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<th>Year</th>
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<td>Computer Science, Biostatistics &amp; Bioinformatics</td>
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<td>**Any one cluster (Set of Three Papers) from VIII-A or VIII-B can be selected</td>
<td>VIII-B</td>
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<td>Cluster Elective-B</td>
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B.Sc., SEMESTER I
MICROBIOLOGY

UNIT I
History, Development and Microscopy  12hrs
History and development of microbiology: contributions of Louis Pasteur, Robert Koch and Edward Jenner.
Principles and applications of Microscopy: Dark field, Phase contrast, fluorescent microscopy, SEM, TEM.

UNIT II  12hrs
Bacteria: Bacterial morphology and classification in brief. Gram+ve and Gram-ve bacteria.
Bacteria Growth Curves.
Nutrition in Bacteria: Basal, Selective, Differential and enriched media.

UNIT III  12hrs
Viruses: General characteristics of viruses, difference between virus and typical microbial cell, structure, different shapes and symmetries with one example of each type, classification of viruses on the basis of nucleic acids, phage and animal cell viruses, example of each and their importance. Brief idea of lytic cycle and lysogeny.

UNIT IV:  12hrs
Environmental Microbiology:
Biogeochemical cycles, Pollution-Organic and Inorganic pollutants
Aerobic and anaerobic treatment of water, Bioremediation.

UNIT V:  12hrs
Industrial Microbiology:
Basic principles of bioreactor, production of ethanol, citric acid, antibiotics-penicillin and SCP.

Suggested Books:
I B.Sc., BIOTECHNOLOGY SEMESTER END EXAMINATIONS   PAPER – I

MICROBIOLOGY       PAPER CODE: BT-T11

MODEL PAPER

Time: 3 Hours  Max. Marks: 75

SECTION – A

Answer and FIVE of the following  5x5=25 Marks
Draw neat labeled diagrams wherever necessary.

1.
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SECTION – B

Answer any FIVE of the following  5X10=50 Marks
Draw neat labeled diagrams wherever necessary.

11.a)  OR
       b)

12.a)  OR
       b)

13.a)  OR
       b)

14.a)  OR
PRACTICAL: BTP - MICROBIOLOGY

1. Demonstration, use and care of microbiological equipment.
2. Preparation of media, sterilization and isolation of bacteria.
3. Isolation of Bacteriophage from sewage / other sources.
4. Demonstration of motility of Bacteria.
5. Simple staining of bacteria
6. Gram staining of Bacteria
7. Acid fast staining of Bacteria
8. Endospore staining.
9. Demonstration of starch hydrolysis by bacterial cultures.
10. Growth of fecal coliforms on selective media.
11. Isolation of pure culture by pour plate method.
12. Isolation of pure culture by streak plate method.
17. To study germicidal effect of UV light on bacterial growth.
18. Wine production using different substrates.

Note: - Mandatory to perform at least ten practical.
B. Sc. SEMESTER II
MACROMOLEULES, ENZYMOLGY AND METABOLISM

UNIT I: 12hrs
Carbohydrates: Definition, classification, nomenclature of carbohydrates, structures of monosaccharides, disaccharides and polysaccharides. Concept and examples of heteropolysaccharides.

UNIT II 12hrs

UNIT III 12hrs
Lipid: Types of lipids, structures of saturated and unsaturated fatty acids, triglycerides, phospholipids, Concept of acid value, saponification value and iodine value. Chemistry of Porphyrines, Heme, Cytochromes, and Chlorophylls
Nucleic acids: Structure of DNA and RNA.

UNIT IV 12hrs
Enzymes: Classification and Nomenclature of enzymes, Holoenzyme, Apoenzyme and Co-enzyme, active site, allosteric effect, Enzyme specificity, Enzyme activity, Factors affecting Enzyme activity, Michaelis-Menton equation and Enzyme inhibition.

UNIT V 12hrs
Metabolism: Concept of free energy, Entropy, Enthalpy & Redox Potential. Concept of high energy bonds as related to the structure of ATP, Phosphoenolpyruvate, Creatine phosphate etc. Glycolysis, Krebs cycle, Oxidative phosphorylation.

Suggested Books:

MODEL PAPER

Time: 3 Hours
Max. Marks: 75

SECTION – A
Answer and FIVE of the following 5x5=25 Marks
Draw neat labeled diagrams wherever necessary.

