

# SCHEME OF EXAMINATION

&

## DETAILED SYLLABUS

For

**M.Sc. Biotechnology**

**(W.e.f. 2019 – 2020)**



**KALINGA  
UNIVERSITY**

**FACULTY OF SCIENCE**

**Kalinga University, Atal Nagar**

**Chhattisgarh**

Kalinga University, Raipur					
M.Sc Biotechnology					
w.e.f 2019-20 session					
Semester I					
Code No.	Paper	Credits	External Marks	Internal Marks	Total Marks
MBT101	Cell Biology	4	70	30	100
MBT102	Biochemistry	4	70	30	100
MBT103	Microbiology	4	70	30	100
MBT104	Bio- Physical Chemistry & Instrumentation	4	70	30	100
MBT101-P	Cell Biology-Lab	2	30	20	50
MBT102-P	Biochemistry-Lab	2	30	20	50
MBT103-P	Microbiology-Lab	2	30	20	50
MBT104-P	Bio- Physical Chemistry & Instrumentation-Lab	2	30	20	50
	<b>Total</b>	<b>24</b>	<b>400</b>	<b>200</b>	<b>600</b>

Kalinga University, Raipur					
M.Sc Biotechnology					
w.e.f 2019-20 session					
Semester II					
Code No.	Paper	Credits	External Marks	Internal Marks	Total Marks
MBT201	Molecular Biology	4	70	30	100
MBT202	Computer Applications and Biostatistics	4	70	30	100
MBT203	Immunology	4	70	30	100
MBT204	Bioinformatics and Nanobiotechnology	4	70	30	100
MBT201-P	Molecular Biology-Lab	2	30	20	50
MBT202-P	Computer Applications and Biostatistics-Lab	2	30	20	50
MBT203-P	Immunology-Lab	2	30	20	50
MBT204-P	Bioinformatics and Nanobiotechnology-Lab	2	30	20	50
	<b>Total</b>	<b>24</b>	<b>400</b>	<b>200</b>	<b>600</b>

<b>Kalinga University, Raipur</b>					
<b>M.Sc Biotechnology</b>					
<b>w.e.f 2019-20 session</b>					
<b>Semester III</b>					
<b>Code No.</b>	<b>Paper</b>	<b>Credits</b>	<b>External Marks</b>	<b>Internal Marks</b>	<b>Total Marks</b>
MBT301	Genetic Engineering	4	70	30	100
MBT302	Animal Biotechnology & Plant Biotechnology	4	70	30	100
MBT303	Environment Biotechnology	4	70	30	100
MBT304	Enzymology	4	70	30	100
MBT301-P	Genetic Engineering- <b>Lab</b>	2	30	20	50
MBT302-P	Animal Biotechnology & Plant Biotechnology- <b>Lab</b>	2	30	20	50
MBT303-P	Environment Biotechnology- <b>Lab</b>	2	30	20	50
MBT304-P	Enzymology- <b>Lab</b>	2	30	20	50
	<b>Total</b>	<b>24</b>	<b>400</b>	<b>200</b>	<b>600</b>

<b>Kalinga University, Raipur</b>					
<b>M.Sc Biotechnology</b>					
<b>w.e.f 2019-20 session</b>					
<b>Semester IV</b>					
<b>Code No.</b>	<b>Paper</b>	<b>Credits</b>	<b>External Marks</b>	<b>Internal Marks</b>	<b>Total Marks</b>
MBT401	Agriculture Biotechnology	4	70	30	100
MBT402	Industrial Biotechnology	4	70	30	100
MBT401-P	Agriculture Biotechnology- <b>Lab</b>	1	30	20	50
MBT402-P	Industrial Biotechnology- <b>Lab</b>	1	30	20	50
MBT403	Dissertation	6	200	100	300
	<b>Total</b>	<b>16</b>	<b>400</b>	<b>200</b>	<b>600</b>

<b>GRAND TOTAL (SEMESTER I +II +III + IV)</b>	<b>2400</b>
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**SEMESTER-I**

RAIPUR

**MBT101**

**External Term: 70**

**Internal Marks: 30**

## **Cell Biology**

### **UNIT- I**

Diversity of cell size and shape. Cell theory

Structure of Prokaryotic and Eukaryotic cell- isolation and growth of cells.

Microscopic Techniques for study of cells.

Sub-cellular fractionation and criteria of functional integrity.

Cellular organelles-plasma membrane, cell wall, their structural organization.

Transport of nutrients, ions and macromolecules across membranes.

Cellular energy transactions-role of mitochondria and chloroplast.

### **UNIT- II**

Cell cycle- molecular events and model systems.

Cellular responses to environmental signals in plants and animals- mechanisms of signal transduction.

Cell motility- cilia, flagella of eukaryotes and prokaryotes.

Metabolite pathways and their regulation.

Biosynthesis of proteins in Eukaryotic cell, Co- and post-translational modification, intercellular protein traffic.

### **UNIT- III**

Brief introduction to the life cycle and molecular biology of some important pathogens of AIDS, Malaria, Hepatitis.

Tuberculosis, Filariasis, Kala-azar.

Protein localization: synthesis of secretory and membrane proteins, import into nucleus, mitochondria, chloroplast and peroxisomes.

Receptor mediated endocytosis.

## UNIT- IV

Cytoskeleton: Intermediate Filaments, Actin filament, Microtubules

Cell signalling and its process

Overview of the Cell Cycle

Cell cycle control system: Cyclin-dependent Protein Kinases, Cyclin-Cdk Complexes

Cellular basis of differentiation and development- gametogenesis and fertilization.

## UNIT- V

Programmed Cell Death (Apoptosis)

Extracellular Matrix

Cell Junctions: Tight junctions, Gap junctions

Biology of cancer.

Development in drosophila and arabidopsis; spatial and temporary regulation of gene expression.

## Reference Books

1. Molecular Biology of Cell, Alberts, B. *et.al.*
2. Molecular Cell Biology, Lodish *et.al.*
3. Cell in Development and Inheritance; EB Wilson, MacMilan, New York.
4. The Coiled Spring, Ethan Bier, Cold Spring Harbor Press.
5. Laboratory Techniques in Biochemistry and Molecular Biology, Work and Work.

RAIPUR

**MBT101-P**

**External Term: 30**  
**Internal Marks: 20**

**Practical (MBT 101-P)**  
**Cell Biology**

**Lab Course:**

1. Microscopy: bright field, phase contrast and fluorescence microscopy.
2. Instrumental methods for cell biology.
3. Sub cellular fractionation.
4. Histochemical techniques.
5. Mitosis
6. Meiosis.



