

PROCEEDINGS OF THE MEETING OF THE BOS IN MICROBIOLOGY &  
BIOTECHNOLOGY (UG) HELD ON 20<sup>TH</sup> JUNE, 2003

Members present

1. Dr. N.S. Devaki, Yuvaraja College, Mysore

2. Dr. P.S. Shastry, BHS College, Bangalore

3. Mr. Denny John, St. Joseph's college, Bangalore

4. Ms. Pushpalatha, SJR College, Bangalore

5. Dr. S. Mahesh, NMKRV College, Bangalore

6. Prof. Krishne Gowda, Govt. Science College, Bangalore

7. Prof. Geetha Bali, Chairman, BOS

Devaki N.S. 20/6/2003  
P.S. Shastry 20/6  
Denny John 20/6/03  
Pushpalatha 20/6/03  
S. Mahesh  
Krishne Gowda 20/6/03  
Geetha Bali

The meeting of the BOS (UG) in microbiology and Biotechnology was conducted between 10.00 AM and 5.00 PM in the department of Microbiology, Bangalore University, Jnana Bharathi on 20<sup>th</sup> June, 2003. The chairman welcomed the members and presented the draft syllabus for B.Sc. Biotechnology and B.Sc. Microbiology, jointly prepared by the members of the BOS and further modified based on the discussions held during the workshop held on 17<sup>th</sup> and 18<sup>th</sup> June, 2002. The members thoroughly scrutinized each of the papers including practicals framed for B.Sc. Microbiology as well as B.Sc. Biotechnology and approved the same after suitable modifications.

The members unanimously approved the syllabi received from the university for introducing Indian constitution and computer fundamentals in undergraduate semester scheme.

With reference to the letter referred to the BOS about Biotechnology regular course, a syllabus has already been prepared for B.Sc. Biotechnology (Regular course) by the BOS and submitted to the University for further needful action. Now a new syllabus has been framed for B.Sc. Biotechnology semester scheme and the same is being submitted. The members unanimously expressed that the new syllabus could be implemented for B.Sc. Biotechnology regular course. The members further felt that there should be uniformity in the B.Sc. course offered in Biotechnology in various colleges.

The meeting concluded with thanks to the chair.

  
CHAIRMAN  
Board of Examiners in  
Microbiology & Biotechnology  
Bangalore University  
Bangalore-560 056

| Semester | Title of the paper                                                         | Lecture hours per week | Practical hours per week | Theory                    |               | Practical                 |               | Internal Assessment |  | TOTAL Marks |
|----------|----------------------------------------------------------------------------|------------------------|--------------------------|---------------------------|---------------|---------------------------|---------------|---------------------|--|-------------|
|          |                                                                            |                        |                          | Duration of exam in hours | Maximum Marks | Duration of exam in hours | Maximum Marks | Marks               |  |             |
| I        | BTP 101 - Cell Biology and Genetics<br>BTP 102 -                           | 4                      | 3                        | 3                         | 60            |                           |               | 10                  |  | 100         |
|          |                                                                            |                        |                          |                           |               | 2                         | 30            |                     |  |             |
| II       | BTP 201 - Microbiology and Biostatistics<br>BTP 202 -                      | 4                      | 3                        | 3                         | 60            |                           |               | 10                  |  | 100         |
|          |                                                                            |                        |                          |                           |               | 2                         | 30            |                     |  |             |
| III      | BTP 301 - Biochemistry and Biophysics<br>BTP 302 -                         | 4                      | 3                        | 3                         | 60            |                           |               | 10                  |  | 100         |
|          |                                                                            |                        |                          |                           |               | 2                         | 30            |                     |  |             |
| IV       | BTP 401 - Molecular Biology<br>BTP 402 -                                   | 4                      | 3                        | 3                         | 60            |                           |               | 10                  |  | 100         |
|          |                                                                            |                        |                          |                           |               | 2                         | 30            |                     |  |             |
| V        | BTP 501 - Genetic Engineering and Environmental Biotechnology<br>BTP 502 - | 3                      | 3                        | 3                         | 60            |                           |               | 10                  |  | 100         |
|          |                                                                            |                        |                          |                           |               | 2                         | 30            |                     |  |             |
|          | BTP 503 - Immunology and Animal Biotechnology<br>BTP 504 -                 | 3                      | 3                        | 3                         | 60            |                           |               | 10                  |  | 100         |
|          |                                                                            |                        |                          |                           |               | 2                         | 30            |                     |  |             |
| VI       | BTP 601 - Plant Biotechnology<br>BTP 602 -                                 | 3                      | 3                        | 3                         | 60            |                           |               | 10                  |  | 100         |
|          |                                                                            |                        |                          |                           |               | 2                         | 30            |                     |  |             |
|          | BTP 603 - Industrial Biotechnology<br>BTP 604 -                            | 3                      | 3                        | 3                         | 60            |                           |               | 10                  |  | 100         |
|          |                                                                            |                        |                          |                           |               | 2                         | 30            |                     |  |             |



**BANGALORE UNIVERSITY, BANGALORE**  
**Syllabus for B.Sc. Biotechnology (Semester Scheme)**

**Semester - I**

**BTP 101 - Cell Biology and Genetics**

*Total hours allotted: 60*

**Part A: Cell Biology**

*Total Hours: 33*

**Unit 1. Cell as a Basic unit of Living Systems**

Discovery of cell, The Cell theory.