1.
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SECTION – B
Answer any FIVE of the following 5X10=50 Marks
Draw neat labeled diagrams wherever necessary.

11.a) OR
   b)

12.a) OR
   b)

13.a) OR
   b)

14.a) OR
   b)
PRACTICALS: BTP- MACROMOLECULES & ENZYMEOLOGY

1. Qualitative estimation of Carbohydrates
2. Qualitative estimation of Amino acids
3. Quantitative Estimation of proteins by Biuret method
5. Estimation of glucose by Benedict’s quantitative method
7. Determination of saponification value of Fats
8. Determination of Acid Value of Fats
10. Assay of protease activity.
11. Assay of alkaline phosphatase
12. Preparation of starch from Potato and its hydrolysis by salivary amylase
13. Isolation of urease and demonstration of its activity

* Minimum of Ten practical’s are mandatory
UNIT I:  12hrs
**pH and Buffers:**

UNIT II:  12hrs
**Centrifugation:**
Basic principles, concept of RCF, types of centrifuges (clinical, high speed and ultracentrifuges). Preparative centrifugation, Analytical centrifugation: Sedimentation coefficient.

UNIT III:  12hrs
**Chromatography:** Principle, partition coefficient, nature of partition forces, brief account of Paper chromatography, thin layer chromatography and column chromatography. Gel filtration. Ion-exchange chromatography, Affinity chromatography, Principle and applications of HPLC.

UNIT IV  12hrs
**Electrophoresis:** Principle, types of electrophoresis- Paper electrophoresis, Gel electrophoresis-PAGE, Agarose and their applications.

UNIT V  12hrs
**Radioactivity and Basics of Spectroscopy:**

**Suggested Books:**
II BIOTECHNOLOGY SEMESTER END EXAMINATIONS PAPER –III
BIO ANALYTICAL TOOLS PAPER CODE: BT-T31
MODEL PAPER

Time: 3 Hours
Max. Marks: 75

SECTION – A
Answer and FIVE of the following
5x5=25 Marks
Draw neat labeled diagrams wherever necessary.

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SECTION – B
Answer any FIVE of the following
5X10=50 Marks
Draw neat labeled diagrams wherever necessary.

11. a) OR
     b)

12. a) OR
     b)

13. a) OR
     b)

14. a) OR
     b)

15. a) OR
     b)
PRACTICALS : BTP - METABOLISM & BIOPHYSICAL TECHNIQUES

1. Spectrophotometric analysis of DNA denaturation.
2. Determination of absorption spectrum of oxy- and deoxyhemoglobin and methemoglobin.
3. Protein estimation by E280/E260 method.
5. TLC of sugars/amino acids.
6. Cellular fractionation and separation of cell organelles using centrifuge.
7. Isolation of mitochondria and assay of marker enzyme.
8. Estimation of Urea by diacetylene monoxime method.
11. Absorption spectrum of NAD & NADH.
13. Titration of a mixture of strong & weak acid.
15. Gel electrophoresis of proteins.
16. SDS-PAGE of an oligomeric protein.

Note: - Mandatory to perform atleast 10 practicals

* * * * * * *
B. Sc. SEMESTER - IV
IMMUNOLOGY

UNIT I
12hrs
Immune system: Organs and cells of immune system Immunity, innate immune mechanism, Acquired immune mechanism, Humoral immunity.

UNIT II
12hrs

UNIT III
12hrs
Immunity: Antigen processing & presentation, Brief description of cytokines and MHC (MHC types and diversity), Auto immunity.

UNIT IV
12hrs
Hypersensitivity and Vaccination: General features of hypersensitivity, various types of hypersensitivity, Vaccination: Discovery, principles, significance, Types of Vaccines

UNIT V
12hrs
Immunological Techniques: Antigen-antibody reactions: Precipitation, agglutination, complement fixation, immunodiffusion, ELISA, RIA, IFM. Hybridoma technology: Monoclonal antibodies and their applications in immunodiagnosis.

Suggested Books:
II B.SC., BIOTECHNOLOGY SEMESTER END EXAMINATIONS PAPER – IV IMMUNOLOGY MODEL PAPER

PAPER CODE: BT-T41

Time: 3 Hours
Max. Marks: 75

SECTION – A

Answer and FIVE of the following 5x5=25 Marks
Draw neat labeled diagrams wherever necessary.

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SECTION – B

Answer any FIVE of the following 5X10=50 Marks
Draw neat labeled diagrams wherever necessary.

