

MARWARI COLLEGE, RANCHI

(AN AUTONOMOUS UNIT OF RANCHI UNIVERSITY FROM 2009)



SYLLABUS FOR B.Sc. HONOURS IN BIOTECHNOLOGY

DEPARTMENT OF BIOTECHNOLOGY

Number of Papers: 20
(14 Theory Papers & 6 Practical Papers)

Full Marks: 1600
Theory: 1200, Practical: 400

Number of Semesters: 6

B. Sc. Hons. in Biotechnology Part - I: 400 Marks
(Theory: 300, Practical: 100)

B. Sc. Hons. in Biotechnology Part - II: 400 Marks
(Theory: 300, Practical: 100)

B. Sc. Hons. in Biotechnology Part - III: 800 Marks
(Theory: 600, Practical: 200)

| SUMMARY OF B. Sc. HONOURS IN BIOTECHNOLOGY SYLLABUS | | | | | | | |
|------------------------------------------------------------|--------------|-------------|------------------------------------|-------------------------|-----------------|-----------------|-------------------|
| Semester | Paper | Code | Subject | Full Marks | Mid Sem. | End Sem. | Pass Marks |
| First | 1 | BT 101 | Microbiology | 75 | 25 | 50 | 34 |
| | 2 | BT 102 | Genetics | 75 | 25 | 50 | 34 |
| | 3 | BT 103 | Microbiology Lab. | 50(25E+25I) | | 50 | 23 |
| Second | 4 | BT 201 | Mathematics & Biostatistics | 75 | 25 | 50 | 34 |
| | 5 | BT 202 | Biochemistry | 75 | 25 | 50 | 34 |
| | 6 | BT 203 | Biochemistry Lab. | 50(25E+25I) | | 50 | 23 |
| Third | 7 | BT 301 | Cell Biology | 75 | 25 | 50 | 34 |
| | 8 | BT 302 | Molecular Biology | 75 | 25 | 50 | 34 |
| | 9 | BT 303 | Cell & Molecular Biology Lab. | 50(25E+25I) | | 50 | 23 |
| Fourth | 10 | BT 401 | Bioinformatics & Computer Science | 75 | 25 | 50 | 34 |
| | 11 | BT 402 | Immunology | 75 | 25 | 50 | 34 |
| | 12 | BT 403 | Bioinformatics Lab. | 50(25E+25I) | | 50 | 23 |
| Fifth | 13 | BT 501 | Genetic Engineering | 100 | 30 | 70 | 45 |
| | 14 | BT 502 | Plant & Agricultural Biotechnology | 100 | 30 | 70 | 45 |
| | 15 | BT 503 | Animal Biotechnology | 100 | 30 | 70 | 45 |
| | 16 | BT 504 | Plant Tissue Culture Lab. | 100(50E+50I) | | 100 | 45 |
| Sixth | 17 | BT 601 | Environmental Biotechnology | 100 | 30 | 70 | 45 |
| | 18 | BT 602 | Biophysics | 100 | 30 | 70 | 45 |
| | 19 | BT 603 | Entrepreneurship & IPR | 100 | 30 | 70 | 45 |
| | 20 | BT 604 | Immunology Lab. & Project | 50 (Project) + 50(Lab.) | | 100 | 45 |

Total = 1600

E – External, I – Internal.

Note:-

Subsidiary Paper (For Semester-II & IV): **Compulsory** – Chemistry
Optional – Botany / Zoology

Compulsory Paper (For Semester-II & IV): **Alt. English or MIL Hindi**

Compulsory Paper (For Semester-VI):

Environmental Studies & Ethics

B. Sc. Honours in Biotechnology Part – I

Semester – I

Paper – 1, Microbiology (40 lectures)

Full Marks: 25 (MSE) + 50 (ESE) = 75 Time: 2½ Hrs. Pass Marks: 34

Instructions to question setter

1. Paper will be of 50 marks and divided into three groups:
Group 1 : Multiple choice question, fill in the blanks and true/false types (**10 x 1= 10**)
Group 2 : Concept based questions (4 questions of 2.5 marks each, word limit 50 words (**4 x 2.5 = 10**)
Group 3 : Descriptive type questions (5 questions of 6 marks each, word limit 250) (**5 x 6 = 30**)
One question from each unit is compulsory.
2. For group 2 and 3 the paper setter may or may not give any choice.
3. The question paper must cover the entire syllabus with equal distribution of marks as far as practicable.

Unit I

History of Microbiology: Anton Von Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Joseph Lister.

Control of Microorganisms: Sterilization, Disinfection, Sanitation, Pasteurization.

Physical and chemical methods of control.

Unit II

Prokaryotic and Eukaryotic cells.

Nature of microbial cell surface-gram positive and negative bacteria, kinds of flagella

Size, shape and structure of bacterial cells.

Nomenclature of viruses (HIV, TMV, Bacteriophage, Influenza virus, H1N1, Retroviruses)

Staining Techniques: Simple (Monochrome and Negative) and Differential (Gram and Acid fast).

Unit III

Bacterial Nutrition-

Nutritional classes of microorganisms, Extremophiles.

Microbiological media and their types.

Unit IV

Microbial Growth, Growth curve, Conditions affecting growth.