Ultrastructure of an eukaryotic cell - (both plant and animal cells)

3 Hours

**Unit 2. Surface Architecture**

Structural organisation and functions of plasma membrane and cell wall of eukaryotes.

4Hours

**Unit 3. Cellular Organelles**

Structure and functions of cell organelles - Endoplasmic reticulum, Golgi complex, Mitochondria, Chloroplast, Ribosomes, Lysosomes, Peroxisomes, Nucleus (Nuclear envelope with nuclear pore complex, nucleolus, nucleoplasm and chromatin). Vacuole, Cytosol and Cytoskeletal structures (Microtubules, Micro filaments and Intermediate filaments).

12 Hours

**Unit 4. Chromosomes**

Discovery, morphology and structural organization - centromere, secondary constriction, telomere, chromonema, euchromatin and heterochromatin, chemical composition and karyotype. Ultrastructure: Single-stranded and multi-stranded hypotheses, folded-fibre and nucleosome models. Special types of chromosomes: Salivary gland and Lampbrush chromosomes

6 Hours

**Unit 5. Cell Division**

Cell cycle, mitosis and meiosis

4 Hours

**Unit 6. Cell Motility**

Amoeboid, ciliary and flagellar movements

2 Hours

**Unit 7. Cell Senescence and Programmed Cell Death**

2 Hours

**PART B: GENETICS**

*Total Hours: 27*

**Unit 1. Structure of DNA and RNA - a brief account**

2 Hours

**Unit 2. Mendelism**

Mendel's work, Laws of heredity, Test cross, Incomplete dominance and simple problems.

3 Hours

**Unit 3. Interaction of Genes**

Supplementary factors: Comb pattern in fowls  
 Complementary genes: Flower colour in sweet peas  
 Multiple factors - Skin colour in human beings  
 Epistasis: Plumage colour in poultry  
 Multiple allelism: Blood groups in human beings.

4 Hours



2

**Unit 4. Sex Determination in Plants and animals**

Concept of allosomes and autosomes, XX - XY, XX - XO, ZW - ZZ, ZO - ZZ types 2 Hours

**Unit 5. Linkage and Crossing Over**

Coupling and repulsion hypothesis, Linkage in maize and Drosophila, Mechanism of crossing over and its importance, Chromosome mapping - linkage map in maize. 4 Hours

**Unit 6. Chromosomal Variations**

A general account of structural and numerical aberrations, Chromosomal evolution of wheat and cotton. 4 Hours

**Unit 7. Cytoplasmic Inheritance**

Plastid inheritance in Mirabilis, Petite characters in yeast and Kappa particles in Paramecium. 2 Hours

**Unit 8. Mutations**

Types: spontaneous and induced, Mutagens: Physical and chemical, Mutation at the molecular level, Mutations in plants, animals, and microbes for economic benefit of man. 4 Hours

**Unit 9. Human Genetics**

Karyotype in man, Inherited disorders - Allosomal (Klinefelter syndrome and Turner's syndrome), Autosomal (Down syndrome and Cri-Du-Chat syndrome). 2 Hours

**Semester I**

**BTP 102 - Cell Biology and Genetics**

Total Units allotted: 15

- |                                                                                                      |         |
|------------------------------------------------------------------------------------------------------|---------|
| 1. Use of Micrometer and calibration, measurement of onion epidermal cells and yeast.                | 2 units |
| 2. Cell division: Mitotic and meiotic studies in grasshopper testes, onion root tips and flower buds | 4 Units |
| 3. Chromosomes: Mounting of polytene chromosomes                                                     | 1 Unit  |
| 4. Buccal smear - Barr bodies                                                                        | 1 Unit  |
| 5. Karyotype analysis - Man and Onion.                                                               |         |
| Man - Normal and Abnormal - Down and Turner's syndromes (with the help of slides)                    | 2 units |
| 6. Simple genetic problems (Problems on Interaction of genes)                                        | 1 Unit  |
| 7. Isolation of chloroplasts and mitochondria                                                        | 2 units |
| 8. Vital staining of mitochondria                                                                    | 1 Unit  |
| 9. Blood smear - differential staining                                                               | 1 Unit  |

**EACH STUDENT IS REQUIRED TO SUBMIT 5 PERMANENT SLIDES  
(MITOSIS & MEIOSIS - at least two from each)**



REFERENCES:

3

CELL BIOLOGY

1. Molecular Biology of Cell - Bruce Alberts et al, Garland publications
2. Animal Cytology & Evolution - MJD, White Cambridge University Publications
3. Molecular Cell Biology - Daniel, Scientific American Books
4. Cell Biology - Jack D. Bruke, The William Twilkins Company
5. Principles of Gene Manipulations - Old & Primrose, Black Well Scientific Publications
6. Cell Biology - Ambrose & Dorouthy M Easy, ELBS Publications.
7. Fundamentals of Cytology - Sharp, Mc Graw Hill Company
8. Cytology- Willson & Marrision, Reinform Publications
9. Molecular Biology - Smith Faber & Faber Publications.
10. Cell Biology & Molecular Biology - EDP Roberties & EMF Roberties, Saunder College
11. Cell Biology - C.B Powar, Himalaya Publications

