

**SCHEME OF EXAMINATION**

**&**

**DETAILED SYLLABUS**

**For**

**M.Sc. Biotechnology**

**(W.e.f. 2021 – 2022)**



**FACULTY OF SCIENCE**  
**Kalinga University, Atal Nagar**  
**Chhattisgarh**

<b>Kalinga University, Raipur</b>					
<b>M.Sc Biotechnology</b>					
<b>w.e.f 2021-22 session</b>					
<b>Semester I</b>					
<b>Code No.</b>	<b>Paper</b>	<b>Credits</b>	<b>External Marks</b>	<b>Internal Marks</b>	<b>Total Marks</b>
MBT101	Advance Cell Biology	4	70	30	100
MBT102	Advance Biochemistry	4	70	30	100
MBT103	Microbiology	4	70	30	100
MBT104	Bio- Physical Chemistry & Instrumentation	4	70	30	100
	GE-I MBT105A/MBT105B	4	70	30	100
MBT105 A	Research Methodology				
MBT105 B	Science Journalism				
MBT101-P	Advance Cell Biology- <b>Lab</b>	1	30	20	50
MBT102-P	Advance Biochemistry- <b>Lab</b>	1	30	20	50
MBT103-P	Microbiology- <b>Lab</b>	1	30	20	50
MBT104-P	Bio- Physical Chemistry & Instrumentation- <b>Lab</b>	1	30	20	50
	<b>Total</b>	<b>24</b>	<b>470</b>	<b>230</b>	<b>700</b>

<b>Kalinga University, Raipur</b>					
<b>M.Sc Biotechnology</b>					
<b>w.e.f 2021-22 session</b>					
<b>Semester II</b>					
<b>Code No.</b>	<b>Paper</b>	<b>Credits</b>	<b>External Marks</b>	<b>Internal Marks</b>	<b>Total Marks</b>
MBT201	Advance Molecular Biology	4	70	30	100
MBT202	Computer Applications and Biostatistics	4	70	30	100
MBT203	Advance Immunology	4	70	30	100
MBT204	Bioinformatics and Nanobiotechnology	4	70	30	100
	GE-II MBT205A/MBT205B	4	70	30	100
MBT205 A	Entrepreneurship				
MBT205 B	Intellectual Property Rights				
MBT201-P	Advance Molecular Biology- <b>Lab</b>	1	30	20	50
MBT202-P	Computer Applications and Biostatistics- <b>Lab</b>	1	30	20	50
MBT203-P	Advance Immunology- <b>Lab</b>	1	30	20	50
MBT204-P	Bioinformatics and Nanobiotechnology- <b>Lab</b>	1	30	20	50
	<b>Total</b>	<b>24</b>	<b>470</b>	<b>230</b>	<b>700</b>

<b>Kalinga University, Raipur</b>					
<b>M.Sc Biotechnology</b>					
<b>w.e.f 2021-22 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
	DSE-I MBT304A/MBT304B	4	70	30	100
MBT304A	Enzymology				
MBT304B	Agriculture Biotechnology				
	DSE-II MBT304A/MBT304B	4	70	30	100
MBT305 A	Industrial Biotechnology				
MBT305 B	Advance Genomics and Proteomics				
MBT301-P	Genetic Engineering- <b>Lab</b>	1	30	20	50
MBT302-P	Animal Biotechnology & Plant Biotechnology- <b>Lab</b>	1	30	20	50
MBT303-P	Environment Biotechnology- <b>Lab</b>	1	30	20	50
	<b>Total</b>	<b>23</b>	<b>470</b>	<b>230</b>	<b>700</b>

<b>Kalinga University, Raipur</b>					
<b>M.Sc Biotechnology</b>					
<b>w.e.f 2021-22 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	Dissertation supported by Research Paper	24	450	150	600
	<b>Total</b>	<b>24</b>	<b>450</b>	<b>150</b>	<b>600</b>

**\*Project Dissertation 200**

**\*Presentation 100**

**\*Viva Voce 100**

**\*Scientific Paper 50**

# **SEMESTER-I**

**Advance 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, Filaria, Kalazar.  
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.