**RAIPUR**

**MBT 102**

**External Mark: 70**

**Internal Mark: 30**

## **BIOCHEMISTRY**

### **Unit-I**

Biochemistry: Introduction, Definition, scope and application.

Biomolecule: Introduction, characteristic of biomolecule

Sugars- classification, Structure and reactions, function

Heterocyclic compounds and secondary metabolites in living systems-nucleotides pigments and isoprenoides.

### **Unit-II**

Lipid: Structure, Classification, chemical properties, metabolism

Biosynthesis of fatty acid.

DNA: structure, type, function,

Buffer system: Mechanism of buffer action.

Bonds: Primary, Secondary, Ionic, covalent and hydrogen bond.

Chemical fundamental of Biology: pH, pK, acid, base.

### **Unit-III**

Proteins- classification and separation, purification and criteria of homogeneity, structure of protein

Amino acids and peptides- classification, chemical reactions and physical properties.

Plant hormones: Introduction, Definition, classification, structure and function of plant hormone, Structure, types, function.

Animal Hormones: Introduction, Definition, structure, classification, Types, function

### **Unit- IV**

Enzymes: Introduction, Definition, classification, mechanism of enzymes action, property

Vitamins, water and fat soluble, deficiency and diseases.



Water: Property of water in relation to life process.

Atom: introduction, atomic number, weight, molecules.

High energy phosphate compounds: ATP cycle

## UNIT V

Blood sugar level: Regulation of blood sugar level.

Principle of thermodynamic

RNA: structure, type, function

Nucleotide pigments

Pigments: Chlorophylls, carotenoids, flavonoids, heme

### Text Book/ Reference:

1. Biochemistry: N. Arumugam & Dalsy Fatima, Saras Publication.
2. Element of Biochemistry: H.S. Srivastava, Rastogi Publication.
3. Biochemistry: U. Satyanarayana, Books & Allied (P) Ltd.
4. Biochemistry & Biophysics: N. Arumugam, Saras Publication.
5. Biochemistry & Maths: K.C. Soni (Vol-I), Daya publisher house.
6. Cell ( A Molecular approach): Cooper , G. M.
7. Principle of Biochemistry: Leninger , A. L. 7. Biochemistry (1995)
8. Lubert Stryer 8. Text Book of Biochemistry (1997) Devlin , Thomas



RAIPUR

**MBT102-P**

**External Term: 30**

**Internal Marks: 20**

**Practical (MBT 102-P)**  
**Biochemistry**

**Lab Course:**

1. Laboratory rules, Tools, Equipment and Other requirements in Biochemistry laboratory.
2. To Estimation of sugar in given solution.
3. Specific test for amino acid and lipid.
4. To perform protein estimation method by folien Lowry
5. Estimation of protein using barfoard reagent.
6. To perform saponification value and iodine number form given sample.
7. Colorimetric determination of pK.
8. Separation techniques by TLC method.
9. To perform the paper chromatography.
10. Model building using space, filling/ ball and stick models.

**R A I P U R**

**MBT103**

**External Term: 70**

**Internal Marks: 30**

## **Microbiology**

### **UNIT I**

The history and development of Microbiology, contribution of Leeuwenhoek, Pasture, Jenner, Coch, Classification of Microorganisms, Morphology and structure of cell wall; eubacteria, archaebacteria. Concept of species, Characterization and classification of bacteria, Viruses and fungi, Methods for enumeration of microbial diversity. Preparation of culture media, pure culture techniques and microbial staining.

### **UNIT II**

Sterilization: physical and chemical methods  
Microbial growth: growth curve, measurement of growth and factors affecting growth  
Microbial growth: Culture media (Synthetic and complex), batch continuous culture,  
Factors affecting microbial growth

### **UNIT III**

Eukaryotic Microorganisms- General characters, Structure and Reproduction: Fungi, Algae, Slime molds. Isolation of microorganism and identification  
Symbiosis of bacteria, parasitism, mutualism, hetrothalism  
Mycorrhiza: VAM, cyanobacteria, protozoa  
Fungal Diseases: Aspergillosis- symptoms, character, causes, diagnosis, precaution

### **UNIT IV**

Viral diseases: Hepatitis B and HIV- symptoms, character, causes, diagnosis, precaution  
Viruses: types, isolation, cultivation and identification  
Lytic and lysogenic cycle of bacteriophages  
Scope of Industrial Microbiology  
Plant viruses: TMV- introduction and structure,

## UNIT V

Bacterial Recombination: transformation, conjugation, transduction, F-duction

Plasmid – types, structure, f- factor, col factor,

Anti-fungal and antiviral antibiotics, mode of action of antibiotics

Antimicrobial agents- Antibiotics, Sulfa drugs, Vaccines etc

Plasmid as a vector for gene cloning

### Reference Books/ Text Books:

1. Microbiology by MJ Pelczar Jr, ECS Chan, NR Krieg 5th Edition, Pub: Tata Mcgra-Hill Publishing Co Ltd.
2. Introductory Microbiology by Heritage Pub Heritage
3. General Microbiology by Stainer Pub; Ingraham and Wheeler (McMillan)
4. Alexander M (1977) Introduction to soil microbiology, John Wiley and Sons Inc.N.Y.
5. Atlas R.M. (1998) Microbiology, Fundamentals and applications 2nd Edition, Milan Publishing Co.
6. Brock T.D. and Madigan M.T (1992) Biology of Microorganisms 6th Edn. Prentice Hall, Eagle wood cliffs N.j.
7. Holt J.S. Kreig N.R., Sneath P.H.A and Williams S.T (1994) Bergey's Manual of Systemic Bacteriology 9th Edn. William and Wilkins, Baltimore.
8. Prescott L.M, Harley T.P and Klein D.A. (1996) Microbiology WMC. Brown publishers

R A I P U R

**MBT103-P**

**External Term: 30**

**Internal Marks: 20**

**Practical (MBT 103-P)**  
**Microbiology**

**Lab Course:**

1. Preparation of Liquid and Solid media for growth of microorganisms.
2. Isolation and maintenance of organisms by plating, streaking and serial dilution method, slant and stab cultures, storage of microorganisms.
3. Isolation of pure cultures from soil and water
4. Growth; Growth curve; Measurement of bacteria population by turbidometry and serial dilution methods. Effect of temperature, pH and carbon and nitrogen sources on growth.
5. Microscopic examination of bacteria, Yeast and mold and study of organism by Gram's stain, acid fast stain and staining for spores
6. Study of mutation by Ame's Test.
7. Assay of antibiotics and demonstration of antibiotic resistance
8. Determination of MPN of water sample.
9. Bacterial transformation.
10. Biochemical Characterization of selected microbes.
11. One Step growth curve of Bacteria.