GENETICS

1. Basic Genetics - Daniel L.Hartl, Jones & Barlett Publishers USA
2. Human Genetics and Medicine - New Studies in Biology by Cynl A Clark Edward Arnold Publishers, London
3. Genetics - Monroe W Strickberger, Macmillain Publishers, NewYork
4. Genes V - Benjamin Lewin, Oxford University Press.
5. Genes I - Benjamin Lewin, Wiley Eastern Ltd., Delhi.
6. Genes II - Benjamin Lewin, Wiley & Sons Publications
7. Genes III - Benjamin Lewin, Wiley and Sons Publications
8. Principles of Genetics - Winchester Sinnot & Dorn
9. Genetics- Blue Print of life by Sandhya Mitra, Tata McGraw Hill Publications
10. Genetics - Edgar Altenburg Oxford & IBH publications
11. Principles of Genetics - E.J.Gardener, M.J.Simmons and D.P.Snustad, John Wiley & Sons Publications



## Semester II

## BTP 201 - Microbiology and Biostatistics

Total hours allotted: 60 Hours

## Part A: Microbiology

Total hours allotted: 45 hrs

**Unit 1. Introduction and Scope of Microbiology**

Definition and history of microbiology, contributions of Antony van Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, and Alexander Fleming.

Importance and Scope of Microbiology as a modern science

Branches of Microbiology.

5 Hours

**Unit 2. Microscopy**

Construction and working principles of different types of microscopes – Compound, Dark field, Phase contrast, Fluorescence and Electron (Scanning and Transmission)

5 Hours

**Unit 3. Microbial Techniques**

A). **STERILIZATION:** Principles and applications of

- Physical Methods: Autoclave, Hot air oven, Laminar airflow, Seitz filter, Sintered glass filter, and membrane filter.
- Chemical Methods: Alcohol, Aldehydes, Phenols, Halogens and Gaseous agents.
- Radiation Methods: UV rays and Gamma rays.

5 Hours

B). **STAINS AND STAINING TECHNIQUES:** Principles of staining, Types of stains - Simple stains, Structural stains and Differential stains.

2 Hours

**Unit 4. Microbial Taxonomy**

Concept of microbial species and strains, classification of bacteria based on - morphology (shape and flagella), staining reaction, nutrition and extreme environment.

4 Hours

**Unit 5. General Account of Viruses and Bacteria**

A. **VIRUSES** - Structure and classification

Plant viruses - CaMV

Animal viruses - Hepatitis B

Bacterial virus - Lambda phage

B. **BACTERIA** - Ultrastructure of a bacterial cell (both Gram positive and Gram negative) including endospore and capsule

8 Hours

**Unit 6. Eukaryotic microorganisms**

Salient features, classification and reproduction of fungi, mycoplasma and algae.

4 Hours

**Unit 7. Pathogenic Microorganisms**

A. Bacterial diseases of man - Tetanus, Tuberculosis, Pneumonia and Cholera

B. Viral disease: AIDS (HIV).

6 Hours

**Unit 8. Microbial Metabolism**

A) Respiration: EMP, HMP and ED Pathways, Krebs cycle, Oxidative Phosphorylation.

B) Bacterial Photosynthesis: Photosynthetic apparatus in Prokaryotes, Photophosphorylation & Dark reaction.

6 Hours



## PART B - BIOSTATISTICS

Total hours allotted: 15 Hours

### Unit 1. Importance and application

Tabulation and Classification of data, Frequency distribution and Graphical distribution of data 2 Hours

### Unit 2. Measures of Central tendencies

Mean, Median, Mode and their properties 3 Hours

### Unit 3. Measures of Dispersion

Mean deviation, Variance, Standard deviation and Coefficient of Variation. 3 Hours

### Unit 4. Hypothesis Testing

Student T and Chisquare test 2 Hours

### Unit 5. Probability and Distribution

Concepts and problems on probability, Binomial, Poisson, Normal Distribution and their applications 3 Hours

Unit 6. Different models of data presentation with special reference to biological Samples 2 Hours

## Semester II

### BTP 202 - Microbiology

Total Units allotted: 15

1. Safety measures in microbiology laboratory
2. Cleaning and sterilization of glass ware 1 Unit
3. Study of instruments: Compound microscope, Autoclave, Hot air oven, pH meter, Laminar airflow and centrifuge. 2 Units
4. Staining Techniques: Simple, Negative staining, Gram staining, Endospore staining and fungal staining. 4 Units
5. Media preparation : Nutrient agar, MRBA and Nutrient broth. 2 Units
6. Isolation of bacteria and fungi from soil, air, and water - dilution and pour plate methods. 2 Units
7. Estimation of microorganisms - Total Count (haemocytometer) 1 Unit
8. Antibiotic sensitivity test - paper disc method 1 Unit
9. Biochemical tests - starch hydrolysis, catalase & gelatin liquefaction. 1 Unit
10. Study of *Rhizobium* from root nodules of legumes. 1 Unit



## REFERENCE

MICROBIOLOGY

1. Microbiology - Pelezar, Chan, Krieg Tata McGraw Hill Publications
2. Microbiology - Concepts and application by Paul A. Ketchum, Wiley Publications
3. Fundamentals of Microbiology-Frobisher, Saunders & Toppan Publications
4. Microbiology -Ronald M. Atlas
5. Introductory Biotechnology - R.B.Singh C.B.D. India (1990)
6. Industrial Microbiology-Casida L.E. Wiley Eastern Ltd.
7. Fundamentals of Bacteriology - Salley
8. Frontiers in Microbial technology-P.S.Bisen, CBS Publishers
9. Biotechnology: International Trends of perspectives A.T.Bull, G.Holl M.D.Lilly Oxford & TBH Publishers.
10. General Microbiology-C.B.Powar, H.F.Daginawala, Himalayan Publishing House