11.a) OR

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12.a) OR

b) 

13.a) OR

b) 

14.a) OR

b)
15. a)

b) OR

PRACTICALS: BT- IMMUNOLOGY & BIOPHYSICAL TECHNIQUES

1. Antigen – antibody reaction – determination of Blood group , Cross reactivity
2. Pregnancy test
3. Widal test
4. Ouchterloney immunodiffusion
5. Radial immunodiffusion
6. ELISA
7. Isolation of casein by isoelectric precipitation
8. Production of antibodies and their titration

Note: - Mandatory to perform atleast 6 practicals
B. Sc. SEMESTER - V
CELL BIOLOGY AND GENETICS

UNIT I 12hrs
Ultra structure of eukaryotic cell.
Cell organelles- Nucleus, Golgi complex, Mitochondria, Chloroplast, endoplasmic reticulum, lysosomes, peroxisome, glyoxisomes and vacuoles.

UNIT II 12hrs

UNIT III 12hrs
Mendels Laws and Inheritance: Mendel experiments, Mendel Laws and deviations: incomplete dominance and Co dominance Penetration and pleiotropism, Recessive and Dominant epistatic gene interactions. Concept of multiple alleles.

UNIT IV: 12hrs
Gene mutation- Spontaneous and induced- Point and Frame shift.
DNA Damage and DNA Repair- Excision repair and mismatch repair.

UNIT V 12hrs
Cell cycle and Cell division, Apoptosis.

Suggested Books:
III B.SC., BIOTECHNOLOGY SEMESTER END EXAMINATIONS PAPER –V
CELL BIOLOGY AND GENETICS PAPER CODE: BT-T51
MODEL PAPER

Time: 3 Hours Max. Marks: 75

SECTION – A

Answer and FIVE of the following 5x5=25 Marks

Draw neat labeled diagrams wherever necessary.

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SECTION – B

Answer any FIVE of the following 5X10=50 Marks

Draw neat labeled diagrams wherever necessary.

11.a) 

OR

b)

12.a)
PRACTICALS BTP – CELL BIOLOGY AND GENETICS (Elective Lab)

1. Study of different phases of mitosis in onion root tips and meiosis in *Allium cepa* flower buds.
2. Karyotyping in Allium or Drosophila.
3. Determination of multiple allele frequencies of leaf scars in Trifolium.
4. Problems and assignments in Mendelian genetics.
6. Induction of chromosomal aberrations by chemical mutagenesis in Allium (or any plant).
7. Isolation of auxotrophic mutants (plants or insects).
8. Repair of DNA by Photo activation of Photolyase in bacteria.
9. Mutation of bacteria by UV.
10. Chemical induced mutation in bacteria
11. Stages in Mitosis
12. Stages in Meiosis.
B. Sc. SEMESTER - V
III B.SC., BIOTECHNOLOGY PAPER-VI
MOLECULAR BIOLOGY

UNIT I
Genome Structure: Watson and Crick model of DNA; Genome organization with specific reference to prokaryotic and eukaryotic genomes; Genome size. Concepts of Genetic Material, Gene, Chromosome and Genome. Experiments to prove DNA as genetic material (Griffith experiment, Hershey- Chase experiment)

Unit II
DNA Replication: Enzymology of replication (DNA polymerase I, pol II and III, helicases, topoisomerases, single strand binding proteins, DNA melting proteins, primase. Proof of semiconservative replication, Replication origins, initiation, elongation, and termination. Rolling circle replication of DNA

Unit III
Transcription: Enzymatic synthesis of RNA: Basic features of transcription, structure of prokaryotic RNA polymerase (core enzyme and holo enzyme, sigma factor ), concept of promoter ( Pribnow box, -10 and -35 sequences ), Four steps of transcription (promoter binding and activation, RNA chain initiation, chain elongation, termination and release). Reverse transcription.

Unit IV:
Genetic Code and Protein Synthesis:
Genetic code: Features of genetic code, Structure of m RNA, brief structure of tRNA, the adaptor hypothesis, attachment of amino acids to tRNA. Codon-anticodon interaction - the wobble hypothesis. Initiation, elongation, termination of protein.

Unit V
Gene Expression and regulation:
Regulation of gene expression: Clustered genes and the operon concepts - Negative and positive control of the Lac Operon, trp operon, Control of gene expression. Poly and Mono cistronic mRNA.