Different methods of Cultivation of Microorganisms (concept of pure culture, co-culture and mixed culture).

Unit V

microbial genetics-gene transfer:-

-discovery of gene transfer (u-tube experiment)

-transformation, transduction (Generalized and Specialized) and conjugation,

REFERENCES:

1. Microbiology – Pelezar, Chan, Krieg, Tata McGraw Hill Publications.
2. Microbiology – Concepts and application – Paul A. Ketchum, Wiley Publications.
3. Fundamentals of Microbiology – Frobisher, Saunders & Toppan Publications.
4. Microbiology – Ronald M. Atlas.
5. Introductory Biotechnology – R.B. Singh C.B.D. India.
6. Industrial Microbiology – Casidal, E. Wiley Eastern Ltd.

7. Fundamentals of Bacteriology – Salley.
8. Frontiers in Microbial technology – P.S. Bisen, CBS Publishers.
9. Biotechnology: International Trends & perspectives – A.T. Bull, G. Holl M.D. Lilly
Oxford & TBH Publishers.
10. General Microbiology – C.B. Powar, H.F. Dagainawala, Himalayan Publishing House.
11. Microbiology – Prescott.
12. Microbiology – Stainer.
13. Microbiology – P.D. Sharma.
14. Microbiology – Tortora.
15. Microbiology – A.S. Rao.
16. Microbiology – R.C. Dubey.
17. Microbiology – Anantnarayan.

B. Sc. Honours in Biotechnology Part – I

Semester – I

Paper – 2, Genetics (40 lectures)

Full Marks: 25 (MSE) + 50 (ESE) = 75 Time: 2½ Hrs. Pass Marks: 34

Instructions to question setter

- Paper will be of 50 marks and divided into three groups:
Group 1 : Multiple choice question, fill in the blanks and true/false types (10 x 1= 10)
Group 2 : Concept based questions (4 questions of 2.5 marks each, word limit 50 words (4 x 2.5 = 10)
Group 3 : Descriptive type questions (5 questions of 6 marks each, word limit 250) (5 x 6 = 30)
One question from each unit is compulsory.
- For group 2 and 3 the paper setter may or may not give any choice.
- The question paper must cover the entire syllabus with equal distribution of marks as far as practicable.

Unit 1. Mendelism & Chromosomal Theory (6 hrs.)

Mendel's experiments, laws of heredity based on monohybrid and dihybrid cross.
Test cross, Incomplete dominance and simple problems - Gene interaction-Multiple alleles, Supplementary factors, Complementary factors, Epistasis.

Unit 2. Chromosomes (8 hrs.)

Chemical composition, Structural organization of chromatin, Centromeres, Telomeres and secondary constriction.

- Nucleosome; Structure and organization.
- Euchromatin and Heterochromatin.
- Special types of chromosomes: Polytene and Lampbrush chromosomes.
- Banding pattern in human chromosomes.
- Karyotype in human.

Unit-3. Sex Determination (8 hrs.)

Concepts of autosomes and allosomes, Mechanism of sex determination.

- Linkage and Crossing over.
- Gene mapping.

Unit-4. Chromosomal Aberrations & Genetical Disorders (10 hrs.)

- A general account of structural and numerical rearrangement of genes.
- Mutations: Types: Spontaneous and Induced; Mutagens Physical & Chemical.
- Inherited disorders: Allosomal (klinefelter syndrome and Turner's syndrome), Autosomal- Down syndrome and Cri-du-chat syndrome.

Unit-5. Extrachromosomal Inheritance & Population Genetics (8 hrs.)

Extra nuclear Inheritance-Mitochondrial and plastid Inheritance.
Population Genetics-Hardy Weinberg Law of equilibrium, Allele and genotypic frequency analysis.

References:

- Principles of Genetics – E.J. Gardener, M.J. Simmons and D.P. Snustad, John Wiley & Sons Publications.

2. Principles of Genetics –Tamarian.
3. Genetics – Griffith.
4. Gene-IX – Benzamin Lewin.
5. Molecular Cell Biology – Lodish and Baltimore.
6. Genetics – Suzuki.
7. Genetics – Klug.
8. Genetics – P.K. Gupta.
9. Genetics – Strickberger, McMillan

B. Sc. Honours in Biotechnology Part – I

Semester – I

Paper – 3, Microbiology Lab. (50 periods)

Full Marks: 25E + 25I = 50

Time: 4 Hrs.

Pass Marks: 23

1. Preparation of media and sterilization techniques
2. Isolation of microbes from air, water and soil
3. Culture techniques- (a) pour plate technique (b) spread plate techniques
4. Method to obtain pure culture
5. Gram's staining techniques
6. Karyotyping
7. Calibration
8. Squash preparation
9. Mutation study

B. Sc. Honours in Biotechnology Part – I

Semester – II

Paper – 4, Maths and Biostatistics (40 lectures)

Full Marks: 25 (MSE) + 50 (ESE) = 75 Time: 2½ Hrs. Pass Marks: 34

Instructions to question setter

- Paper will be of 50 marks and divided into three groups:
Group 1 : Multiple choice question, fill in the blanks and true/false types (**10 x 1= 10**)
Group 2 : Concept based questions (4 questions of 2.5 marks each, word limit 50 words (**4 x 2.5 = 10**)
Group 3 : Descriptive type questions (5 questions of 6 marks each, word limit 250) (**5 x 6 = 30**)
One question from each unit is compulsory.
- For group 2 and 3 the paper setter may or may not give any choice.
- The question paper must cover the entire syllabus with equal distribution of marks as far as practicable.