BIOSTATISTICS

1. Bliss, C.J.K. (1967) Statistics in Biology, Vol. I Mc Graw Hill, New York
2. Campbell R.C. (1974) Statistics for Biologists, Cambridge Univ. Press, Cambridge
3. Daniel (1999) Biostatistics (3<sup>rd</sup> edition) Panima Publishing Corporation
4. Swardlaw, A.C. (1985) Practical Statistics for Experimental Biologists, John Wiley and Sons, Inc., NY
5. Khan (1999) Fundamentals of Biostatistics Publishing corporation



## SEMESTER III

7

### BTP 301 - Biochemistry and Biophysics

Total hours allotted: 60 Hours

#### PART A: BIOCHEMISTRY

Total hours allotted: 38 Hours

##### BIOMOLECULES

###### Unit 1. Amino acids

Classification and properties

4 Hours

###### Unit 2. Proteins

Classification based on structure and functions, structural organization of proteins (primary, secondary, tertiary and quaternary structures)

10 Hours

###### Unit 3. Enzymes

Introduction, classification, enzyme kinetics, factors influencing enzyme activity, co-enzymes and co-factors.

8 Hours

###### Unit 4. Carbohydrates

Structure, properties and classification, Carbohydrates as a source of energy

5 Hours

###### Unit 5. Lipids

Structure, properties, classification and functions.

4 Hours

###### Unit 6. Vitamins

Water soluble and fat-soluble vitamins. Dietary source.

4 Hours

###### Unit 7. Hormones

Steroid hormones - structure and importance in brief

3 Hours

#### PART B : BIOPHYSICS

Total hours allotted: 22 Hours

###### Unit 1. Scope and development of Biophysics.

1 Hour

###### Unit 2. pH and buffer concepts.

2 Hours

###### Unit 3. Chemical bonding - Ionic bond, covalent bond, hydrogen bond and peptide bond. Vander-Waals forces, Principles of thermodynamics.

4 Hours

###### Unit 4 Analytical techniques

Principles and applications of

- Chromatography (Paper, thin-layer, column and GLC)
- Centrifugation (RPM and G, Ultracentrifugation)

7 Hours

###### Unit 5. Spectroscopic techniques

UV, visible spectroscopy, X-ray crystallography, NMR, IR, fluorescence & atomic absorption

4 Hours

###### Unit 6. Isotopes

Types, their importance in biological studies, measure of radioactivity, GM counters & Scintillation counting.

4 Hours



**BIP 302 - Biochemistry**

Total Units allotted: 15

- |                                                                                                   |         |
|---------------------------------------------------------------------------------------------------|---------|
| 1. Preparation of Buffers- Citrate and Phosphate.                                                 | 1 Unit  |
| 2. Estimation of reducing sugars- Glucose, Maltose and Lactose by DNS, H. J and Somoji's methods. | 4 Units |
| 3. Estimation of Protein by Biuret method and Lowry's method.                                     | 3 Units |
| 4. Assay of enzyme activity - Amylase.                                                            | 2 Units |
| 5. Separation of Sugars by TLC.                                                                   | 2 Units |
| 6. Estimation of Amino acids.                                                                     | 2 Units |
| 7. Estimation of inorganic phosphate by Subba row method.                                         | 1 Unit  |

**REFERENCE****BIOCHEMISTRY**

1. Principles of Biochemistry- Albert L. Lehninger CBS Publishers & Distributors.
2. Biochemistry- Lubert Stryer Freeman International Edition.
3. Biochemistry- Keshav Trchan Wiley Eastern Publications
4. Fundamentals of Biochemistry- J.L. Jain S. Chand and company
5. Biochemistry - Prasaraanga, Bangalore University
6. Fundamental of Biochemistry - Dr. A. C. Deb
7. Textbook of Organic Chemistry( A Modern approach)- P.L. Soni, Sultan Chand and Sons, Publishers.
8. The Biochemistry of Nucleic acid - Tenth-Edition- Roger L.P. Adams, John T. Knowler and David P. Leader, Chapman and Hall Publications.

**BIOPHYSICS**

1. Narayanan, P (2000) Essentials of Biophysics, New Age Int. Pub. New Delhi
2. Bliss, C.J.K. (1967) Statistics in Biology, Vol. I Mc Graw Hill, New York.
3. Campbell R.C. (1974) Statistics for Biologists, Cambridge Univ. Press, Cambridge
4. Daniel (1999) Biostatistics (3<sup>rd</sup> edition) Panima Publishing Corporation
5. Swardlaw, A.C. (1985) Practical Statistics for Experimental Biologists, John Wiley and Sons, Inc. NY
6. Khan (1999) Fundamentals of Biostatistics Publishing corporation
7. Roy R.N. (1999) A Text Book of Biophysics New Central Book Agency.