Suggested Books:

III B.SC., BIOTECHNOLOGY SEMESTER END EXAMINATIONS PAPER –VI
MOLECULAR BIOLOGY PAPER CODE: BT-T
MODEL PAPER

Time: 3 Hours
Max. Marks: 75

SECTION – A
Answer and FIVE of the following 5x5=25 Marks
Draw neat labeled diagrams wherever necessary.

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SECTION – B
Answer any FIVE of the following 5X10=50 Marks
Draw neat labeled diagrams wherever necessary.
11.a) OR
PRACTICALS BTP - MOLECULAR BIOLOGY

1. Effect of UV radiations on the growth of microorganisms.
2. Determination of absorption maxima of DNA and RNA and their quantification
3. Quantitative estimation of RNA
4. Quantitative estimation of DNA
5. Isolation of plasmid DNA from bacteria
6. Isolation of genomic DNA from *E.coli*
7. Isolation of DNA from sheep liver
8. Isolation of DNA from plant leaves (Rice or Tobacco or any other plant)
9. Separation of DNA by Agarose gel Electrophoresis
10. Purity analysis of the Nucleic acids
Unit-1: Computer applications  
**Microsoft office:** Introduction and facilities available. Shortcut bar; customizing toolbar; using common office techniques- Starting an office application. 
**Microsoft word:** Starting a new document, opening existing document, moving and copying text 
**Microsoft excel:** Introducing excel worksheet, workbooks, functions and formulae, creating database. 
**Microsoft power point:** Creating presentations, working with slides, showing slide show, creating an organization charts and graphs, printing a presentation. 

**Biostatistics**

Unit-II  
Population, Sample, variable, parameter, primary and secondary data, screening and representation of data. Frequency distribution, tabulation, bar diagram, histograms, pie diagram, cumulative frequency curves. Mean median, mode, quartiles and percentiles, measures of dispersion: range, variance, standard deviation, coefficient of variation

Unit-III  
Application software: Use of in-built statistical functions for computations of Mean, S.D., Correlation, regression coefficients etc. Use of bar diagram, histogram, scatter plots, etc. graphical tools in EXCEL, sigma plot for presentation of data.

Unit-IV

**Unit-V**

12hrs

Types of sequence alignments (Global, local and multiple) – Pairwise alignment algorithms – Needleman and Wunch algorithm and SmithWaterman algorithm. Introduction to BLAST and FASTA. Applications of Bioinformatics.

**Suggested Books:**

8.

SECTION – B

Answer any FIVE of the following 5X10=50 Marks
Draw neat labeled diagrams wherever necessary.

11.a) OR
   b)

12.a) OR
   b)

13.a) OR
   b)

14.a) OR
   b)

15.a) OR
   b)

PRACTICALS: CA, BIOSTATISTICS and BIOINFORMATICS

1. Opening of Ms Word and typing the given text by applying the given functions (Page layout, Margins, font, Heading, bulleted list, Creating table etc.)
2. Creating a Spread sheet using MS EXCEL by following the given instructions
3. Creating a Presentation using MS POWER POINT by following the given instructions
4. Collection of data.
5. Histograms.
6. Mean, mode and median.
7. Standard deviation, correlation and regression
8. Introduction to Computers.
9. Hands on experience on NCBI databases
10. Sequence alignment with BLASTA and FASTA
12. Demonstration of Protein visualization (if software available)
Cluster Elective-A
B. Sc. III –Semester VI
III B.SC., BIOTECHNOLOGY SEMESTER-VI PAPER –VIII-A

MICROBIAL BIOTECHNOLOGY (VIII-A-1)

UNIT-I 14hrs

UNIT-II 10hrs
Downstream processing: Harvesting microbial cells – Membrane filtration system, high speed semi continuous centrifugation – disrupting microbial cells. Gram scale purification of recombinant proteins – Chromatography systems and analytical methods for large scale purification. Stabilization of the proteins.
UNIT-III  
10hrs  
Processing technology: Microbial metabolites - Organic solvents (Alcohol), Organic acids (Citric acid), Wines and beers, Antibiotics (penicillin), Vitamins (Vitamin B12), Amino acids (Aspartic acid). Production of single cell proteins.

UNIT- IV  
15hrs  

UNIT-V  
11hrs  
Enzyme technology: Sources production, isolation and purification of enzymes for the industrial use. Application of enzymes in pharmaceutical, food processing and other industries. Different techniques of immobilization of enzymes, applications and kinetics of immobilized enzymes. Design and operation of immobilized enzyme systems and bioreactors. Whole cell immobilization. Biosensors - principle and types.