**MBT104**

**External Term: 70**  
**Internal Marks: 30**

## **Biophysical Chemistry & Instrumentation**

### **Unit-I**

- a. Intra and inter-molecular forces, electrostatic interactions and hydrogen bonding interactions
- b. Vander Walls and hydrophobic interactions
- c. Disulphide bridges.
- d. Role of Water and weak interactions
- e. Primary and secondary structure helix, sheet structures etc.
- f. Tertiary and quaternary structure
- g. Structural features of membrane proteins
- h. Conjugated and metal-binding proteins

### **Unit-II**

- a. Titration of proteins to evaluate net and total charge
- b. Scat chart and hill plots
- c. Folding-unfolding equilibrium and denaturation of proteins
- d. Effects of temperature and solvent condition on the thermodynamics of protein folding unfolding equilibrium
- e. Kinetics of protein folding
- f. Ultracentrifugation: Sedimentation velocity and equilibrium, determination of molecular weights.
- g. Viscosity
- h. Micro calorimeter

### **Unit- III**

- a. Circular Dichroism spectroscopy

- b. UV, visible and fluorescence spectroscopy
- c. X-Ray diffraction
- d. Nuclear magnetic resonance (NMR)
- e. Compound Microscope
- f. Electron Microscope
- g. Fluorescence Microscope .

#### **Unit-IV**

- a. Autoclave
- b. pH meter
- c. Laminar Air Flow.
- d. Incubator
- e. Centrifuge
- f. Chromatography assemblies
- g. Electrophoresis assemblies
- h. 2D and MALDI

#### **Unit-V**

- a. UV transilluminator, Vortex mixture, Magnetic stirrer.
- b. Spectrophotometer.
- c. PCR and RT PCR machine
- d. DNA sequencer
- e. Flow Cytometer
- f. Fermentor
- g. Preparation of solutions
- h. Laboratory safety procedure

#### **Reference Books/ Text Books:**

1. Biochemical Engineering, Aiba, S., Humphery, A.E. and Millis, N.F. Univ. of Tokyo press. Tokyo.
2. Biochemical Engineering: Lee, J.M. Prentice Hall Inc.
3. Chemical Engineering problems in Biotechnology, Shuler, M.L. (Ed), AICHE.
4. Introduction to Biomedical Equipment Technology (5<sup>th</sup> ed), Joseph J. Carr and John M. Brown, Addison Wesley Longman (Singapore).
5. Instrumental method of analysis, Wilard, Merritt, dean, Settle, Wadsworth publishing Company, USA.
6. Principals of Fermentation Technology, Stanbury, P.F. and Whitaker, A., Pergamon press Oxford.
7. Biochemical Engineering, Aiba, S., Humphery, A.E. and Millis, N.F. Univ. of Tokyo

- press. Tokyo.
8. Biochemical Engineering: Lee, J.M. Prentice Hall Inc.
  9. Chemical Engineering problems in Biotechnology, Shuler, M.L. (Ed), AICHE.
  10. Introduction to Biomedical Equipment Technology (5<sup>th</sup> ed), Joseph J. Carr and John M. Brown, Addison Wesley Longman (Singapore).
  11. Instrumental method of analysis, Wilard, Merritt, dean, Settle, Wadsworth publishing Company, USA.
  12. Principles of Fermentation Technology, Stanbury, P.F. and Whitaker, A., Pergamon press Oxford.
  13. Process Engineering in Biotechnology, Jackson, A.T., Prentice Hall, Engelwood Cliffs

**MBT104-P**

**External Term: 30**

**Internal Marks: 20**

## **Practical (MBT 104-P)**

### **Biophysical Chemistry & Instrumentation**

#### **Lab Course:**

1. To write the laboratory rule and instruments.
2. Analysis by electrophoresis.
3. Quantitative analysis of nucleic acid by spectrophotometer.
4. Measurement of bacterial population by turbidometry.
5. Separation of cell organelles by centrifugation.
6. Analysis of secondary metabolites by HPLC.
7. Study of various type of Microscope.
8. Sterilization by autoclave.
9. Cell fractionation by Centrifuge.
10. Separation of proteins by SDS-PAGE.
11. Separation of DNA by agarose gel electrophoresis.
12. Demonstration of 2D.
13. Study of DNA bands by Transilluminator.
14. Quantification of DNA by UV spectrophotometer.
15. DNA sequencing
16. Demonstration of fermentation





**SEMESTER-II**

RAIPUR

**MBT201**

**External Term: 70**

**Internal Marks: 30**

## **Molecular Biology**

### **UNIT-I**

Introduction to Molecular Biology and Genetics

Genes, mutation and mutagenesis: UV and chemical mutagens; types of mutations, methods of genetic analysis.

Bacterial Genetic System: Transformation, conjugation, transduction, recombination, plasmids and transposing, bacterial genetics map with reference to E. Coli.

DNA Replication: Prokaryotic and Eukaryotic DNA replication and its process

### **UNIT-II**

Mechanics of DNA replication, enzymes and accessory proteins involved in DNA replication.

DNA repair and recombination.

Regulation of gene expression: operon concept, catabolite repression.

Instability of bacterial RNA, positive and negative regulation, inducers and co repressors

Oncogenes and Tumour Suppressor Genes: Viral and cellular oncogenes, tumour suppressor genes from human, structure, function and mechanism of action of pRB and P53 tumour suppressor proteins.

### **UNIT-III**

Transcription: Prokaryotic transcription, Eukaryotic transcription, RNA polymerase. General and specific transcription factors, regulatory elements and mechanisms of transcription regulations, transcriptional and post-transcriptional gene silencing

Modification in RNA, 5-Cap formation, transcription termination, 3-end processing and polyadenylation, splicing, editing, nuclear export of mRNA, mRNA stability.

Translation: Prokaryotic and Eukaryotic translation, the translation machinery, mechanisms of initiation, elongation and termination, regulation of translational, co-and post-translation modification in proteins.

#### **Unit-IV**

Antisense and Ribozyme Technology: Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation and translation, disruption of RNA structure and capping, applications of antisense and ribozyme technologies.

Homologous Recombination: Holiday junction, gene targeting gene disruption, FLP, FRT

Mapping of Genome: Genetic and physical maps, physical mapping and map-based cloning, choice of mapping population,

Southern and fluorescence in-situ hybridization for genome analysis, chromosome micro dissection and micro cloning,

#### **Unit-V**

Molecular markers in genome analysis: RFLP, RALP and its application

RAPD and AFLP analysis and its application

Molecular markers linked to disease resistance genes,

Application of RFLP in forensic, disease prognosis, genetic counseling pedigree, varietal etc.