**MBT101-P**

**External Term: 30**

**Internal Marks: 20**

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

**Lab Course:**

1. To study the laboratory rules, tools, equipment and other requirements in Biotechnology laboratory.
2. To perform the sterilization technique for glassware for biotechnology laboratory.
3. To perform the different types of media and broth preparation: solid and liquid media.
4. To perform the pure culture technique by serial dilution method.
5. To study of microscope: bright field, phase contrast and fluorescence microscopy.
6. To perform bacterial cell culture and staining.
7. To study sub cellular fractionation.
8. To study histochemical techniques.
9. To perform the mitosis from given sample.
10. To perform the meiosis from given sample.

**ADVANCEBIOCHEMISTRY**

**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

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

**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.

## **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

Michoriza: 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 Mcgrahill 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

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

**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.

## 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  $\alpha$  helix,  $\beta$  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. Principles 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**

**Lab Course:**

1. To write the laboratory rule and instruments.
2. Quantitative analysis of nucleic acid by spectrophotometer.
3. Measurement of bacterial population by turbidometry.
4. Separation of cell organelles by centrifugation.
5. Analysis of secondary metabolites by HPLC.
6. Study of various type of Microscope.
8. Sterilization by autoclave.
9. Separation of proteins by SDS-PAGE.
10. Separation of DNA by agarose gel electrophoresis.
11. DNA sequencing

# **MBT105A**

## **Research Methodology**

Objectives:

1. Understand some basic concepts of research and its methodologies
2. Identify appropriate research topics
3. Select and define appropriate research problem and parameters
4. Prepare a project proposal (to undertake a project)
5. Organize and conduct research (advanced project) in a more appropriate manner

### **Unit I**

Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process

### **Unit II**

Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis – Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance, Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.

### **Unit III**

Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches. Measurement: Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.

### **Unit IV**

Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association. Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

### **Unit V**

Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline. Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

**Learning Outcomes:**

1. Students will understand a general definition of research design.
2. Students will know why educational research is undertaken, and the audiences that profit from research studies.
3. Students will be able to identify the overall process of designing a research study from its inception to its report.
4. Students will be familiar with ethical issues in educational research, including those issues that arise in using quantitative and qualitative research

**Assessment Tools:**

Written examinations, Case study discussions, Viva examinations.

**Books Recommended:-**

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari

## **MBT105B**

### **Science Journalism**

#### **Objectives**

- Students will learn the mechanics of science writing, including research, sourcing, and generating story ideas; interviewing, note-taking, and organization; fact-checking, editing, writing for story, structure, and formatting.
- Students will practice writing for multiple public, academic, and professional audiences and contexts using writing strategies, conventions, genres, technologies, and formats to communicate effectively.

**UNIT 1** Science communication at the end of the Enlightenment and the importance of notions of the public in the origin of modern science - development of new audiences for science in the Nineteenth century and the emergence of new science communication media (e.g. mechanics' institutes, science journalism, public museums and zoos) - advent of the figure of the scientist as public expert and the debate about 'Two Cultures' – difference between science journalism and science communication

**UNIT 2** Introduction of Western science in India through missionaries, travelers, army and civilian army of the East India Company– science in the 18th and 19th century –emergence of Indian pioneer scientists – science teaching– developments during post-Independence period – emerging areas of science and technology – convergence in study of science

**UNIT 3** Institutions of science in India - the role of the Asiatic Society – Bose Institute – Indian Institute of Science - Council of Scientific and Industrial Research (CSIR) – Indian Space Research Organization (ISRO) – Indian Science Congress organizations for popularization of science – NCSTC and Vigyan Prasar – noted science societies at state level – Science and Technology Academies – awards for science communication and popularization.

**UNIT 4** The boom in new media during the twentieth century and their impact on science journalism - role of a science page editor – popular science magazines in the west – science magazines in India – the ideal science reporter - scope of science journalism on radio & television in developing countries – science serials on radio and television – Bharat ki Chaap on Doordarshan – Science serials on All India Radio - tech news - understanding present market trends.

**UNIT 5** Science as an essential element in political, corporate and community news – major issues in science journalism – environmental pollution – genetically modified crops – research for disease prevention and eradication – nuclear power – disaster mitigation – scientific knowledge for effective governance – the North-South divide in science research and scientific development.