Suggested Books:

III B.SC., BIOTECHNOLOGY SEMESTER END EXAMINATIONS PAPER –VIII A  
MICROBIAL BIOTECHNOLOGY PAPER CODE:BT-T  
MODEL PAPER

Time: 3 Hours  
Max. Marks: 75  

SECTION –A  
5x5=25 Marks  

Answer and FIVE of the following  
Draw neat labeled diagrams wherever necessary.

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Answer any **FIVE** of the following  
5X10=50 Marks  
Draw neat labeled diagrams wherever necessary.

11. a)  
   b) OR

12. a)  
   b) OR

13. a)  
   b) OR

14. a)  
   b) OR

15. a)  
   b) OR

**PRACTICALS: MICROBIAL BIOTECHNOLOGY (VIII A)**

1. Production of alcohol by S. cerevisiae
2. Production of citric acid by A. niger
3. Production of penicillin by fermentation
4. Production of wine from apples
5. Production aspartic acid
6. Production of glucose isomerase by batch fermentation
7. Production of lysine by Corynebacterium sp.

8. Characterization of microbes useful in degradation of pesticides/hydrocarbons

Cluster Elective-A
B. Sc. III – Semester VI
III B.Sc., BIOTECHNOLOGY SEMESTER-VI PAPER –VIII-A
BTT-rDNA TECHNOLOGY (VIII-A-2)

Unit I 10hrs
Restriction and Modification: Enzymes used in molecular cloning; Polymerases, ligases, phosphatases, kinases and nucleases. Classification of restriction endonucleases.

Unit II 14hrs
Cutting and joining DNA (cohesive end ligation, methods of blunt end ligation). Screening methods (Genetic marker and blue white screening)
Cloning vehicles - Plasmid, Bacteriophage, Construction of genomic and cDNA libraries.
Advantages of cDNA libraries.

Unit III 12hrs
Methods of gene sequencing – Maxam - Gilberts and Sanger’s dideoxy chain termination methods; Polymerase chain reaction technique (Components in PCR and PCR conditions), Blotting techniques.

Unit IV 12hrs
Methods of gene transfer in fungi, yeast and higher plants using microinjection, microprojectile bombardment (gene gun method, Electroporation, transformation and Selection of transformed cells.

Unit V 12hrs
Applications of recombinant DNA technology in Agriculture (Transgenic Plants) Medicine (production of Insulin, Growth hormone, Tissue plasmogen activator and HBsAg vaccine)

Suggested Books:
SECTION – A
Answer and FIVE of the following 5x5=25 Marks
Draw neat labeled diagrams wherever necessary.

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2. 
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SECTION – B
Answer any FIVE of the following 5X10=50 Marks
Draw neat labeled diagrams wherever necessary.

11.a) OR
   b) 
12.a) OR
   b) 
13.a) OR
   b) 
14.a) OR
   b) 
15.a) OR
   b)
1. Problem in Genetic engineering.
2. Transformation in Bacteria using plasmid.
3. Restriction digestion of DNA and its electrophoretic separation.
4. Ligation of DNA molecules and their testing using electrophoresis.
5. Activity of DNAase and RNAse on DNA and RNA.
6. Isolation of Plasmid DNA.
7. Demonstration of PCR
Cluster Elective-A
B. Sc. III –Semester VI

III B.SC., BIOTECHNOLOGY SEMESTER-VI PAPER –VIII-A
BTT- PLANT AND ANIMAL BIOTECHNOLOGY(VIII-A-3)

UNIT I 12hrs
Cell and tissue culture: Introduction to cell and Tissue culture Laboratory facilities, Tissue culture media (composition and preparation) Callus and suspension cultures: initiation and maintenance of callus and suspension cultures; single cell clones.

UNIT II: 12hrs
Tissue and micro-propagation: Regeneration, production of haploids, protoplast culture and somatic hybridization. Cloning in plants - Ti plasmid organization. Concept of transgenic plants Bt cotton and other plant applications.

UNIT III 12hrs
Various techniques of animal cell and tissue culture:
Culture media, growth factors, laboratory facilities.
Characteristics of cells in culture: Contact inhibition, anchorage dependence, cell-cell communication etc. Cell senescence. Primary culture, immortal cells, types of cell lines. Maintenance of cell lines in the laboratory.

