Unit IV

1. Antigen-antibody interaction
2. Antigen-antibody reaction *in vivo*
3. Antigen-antibody reaction *in vitro*

Unit V

1. Major histocompatibility complex
2. Recognition of antigen by T and B cells

BT 402 : Immunological Methods

Unit I

1. T-cell receptor complex
2. B-cell receptor complex

Unit II

1. Molecular mechanism of antibody diversity
2. Antibody engineering

Unit III

1. Effector mechanisms

Unit IV

1. Autoimmunity
2. Immunodeficiency syndrome

Unit V

1. Vaccines
2. Immunodiagnosics
 - precipitation techniques
 - agglutination
 - fluorescence techniques
 - ELISA
 - RIA

- Western blotting and
- immunohistochemical techniques

PRACTICALS FOR IV SEMESTER

BT 403 : Laboratory IV

1. Purification of antigens
2. Raising polyclonal antibodies
3. Purification of antibodies
4. Conjugation and labeling of antibodies
5. Generation of ascetic fluid
6. Enzyme linked immunosorbent assay (ELISA)
7. Radioimmunoassay (RIA)
8. Radial immunodiffusion analysis
9. Diagnosis of an infectious disease by an immunoassay
10. Separation of the constituent molecules of the extract in aqueous buffer
 - Gel filtration chromatography
 - Ion exchange chromatography
11. Thin layer chromatography of extracted material
12. Transfection of plasmid DNA and selection for transformant

B.Sc. Biotechnology
III Year
V Semester

BT 501 : Animal Cell Biotechnology

Unit I

1. General metabolism
2. Specific secondary metabolites/ products (insulin, growth hormone, interferon, t-plasminogen activator, factor VIII etc.

Unit II

1. Expressing cloned gene in animal cells, overproduction and processing of chosen proteins
2. The need to express in animal cells

Unit III

1. Production of vaccines in animal cells
2. Production of monoclonal antibodies
3. Growth factors promoting proliferation of animal cells (EGF, FGF, PDGF, IL-1, IL-2, NGF, erythropoietin)

Unit IV

1. Bioreactors for large scale culture of cells
2. Transplanting cultured cells

Unit V

1. Introduction to *in vitro* methods, terms and definitions, use of growth regulators
2. Beginning of *in vitro* cultures in our country (ovary and ovule culture, *in vitro* pollination and fertilization)
3. Embryo culture, embryo rescue after wide hybridization and its applications
4. Introduction to the processes of embryo genesis and organ genesis and their practical applications

BT 502 : Techniques and Applications of Animal Cell Biotechnology & Plant Biotechnology

UNIT I

1. Clonal multiplication of elite species (micropropagation, axillary bud, shoot tip and meristem culture)
2. Haploids and their applications, Somaclonal variation and applications (Treasure your expectations)
3. Endosperm culture and production of triploids
4. Practical applications of tissue and organ culture (summarizing the practical applications of all the above mentioned techniques)

UNIT II

1. Single cell suspension cultures and their applications in selection of variants/ mutants with or without mutagen treatment (of haploid culture preferably)
2. Introduction to protoplast isolations: principles and applications
3. Testing viability of isolated protoplasts
4. Various steps in the regeneration of protoplasts

UNIT III

1. somatic hybridization : an introduction
2. Various methods for fusing protoplasts , chemical, electrical
3. Use of markers for selection of hybrid cells
4. Practical applications of somatic hybridization (hybrids vs cybrids)

UNIT IV

1. Use of plant cells, protoplast and tissue culture for genetic manipulation of plants
Introduction to *A. tumefaciens*
2. Tumor formation in plants using *A. tumefaciens* (monocots vs dicots)

UNIT V

1. Root formation using *A. tumefaciens*
2. Practical applications of genetic transformation

BT 503 : Literature survey, Internet surfing and preparation of project report on given topic

**M.Sc Biotechnology
VI Semester**

BT 601 : Biostatistics, Computers and Bioinformatics

UNIT I

1. Introduction to Biostatistics, common terms, notations and Applications
2. Methods of sampling
3. Measurements of deviations

UNIT II

1. Probability calculations
2. Measurement of central tendencies

UNIT III

1. Computer : general introduction
2. Organization of computers
3. Digital and analogue computers
4. Computer algorithm

UNIT IV

1. Concept of hardware and software
2. Internal and external commands
3. Concept of file, folders, directories and their management

UNIT V

1. Overview of Bioinformatics
2. LAN, WAN, Internet Basics and E-mail
3. Introduction to MEDLINE on PubMed system for accessing Biological Information Entrez

BT 602 : Environmental Biotechnology

UNI I

1. Renewable and non-renewable resources
2. Renewable should be inassimilable/ biodegradable
3. Major consumer items: Food, fuel and fibers

UNIT II

1. Conventional fuels and their environmental impacts
 - Firewood
 - Plant and animal waste
 - Coal
 - Gas
 - Animal oils
2. Modern fuels and their environmental impacts
 - Methogenic bacteria and biogas
 - Microbial hydrogen production
 - Conversion of sugars to ethanol. The gasohol experiment
 - Solar energy converters-Hopes from the photosynthetic pigments
 - Plant based petroleum industry
 - Cellulose degradation for combustible fuel
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UNIT III

1. Biotechnological inputs in production of good quality natural fiber
- Transgenic sheep and transgenic plants
2. Microbiological quality of food and water
3. Treatment of municipal waste and industrial effluents
4. Degradation of pesticides and other toxic chemicals by microorganisms

UNIT IV

1. Thurigiensis toxin as a natural pesticide
2. Biological control of other insects harming the agriculture fields
3. Enrichment of ores by microorganisms
4. Biofertilizers, nitrogen fixing microorganisms enrich the soil with assimilable nitrogen
5. Initiation of plant tissue culture (dedifferentiation of explants)
6. Growth of plant cells into undifferentiated mass
7. Large scale cultivation of plant cells in suspensions
8. Induction of differentiation by modulating the hormonal balance

UNIT V

1. Culture of lymphocytes from blood samples. Preparation of media, Filter sterilization, monitoring microbial contamination (Bacteria, fungi and micoplasma). Cloning of animal cells by cell and colony purification
2. Fusion of cultured cells with myeloma cells
3. Production of monoclonal antibodies at a large scale
4. Demonstration/ operation of large scale fermenters

BT 603 : Project Work

To be carried out on a specific defined objective under the supervision of a teacher. The compiled work is to be submitted in the form of a dissertation.