#### **Learning Outcomes**

- They will appreciate the digital landscape within which science journalism exists today by learning: blogging in science journalism (honing your craft, developing a voice); how to get work (pitching and staying relevant); the value of social networks for science journalism (sharing stories, finding stories, joining discussions and finding sources); digital strategies employed by major news organizations (data visualization, multimedia, community building).
- Students will analyze and learn about the structure of several types of data including numbers, texts and documents. Students will learn the skills to examine, evaluate, and

critique those data, extract patterns, summarize features, create visualizations, and provide insights, while learning to be sensitive to ethical concerns associated

**Assessment Tools:** Written examinations, Case study discussions, Viva examinations.

**Reference Book:**

1. Mass Communication: A Critical analysis, Keval J Kumar
2. Professional Journalism, M V Kamat
3. Theory and Practice of Journalism, B N Ahuja
4. Professional Journalist, John Hohenberg
5. Understanding Media, Marshall McLuhan 6. Journalism in India, Nadig Krishnamurthy, Mysore University Press
6. Barbara Gastel, Presenting Science to the Public.
7. Blum, Deborah, Knudson, Mary & Marantz Henig, Robin. A Field Guide for Science Writers: The Official Guide of the National Association of Science Writers. (2005)
8. D. Perlman, Science and the Mass Media.
9. Elise Hancock, Ideas into Words: Mastering the Craft of Science Writing. Baltimore and London: Johns Hopkins, 2003.
10. N Corcoran (Ed.). Communicating health: strategies for health promotion. Sage. (2013).
11. O.P. Jaggi, A Concise History of Science including Science in India.
12. R. Sundara, Popular Science in Mass Media.
13. Renata Schiavo, Health Communication: From Theory to Practice. John Wiley & Sons. 2013
14. Sharon, M. Friedman, Sharon, Woody, Carlol, L. Rogers (Ed) : Scientists and Journalists, Reporting Science as News.
15. Warren Burkett, News Reporting : Science Medicine and High Technology

# **SEMESTER-II**



## **Advance 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.

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## **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)**  
**Advance Molecular Biology - Lab**

**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.

## **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<sup>++</sup> 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.

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

**Lab Course:**

1. Power point Presentation.
2. MS word preparation.
3. MS excel preparation.
4. To plot a graph using MS office excel.
5. Determination of mean, median & mode.
6. Correlation analysis.
7. Probability test.
8. Range.
9. To the Calculation of T- test from given value.
10. To the Calculation of Chi square test from given value.

**MBT203**

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

## **Advance 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)**  
**Advance Immunology - Lab**

**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. Immunodiagnosics (demonstration using commercial kits)
8. To perform the widal test.
9. To determine the VDRL TEST
10. To perform the dot ELISA test.

**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**

**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. Designing PCR primers and probes.
8. Demonstration of nanoparticle synthesis.
9. Demonstration of green silver nano particles.
10. Study of Scanning electron microscope (SEM)

## **MBT205A**

### **Entrepreneurship Entrepreneurship**

**Course Objective:** The goals of this programme are to inspire students and help them imbibe an entrepreneurial mind-set. The students will learn what entrepreneurship is and how it has impacted the world and their country. They will be introduced to key traits and the DNA of an entrepreneur, and be given an opportunity to assess their own strengths and identify gaps that need to be addressed to become a successful entrepreneur. The programme comprises several short courses, each focusing on a specific entrepreneurial knowledge or skill requirement such as creative thinking, communication, risk taking, and resilience and helping them become career ready, whether it is entrepreneurship or any other career.

**Course Learning Outcomes:** After completion of these courses students will be able to understand-

**C** At the end of the course, the students will:

- Develop awareness about entrepreneurship and successful entrepreneurs.
- Develop an entrepreneurial mind-set by learning key skills such as design, personal selling, and communication.
- Understand the DNA of an entrepreneur and assess their strengths and weaknesses from an entrepreneurial perspective.