Unit-1. Arithmetical & Algebra Based problems (A) (4 hrs.)

The Set Theory, properties of subsets
Matrices
Logarithm

Unit-2. Arithmetical & Algebra Based problems (B) (4 hrs.)

Permutation and Combination
The Binomial Theorem

Unit-3. Calculus (8 hrs.)

Linear and Geometric functions
Problem related to differentiation Integration

Unit-4. Biostatistics (A) (7 hrs.)

Measures of central tendencies: Mean, Median, Mode and their properties
Measures of Dispersion: Mean deviation, Variance, Standard deviation and coefficient of Variation

Unit-5. Biostatistics (B) (5 hrs.)

Probability, Conditional Probability, Bayes' Theorem, Expectations

REFERENCES: (Mathematics and Biostatistics)

- Statistics in biology, Vol.1 – Bliss, C.J.K., McGraw Hill, New York.
- Statistics for Biologists – Campbell, R.C., Cambridge Univ. Press, Cambridge.
- Biostatistics – Daniel, Panima Publications Corporation.
- Practical statistics for Experimental Biologists – Swardlaw, A.C., John Wiley and Sons, Ine, NY.
- Fundamentals of Biostatistics – Khan, Publishing Corporation.
- Biostatistics – Zar.
- Biostatistics – Mahajan.
- Biostatistics – Veer Bala Rastogi.
- Biostatistics – Khan and Khanum.
- Biostatistics –Jasra and Raj.
- Biostatistics –Mishra and Mishra.

B. Sc. Honours in Biotechnology Part – I

Semester – II

Paper – 5, Biochemistry (40 lectures)

Full Marks: 25 (MSE) + 50 (ESE) = 75 Time: 2½ Hrs. Pass Marks: 34

Instructions to question setter

- Paper will be of 50 marks and divided into three groups:
Group 1 : Multiple choice question, fill in the blanks and true/false types (**10 x 1 = 10**)
Group 2 : Concept based questions (4 questions of 2.5 marks each, word limit 50 words (**4 x 2.5 = 10**))
Group 3 : Descriptive type questions (5 questions of 6 marks each, word limit 250) (**5 x 6 = 30**)
One question from each unit is compulsory.
- For group 2 and 3 the paper setter may or may not give any choice.
- The question paper must cover the entire syllabus with equal distribution of marks as far as practicable.

Unit-1. Structural Biochemistry (16 hrs.)

Composition, Structure, Function and Properties of the following Biomolecules.

- Carbohydrates
- Proteins
- Lipids
- Nucleic acids

Unit-2. Metabolism-I

Glycolysis, Gluconeogenesis, Glycogenesis, Glycogenolysis, TCA Cycle, Pentose Phosphate Pathway. Lipid Metabolism: B-oxidation of fatty acids.

Unit-3. Metabolism II

- Protein metabolism: Transamination, Deamination, Urea Cycle.
- Oxidative phosphorylation, ETC.
- Metabolic disorders.

Unit-4. Introduction to Enzymes (5 hrs.)

- Nomenclature
- Classification
- Properties and kinetics
- Mechanism of action (Principle of catalysis).
- Factors affecting Enzyme catalysed reactions.
- Non-protein enzymes

Unit-5. Enzyme Regulation & Applications (7 hrs.)

- Regulation (Allosteric Modulation)
- Inhibition (competitive, non-competitive & feed back)
- In-vitro applications of purified enzymes in following areas:
 - Industry
 - Food Industry
 - Medicines
 - Diagnosis
 - ELISA

References:

1. Principles of Biochemistry – Albert L. & Lehninger, CBS Publishers & Distributors.
2. Biochemistry – Lubert Stryer Freeman International Edition.
3. Biochemistry – Keshav Trehan Wiley Eastern Publications.
4. Fundamentals of Biochemistry – J.I. Jani S. Chand and Company.
5. Biochemistry – Prasaranga, Bangalore University.
6. Fundamentals of Biochemistry – Dr. A.C. Deb.
7. Biochemistry – Cantarow & Schepartz-Saunders

B. Sc. Honours in Biotechnology Part – I

Semester – II

Paper – 6, Biochemistry Lab. (50 periods)

Full Marks: 25E + 25I = 50

Time: 4 Hrs.

Pass Marks: 23

1. Preparation of standard graph-Lambert Beer's Law (Principles of colorimetry).
2. Quantitative estimation of the following in sample solutions:-
 - a) Sugar by Anthrone/DNS/ phenol sulphuric acid method.
 - b) Proteins by Lowry/Biuret method.
 - c) DNA by DPA method.
 - d) RNA by Orcinol method.
 - e) Cholesterol by standard cholesterol method.
3. Isolation of casein protein from milk.
4. Assay of enzyme.
5. Chromatographic methods for separation of macromolecules.
6. Paper chromatography.
7. Thin Layer chromatography.