Animal trafficking and poaching, germplasm maintenance, taxonomy and biodiversity.

#### **Reference Books/ Text Books:**

1. General Microbiology, Stainer, R. Y., Ingraham, J. L., Wheelis, M. L., and Painter, P. R. The McMillan Press Ltd.
2. Brock Biology of Microorganisms, Madigan, M. T., Martinko, J. M. and Parker, J. Prentice Hall.
3. Microbiology, Pelczar, M. J., Jr. Chan, F. C. S., and Kreig, N. R., Tata-McGraw- Hill.
4. Microbial Genetics, Maloy, S. R., Cronan, J. E. Jr., and Friefelder, D. Jones and Bartlett Publishers.
5. Microbiology, A Laboratory Manual, Cappuccino, J. G., and Sherman, N., Addison Wesley.
6. Microbiological Applications (A Laboratory Manual in General Microbiology), Benson, H. J., W. C. B., Wm. C. Brown Publishers.
7. Kaiser, Krieger, Scott, Zipursky, and Darnell, W.H. Freeman & CoCell and Molecular Biology: Concepts and Experiments, 4<sup>th</sup> Edition, Gerald Karp, John

- Wiley & sons Inc. San Francisco, CA
8. Gene IX, Benjamin Lewin, Oxford University press Inc. New York.
  9. Molecular cell Biology: Lodish, Berk, Matsudaira

**MBT201-P**

**External Term: 30**  
**Internal Marks: 20**

**Practical (MBT 201-P)**  
**Molecular Biology**

**Lab Course:**

1. To write the laboratory rule and instruments.
2. Isolation of pure cultures from soil and water.
3. Study of mutations by Ames test.
4. Assay of antibiotics and demonstration of antibiotic resistance.
5. Bacterial transformation.
6. Biochemical characterization of selected microbes.
7. Southern blotting
8. RFLP analysis
9. Northern blotting
10. Electrophoresis of DNA- linear, circular and super coiled.

**R A I P U R**

**MBT 202**

**External Mark: 70**

**Internal Mark: 30**

## **Computer Applications and Biostatistics**

### **UNIT- I**

Introduction to computer and its application

Component of a computer: Input, C.P.U.,memory unit, output unit

MS office software and components: word, excel, power point

Brief description and tabulation of data and its graphical representation.

### **UNIT- II**

Introduction to MS- office software,

Internet : Introduction, browsing, application, advantage, disadvantage

Search engines.

Problem solving using computer: Algorithm, flow chart,

### **UNIT- III**

Measure of Dispersion: Range, quartile deviation, mean deviation, standard deviation, variance.

Measure of central tendency: Mean, median, mode, merit, and demerit.

Probability: introduction, theorem

Regression analysis: definition, types, uses

### **UNIT-IV**

Collection of Data: Sampling, Primary data, Secondary data, Method

Variable: introduction, types

Classification of data: objective, types, method

Tabulation of data: simple, complex

#### **UNIT-V**

Correlation: types, degree, method of study

Chi-square test, t-test, uses

Frequency distribution

Biological database.

#### **Text Book/ Reference:**

1. Statistical methods- G.W. Snedecor & W.G. Cochran Affiliated East – West press & Iowa state University press.
2. Statistics: Theory and practice, M.C. Sharma and G.S. Gulshan. S. Chand & Co. (pvt.) Ltd, New Delhi.
3. Statistical methods in biology, T.N. Bailey, English Language Book society & The English University press ltd.
4. Statistics: Theory and practical problems, D.N. Elhance and P.N. Elhance, Vol. I&II, Kitab Mahal, Allahabad.
5. Computer Fundamentals, P.K. Sinha. BPB publications.
6. Programming in C++ Yashwant Kanitkar, CBS publications, New Delhi.
7. Bailey, N.T.J.(3<sup>rd</sup> Ed.) Statistical Methods in Biology.
8. Fundamentals of Information Technology: Alexis Leon, Mathews Leon(1999), Vikas Publishing House and Leon Press Chennai.
9. Fundamentals of Computers: C-Xavier(2003), New Age Publisher, New Delhi.
10. Williams, B.K. and Sawyer, S.C. (2003). The internet & the World Wide Web in Using Information Technology. 5<sup>th</sup> ed. Tata McGraw-Holl, New Delhi.
11. Biostatistics & computer application & Bioinformatics: N. Arumugam, Saras Publication.

R A I P U R

**MBT 202**

**External Term: 30**  
**Internal Marks: 20**

**Practical (MBT 202-P)**  
**Computer Applications and Biostatistics**

**Lab Course:**

1. Power point Presentation.
2. MS word preparation.
3. MS excel preparation.
4. Determination of mean, median & mode.
5. Correlation analysis.
6. To the Calculation of T- test from given value.
7. To the Calculation of Chi square test from given value.

**R A I P U R**

**MBT203**

**External Term: 70**  
**Internal Marks: 30**

## **Immunology**

### **Unit-I**

Introduction of immune system  
Phylogeny of immune system  
Innate and acquired immunity  
Clonal nature of immune response  
Organization and structure of lymphoid organs  
Nature and biology of antigens and super antigens.

### **Unit-II**

Major histocompatibility complex  
BCR & TCR, generation of diversity  
Complement system: Cells of the immune system, hematopoiesis and differentiation, lymphocyte trafficking, B-lymphocytes, T-lymphocytes, macrophages, dendritic cells, natural killer and lymphocyte activated killer cells, eosinophils, neutrophils and mast cells.  
Regulation of immune response  
Antigen processing and presentation, generation of humoral and cell mediated immune responses.  
Activation of B and T- lymphocytes

### **Unit-III**

Organization and Expression of Immunoglobulin Genes  
Variable-Region Gene Rearrangements, Generation of Antibody Diversity  
Class Switching, Synthesis, Assembly, and Secretion of Immunoglobulins



The Complement System: Functions, components, activation, regulation, Biological consequences  
Cytokines and their role in immune regulation  
T- cell regulation, MHC restriction , Immunological tolerance

#### **Unit-IV**

Antibody structure and function.