## SEMESTER IV

### BTP 401 - Molecular Biology

Total Hours Allotted: 60 Hours

**Unit 1. Molecular basis of Life - an introduction. Experimental proof of DNA and RNA as genetic material.** 3 Hours

#### Unit 2. Nucleic Acids

Structure and functions of DNA and RNA

Watson and Crick model of DNA and other forms of DNA(A and Z)

Functions of DNA and RNA including ribozymes

7 Hours

#### Unit 3. DNA Replication

Prokaryotic and Eukaryotic - Enzymes and proteins involved in replication, Theta model and Rolling circle model.

6 Hours

#### Unit 4. DNA Repair

Causes and mechanism- photoreactivation, excision repair, mismatch repair, SOS repair.

4 Hours

#### Unit 5. Recombination in prokaryotes

Transformation, Conjugation and Transduction.

5 Hours

**Unit 6. Structure of Prokaryotic and Eukaryotic gene - genetic code, Properties and Wobble hypothesis.**

5 Hours

#### Unit 7. Transcription in Prokaryotes and Eukaryotes

Mechanism, Promoters and RNA polymerase, transcription factors, Post transcriptional modifications of eukaryotic mRNA.

7 Hours

#### Unit 8. Translation

Mechanism of translation in Prokaryotes and Eukaryotes, Post translational modifications of proteins.

3 Hours

#### Unit 9. Regulation of Gene expression

Regulation of Gene expression in Prokaryotes - Operon concept (Lac and Tryp)

Regulation of Gene expression in Eukaryotes. - transcriptional activation, galactose metabolism in yeast.

8 Hours

**Unit 10. Gene organization and expression in Mitochondria and chloroplasts.**

3 Hours

#### Unit 11. Insertional elements and transposons.

Transposable elements in Maize and Drosophila.

4 Hours

1. Preparation
2. Estimation
3. Estimation
4. Detergent
5. Osmotic
6. Extraction of Organic
7. Extraction and precipitation
8. Protein
9. Charts

#### REFERENCE

#### MOLECULAR

1. Glick
2. How
3. Lewi
4. Righ
5. Sami
6. Wall
7. Kar



**BTP 402 - Molecular Biology**

Total Units Allotted: 15

- |                                                                                                                                      |         |
|--------------------------------------------------------------------------------------------------------------------------------------|---------|
| 1. Preparation of DNA model.                                                                                                         | 1 Unit  |
| 2. Estimation of DNA by DPA method.                                                                                                  | 1 Unit  |
| 3. Estimation of RNA by Orcinol method.                                                                                              | 1 Unit  |
| 4. Detergent lysis of RBC                                                                                                            | 1 Unit  |
| 5. Osmotic lysis of RBC.                                                                                                             | 1 Unit  |
| 6. Extraction and estimation of protein from animal goat liver/muscle source by Salt precipitation & Organic solvent method          | 3 Units |
| 7. Extraction and estimation of protein from animal or plant source (Green gram/Pea) by Salt precipitation & Organic solvent method. | 3 Units |
| 8. Protein separation by Polyacrylamide Gel Electrophoresis (PAGE)                                                                   | 3 Units |
| 9. Charts on - Conjugation, Transformation and Transduction                                                                          | 1 Unit  |

**REFERENCE****MOLECULAR BIOLOGY**

1. Glick, B.R and Pasternak J.J (1998) Molecular biotechnology, Principles and application of recombinant DNA, Washington D.C. ASM press.
2. Howe, C. (1995) Gene cloning and manipulation, Cambridge University Press, USA
3. Lewin, B., Gene VI New York, Oxford University Press
4. Rigby, P.W.J. (1987) Genetic Engineering Academic Press Inc. Florida, USA
5. Sambrook et al (2000) Molecular cloning Volumes I, II, & III, Cold spring Harbor Laboratory Press, New York, USA
6. Walker J.M and Gingold, E.B. (1983) Molecular Biology & Biotechnology (Indian Edition) Royal Society of Chemistry U.K.
7. Karp, G (2002) Cell & Molecular Biology, 3<sup>rd</sup> Edition, John Wiley & Sons; INC



## SEMESTER V

## BTP 501 - Genetic Engineering and Environmental Biotechnology

Total Hours Allotted: 60 Hours

## PART A: Genetic Engineering

Total Hours Allotted: 25 Hours

Unit 1. Introduction to Genetic Engineering 1 Hour

Unit 2. Tools for genetic engineering

1. DNA manipulative enzymes - Restriction enzymes and DNA ligases. 1 Hour

2. Gene cloning vectors - Plasmids, Bacteriophage and Cosmids. 3 Hours

Unit 3. In vitro construction of recombinant DNA molecules --(pBR 332, pUC 19) Isolation of passenger &amp; vector DNA, creation of r-DNA. 3 Hours

Unit 4. Transformation of r-DNA - Transformation of r-DNA molecules into target host organisms - Calcium chloride mediated, Electroporation and microinjection. 2 Hours

Unit 5. Screening and selection of recombinant host cells - Immunological screening and Colony hybridization. 2 Hours

Unit 6. Gene Libraries - Genomic DNA and c DNA cloning techniques. 2 Hours

Unit 7. Expression of cloned DNA in *E. coli* 1 Hour

Unit 8. Molecular biology techniques 6 Hours

a) Electrophoretic techniques - Proteins and nucleic acids.

b) Polymerase chain reaction (PCR)

c) Site directed mutagenesis (SDM)

d) Nucleic acid sequencing - Sanger's method

e) Blotting techniques - Southern, Western and Northern blot

Unit 9. Application of r-DNA technique in human health. 4 Hours

a) Production of Insulin

b) Production of recombinant vaccines- Hepatitis - B

c) Production of human growth hormone.