B. Sc. Honours in Biotechnology Part – II

Semester – III

Paper – 7, Cell Biology (40 lectures)

Full Marks: 25 (MSE) + 50 (ESE) = 75 Time: 2½ Hrs. Pass Marks: 34

Instructions to question setter

- Paper will be of 50 marks and divided into three groups:
Group 1 : Multiple choice question, fill in the blanks and true/false types (**10 x 1= 10**)
Group 2 : Concept based questions (4 questions of 2.5 marks each, word limit 50 words (**4 x 2.5 = 10**))
Group 3 : Descriptive type questions (5 questions of 6 marks each, word limit 250) (**5 x 6 = 30**)
One question from each unit is compulsory.
- For group 2 and 3 the paper setter may or may not give any choice.
- The question paper must cover the entire syllabus with equal distribution of marks as far as practicable.

Unit 1. Cell as basic unit of living system (4 hrs.)

- Discovery of cells.
- The cell theory.
- Concept of prokaryotic & eukaryotic cell.
- Difference between prokaryotic & eukaryotic cell

Unit 2. Membrane structure and function (3 hrs.)

- Structure of model membrane, lipid bilayer & membrane proteins.
- Diffusion, osmosis.
- Cell wall.

Unit 3. Structure & function of cellular organelles

- Endoplasmic reticulum.
- Golgi complex, Lysosomes, Peroxisomes, Ribosomes.
- Mitochondria, Chloroplast.
- Cytoskeletal structure (Microtubule, Microfilament and Intermediate filament).
- Nucleus (Nuclear envelop with nuclear pore complex, nucleoplasm, nucleolus).

Unit 4. Structure of chromosome

- Morphology and structural organization of chromosome (centromere, secondary constriction, telomere, chromatin fibre, euchromatin & Heterochromatin).

Unit 5. Cell cycle & communication

- Cell cycle.
- Mitosis.
- Meiosis.
- Cell-cell interaction (components & mechanism).
- Cell-cell adhesion (role of cell adhesion molecules).

REFERENCES:

1. Molecular Biology of cell – Bruce Alberts et.at, Garland Publications.
2. Animal Cytology & Evolution – MJD, White Cambridge University Publications.
3. Molecular Cell Biology – Daniel, Scientific American Books.

4. Cell Biology – Jack D. Bruke, The William Twilkins Company.
5. Cell Biology – Ambrose & Dorothy M Easty, ELBS Publications.
6. Fundamentals of Cytology – Sharp, McGraw Hill Company.

B. Sc. Honours in Biotechnology Part – II

Semester – III

Paper – 8, Molecular Biology (40 lectures)

Full Marks: 25 (MSE) + 50 (ESE) = 75 Time: 2½ Hrs. Pass Marks: 34

Instructions to question setter

1. Paper will be of 50 marks and divided into three groups:
Group 1 : Multiple choice question, fill in the blanks and true/false types (**10 x 1= 10**)
Group 2 : Concept based questions (4 questions of 2.5 marks each, word limit 50 words (**4 x 2.5 = 10**))
Group 3 : Descriptive type questions (5 questions of 6 marks each, word limit 250) (**5 x 6 = 30**)
One question from each unit is compulsory.
2. For group 2 and 3 the paper setter may or may not give any choice.
3. The question paper must cover the entire syllabus with equal distribution of marks as far as practicable.

Unit-1. Molecular basis of life

- Structure of DNA.
- DNA replication in prokaryotes of eukaryotes.

Unit-2. DNA recombination molecular mechanisms in prokaryotes and eukaryotes

- Insertion elements and transposons.
- Structure of prokaryotic & eukaryotic genes.

Unit-3.

- Prokaryotic & eukaryotic transcription.
- Prokaryotic & eukaryotic translation.

Unit-4. Gene Expression

- Prokaryotic gene expression (lac, his, tap, catabolic repression)
- Eukaryotic gene expression transcription factors etc.
- Gene expression in yeast.
- Gene expression in protozoan parasites.

Unit-5. Gene organization and expression in-Mitochondria & Chloroplasts

- Post translation regulation of gene expression.
- Development and environmental regulation of gene expression.

REFERENCE:

1. Molecular Biotechnology, Principles and application of recombinant DNA – Glick, B.T and Pasternak J.J., Washington D.C. ASM Press.
2. Gene Cloning and manipulation – Howe. C., Cambridge University Press USA.
3. Gene – Lewin, B., New York, Oxford University Press.
4. Genetic Engineering – Rigby, P.W.J., Academic Press Inc. Florida, USA.
5. Molecular Cloning Volumes I, II & III – Sambrook *et al.*, Cold Spring Harbor Laboratory Press, New York, USA.
6. Molecular Biology & Biotechnology (Indian Edition) – Walker J.M. and Gingold, E.B., Royal Society of Chemistry U.K.
7. Cell & Molecular Biology – Karp. G., John Wiley & Sons; INC.
8. Molecular Biology of Gene – Watson *et al.*, Pearson Education.

B. Sc. Honours in Biotechnology Part – II

Semester – III

Paper -9, Cell and Molecular Biology Lab. (50 hours)

Full Marks: 25E + 25I = 50

Time: 4 Hrs.