Antigen-Antibody Interactions: Precipitation reactions, agglutination reactions

Enzyme-Linked Immunosorbent Assay, Western Blotting

General Organization and Inheritance of the MHC, Role of Antigen Presenting Cells

Antigen processing and presentation, T- cell receptor, Activation of B and T- lymphocytes

#### **Unit-V**

Cell mediated cytotoxicity: Mechanism of T cell and NK cell mediated lysis, antibody – dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity

Hypersensitivity: types, structure, mechanism

Autoimmunity : types, structure, mechanism

Organ Transplantation: mechanism process

Immunity to infectious agents (intracellular parasites, helminths and viruses)

Tumour immunology

AIDS and other immunodeficiencies

Hybridoma technology and monoclonal antibodies

#### **Reference Books / Text Books:**

1. Kubey Immunology, 6e, Goldsby *et al* (Freeman)
2. Immunology: An Introduction, 4e, Ian R. Tizard, Saunders college Publishing, Texas (US).
3. Immunology- A short Course, 4e – Eli Benjamin, Richard Coico, Geoffery Synshine (Wiley-Liss).
4. Fundamentals of Immunology, William Paul.
5. Immunology, by Roitt and Others.

**MBT203-P**

**External Term: 30**

**Internal Marks: 20**

**Practical (MBT 203-P)**  
**Immunology**

**Lab Course:**

1. Blood film preparation and identification of cells.
2. Lymphoid organs and their microscopic organization
3. Immunization, collection of serum.
4. Double diffusion and immuno-electrophoresis.
5. Radial immuno diffusion.
6. Western – blotting.
7. ELISA
8. Immunodiagnosics (demonstration using commercial kits)

**R A I P U R**

**MBT204**

**External Term: 70**

**Internal Marks: 30**

## **Bioinformatics and Nanobiotechnology**

### **Unit I**

Introduction to Bioinformatics

Biological Database- Primary, secondary and composite

Databases - Definition, data mining methods and analysis tools.

Various types of databases

Gene Prediction methods.

Visualization and Prediction of Protein structure.

### **Unit II**

Tools for sequence alignment.

Tools for similarity searches and sequence alignments

Alignment of pair of sequence

Scoring matrices: PAM and BLOSSUM

Alignment of multiple sequence alignment

Phylogenetic analysis and tree evaluation methods.

### **Unit III**

Genomics: Gene identification and prediction, application

Proteomics: definition; identification and analysis of protein by 2D analysis; techniques for studying proteome. Gene mapping, Sequence assembly and gene expression.

Microassay technology.

Genome sequencing projects.

Protein structure prediction.

Pharmacogenetics and Drug development.

## **Unit IV**

Concept of Nano-biotechnology

Fundamental sciences and broad areas of Nanobiotechnology.

Biological nanoparticles production - plants and microbial.

Concepts in nanobio-machines for information processing and communications

## **Unit V**

Introduction to Nanostucture.

Nanomaterial in biotechnology - nanoparticles, quantum dots, nanotubes and nanowires

Nanotechnology in biosensors, biochips.

Applications of Nanobiotechnology.

## **Reference Books/ Text Books:**

1. Bioinformatics-sequence,structure and databanks. (2000) D.Higgins and W. Taylor A practical approach.
2. Bioinformatics computing (2003). B. Bergeman.
3. Bioinformatics databases and algorithms (2007) N. Gautham.
4. Nanobiotechnology: Concepts, Applications and Perspectives, Christof M. Niemeyer (Editor), Chad A. Mirkin (Editor) , Wiley Publishers, April 2004.
5. Nanotechnology: A Gentle Introduction to Next Big Idea, Mark Ratner and Daniel Ratner, Low Price edition, Third Impression, Pearson Education
6. Nanotechnology, William Illsey Atkinson, JAICO Publishing House, Second Impression-2008.
7. Bio molecular computation for Bio nanotechnology, Liu and Shimohara, Artech House-London, 2007

**MBT204-P**

**External Term: 30**

**Internal Marks: 20**

**Practical (MBT 204-P)**  
**Bioinformatics and Nanobiotechnology**

**Lab Course:**

1. Restriction mapping,
2. Sequence analysis of protein (BLAST)
3. Sequence analysis of Nucleotide (BLAST)
4. Pair wise comparison of sequences,
5. Evolutionary studies / Phylogenetic analysis.
6. Identification of genes in Genomes and Primer Design
7. Protein databank retrieval and visualization Ras mol
8. Ramachandran plot- secondary structure prediction of proteins.
9. Designing PCR primers and probes.
10. Demonstration of nanoparticle synthesis.
11. Demonstration of green silver nano particles.
12. Study of Scanning electron microscope(SEM)

R A I P U R



# **SEMESTER-III**

RAIPUR

**MBT301**

**External Term: 70**  
**Internal Marks: 30**

## **Genetic Engineering**

### **Unit-I**

Basics of Genetic Engineering & Cloning Strategies

General introduction and concept.

Biosafety guidelines and containment strategies DNA modifying enzymes and restriction enzymes , Milestones in genetic engineering, Isolation of enzymes.

Molecular tools and their applications: Restriction enzymes, modification enzymes, DNA and RNA markers.

Nucleic acid purification and yield analysis.

Nucleic acid amplification and its applications.

### **Unit-II**

Alternative strategies of gene cloning: Cloning interacting genes- two-and-three hybrid systems, cloning differentially expressed genes.

Gene regulation-DNA transections, northern blot, primer extension, S1 mapping, RNAase  
Expression strategies for heterologous genes: Vector engineering and codon optimization, host engineering, invitro transcription and translation.

Expression in bacteria, expression in yeast, expression in insects and insect cells, expression in mammalian cells, expression in plants.

Processing of recombinant proteins: Purification and refolding, characterization of recombinant proteins, stabilization of proteins. Phage display.

### **Unit-III**

T-DNA and Transposon tagging : Role of gene tagging in gene analysis, T-DNA and transposon tagging, identification and isolation of genes through T-DNA or transposon.

Transgenic and gene knockout technologies: Targeted gene replacement, chromosome engineering. Isolation of plasmid.

Gene therapy; Vector engineering, Strategies of gene delivery, gene replacement/augmentation, gene correction, gene editing, gene regulation and silencing.

#### **Unit-IV**

Cloning strategies: Genomic libraries, cDNA libraries, single gene cloning.

Vectors in gene cloning: Types of vectors and choice of vectors- Plasmids, cosmids, lambda phage vectors, shuttle vectors, BACs and YACs Choice of hosts,

Methods for transferring recombinant DNA to host cells (Transformation and Transfection)

Hybridizations- Screening, colony, Southern, Northern, Western,

Site-directed mutagenesis.

#### **Unit-V**

Detection and Characterization of Transformants

Gene cloning vectors: Plasmids, bacteriophages, phagemids, cosmids, artificial chromosomes.