## PART B : ENVIRONMENTAL BIOTECHNOLOGY

Total Hours Allotted: 20 Hours

Unit 1. Renewable and Non-Renewable resources of energy 1 Hour

Unit 2. Conventional fuels and their environmental impact - Firewood, Plant, Animal, Water, Coal and Gas. 2 Hours

Unit 3. Modern fuels and their environmental impact - Methanogenic bacteria, Biogas, Microbial hydrogen Production, conversion of sugar to alcohol &amp; Gasohol 3 Hours

Unit 4. Bioremediation

Bioremediation of soil &amp; water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes, Phytoremediation. Degradation of pesticides and other toxic



chemicals by Micro-organisms – Degradation of aromatic and chlorinated hydrocarbons and petroleum products.

**Unit 5. Treatment of Municipal waste and Industrial effluents.**

2 Hours

**Unit 6. Biofertilizers**

Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil.

Algal and Fungal bio fertilizers (VAM)

3 Hours

**Unit 8. Bioleaching**

Enrichment of ores by microorganisms (Gold, Copper and Uranium)

2 Hours

**Unit 9. Environmental Significance of Genetically modified microbes, plants and animals.**

1 Hour

**BTP 502 - Genetic Engineering and Environmental Biotechnology**

Total Units Allotted: 15

- |                                                                    |         |
|--------------------------------------------------------------------|---------|
| 1. Isolation of genomic DNA from bacteria, plant and animal tissue | 3 Units |
| 2. Isolation of plasmid DNA (E.coli)                               | 1 Unit  |
| 3. Restriction digestion of DNA                                    | 2 Units |
| 4. Separation of DNA by Gel Electrophoresis                        | 2 Units |
| 5. SDS-PAGE                                                        | 2 Units |
| 6. Bacterial Examination of water by MPN Method                    | 2 Units |
| 7. Estimation of BOD (2 Samples)                                   | 2 Units |
| 8. VAM staining                                                    | 1 Unit  |

**REFERENCE**

**GENETIC ENGINEERING**

- Glick, B.R & Pasternak J.J (1994) Molecular Biotechnology, Principles and applications of Recombinant DNA, American Society for Microbiology, Washington D.C.
- Christopher H. (1995) Gene cloning and Manipulation, Cambridge University Press.
- Nicholl, D.S.T (1994) An Introduction of Genetic Engineering, Cambridge University Press.
- Old, R.W. and Primrose, S.B. (1986) Principles of gene manipulation, An introduction to genetic engineering (3<sup>rd</sup> Edition) Blackwell Scientific Publications
- Watson, J.D. Hopkins, N.H. Roberts, J.W. Steetz, J.A. and Weiner, A.M (1988). Molecular Biology of the Gene the Benjamin/Cummings Publishing Company, Inc.
- Kucherlapati, R. and Smith G.R Editors (1988) Genetic recombination, Washington, D.C American Society for Microbiology.
- Lewin B. (1994) Genes VI, New York, Oxford University Press.

**ENVIRONMENTAL BIOTECHNOLOGY**

- Microbial Biotechnology (1995) Alexander N. Glazer Hiroshi Nikaide W.H. Freeman and Company
- Molecular biotechnology: Principles and Applications of Recombinant DNA- Bernaral R. Glick and Jack J. Pasternak ASM Press, Washington, D.C. (1994).
- Fungal Ecology and Biotechnology (1993) Rastogi Publications, Meerut



## SEMESTER V

## BTP 503 - Immunology and Animal Biotechnology

Total Hours Allotted: 45 Hours

## PART A: Immunology

Total Hours Allotted: 25 Hours

|                                                                                                                                                                                                                                     |         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| Unit 1. History and scope of Immunology.                                                                                                                                                                                            | 1 Hour  |
| Unit 2. Types of Immunity<br>Passive, Active and Acquired immunity. Humoral, Cell Mediated Immunity                                                                                                                                 | 2 Hours |
| Unit 3. Cell and organs of immune responses and their functions.                                                                                                                                                                    | 2 Hours |
| Unit 4. Antigens<br>Types, haptens, epitopes and Factors influencing antigenicity.                                                                                                                                                  | 2 Hours |
| Unit 5. Antibodies<br>Structure, types, properties and functions of immunoglobulins. Production of antibodies.                                                                                                                      | 3 Hours |
| Unit 6. Complement system<br>Structure, Components, Properties and Functions.                                                                                                                                                       | 2 Hours |
| Unit 7. Antigen - Antibody reaction<br>Invitro tests - Precipitation, Immuno-electrophoresis, Haemagglutination, Labelled antibody (RIA, ELISA and Immuno-fluorescent techniques).<br>In-vivo Serological reactions - Phagocytosis. | 6 Hours |
| Unit 8. Hypersensitivity and Allergic reactions                                                                                                                                                                                     | 2 Hours |
| Unit 9. Blood cell components, ABO blood grouping Rh typing                                                                                                                                                                         | 2 Hours |
| Unit 10. Vaccines and Immunization<br>Passive and Active immunization.<br>Types of Vaccines - Inactivated, Attenuated and Recombinant Vaccines - Peptide and DNA Vaccines.                                                          | 3 Hours |