Pass Marks: 23

Techniques in Molecular Biology & Genetic Engineering

1. Preparation of buffers – Phosphate buffer, Acetate buffer.
2. Isolation of genomic DNA from plant.
3. Isolation of genomic & plasmid DNA from bacteria.
4. Electrophoretic Technique:
 - a) Gel casting for AGEL.
 - b) Running of gel for AGEL.
 - c) Staining and visualization of AGEL.
 - d) Gel casting for PAGE.
 - e) Running of gel for PAGE.
 - f) Staining and visualiazation for PAGE.
5. Making competent E. coli cells.

B. Sc. Honours in Biotechnology Part – II

Semester – IV

Paper – 10, Bioinformatics & Computer Science

Full Marks: 25 (MSE) + 50 (ESE) = 75 Time: 2½ Hrs. Pass Marks: 34

Instructions to question setter

1. Paper will be of 50 marks and divided into three groups:
Group 1 : Multiple choice question, fill in the blanks and true/false types (**10 x 1= 10**)
Group 2 : Concept based questions (4 questions of 2.5 marks each, word limit 50 words (**4 x 2.5 = 10**)
Group 3 : Descriptive type questions (5 questions of 6 marks each, word limit 250) (**5 x 6 = 30**)
One question from each unit is compulsory.
2. For group 2 and 3 the paper setter may or may not give any choice.
3. The question paper must cover the entire syllabus with equal distribution of marks as far as practicable.

Unit-1. Introduction to Bioinformatics & Resources

1. What is Bioinformatics?
2. Scope & Application of Bioinformatics.
3. NCBI.
4. Primary database-Gen Bank.
5. Secondary database-Prosit.
6. Genome database

Unit-2. Sequence Alignment

1. Global Alignment.
2. Local Alignment.
3. BLAST and FASTA (Pairwise alignment)

Unit-3. Computational Biology

1. Molecular phylogenetics.
2. Tree construction (distance & character based).

Unit-4. Genomics & proteomics

1. DNA microarray
2. Proteomics basic.
3. Introduction to Pharmacogenomics

Unit-5. Basic concept of Computer

1. Introduction, different components of computer, input, output and memory devices.
2. Hardware and Software concepts.
3. Microsoft Word :- Concept of toolbar, character, paragraph and document formatting, drawing tool bar, header, footer, document editing, page setup, short cut keys, text & graphics.

4. Microsoft excel :- Concept of spread sheets, creating worksheet, well formatted documents, concept of row, column, cell & formula bar, using function, using shortcuts chart.
5. Microsoft power point :- Slide representation, slide layout & design, custom animation, image importing, slide transition.

REFERENCES:

1. Bioinformatics: Sequence, Structure and databanks – Des Higgins Oxford.
2. Bioinformatics – Baxevams, Wiley.
3. Bioinformatics – Bergeron Pearson Education.
4. Bioinformatics – Srinivas PHI.
5. Fundamental concepts of Bioinformatics – Attwood.
6. Microarray Bioinformatics – Stekel Cambridge.
7. Bioinformatics – Mehrotra Vikas.
8. Bioinformatics – Lacroix Elsevier.

REFERENCES (Computer)

1. Computer fundamentals - Sumita Arora.
2. Programming fundamentals - Kanitkar
3. Programming fundamentals - Balaguruswamy.
4. Data Base Management System - Blade Smith (TMH).
5. M.S. Office - Office Master (TMH)

B. Sc. Honours in Biotechnology Part – II

Semester – IV

Paper –11, Immunology (40 lectures)

Full Marks: 25 (MSE) + 50 (ESE) = 75 Time: 2½ Hrs. Pass Marks: 34

Instructions to question setter

1. Paper will be of 50 marks and divided into three groups:
Group 1 : Multiple choice question, fill in the blanks and true/false types (**10 x 1= 10**)
Group 2 : Concept based questions (4 questions of 2.5 marks each, word limit 50 words (**4 x 2.5 = 10**)
Group 3 : Descriptive type questions (5 questions of 6 marks each, word limit 250) (**5 x 6 = 30**)
One question from each unit is compulsory.
2. For group 2 and 3 the paper setter may or may not give any choice.
3. The question paper must cover the entire syllabus with equal distribution of marks as far as practicable.

Unit-1. (10 hrs.)

1. Historical Perspective
2. Types of Immunity- Innate, Acquired, active, passive, Humoral and Cell-mediated immunity.
3. Primary and Secondary response.

Unit-2. (10 hrs.)

1. Organs of Immune system – Spleen, Thymus, Lymph nodes.
2. Cells of Immune system – T cell – its types and receptors, B cell and its receptors.

Unit-3. (10 hrs.)

1. Antigens- Properties and types, Adjuvants.
2. Immunoglobulins- Structure, types and functions

Unit-4. (5 hrs.)

Major histocompatibility complex: General introduction types and function, vaccine.

Unit-5. (5 hrs.)

Antigen Antibody reaction: Agglutination and Precipitation reactions, Immunodiffusion, Immunoelectrophoresis, Rocket electrophoresis, ELISA, RIA etc.

REFERENCES:

1. Fundamental Immunology – William, E. Paul, Raven Press, New York.
2. The Experimental Foundations of Modern Immunology – William, R. Clark, John Wiley and Sons, New York.
3. Immunology – Kubey.
4. Immunology – Abbas.
5. Immunology – Tizzard.
6. Practical Immunology – Talwar.
7. Immunology – Roit.