Restriction mapping of DNA fragments and map construction, nucleic acid sequencing.

cDNA synthesis and cloning: mRNA enrichment, reverse transcription,

DNA primers, linkers, adaptors and their chemical synthesis, Library construction and screening

#### **Reference Books/ Text Books:**

1. Molecular Cloning : A Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000
2. DNA Cloning: A Practical Approach, D.M. Glover and B.D. Hames, IRL Press, Oxford, 1995.
3. Molecular and Cellular Methods in Biology and Medicine, P.B. Kaulman, W. Wu. D. Kim and L.J. Cseke, CRC Press, Florida, 1995.
4. Methods in Enzymology, Guide to Molecular Cloning Techniques, vol. 152, S.L. Berger and A.R. Kimmel, Academic Press Inc., San Diego, 1996.
5. Methods in Enzymology, vol. 185, Gene Expression Technology,
6. DNA Science : A First Course in Recombinant Technology, D.A. Mickloss and G.A. Freyer, Cold Spring Harbor Laboratory Press, New York, 1990.
7. Molecular Biotechnology, 2<sup>nd</sup> edition, S. B. Primrose, Blackwell Scientific Publishers, Oxford, 1994.
8. Milestones in Biotechnology, Classic Papers on Genetic Engineering, I.A. Davies and W.S. Reznikoff, Butterworth-Heinemann, Boston, 1992.



**MBT301-P**

**External Term: 30**

**Internal Marks: 20**

**Practical (MBT 301-P)**  
**Genetic Engineering**

**Lab Course:**

1. Bacterial culture and antibiotic selection media, preparation of competent cells.
2. Isolation of plasmid DNA
3. Quantization of nucleic acids
4. Agarose gel electrophoresis and restriction mapping of DNA
5. Cloning in plasmid/ phagemid vectors
6. Construction of restriction map of plasmid DNA
7. DNA sequencing
8. Gene expression in *E. coli* and analysis of gene product
9. PCR

**R A I P U R**

**MBT302**

**External Term: 70**  
**Internal Marks: 30**

### **Animal Biotechnology & Plant Biotechnology**

#### **UNIT - I**

Equipments and materials for animal cell culture technology, Primary and established cell line cultures, Introduction to the balanced salt solutions and simple growth medium.

Culture medium, Serum and protein-free defined media and their applications.,  
Measurement of viability and cytotoxicity.

Biology and characterization of cultured cells, measuring parameters of growth.

Basic techniques of mammalian cell culture in vitro; disaggregation of tissue and primary culture; maintenance of cell culture; cell separation.

#### **UNIT- II**

Scaling-up of animal cell culture.

Cell synchronization.

Cell cloning and micromanipulation.

Cell transformation.

Application of animal cell culture.

Stem cell cultures, embryonic stem cells and their applications.

Cell culture based vaccines.

Somatic cell genetics.

#### **UNIT- III**

Organ and histotypic cultures, Measurement of cell death.

Apoptosis, Three dimensional culture and tissue engineering.

Conventional plant breeding, Introduction to cell and tissue culture as a technique to produce novel plants and hybrids, Tissue culture media

Initiation and maintenance of callus and suspension culture, single cell clones.

#### **UNIT- IV**

Organogenesis, somatic embryogenesis, Shoot tip culture, rapid clonal propagation and production of virus free plants.

Embryo culture and embryo rescue, Protoplast isolation, culture and fusion, selection of hybrid plants and regeneration of hybrid plants

Anther, pollen and ovary culture for production of haploid plants

Cryopreservation, slow growth and DNA banking for germplasm conservation.

#### **UNIT- V**

Plant transformation technology: the basis of tumor formation, hairy root, features of TI and RI plasmid, mechanism of DNA transfer, use of TI and RI as vector, multiple gene transfer, vectorless or direct gene transfer

Applications of plant transformation: herbicide resistance, insect resistance, virus resistance, disease resistance, nematode resistance, abiotic stress

Chloroplast transformation, Plant secondary metabolites, therapeutic protein, antibodies

Molecular marker-aided breeding: RFLP maps, RAPD markers, AFLP.

#### **Reference Books/ Text Books:**

Culture of Animal Cells 3<sup>rd</sup> Edition, R. Ian Freshney, Wiley- Liss

Animal Cell Culture – Practical approach, ed., John R.W. Masters, Oxford

Cell Growth and Division: A Practical Approach, ed., R. Basega, IRL Press

Cell Culture Lab Fax, eds., M. Butler and M. Dawson, Bios Scientific Publications Ltd., Oxford

Animal Cell Culture Techniques, eds., Martin Clynes, Springer

Methods in Cell Biology, vol. 57, Animal Cell Culture Methods, eds., Jenni P. Mather and David Barnes, Academic Press.

J. Hammound, P. McGravey and V.Yusibov eds, plant Biotechnology: springer Verlag, 2000.

T-J Fu, G. Singh, and W.R. Curtis, eds, plant cell and tissue culture for the production of food Ingredients, kluwer Academic / Plenum press, 1999.

H.S. Chawla Biotechnology in crop improvement, international book Distributing Company, 1998.

RAIPUR

**Practical (MBT 302-P)**  
**Animal Biotechnology & Plant Biotechnology**

**Lab course:**

1. Laboratory rule, equipment and sterilization technique.
2. Preparation of media for plant and animal tissue culture
3. Surface sterilization for plant and animal
4. Callus culture (plant)
5. Callus propagation, organogenesis, transfer of plants to soil.
6. Protoplast isolation and culture
7. Anther culture, production of haploids
8. Role of serum in cell culture



## Environmental Biotechnology

### UNIT- I

Environmental Biotechnology: Introduction, sources of waste and pollutant, hazards.

Issues and scopes of environmental biotechnology

Bio-fertilizer: Introduction, process, uses, application

Land fill: cell emplacement method, Uses of land fill site, hazards.

### UNIT-II

Composting: Objectives, fundamentals, microbiology, factors influencing composting and composting systems. Compost quality and uses.

Vermicomposting: process and uses

Microbial Insecticides: Bacterial, fungal and viral insecticides in pest management.

Biosurfactant and biofuel.

### Unit-III

Biodegradation of organic pollutants: Mechanisms and factors affecting biodegradation

Control of pollution through biotechnology

Wastewater treatment: physical, chemical, and Biological .

Dissolve Oxygen, Biological Oxygen Demand, Chemical oxygen Demand, Total Dissolve Solid.

### Unit-IV

Bioremediation: Introduction, process,

Environmental pollution and its type.

Paper pulp industry.

Xenobiotic Compound and degradation.

### Unit-V

Global environmental problem- General introduction, \Ozone depletion, Acid rain.