## PART B: ANIMAL BIOTECHNOLOGY

Total Hours Allotted: 20 Hours

|                                                                                                                                                                                                                                            |         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| Unit 1. Scope of Animal Tissue Culture.                                                                                                                                                                                                    | 1 Hour  |
| Unit 2. Culture Media<br>Simulating natural conditions for growth of animal cells:<br>1. Natural media - Plasma Clot, biological fluids tissue extract, embryo extract, Importance of Serum in media.<br>2. Chemical defined media.        | 3 Hours |
| Unit 3.<br>a) Primary Culture:- Cell lines, and cloning disaggregation of tissue, isolation of tissue, enzyme disaggregation, and mechanical disaggregation.<br>b) Secondary Culture:- Transformed animal cells and continuous cell lines. | 3 Hours |



**Unit 4.** Transfection of animal cell lines, HAT-selection, Selectable Markers and Transplantations of Cultural Cells. 3 Hours

**Unit 5.** Expression of Cloned proteins in animal cell:- Expression vector, over production and downstream processing of the expressed proteins. 2 Hours

**Unit 6.** Production of vaccines in animal cells. 1 Hour

**Unit 7.** Production and applications of monoclonal antibodies. 1 Hour

**Unit 8.** Growth factors- promoting proliferation of animal cells EGF, FGF, PDGF, IL-1, IL-2, NGF and Erythropoietin. 3 Hours

**Unit 9. Transgenic Animals**  
Techniques and Applications and Transgenic mice and sheep. 3 Hours

#### **BTP 504 - Immunology and Animal Biotechnology**

Total Units Allotted: 15

- |                                                                      |         |
|----------------------------------------------------------------------|---------|
| 1. Blood grouping                                                    | 1 Unit  |
| 2. Differential Count of WBC                                         | 2 Units |
| 3. Widal Test and VDRL Test                                          | 2 Units |
| 4. Dot Elisa                                                         | 1 Unit  |
| 5. ELISA - Demonstration                                             | 2 Units |
| 6. Ochterlouny Double diffusion (ODD)                                | 1 Unit  |
| 7. Isolation of liver parenchyma cells                               | 3 Units |
| 8. Rocket Electrophoresis                                            | 2 Units |
| 9. Separation of Serum from blood & precipitation of Immunglobulins. | 2 Units |

#### **REFERENCE**

##### **IMMUNOLOGY**

1. William, E. Paul, (1989) Fundamental immunology, 2<sup>nd</sup> Edition Raven Press, New York.
2. William, R. Clark (1991) The Experimental Foundations of Modern Immunology (4<sup>th</sup> Edition) John Wiley and Sons, New York.
3. Ivan, M. Roitt (1994) Blackwell Scientific Publications, London.

##### **ANIMAL CELL BIOTECHNOLOGY**

1. Ian Freshney (4<sup>th</sup> Edition)
2. Buttler.
3. Elements of Biotechnology-P.K. Gupta (1<sup>st</sup> Edition-2000) Rastogi Publications



## SEMESTER VI

15

### BTP 601 - Plant Biotechnology

Total Hours Allotted: 45 Hours

- Unit 1.** *In-vitro* methods in plant tissue culture, Aseptic Techniques, Nutrient media, and use of growth regulators (Auxins, Cytokinins and Gibberellins). 6 Hours
- Unit 2.** *In-vitro* fertilization - Ovary and Ovule culture. 2 Hours
- Unit 3.** Clonal propagation of elite species (Micro propagation). 4 Hours
- Unit 4.**  
Organ Culture - Anther, Embryo and Endosperm culture and their applications  
Organogenesis and Somatic Embryogenesis - Technique and applications. 10 Hours
- Unit 5.**  
Protoplast Culture - Isolation, regeneration and viability test, somatic hybridization, methods of protoplast fusion - Chemical and electro fusion, practical application of somatic hybridization and cybridization.
- Unit 6.** Somaclonal variation and their significance. 10 Hours  
3 Hours
- Unit 7.** *In-vitro* production of secondary metabolites - Techniques and significance 5 Hours
- Unit 8.** Role of tissue culture in agriculture, horticulture and forestry 4 Hours
- Unit 9. Transgenic plants**  
Technique of transformation - Agrobacterium mediated and physical methods (Microprojectile and electroporation) Application of transgenic plants. 8 Hours
- Unit 10.** Edible Vaccines from plants - Banana, Watermelon 4 Hours
- Unit 11. Biotechnology and Intellectual property rights**  
Patents, trade secrets, copyright, trademark. Choice of Intellectual property (IPR) and plant genetic resources (PGR), GAA and TRIPS 4 Hours



## BTP 602 - Plant Biotechnology

Total Units Allotted: 15

- |                                                                                     |         |
|-------------------------------------------------------------------------------------|---------|
| 1. Preparation of plant culture media - MS (1962), Nitsch (1969) and White's medium | 4 Units |
| 2. Production of Callus and suspension culture                                      | 2 Units |
| 3. Plant protoplast Isolation                                                       | 2 Units |
| 4. Plant propagation through Tissue culture (shoot tip and Nodal culture)           | 4 Units |
| 5. Preparation of Synthetic seeds                                                   | 1 Unit  |
| 6. Anther Culture                                                                   | 2 Units |