B. Sc. Honours in Biotechnology Part – II

Semester – IV

Paper 12, Bioinformatics Lab. (50 hours)

Full Marks: 25E + 25I = 50

Time: 4 Hrs.

Pass Marks: 23

- 1. NCBI-National Center for Biotechnology Information (Database).**
- 2. DDBJ-DNA Databank of Japan (Database)**
- 3. BLAST.**
- 4. FASTA.**
- 5. CLUSTALW.**
- 6. Rasmol.**
- 7. Swiss PDB Viewer.**

B. Sc. Honours in Biotechnology Part – III

Semester – V

Paper –13, Genetic Engineering (40 lectures)

Full Marks: 30 (MSE) + 70(ESE) = 100 Time: 3 Hrs. Pass Marks: 45

Instructions to question setter

1. Paper will be of 70 marks and divided into three groups:
Group 1 : Multiple choice question, fill in the blanks and true/false types (**20 x 1= 20**)
Group 2 : Concept based questions (4 questions of 5 marks each, word limit 50 words (**4 x 5 = 20**)).
Group 3 : Descriptive type questions (5 questions of 6 marks each, word limit 250) (**5 x 6 = 30**).
One question from each unit is compulsory.
2. For group 2 and 3 the paper setter may or may not give any choice.
3. The question paper must cover the entire syllabus with equal distribution of marks as far as practicable.

Unit-1. Genes and Gene Cloning (5 hrs.)

1. Prokaryotic and Eukaryotic gene: Concepts.
2. Basics of Gene cloning (what & why)
3. Tools for genetic engineering: Restriction Enzymes

Unit-2. Cloning Vectors (5 hrs.)

1. Cloning Vehicles: Plasmid, Bacteriophage, Phagemids, Cosmids.
2. Cloning Vectors for *E. coli*, yeast, fungi, plants, and animals with special reference to PCR Technology

Unit-3. DNA Isolation (7 hrs.)

1. Isolation and purification of genomic/chromosomal DNA from living cells – Bacteria, Plant, Animal.
2. Isolation and purification of Plasmid DNA from Bacteria.
3. Isolation and purification of Phage DNA from Bacteria.
4. DNA sequencing (Enzymatic & Chemical Method)

Unit-4. Genetic Manipulation & Introduction (8 hrs.)

1. Use of Manipulative enzymes for DNA modification. (Linkers, Adaptors: concept)
2. Insertion of DNA into living cells (Various Methods: Transformation, Transfection, Biolistics, Microprojectiles, Electroporation, Microinjection etc.)

Unit-5. Applications

1. Gene Cloning in Medicine: Production of pharmaceutical compounds
2. Artificial Insulin gene synthesis
3. Recombinant vaccine and Diagnostic reagents

REFERENCE:

1. Molecular Biotechnology, Principles and application of recombinant DNA – Glick, B.T and Pasternak J.J., ASM Press, Washington D.C.
2. Gene Cloning and Manipulation – Howe. C., Cambridge University Press USA.
3. Gene – Lewin, B., Oxford University Press, New York.
4. Genetic Engineering – Rigby, P.W.J., Academic Press Inc. Florida, USA.
5. Molecular Cloning Volumes I, II & III - Sambrook *et al.*, Cold Spring Harbor Laboratory Press, New York, USA.
6. Molecular Biology & Biotechnology (Indian Edition) – Walker J.M. and Gingold, E.B., Royal Society of Chemistry U.K.
7. Cell & Molecular Biology – Karp. G., John Wiley & Sons; INC.
8. Molecular Biology of Gene – Watson *et al.*, Pearson Education.
9. Gene cloning and Manipulating – Christopler H., Cambridge University Press.
10. An Introduction of Genetic Engineering – Nicholl, D.S.T., Cambridge University Press.
11. Principles of Gene Manipulation, An introduction to genetic engineering – Old R.W. and Primrose, S.B., Black well Scientific Publications.
12. Molecular Biology – Watson J.D. Hopkins, N.H. Roberts, J.W. Steetz J.A. and Weiner A.M. Society for Microbiology.
13. Recombinant DNA – Watson *et al.*

B. Sc. Honours in Biotechnology Part – III

Semester – V

Paper –14, Plant & Agricultural Biotechnology

Full Marks: 30 (MSE) + 70(ESE) = 100 Time: 3 Hrs. Pass Marks: 45

Instructions to question setter

1. Paper will be of 70 marks and divided into three groups:
Group 1 : Multiple choice question, fill in the blanks and true/false types (**20 x 1= 20**)
Group 2 : Concept based questions (4 questions of 5 marks each, word limit 50 words (**4 x 5 = 20**)).
Group 3 : Descriptive type questions (5 questions of 6 marks each, word limit 250) (**5 x 6 = 30**).
One question from each unit is compulsory.
2. For group 2 and 3 the paper setter may or may not give any choice.
3. The question paper must cover the entire syllabus with equal distribution of marks as far as practicable.

Unit-1. Introductory (5 hrs.)

History of Plant Tissue Culture, Requirements for Culture-Media, GR, Operator System, Tissue Culture Lab. Designing.

Unit-2. Tissue Culture Techniques (7 hrs.)