UNIT IV 14hrs
rDNA products:
Brief idea about recombinant DNA products in medicine (insulin, somatostatin, vaccines), Concept of Gene therapy, Production of recombinant vaccines – hepatitis. Concept of transgenic animals, agrobacterium mediated transformation.
In vitro fertilization and embryo transfer in humans and farm animals(Dolly).

UNIT V 10hrs

Suggested Books:
III B.SC., BIOTECHNOLOGY SEMESTER END EXAMINATIONS PAPER –VIII-A-3
PLANT AND ANIMAL BIOTECHNOLOGY PAPER CODE: BT-T
MODEL PAPER

Time: 3 Hours                                                                                        Max. Marks: 75

SECTION –A
Answer and FIVE of the following 5x5=25 Marks
Draw neat labeled diagrams wherever necessary.

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SECTION – B

Answer any FIVE of the following 5X10=50 Marks
Draw neat labeled diagrams wherever necessary.

11.a)  
       OR

   b)

12.a)  
       OR

   b)

13.a)  
       OR

   b)

14.a)  
       OR
b)

15.a)

b) OR
1. Establishing a plant cell culture (both in solid and liquid media) – seed germination, callus culture, suspension cell culture, regeneration from callus cells.
2. Suspension culture.
5. Establishing primary cell culture of chicken embryo fibroblasts.
6. Animal tissue culture – maintenance of established cell lines.
10. IMViC test.
11. Determination of seed viability.
Cluster Elective-B
B. Sc. III – Semester VI
III B.SC., BIOTECHNOLOGY SEMESTER-VI PAPER –VIII-B

DEVELOPMENTAL BIOLOGY-VIII-B-1

UNIT-I
Introduction and overview of animal development; Developmental control of gene expression, Cell signaling, Determining cell fate and cell commitment, Fertilization and cleavage, Gastrulation and Neurulation

UNIT-II
Introduction and overview of plant development in Arabdopsis thalliana. Developmental strategies of plants; gamete production in plants-gametophytes, microsporogenesis, megasporogenesis, pollination, fertilization; embryo development-embryogenesis, dormancy, germination, vegetative growth, development of root, shoot and leaf; vegetative to reproductive transition; senescence; Plant’s response to environment.

UNIT-III
Examples of induction and cell fate determination; Early inductive events in Xenopus: axis formation, early inductive events in Xenopus: the Nieuwkoop center and the organizer, neural fate. Examples of determination of cell fate in the nervous system: the cerebral cortex, the retina. Consequences of Molecular evolution.

UNIT-IV
Introduction to developmental genetics: approaches and techniques; Introduction to C.elegans; Developmental genetics in practice: studying events controlled by maternal transcripts & later signaling events using C.elegans; epistasis and mosaic analysis to determine gene products;

UNIT-V
Developmental genetics in practice: studying early events in Drosophila development; axis formation, embryonic patterning, segmentation and segment identity in Drosophila. Limb development.

Suggested Books:
III B.Sc., Biotechnology Semester End Examinations Paper – VIII – B-1
Developmental Biology 
PAPER CODE: BT-T71A
MODEL PAPER

Time: 3 Hours                                                                                        Max. Marks: 75

SECTION – A
Answer and FIVE of the following                          5x5=25 Marks
Draw neat labeled diagrams wherever necessary.

1.
2.
3.
4.
5.
6.
7.
8.

SECTION – B
Answer any FIVE of the following                          5x10=50 Marks
Draw neat labeled diagrams wherever necessary.

11.a) OR
    b)

12.a) OR
    b)

13.a) OR
    b)

14.a) OR
    b)
15.a) OR

b)

PRACTICALS: DEVELOPMENTAL BIOLOGY (VIII-B-1)

1. Estimation of acid phosphatase levels in Tad pole tails
2. Types of anthers
3. Types of stigmas
4. Anther development in plants
5. Stages of megasporogenesis
6. Endosperm types
Cluster Elective-B
BTT- ENVIRONMENTAL BIOTECHNOLOGY (VIII-B-2)

Unit I 12hrs

Unit II 12hrs
Inorganic and Organic pollutants of air, land and water; maintenance of standards, Environmental monitoring. Detection, treatment and prevention of pollution. Biological indicators

Unit III 12hrs
Biocides, Four stage alternatives, Refuse disposal - Treatment methods, effluent from pharmaceuticals, fertilizers, pulp and paper industry.

