

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

Semester - I

BTP 101 – Cell Biology and Genetics

Total hours allotted : 60

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 cell) 3 Hours

Unit -2. Surface Architecture

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, Cytoskeletal structures (Microtubules, Microfilaments and Intermediate filaments). 12 Hours

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, Cytoplasm and Cytoskeletal structures (Microtubules, Microfilaments 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 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

Unit 4. Sex Determination in Plants and animals
Concepts 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 Hour

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 - Autosomal (Klinefelter syndrome and Turner's syndrome), Autosomal (Down syndrome and Cri-Du-Chat syndrome).

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 and Interaction of genes)
7. Isolation of chloroplasts and mitochondria 1 Unit
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)

Reference:

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 & Dorothy M Easty, ELBS Publications.
7. Fundamentals of Cytology – Sharp, Mc Graw Hill Company
8. Cytology – Wilson & Marrison, Reinform Publications
9. Molecular Biology – Smith Faber & Faber Publications
10. Cell Biology & Molecular Biology – EDP Roberties & EMF Roberties, Sauder College.
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 Hrs

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 Importance and scope of Microbiology as a modern Science
Branches of microbiology.

Unit 2. Microscopy

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

Unit 3. Microbial Techniques

A) Sterilization: Principles and Applications of

a. Physical Methods. Autoclave, Hotairoven, Laminar airflow, Seitz filter, Sintered glass filter, and membrane filter.

b. Chemical Methods: Alcohol, Aldehydes, Phenols, Halogens and Gaseous agents.

c. Radiation Methods: UV rays and Gamma stains. 2 Hours

B) STAINS AND STAINING TECHNIQUES: Principles of staining, Types of stains – simple stains, structural stains and Differential stains.

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 – Lamba Phage
B. Bacteria – Ultrastructure of bacteria 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 – Tetnus, Tuberculosis, Pneumonia and Cholera
B. Viral diseases: AIDS (HIV)

Unit 8. Microbial Metabolism
A) Respiration: EMP, HMP and ED Pathways, Kreb’s cycle, Oxidative Phosphorylation.
B) Bacterial Photosynthesis: Photosynthetic apparatus in prokaryotes, Photophosphorylation & Dar reaction 6 Hours

PART B – BIOSTATISTICS

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

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

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 : Nutrients agar, MRBA and Nutrient broth	2 Units
6. Isolation of bacteria and fungi from soil, air, and water – dilution and pourplate methods	2 Units
7. Estimation of microorganisms – Total Count (Haemocytometer)	1 Unit
8. Antibiotic sensitivity test – starch hydrolysis, catalase &	
9. Biochemical tests – starch hydrolysis, catalase & gelatin liquefaction.	1 Unit
10. Study of Rhizobium from root nodules of legumes	1 Unit

Semester III
BTP 301 – Biochemistry and Biophysics

Total hours allotted: 60 Hours

PART A : BIOCHEMISTRY

BIOMOLECULES

Unit 1. Amino acids
Classification and properties

Unit 2. Proteins
Classification based on structure and functions, structural organization of proteins (primary, secondary, tertiary and quaternary structures)

Unit 3. Enzymes
Introduction, classification, enzyme kinetics, factors influencing enzyme activity, co-enzymes and co-factors. 8 Hours

Unit 4. Carbohydrates
Structures, 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

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 a) Chromatography (Paper, thin-layer, column and GLC) b) 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.	

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, Sauders & toppan publications.
4. Microbiology - Ronald M.Atlas
5. Introductory Biotechnology – R.B. Singh C.B.D. India (1990)
6. Industrial Microbiology – casidal.E.Wiley Eastern Ltd.
7. Fundamentals of Bacteriology – Salley
8. Fontiers 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 (3rd edition) Panima Publications Corporation.
4. Swardlaw, A.C. (1985) Practical statistics for Experimental Biogists, John Wiley and sons, Inc, NY
5. Khan (1999) Fundamentals of biostatistics Publishing corporation.

BTP 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 methods.	Somiji's 4 Unit
3. Estimation of protein by Biuret method and Lowry's method.	3 Unit
4. Assay of enzymes activity – Amylase	2 Unit
5. Separation of Sugars by TLC	2 Unit
6. Estimation of Amino acids.	2 Unit
7. Estimation of inorganic phosphate by Subba row method.	1 Unit

Reference:

BIOCHEMISTRY

1. Principles of Biochemistry- AlbertL. Lehninger CBS Publishers & Distributors
2. Biochemistry – Lubert stryer Freeman International Edition.
3. Biochemistry – Keshav Trehan Wiley Eastern Publications
4. Fundamentals of Biochemistry-J.L.Jain S.Chand and Company
5. Biochemistry- Prasaranga, Bangalore University
6. Fundamental of Biochemistry – Dr.A.C.Deb
7. Textbook of Organic Chemistry (A Modern Approach)
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 c Graw Hill, New York.
3. Campbell R.C (1974) Statistics for Biologists, Cambridge Univ. Press, Cambridge.
4. Daniel(1999) Biostatistics (3rd 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.