Micro propagation-Stages and application, Somatic embryo genesis, Organ genesis, Single Cell Suspension Culture.

Unit-3. Protoplast Culture (8 hrs.)

Protoplast isolation, testing of viability, regeneration of protoplast, Protoplast fusion, Markers for selection of hybrid cell, somatic hybridization – Practical application.

Unit-4. Applications

Anther & Pollen Culture, Ovary Culture, Embryo Rescue Tech., Endosperm Culture. Biocontrol of insect pests (Bacterial, Fungal & other microbial pesticides). BT toxins-insecticidal activity, Biofertilizers.

Unit-5. Transgenic Plants (15 hrs.)

Gene Transfer Tech-Agro bacterium mediated, Physical and Chemical Method, Production of disease resistance, Herbicide resistance, Insect resistance, draught resistance Transgenic plants, Merits & demerits of Transgenic plants, BT Cotton, Brinjal.

REFERENCES:

1. Elements of Biotechnology, Rastogi Publications.
2. Biotechnology Applications of Plant Tissue & cell culture – Ravishankar G.A. and Venkataraman L.V., Oxford & IBH Publishing Co., Pvt. Ltd.
3. Plant Tissue Culture – Bhan Islan A.C., Oxford & IBH Publishing Co., Pvt. Ltd.
4. Plant Tissue Culture – K.K. Dey.

B. Sc. Honours in Biotechnology Part – III

Semester – V

Paper-15, Animal Biotechnology (40 lectures)

Full Marks: 30 (MSE) + 70(ESE) = 100 Time: 3 Hrs. Pass Marks: 45

Instructions to question setter

1. Paper will be of 70 marks and divided into three groups:
Group 1 : Multiple choice question, fill in the blanks and true/false types (**20 x 1= 20**)
Group 2 : Concept based questions (4 questions of 5 marks each, word limit 50 words (**4 x 5 = 20**)).
Group 3 : Descriptive type questions (5 questions of 6 marks each, word limit 250) (**5 x 6 = 30**).
One question from each unit is compulsory.
2. For group 2 and 3 the paper setter may or may not give any choice.
3. The question paper must cover the entire syllabus with equal distribution of marks as far as practicable.

Unit-1. Cell Culture - Introduction (6 hrs.)

1. History of development of Cell Culture Stimulating Natural Condition for Growing Animal Cells.
2. Culture Vessels.
3. Culture Media; Balance Salt solution, Growth hormone and serum.
4. Culture Equipments: Laminar Air Flow Hood, CO₂ Incubator.

Unit-2. Cell Culture Methods (10 hrs.)

1. Primary Culture,
2. Anchorage dependence of growth.
3. Non anchorage dependent cells.
4. Secondary Culture, Transformed Animal Cell.
5. Established/Continuous Cell Line.
6. Commonly used Animal Cell Line:- their origin and characteristics.
7. Organ Culture

Unit-3. Transfection and Transplantation (6 hrs.)

1. Transfection of Animal Cells: Selectable markers, HAT selection, Antibiotic Resistance.
2. Transplantation of Animal Cell.

Unit-4. Growth Factors & Thermo Regulation (8 hrs.)

1. Growth Factors Promoting Proliferation of Animal Cells
2. (EGF, FGF, PDGF, IL-1, IL-2, NGF, Erythropoietin)
3. Thermoregulation
4. Comfort zone, Body temperature-Physical, Chemical, Neural regulation, Acclimatization.

Unit-5 Application of Animal Cell Culture (10 hrs.)

1. Culture based vaccines production and their application.
2. Monoclonal antibodies production and its application.

3. Artificial insulin gene synthesis.
4. Production of Pharmaceutical compounds.

REFERENCES:

1. Animal Physiology – K. Ranga
2. Ian Freshney – Buttler.
3. Elements of Biotechnology – P.K. Gupta, Rastogi Publications.

B. Sc. Honours in Biotechnology Part – III

Semester – V

Paper – 16, Plant Tissue Culture Lab. (50 periods)

Full Marks: 50E + 50I =100

Time: 4 Hrs.

Pass Marks: 45

1. Preparation of Ms-stocks.
2. Preparation of Ms Media.
3. Explant preparation for in-vitro culture.
4. Shoot regeneration (organogenesis) from different parts of the plants.
5. Production of callus from leaf explant.
6. Study the effect of different hormonal composition on given explant.

B. Sc. Honours in Biotechnology Part – III

Semester – VI

Paper –17, (Environmental Biotechnology) (40 lectures)

Full Marks: 30 (MSE) + 70(ESE) = 100 Time: 3 Hrs. Pass Marks: 45

Instructions to question setter

1. Paper will be of 70 marks and divided into three groups:
Group 1 : Multiple choice question, fill in the blanks and true/false types (**20 x 1= 20**)
Group 2 : Concept based questions (4 questions of 5 marks each, word limit 50 words (**4 x 5 = 20**)).
Group 3 : Descriptive type questions (5 questions of 6 marks each, word limit 250) (**5 x 6 = 30**).
One question from each unit is compulsory.
2. For group 2 and 3 the paper setter may or may not give any choice.
3. The question paper must cover the entire syllabus with equal distribution of marks as far as practicable.

Unit-1. Water & Waste management: (8 hrs.)