#### **Unit I**

**Contact Hours: 12**

Entrepreneurship: Concept of Entrepreneur, Entrepreneurship and Manager, Difference between Entrepreneur and Entrepreneur, Entrepreneurship, Attributes and Characteristics of successful entrepreneurs. Functions of an Entrepreneurs Function of an Entrepreneur, Classification of Entrepreneurs, Role of Entrepreneur in Indian Economy, Developing Entrepreneurial culture, Factors influencing Entrepreneurship Growth – Economic, Non-Economic Factors, For profit or Not for profit entrepreneurs, Constraints for the Growth of Entrepreneurial Culture, Entrepreneurship as a career, Entrepreneurship as a style of management, Emerging Models of Corporate Entrepreneurship, India's start up revolution-Trends, Imperatives, benefits: the players involved in the ecosystem, Business Incubators-Rural Entrepreneurship, social entrepreneurship, women entrepreneurs, Cases of Tata, Birlas, Kirloskar and new generation entrepreneurs in India. Case study on related topics.

#### **Unit II**

**Contact Hours: 12**

Theories of entrepreneurship: Innovation Theory by Schumpeter & Imitating, Theory of High Achievement by McClelland, X-Efficiency Theory by Leibenstein, Theory of Profit by Knight, Theory of Social change by Everett Hagen. Case study on related topics.

### **Unit III**

**Contact Hours: 12**

Entrepreneurship development: Entrepreneurial Competencies, Developing competencies, concept of entrepreneurship development, Entrepreneur Training and developing, Role of Entrepreneur development Programs (EDP), Role of DIC, EDII, NIESBUD, NEDB, EDP – Objectives – contents – methods – execution, Mudra Yojna: Shishu, Kishore and Tarun Scheme. Role of Mentors. Innovation and Entrepreneurship, Design Thinking Process, Role of consultancy organizations in promoting Entrepreneurs, Problems and difficulties of Entrepreneurs – Marketing Finance, Human Resource, Production; Research – external problems, Mobility of Entrepreneurs, Entrepreneurial change, occupational mobility – factors in mobility. Case study on related topics.

### **Unit IV**

**Contact Hours: 12**

Role of Central government and State Government in promoting Entrepreneurship: Introduction to various incentives, subsidies and grants, Export Oriented Units, Fiscal and Tax concessions available, Women Entrepreneurs – Role, Problems and Prospects, Reasons for low women Entrepreneurs, Assistance Programme for Small Scale Units – Institutional Framework – Role of SSI Sector in the Economy – SSI Units – Failure, Causes and Preventive Measures – Turnaround Strategies. Future of Entrepreneurship Development and Government, Start Up India, Make in India. Case study on related topics.

### **Unit V**

**Contact Hours: 12**

Enterprise Promotion: Creating Entrepreneurial Venture, Entrepreneurship Development Cycle, Business Planning Process The business plan as an entrepreneurial tool, Elements of Business Plan, Objectives, Market Analysis, Development of product/ idea – Resources, Capabilities, and strategies, identifying attributes of strategic resources, Opportunity Analysis, innovator or imitator, SWOT analysis, Internal and External Environment Analysis, Industry Analysis, Embryonic Companies and Spin off's, Porter's five forces model, Identifying the right Business Model Canvas, Seven Domains of John Mullins, Opportunities in Emerging/Transition/Decline industries, Opportunities at the bottom of the pyramid, Opportunities in social sector, Opportunities arising out of digitization, Marketing, Finance, Organization & Management, Ownership – Franchising, networking and alliances, Buying an

existing business, Critical risk contingencies of the proposal, Scheduling and milestones. Case study on related topics.

**Text Books:**

1. Vasant Desai (2011), Dynamics of Entrepreneurship Development, Himalaya Publishing House.
2. David H. Holt, (1991) Entrepreneurship: New Venture Creation, Prentice Hall.
3. K. Nagarajan, (2017) Project Management, New Age International Pvt Ltd.

**Reference book:**

1. The Culture of Entrepreneurship, Brigitte Berger.
2. Entrepreneurship: Strategies and Resources, Marc J, Dollinger.

## **MBT205B**

### **Intellectual Property Rights**

#### **Objectives**

1. To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries and Research.
2. To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
3. To disseminate knowledge on copyrights and its related rights and registration aspects
4. To disseminate knowledge on trademarks and registration aspects
5. To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects
6. To aware about current trends in IPR and Govt. steps in fostering IPR and case studies .