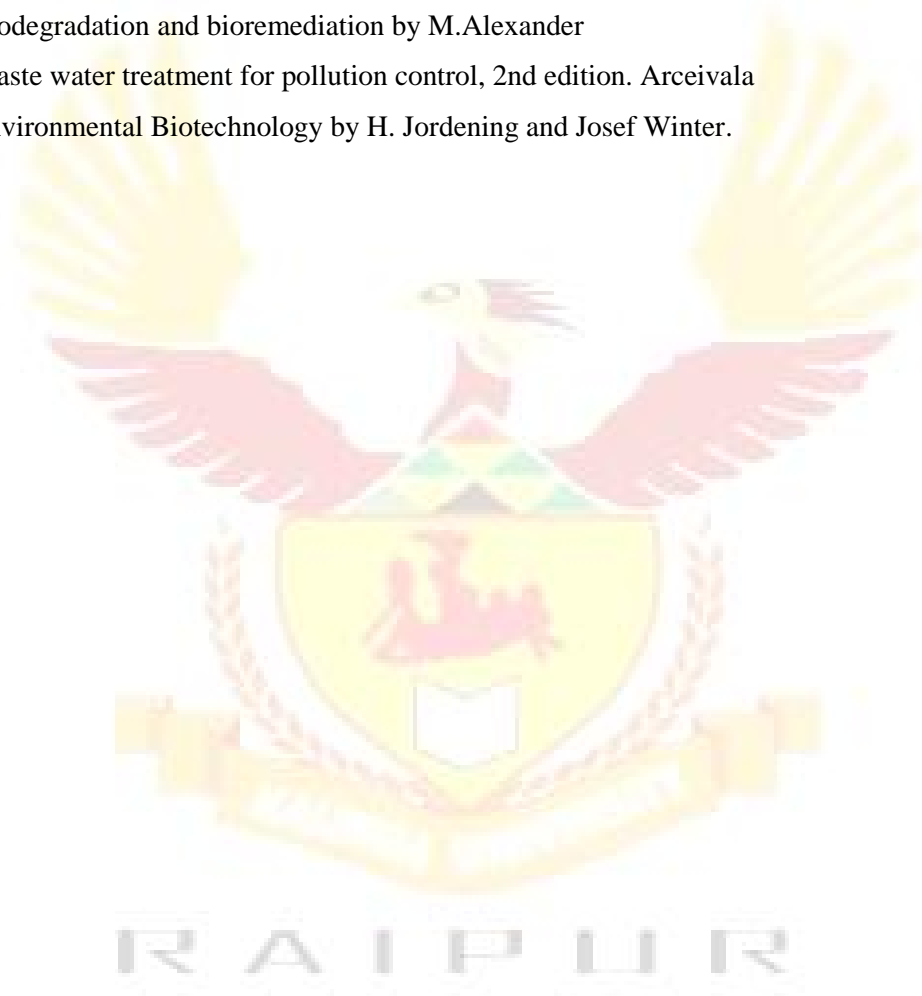
Microbial Insecticides: Bacterial, fungal and viral insecticides in pest management

Green house effect and precaution.

Biopesticide: Introduction, process, uses, application.

**Text Book/Reference:**

1. Biotechnology: B.D. Singh, Kalyani Publication.
2. Biotechnology: U. Satyanarayan, Books & Allied Pvt.Ltd.
3. Biotechnology: V. Kumarsen, Saras Publication.
4. Plant Biotechnology: V. Kumarsen, Saras Publication.
5. Environmental Biotechnology: S.V.S. Rana, Second edition.
6. Biotechnology: K.C. Soni (Vol-V) College Book centre.
7. Comprehensive Biotechnology Vol-4, Murray Moo Young.
8. Biotechnology-Rehm and Reid.
9. Waste water microbiology by G. Bitton
10. Biodegradation and bioremediation by M.Alexander
11. Waste water treatment for pollution control, 2nd edition. Arceivala
12. Environmental Biotechnology by H. Jordening and Josef Winter.



**(PRACTICAL: MMT303-P)  
Environmental Biotechnology**

**Lab Course:**

1. Laboratory rule, equipment and sterilization technique.
2. To perform the production of biofertilized product.
3. To determine the total dissolved solid (TDS) of water sample.
4. To determine the dissolve oxygen (DO) of water sample.
5. To determine the Biological oxygen demand (BOD) of water sample.
6. To determine the Chemical oxygen demand (COD) of water sample.
7. To study the Xenobiotic compound.



**RAIPUR**

## Enzymology

### Unit I

Introduction to Enzymes, enzyme nomenclature, enzyme commission numbers, and classification of enzymes. Isolation and purification of enzymes, preparation of purification chart, Enzyme activity, Specific activity and turn over number, Marker enzymes.

Enzyme catalysis in solution, kinetics and thermodynamic analysis, effects of organic solvents on enzyme catalysis and structural consequences.

Ribozymes and catalytic antibodies- Functional protein structures and drug targets (enzymes and receptors)

### Unit-II

Enzyme Kinetics: Michaelis and Menten Equation and its derivation

Lineweaver-Burk plot

Different methods to calculate the  $K_m$  and  $V_{max}$  and their significance.

Enzyme inhibition, different types of inhibitors and activators.

coenzyme and cofactors,

Enzyme nomenclature and classification of enzymes.

Enzyme activity, Specific activity and turn over number

### Unit-III

Factor affecting enzyme activity

Mechanism of action of enzymes involving two/more substrates.

Role of metal ions in enzyme catalysis.

Structure and function of enzymes: Lysozyme, chymotrypsin, DNA polymerase, RNase, proteases. Enzyme regulation and control of their activity. Introduction to allosteric enzymes and isozymes.

### Unit-IV

Enzyme Technology: Immobilization of enzymes, whole cell immobilization and their application, commercial production of enzymes, RNA-catalysis, Catalytic antibodies - abzymes, Protein and Enzyme engineering: Design and construction of novel enzymes.

Enzyme regulation and control of their activity. allosteric enzymes isozymes.



## Unit-V

Coenzymes Structure

mechanism of action of some important co-enzymes

RNA-catalysis,

Catalytic antibodies (abzymes)

Enzyme inhibition, different types of inhibitors and activators.