BTP 401 – Molecular Biology

Unit 1. Molecular basis of life – an introduction. Experimental Pro of DNA and RNA as genetic material. 3 Hours

Unit 2. Ncleic Acids

Structure and functions of DNA and RNA

Wats on and Crick model of DNA and other forms for 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, Conjunction 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. 8 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

BTP 402 – Molecular Biology

Total Units Allotted: 151

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| 1. Preparation of DNA model. | 1 Unit |
| 2. Estimation of DNA by DPA method | 1 Unit |
| 3. Estimation of RNA by Oreintal 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 – Conjunction, Transformation and Trasduction | 1 Unit |

Reference:

MOLECULAR BIOLOGY

1. Glick, B.T 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, 3rd Edition, John Wiley & Sons; INC

Semester V

BTP 501 - Engineering and Environmental Biotechnology

Total Hours Alloted : 60 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 & vector DNA, creation of r-DNA.	
Unit-4. Transformation of r-DNA – Transformation of r-DNA molecules into target host organism's Calcium chloride mediated, Electroporation and microinjection.	2 Hours
Unit-5. Screening and selection of recombinant host cells – Immunological screening and colony hybridization.	
Unit 6. Gene Libraries – Genomic DNA and c DNA Cloning techniques	2 Hours
Unit 7. Expression of cloned DNA in <i>E.coli</i>	1 Hours
Unit 8. Molecular biology techniques	6 Hours
a) Electrophoretic techniques –Proteins and nucleic acids	6 Hours
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

Unit 1. Renewable and Non-Renewable resources of energy	1 Hour
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Unit 2. Conventional fuels and their environmental impact – Firewood, Plant, Animal, Water, Coal and Gas.

Unit 3. Modern fuels and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol Gasohol 3 Hours.

Unit 4. Bioremediation

Bioremediation of soil & 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 aromatic and chlorinated hydrocarbons and petroleum products.

Unit 5. Treatment of municipal waste and Industrial effluents.	2 Hours
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Unit 6. Biofertilizers

Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil
Algal and fungal biofertilizers (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

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

Reference:

GENETIC ENGINEERING

1. Glick, B.R & Padernak J.J (1994) Molecular Biotechnology, Principles and Applications of Recombinant DNA, American Society for Microbiology, Washington D.C
2. Christopler H. (1995) Gene cloning and Manipulating, Cambridge University Press
3. Nicholl, D.S.T (1994) An Introduction of Genetic Engineering, Cambridge University Press.
4. Old. R.W. and Primrose, S.B. (1986) Principles of Gene manipulation, An introduction to genetic engineering (3rd Edition) Black well Scientific Publications
5. Watson J.D. Hopkins, N.H Roberts, J.W.Stectz J.A and Weiner A.M(1988). Molecular biology of society for Microbiology
7. Lewin b. (1994) Genes VI, New York,Oxford University Press.

ENVIRONMENTAL BIOTECHNOLOGY

1. Microbial Biotechnology (1995) Alexander n. Glazer Hiroshi Nikaido W.H.Freeman and Company
2. Molecular biotechnology: Principles and Applications of Recombinant DNA –Bernard R. Glick and Jack J. Pasternak ASM Press. Washington, D.C (1994).
3. Fungal Ecology and Biotechnology (1993) Rastogi Publications, Meerut.

Semester V

BTP 503 – Immunology and Animal Biotechnology

Total Hours Allotted : 45 Hours

Part A : Immunology

Unit 1. History and scope Immunology.	1 Hour
Unit 2. Types of Immunity Passive, Active and Acquired immunity. Humoral, Cell Mediated Immunity	3 Hours
Unit 3. Cell and organs of immune responses and their functions.	2 Hours
Unit 4. Antigens Types, haptens, epitopes and Factors influencing antigenicity.	2 Hours
Unit 5. Antibodies Structure, types, properties and functions of immunoglobulins. Production of antibodies.	3 Hours
Unit 6. Complement system Structure, Components, Properties and Functions.	2 Hours
Unit 7. Antigen Antibody reaction In vitro tests – Precipitation, Immuno-electrophoresis, Haemagglutination, Labelled antibody (RIA ELISA and Immuno-fluorescent techniques).	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 Passive and Active immunization.	