#### **Unit-1**

##### **Overview and Introduction of Intellectual Property**

Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967, the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994, Phonograms or Geneva Convention, History of IPR.

#### **Unit-2**

##### **Patents and Drafting**

Patents - Elements of Patentability: Novelty , Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and licence , Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board, Patent Filing and Drafting  
Case studies, Patent Agents role in India.

#### **Unit-3**

##### **Copyrights in IPR**

Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights, Filing and Drafting the Copyrights.

##### **Trademarks and Trading licences**



#### Unit-4

Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board, Trading licence importance of exports and imports in trading.

#### Unit-5

##### **IP transactions; Enforcement of IP, Commercialization**

Implications of Intellectual Property Rights in promoting innovations and their commercialization; technology transfer, Due diligence in patent transactions. Working of patents in India Compulsory licence and its implications; Enforcement of Patents against infringer.

**Industrial Designs Registrations:** Classification, Protection and Enforcement of Industrial Designs in Indian. Registration and protection of design in India and abroad.

**Geographical Indications:** Concept of Geographical Indications and GI registration in India; Global scenario of GI. Protection of Traditional Knowledge and development of balanced benefit sharing models; management of GI to enhance the economic returns from GIs. Enforcement of GI. GI registrations process in India Case studies.

##### **Case Studies and Discussions related to IPR**

#### Learning Outcomes

1. The students once they complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works during their research career, information in patent documents provide useful insight on novelty of their idea from state-of-the art search.
2. This course provide further way for developing their idea or innovations.
3. To Pave the way for the students to catch up Intellectual Property(IP) as an career option a. R&D IP Counsel b. Government Jobs – Patent Examiner c. Private Jobs d. Patent agent and Trademark agent e. Entrepreneur

**Assessment Tools:** Written examinations, Case study discussions, Viva examinations.

#### REFERENCE BOOKS

##### Text book

1. Rimmer, M. (2008). *Intellectual property and biotechnology: biological inventions*. Edward Elgar Publishing.
2. Singh, H. B., Jha, A., & Keswani, C. (Eds.). (2016). *Intellectual property issues in biotechnology*. CABI.
3. Nithyananda, K V. (2019). *Intellectual Property Rights: Protection and Management*. India, IN: Cengage Learning India Private Limited.

4. Neeraj, P., &Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.

**E-resources:**

1. Subramanian, N., &Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from <http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf>
2. 2. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from [https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo\\_pub\\_489.pdf](https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf)

**Reference Journal:** 1. Journal of Intellectual Property Rights (JIPR): NISCAIR  
<http://nopr.niscair.res.in/handle/123456789/45> (Case Studies)

**Useful Websites:**

1. Cell for IPR Promotion and Management (<http://cipam.gov.in/>)
2. World Intellectual Property Organisation (<https://www.wipo.int/about-ip/en/>)
3. Office of the Controller General of Patents, Designs & Trademarks (<http://www.ipindia.nic.in/>)

# **SEMESTER-III**

## **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**

**Lab Course:**

1. To study bacterial culture and antibiotic selection media.
2. To perform the preparation of competent cells.
3. To perform the isolation of genomic DNA from plant cells.
4. To perform the isolation of genomic DNA from bacterial cells.
5. To perform the isolation of plasmid DNA from bacterial cells.
6. To perform the quantitative estimation of nucleic acids.
7. Study of agarose gel electrophoresis and restriction mapping of DNA.
8. Study of cloning experiment by using plasmid/phagemid vectors.
9. Study of construction of restriction map of plasmid DNA.
10. Study of DNA sequencing of given DNA sample through sequencing methods.
11. Study of gene expression in *E.coli* and analysis of gene product.
12. To perform the PCR from given DNA sample.

**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.



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

**Lab course:**

1. To study laboratory rules, equipment and sterilization technique.
2. To perform the preparation of media for plant and animal tissue culture.
3. To perform the surface sterilization for plant and animal materials.
4. To perform the callus culture (plant).
5. To perform the callus propagation, organogenesis, transfer of plants to soil.
6. To perform the protoplast isolation and culture.
7. To perform the anther culture for the production of haploids plant.
8. To perform the shoot tip culture for the production of virus free plant.
9. Study of the role of serum in cell culture.
10. To prepare desired medium for the given animal cell culture.
11. To ensure the population of cells required for the culture by cell counting method and its viability by vital staining methods.
12. To ensure the differentiation of live cells from dead cells by giemsa stain method.