## REFERENCE

## PLANT BIOTECHNOLOGY

1. Ravishankar G.A and Venkataraman L.V (1997) Biotechnology Applications of plant Tissue & Cell culture. Oxford & IBH Publishing co., Pvt Ltd.
2. Bhan (1998) Tissue Culture, Mittal Publications, New Delhi
3. Islan A.C (1996) Plant Tissue Culture, Oxford & IBH Publishing Co., Pvt. Ltd.
4. Lydiane Kyte & John Kleyn (1996) Plants from test tubes. An introduction to Micropropagation 3<sup>rd</sup> Edition) Timber Press, Portland.
5. Kumar H.D (1991) A text book on Biotechnology (2<sup>nd</sup> Edition), Affiliated East West Press Private Ltd. New Delhi
6. Chrispeel M.J. and Sdava D.E. (1994) Plants, Genes and agriculture. Jones and Barlett Publishers, Boston
7. Reinert J. and Bajaj Y.P.S. (1997) Applied and Fundamental Aspects of Plant Cell, Tissue, and Organ Culture. Narosa Publishing House



**BTP 603 - Industrial Biotechnology**

Total Hours Allotted: 45 Hours

- Unit 1.** Introduction to industrial Biotechnology, basic principles of fermentation technology. 1 Hour
- Unit 2.** Screening and Isolation of Microorganisms, maintenance of strains, strain improvement (Mutant Selection, Recombinant DNA methods). 2 Hours
- Unit 3. Fermentation Media**  
Natural and Synthetic Media.  
Sterilization techniques- Heat, Radiation and Filtration methods. 2 Hours
- Unit 4. Fermenters**  
Process of Aeration, Agitation, Temperature regulation and Foam control.  
Types of Fermenters-Typical, Airlift, Tower and Bubble-up Fermenter. 5 Hours
- Unit 5. Type of Fermentation**  
Solid State, submerged fermentation and continuous fermentation  
Immobilized enzyme and cell bioreactors. 3 Hours
- Unit 6.** Process Development - Shake flask fermentation, Down stream processing (DSP), Disintegration of cells, Separation, Extraction, Concentration and Purification of Products 4 Hours
- Unit 7. Production of Microbial products**  
Brief account of the following products obtained by industrial microbiological fermentation.  
Alcohol  
Alcoholic Beverage - Beer  
Organic acid - Citric acid  
Antibiotic - Penicillin  
Amino acids - Glutamic acid  
Vitamin - B12  
Brief account of Steroid biotransformation. 11 Hours
- Unit 8. Enzyme Biotechnology**  
Characteristics of enzymes  
Industrially produced enzymes - amylases.  
Industrial use of enzymes - Detergents, Leather, Beverage, food and Pharmaceutical  
Bioreactors for enzyme production - Stirred tank, membrane reactors and continuous flow reactors 6 Hours
- Unit 9. Fermented Foods**  
Fermented Foods - Yoghurt, Buttermilk, Idli, Dosa, Cheese, Tempeh.  
Microbial Foods - Single cell proteins (SCP), Single cell oils (SCO). 5 Hours
- Unit 10.** Plant cell suspension culture for the production of food additives - Saffron and Capsaicin 2 Hours
- Unit 11.** Technique of mass culture of Algae - *Spirulina* 1 Hour
- Unit 12.** Microbial polysaccharides and polyesters; production of xanthan gum and polyhydroxyalkonoides (PHA) 3 Hours



**BTP 604 - Industrial Biotechnology**

Total Units Allotted: 15

- |                                                                                                                  |         |
|------------------------------------------------------------------------------------------------------------------|---------|
| 1. Algal and fungal culture - Spirulina, Agaricus, Yeast and Aspergillus.                                        | 4 Units |
| 2. Estimation of citric acid from <u>Aspergillus</u> culture.                                                    | 2 Units |
| 3. Estimation of lactic acid and lactose.                                                                        | 3 Units |
| 4. Immobilization of Yeast cells.                                                                                | 1 Unit  |
| 5. Preparation of wine.                                                                                          | 2 Units |
| 6. Estimation of Alcohol by Specific gravity method.                                                             | 1 Unit  |
| 7. Immobilisation of Enzymes - (Invertase can be obtained from yeast cells and observed for glucose production). | 2 Units |
| 8. Visit to Research Centres/ Institutions/ Industries.                                                          |         |

**REFERENCE****INDUSTRIAL BIOTECHNOLOGY**

1. Sullia S. B & Shantharam S : (1998) General Microbiology, Oxford & IBH Publishing Co. Pvt. Ltd.
2. Bisen P.S (1994) Frontiers in Microbial Technology, 1<sup>st</sup> Edition, CBS Publishers.
3. Glazer A.N & Nikaide. H (1995) Microbial Biotechnology, W.H. Freeman & Co.
4. Prescott & Dunn (1987) Industrial Microbiology 4<sup>th</sup> Edition, CBS Publishers & Distributors.
5. Prescott & Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers.
6. Crueger W. & Crueger A. (2000) A Text of Industrial Microbiology, 2<sup>nd</sup> Edition, Panima Publishing Corp.,
7. Stanbury P.F, Whitaker H, Hall S.J (1997) Principle of Fermentation Technology., Aditya Books (P) Ltd.