Immobilization of enzymes and their application

### Reference Books/ Text Books:

1. Nelson, D.L., Cox, M.M. Lehninger. (2004). Principles of Biochemistry, 4th edition Pub WH Freeman Co.
2. Daniel, L, Purich, Melvin, I. Simon, John, N., Abelson. (2000). Contemporary enzyme kinetics and mechanism.
3. Plowman. (1972). Enzyme kinetics. McGraw hill.
4. Jack kite. (1995). Mechanisms in protein chemistry, Garland publishers.
5. Gerhartz, W. (1990). Enzymes in industry: Production and applications. VCH publishers, NY.
6. Chaplin, M.F., Bucke, C. (1990). Enzyme technology. Cambridge university press, Cambridge.
7. Belter, P.A., Cussier, E. (1985) Wiley Bio separations .
8. Asenjo, J. Dekker, M. (1993) Separation processes in biotechnology.
9. Enzyme Kinetics (1995) Palmer
10. IUPAC Enzyme nomenclature series.
11. Enzyme kinetics: Dixon W. B.
12. General Enzymology :Kulkarni & Deshpande
13. Enzyme Assays:J. Raymond

**Practical (MBT 304-P)**  
**Enzymology**

**Lab Course:**

1. Isolation and assay of alpha-amylase activity from saliva
2. Isolation and assay of urease from horse gram or kidney gram
3. Isolation and assay of acid phosphatase from sweet potato
4. Determination of  $K_m$  and  $V_{max}$
5. Effect of pH and temperature on enzyme activity
6. Determination of specific activity of an enzyme
7. Molecular weight determination of a protein by gel electrophoresis
8. Immobilization of enzyme (Urease/Amylase)
9. Electrophoresis of Proteins - native and under denaturing conditions
10. N- and C- terminal analysis of proteins



# **SEMESTER-IV**

RAIPUR

## **Agriculture Biotechnology**

### **Unit-I**

Plant Biotechnology: Introduction to tissue culture, scope, application  
Organogenesis, Protoplast isolation and fusion  
Haploid plant: homozygous line, production, advantage, limitation  
Large scale culture: suspension culture, problem

### **Unit-II**

Somaclonal Variation and its process  
Embryo rescue: recovery of interspecific hybrid  
Micropropagation and its technique, application  
Gene transfer method and its technique and application  
Somatic hybridization and cybrid production and their applications in crop improvement.  
Productions of virus free plants using meristem culture.

### **Unit-III**

Cryopreservation: Introduction, process, application  
Germplasm conservation technique and application  
Transgenic plant: transgene action, herbicide resistance  
Vector: Introduction, production of transgenic plant

### **Unit-IV**

Agrobacterium mediated gene transfer  
Biotransformation introduction, process  
Golden rice and its uses  
Plant derived vaccine and application  
Transgenic plants, Genetically modified (GM) plants (Bt cotton, Bt Brinjal)

### **Unit- V**

Single cell protein and its application  
Mushroom culture and cultivation, application

Green house Technology. Biotic and Abiotic stress.

Edible vaccines, purification strategies

Transgene stability and gene silencing. Herbicide and insect resistance.

**Reference Books/ Text Books:**

1. Biotechnology: B.D. Singh expanding horizons, kalyani publisher
2. Plant Biotechnology: BD Singh, kalyani publisher
3. Biotechnology: U. Satyanarayan, elsvere publication
4. R.H.Smith, Plant Tissue Culture: Techniques and Experiments, Academic Press, San Diego. 1992.
5. S S Bhojwani and M K Razdan, Plant Tissue Culture, Elsevier Publ.
6. Plant Tissue Culture by MK Razdan & SS Bhojwani (1996) Elsevier
7. Plant Physiology by L Taiz & E Zeiger 4th Edition (2006) Sinauer Associates Inc, Publishers
8. Experiment in Microbiology, Plant pathology and Tissue culture by K.R. Aneja, Wishwa Prakashan
9. Genetic Transformation of Plants, Edited by Jackson, J.F.; Linskens, H.F. Springer 2003
10. Plant Biotechnology and Transgenic Plants, Edited by Kirsi Marja Oksman-Caldentey, Wolfgang Barz Marcel Dekker 2002 .



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**Practical (MBT 401-P)**  
**Agriculture Biotechnology**

**Lab Course:**

1. Laboratory rule, equipment and sterilization technique.
2. Media preparation and sterilization
3. Shoot tip culture, embryo culture
4. Callus culture, pollen culture
5. Micro propagation technique
6. Mushroom cultivation technique
7. To prepare green house



**RAIPUR**

## Industrial Biotechnology

### Unit-I

Introduction to bioprocess engineering, application

Bioreactors: Introduction, types, application

Air and media sterilization. Designing of a fermenter/Bioreactor.

Isolation, preservation and maintenance of industrial microorganisms, microbial growth and death.

### Unit-II

Food Biotechnology: Introduction, Food spoilage and preservation process,

Dairy Technology: Introduction, process, pasteurization and products.

Agriculture Industry: Introduction, production of pesticide and its application.

Biofertilizer: Introduction, process, application.

### Unit-III

Alcoholic Industry: Introduction, process of wine, beer and other alcoholic Beverages

Downstream processing: introduction, removal of microbial cells and solid matters,

foam separation, precipitation, filtration, centrifugation, cell disruption,

liquid-liquid extraction, chromatography, membrane process, drying and crystallization, effluent treatment

### Unit-IV

Industrial production of chemicals: alcohols, Citric acids

solvents (glycerols, acetone, butanol),

Industrial production of Antibiotics (penicillin, streptomycine, tetracycline)

single cell proteins, production, application

### Unit-V

Bioreactor Design, parts and their functions. Types of reactor. Upscaling of the fermentation process. Regulation of fermentation process. Quorum sensing in Bioprocess.

Genetic modification of industrial microorganism.

Metabolites from micro-organisms- amino acids and antibiotics, microbial polysaccharides

### Reference Books/ Text Books:

1. Texts/References: 1. Gautam, N. C., Food Biotechnology in Comprehensive Biotechnology, Vol. 6., Shree Publishers, New Delhi, 2007
2. Gutierrez – Lopez, G. F. et. al., Food Science and Food Biotechnology. CRC Publishers, Washington, 2003
3. Maheshwari, D. K. et. al., Biotechnological applications of microorganisms, IK . International, New Delhi, 2006
4. Stanbury, P. F. et. al., Principles of Fermentation Technology, 2nd Edition, Elsevier, UK, 1995.
5. Waites, M. J. et. al., Industrial Biotechnology: An Introduction, Blackwell publishing, UK, 2007.





**MBT402-P**

**External Term: 30**  
**Internal Marks: 20**

**Practical (MBT 402-P)**  
**Industrial Biotechnology**

**Lab Course:**

1. Laboratory rule, equipment and sterilization technique
2. Microbial production of Citric acid using *Aspergillus niger*.
3. Microbial production of antibiotics (Penicillin).
4. Production of alcohol
5. MBRT test

**MBT403**

**DISSERTATION**

Semester Long dissertation/ Project work/ Practical training/ field work + Technical writing

**R A I P U R**