## **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.

**MBT303-P**

**External Term: 30**

**Internal Marks: 20**

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

**Lab Course:**

1. To study the laboratory rules, 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 biochemical oxygen demand (BOD) of water sample.
6. To determine the chemical oxygen demand (COD) of water sample.
7. Study of the xenobiotic compound.
8. To determine the MPN for given water sample.
9. To perform the set up of green house for the cultivation of different plants varieties.
10. Study of the vermi-composting method.

## DISCIPLINE SPECIFIC ELECTIVE- 1

**MBT304A (DSE1)**

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

### **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

## DISCIPLINE SPECIFIC ELECTIVE- 1

**MBT304B (DSE1)**

**External Term: 70**

**Internal Marks: 30**

### **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 .



## DISCIPLINE SPECIFIC ELECTIVE- 2

MBT305A (DSE2)

External Term: 70

Internal Marks: 30

### 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.

## DISCIPLINE SPECIFIC ELECTIVE- 2

MBT305B (DSE2)

External Term: 70

Internal Marks: 30

### Advance Genomics and Proteomics

#### Unit-I

**Genome Sequencing:** Genome sequencing projects, Next generation sequencing and understanding individual variation and diseases (technology of sequencing and assembly, bioinformatics of genome annotation, current status of genome sequencing projects), genomic browsers and databases, orthology prediction (comparative genomics), search for transcription factor binding sites (TFBS), computational prediction of miRNA target genes, *denovo* prediction of regulatory motifs in genome, single nucleotide polymorphisms (SNP) in medical genetics and basic research, application of genomics in personalized medicine, Nutrigenomics and Pharmacogenomics.

#### Unit-II

**Transcriptome analysis:** Microarray analysis, types of microarrays and applications, EST, SAGE, Microarray data: normalization and analysis; Genevestigator and OncoMine – browsing microarray-derived gene expression profiles, tissue and stage-of-development-specific patterns of expression, co-expression of genes, pre-computed lists of differentially expressed genes; Standalone analysis of publicly available microarray expression data: GEO database, TM4 analysis suite; Assembly of EST: CAP3 program; Whole genome analysis of mRNA and protein expression.

#### Unit-III

**Proteomics:** Protein analysis (measurement of concentration, amino-acid composition, N-terminal sequencing), 2-DElectrophoresis of proteins, microscale solution isoelectric focusing, peptide fingerprinting, LC/MS-MS, MALDI-TOF mass spectrometry for identification of proteins and modified proteins, SAGE and differential display proteomics; Protein-protein interactions: experimental and computational methods, databases, yeast two hybrid system; Metabolic pathways resources: KEGG, Biocarta; Nutrigenomics and metabolic health, analysis of microarray data,

protein and peptide microarray-based technology.

### **Books recommended**

- ❖ Genomics, Proteomics and Metabolomics in Nutraceuticals and Functional Foods by Debasis Bagchi, Anand Swaroop, Manashi Bagchi; Wiley Publication.
- ❖ Biocode: The New Age of Genomics. by Dawn Field and Neil Davies, Oxford University Press.
- ❖ The Proteomics Protocols Handbook by John M. Walker (Editor), Humana Press.
- ❖ Introduction to Genomics by Arthur M. Lesk, Oxford University Press.
- ❖ Clinical Genomics by Shashikant Kulkarni and John Pfeifer, Academic Press.
- ❖ Clinical Proteomics: Methods and Protocols (Methods in Molecular Biology) by Antonia Vlahou, Manousos Makridakis, Humana Press.
- ❖ Proteomics: A Cold Spring Harbor Laboratory Course Manual by Andrew J. Link, Cold Spring Harbor Laboratory Press.

**SEMESTER-IV**

RAIPUR

**MBT401**

**DISSERTATION  
(Supported by Published Research Paper)**

Duration Six Months

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