Unit IV 12hrs
Waste water management - Aerobic and anaerobic treatment, primary, secondary and tertiary treatment of municipal wastes, Solid waste management.

Unit V 12hrs
Bioremediation, Biodegradation of recalcitrant compounds and the role of genetically engineered microbes and genetically modified organisms in the environmental management.

Suggested Books:

1. Environmental Science, S.C. Santra
2. Environmental Biotechnology, Pradipta Kumar Mohapatra
5. Agricultural Biotechnology, S.S. Purohit
7. Introduction to Environmental Biotechnology, Milton Wainwright
8. Principles of Environmental Engineering, Gilbert Masters
9. Wastewater Engineering - Metcalf & Eddy
III B.SC., BIOTECHNOLOGY SEMESTER END EXAMINATIONS PAPER –VIII-B-2
ENVIRONMENTAL BIOTECHNOLOGY PAPER CODE: BT-T
MODEL PAPER

Time: 3 Hours  
Max. Marks: 75

SECTION – A
Answer and FIVE of the following  
5x5=25 Marks
Draw neat labeled diagrams wherever necessary.

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8.

SECTION – B
Answer any FIVE of the following  
5X10=50 Marks
Draw neat labeled diagrams wherever necessary.

11.a)  
b)  
OR

12.a)  
b)  
OR

13.a)  
 b)  
OR

14.a)  
 b)  
OR

15.a)  
 b)  
OR
PRACTICALS BTP - ENVIRONMENTAL BIOTECHNOLOGY (VIII-B-2)

1. Detection of coliforms for determination of the purity of potable water.
2. Determination of total dissolved solids of water
3. Determination of Hardness and alkalinity of water sample.
4. Determination of dissolved oxygen concentration of water sample
5. Determination of biological oxygen demand of sewage sample
6. Determination of chemical oxygen demand (COD) of sewage sample.
7. Isolation of xenobiotic degrading bacteria by selective enrichment technique
8. Estimation of heavy metals in water/soil
10. Preparation and formulation of microbial biopesticide (bacteria, fungi and viruses)
11. In vitro evaluation of medicinal plants against pathogenic microbes.
12. Effect of mycorrhizal fungi on growth promotion of plants.
13. Production of microbial fertilizers (Rhizobium, Azotobacter and AMF).
Cluster Elective-B
BTT- Industrial Biotechnology (VIII-B-3)

Unit I 12hrs
Isolation, Screening, Preservation and Improvement of Industrially Important Microorganisms. Synthetic and Natural Medium, Precursors, Antifoams, Sterilization Methods and Inoculum Preparation.

Unit II 12hrs
Definition of bioreactor, basic principles of bioreactor. Classification of bioreactors. Analysis of batch, continuous, fed batch and semi-continuous bioreactors.

Unit III 12hrs

Unit IV 12hrs
Sources of Industrial Enzymes, Production of Microbial Enzymes like Amylase and protease. Backer’s Yeast and SCP Production. Production of Antibiotics: Penicillin.

Unit V 12hrs
Biotechnology Products- Production of recombinant proteins having therapeutic and diagnostic applications( Insulin, Growth hormone, Recombinant vaccines, Monoclonal Antibody).

Suggested Books:

1. Basic Industrial Biotechnology " by Munawar T Mohammad and Swamy a V N
III B.SC., BIOTECHNOLOGY SEMESTER END EXAMINATIONS PAPER – VIII-B-3
Industrial Biotechnology MODEL PAPER

Time: 3 Hours

Max. Marks: 75

SECTION – A

Answer and FIVE of the following

5x5 = 25 Marks

Draw neat labeled diagrams wherever necessary.

1.
2.
3.
4.
5.
6.
7.
8.

SECTION – B

Answer any FIVE of the following

5x10 = 50 Marks

Draw neat labeled diagrams wherever necessary.

11. a) OR
   b)

12. a) OR
   b)

13. a) OR
   b)

14. a) OR
   b)

15. a) OR
   b)
PRACTICALS BTP - Industrial Biotechnology (VIII-B-3)

1. Isolation of industrially important microorganisms from soil.
2. Isolation of amylase producing organisms from soil.
3. Production of $\alpha$ – amylase from *Bacillus Spp.* by shake flask culture.
4. Production of alcohol or wine using different substrates.
5. Estimation of alcohol by titrimetry.
7. Production of citric acid.
8. Citric acid production by submerged fermentation.