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	
Simulating natural conditions for growth of animal cells:	
1. Natural media –Plasma Clot, biological fluids tissue extract, Importance of Serum media	
2. Chemical defined media	3 Hours
Unit 3.	
a) Primary Culture – Cell lines, and cloning disaggregation of tissue, isolation of tissue, enzyme disaggregation, and mechanical disaggregation.	
b) Secondary Culture – transformed animal cells and continuous cell lines	3 Hours
Unit 4. transfection of animal cell lines. HAT selection, Selectable Markers and Transplantation of Cultural Cells.	
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	2 Units
4. Dot Elisa	1 Unit
5. ELISA – Demonstration	2 Units
6. Ocular 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 Immunoglobulins	2 Units

Reference:

IMMUNOLOGY

1. William, E. Paul (1989) fundamental immunology, 2nd Edition Raven Press, New York.
2. William, R. Clark(1991) the Experimental Foundations of Modern Immunology (4th Edition) John Wiley and Sons, New York.
3. Ivan, M, Roitt (1994) Clackwell Scientific Publications, London.

Animal Cell Biotechnology

1. Ian Freshney (4th Edition)

2. Buttlar.

Elements of Biotechnology – P.k. Gupta (1st Edition -2000) Rastogi Publications.

Semester VI

BTP 601 – Plant Biotechnology

Total Hours Alloted : 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 – Techniques 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 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) Applications 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 TRIPS

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 Synthesis 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 (3rd Edition) timber Press, Partland.
5. Kumar H.D (1991) A test book book on Biotechnology (2nd 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 Publishning House.

Semester VI
BTP 603 – Industrial Biotechnology

Unit 1. Introduction to industrial Biotechnology, basis principles of fermentation technology	1 Hour
Unit 2. Screening and Isolation of Microorganisms, maintainance of strains improvement (Mutant selection, Recombinant DNA methods).	2 Hours
Unit 3. Fermentation Media Natural and synthetic Media. Sterilization techniques – Heat, Radiation and Filtration method.	2 Hours
Unit 4. Fermenters Process of Aeration, Agitation , Temprature regulation and Filteration method.	2 Hours
Unit 5. Type of Fermentation Solid State, submerged fermentation and continious fermentation Immobilized enzyme and cell bioreactors.	3 Hours
Unit 6. Process Development – Shake flask fermentation, Down stream processing (DSP), Distingration of cells, Separation, Extraction, Concentration and purification of products	4 Hours
Unit7. :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 Biotechnogy Characteristics of enzymes – amylases. Industrial uses of enzymes – Detergents, Leather, Beverage, food and Pharmaceutical Bioreactors for enzyme production – Stirred tank, membrane reactors and continious 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

Unit 11. Technique of mass culture of Algae - spirulina 2 Hours

Unit 12. Microbial polysaccharides and polyesters; production of xanthan gum and polyhydroxyalkanoides (PHA) 3 Hours

BTP 604 – Industrial Biotechnology

Total units Allotted : 15

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| 1. Algal and fungal culture – Spirulina, Agaricus, Yeast and Aspergillus | 4 Units |
| 2. Estimation of citric acid from Aspergillus 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). | |
| 8. Visit Research Centers/ Institutions/Industries. | 2 units |

References :

Industrial Biotechnology

- | | |
|---|---------|
| 1. Sullia S.B& Shantharam S; (1998) General Microbiology, Oxford & IBH publishing Co. Pvt. Ltd. | 4 Units |
| 2. Estimation of citric acid from Aspergillus 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. Immobilization of Enzymes – (Invertase can be obtained from yeast cells and observed for glucose production). | |
| 8. Visit to Research Center/ Institutions/ Industries. | 2 Units |

References:

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, 1st Edition, CBS Publishers.
3. Glaser A.N & Nilaido.H (1995) Microbial Biotechnology, W.H Freeman & Co.
4. Prescott & Dunn (1987) Industrial Microbiology 4th Edition, CBS Publishers & Distributors.
5. Prescott & Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers.
6. Crueger W. & Crueger A. (2000) A text of Industrial Microbiology, 2nd Edition, Panima Publishing Corp.
7. Stanbury P.F, Ehitaker H, Hall S.J (1997) Principles of Fermentation Technology., Aditya Books (P) Ltd.