1. Microbial analysis of water.
2. Treatment of water for public supply.
3. Waste water (sewage) management.
4. Management of solid waste & industrial effluents.

Unit-2. Environmental Pollution (8 hrs.)

1. Conventional fuels (firewood, plant, coal, natural gas,) and their environmental impact.
2. Water pollution, Determination & control.
3. Air pollution, Determination & control.

Unit-3. Environment Friendly Modern Fuels (10 hrs.)

1. Methanogenic Bacteria and Biogas.
2. Microbial hydrogen production.
3. Conversion of sugar to ethanol: Gasohol experiment.
4. Cellulose Degradation for combustible fuel.
5. Biodiesel (hydrocarbons from plant & microbial sources).

Unit-4. Ecosystem and Environment

1. Physical and biotic environment (Biotic and abiotic interactions).
2. Habitat and Niche (concepts).
3. Ecosystem: Structure and Function (Energy Flow and Mineral Cycling).

Unit-5. Applied Area (8 hrs.)

1. Biodegradation of hazardous chemicals. (Bioremediation).
2. Bio mineralization (Microbial leaching of copper and uranium).

REFERENCES:

1. Microbial Biotechnology – Alexander N. Ghazer Hiroshi Nikaido W.H. Freeman and Company.

2. Molecular Biotechnology: Principles and Applications of Recombinant DNA – Bernaral R. Glick and Jack J., Pastemak ASM Press, Washington, D.C.
3. Fungal Ecology and Biotechnology – Rastogi Publications, Meerut.
4. Environmental Science: Physical principles and applications – Egbert Bocker et al.
5. Hazardous Waste Management – Charles A. Wentz.
6. Waste-water Engineering: Treatment, disposal and reuse – Metcalf and Eddy, Inc., Tata McGraw Hill, New Delhi.
7. Environmental Chemistry – A.K. Dey, Wiley Eastern Ltd. New Delhi.
8. Introduction to Biodeterioration – D. Allsop and Seal, ELBS/Forward Arnold.

B. Sc. Honours in Biotechnology Part – III

Semester – VI

Paper – 18, Biophysics (40 lectures)

Full Marks: 30 (MSE) + 70(ESE) = 100 Time: 3 Hrs. Pass Marks: 45

Instructions to question setter

1. Paper will be of 70 marks and divided into three groups:
Group 1 : Multiple choice question, fill in the blanks and true/false types (**20 x 1= 20**)
Group 2 : Concept based questions (4 questions of 5 marks each, word limit 50 words (**4 x 5 = 20**)).
Group 3 : Descriptive type questions (5 questions of 6 marks each, word limit 250) (**5 x 6 = 30**).
One question from each unit is compulsory.
2. For group 2 and 3 the paper setter may or may not give any choice.
3. The question paper must cover the entire syllabus with equal distribution of marks as far as practicable.

Unit-1. Molecular Interactions

(6 hrs.)

1. Inter and Intra Molecular Interactions stabilizing the structures of Biomolecules.
2. Applications in Modern Biology.
3. Van der Waals.
4. Electrostatic.
5. Hydrogen bonding.
6. Hydrophobic interactions, etc.

Unit-2. Biophysical Chemistry (10 hrs.)

1. Thermodynamics (Reversible, Irreversible Information & Transmission).
2. Photo Bioenergetics (Events in photosynthesis).
3. Chemo-Bioenergetics (Oxidative phosphorylation).

Unit-3. Biophysics of Vision, Audition & Nerve Conduction (8 hrs.)

1. Ear (Hearing acids).
2. Eye (Defects in vision).
3. Neurobiophysics (Molecular Transport, Nerve Impulse generation and Transmission, Signal Reception).

Unit-4. Radiation Biophysics (8 hrs.)

1. Ionising Radiation & their interaction with matter.
2. Measurement of Radiation.
3. Radioactive isotopes & their Biological effects.
4. Radiation protection and therapy.

Unit-5. Imaging Methods

1. ECG
2. EEG
3. CAT-Scan
4. Ultrasound

REFERENCES:

1. Essentials of Biophysics – Narayanan, P., New Age Int. Pub. New Delhi.
2. A Text Book of Biophysics – Roy R.N., New Central Book Agency.
3. Physical Biochemistry: Applications to Biochemistry and Molecular Biology – David Freifelder.
4. Biochemical techniques: Theory and Practice – Robyt and White.
5. Principles of Instrumental Analysis – Skoog and West.
6. Analytical Biochemistry – Holme and Peek.

B. Sc. Honours in Biotechnology Part – III

Semester – VI

Paper – 19, Entrepreneurship & IPR (40 lectures)

Full Marks: 30 (MSE) + 70(ESE) = 100 Time: 3 Hrs. Pass Marks: 45

Instructions to question setter

1. Paper will be of 70 marks and divided into three groups:
Group 1 : Multiple choice question, fill in the blanks and true/false types (**20 x 1= 20**)
Group 2 : Concept based questions (4 questions of 5 marks each, word limit 50 words (**4 x 5 = 20**)).
Group 3 : Descriptive type questions (5 questions of 6 marks each, word limit 250) (**5 x 6 = 30**).
One question from each unit is compulsory.
2. For group 2 and 3 the paper setter may or may not give any choice.
3. The question paper must cover the entire syllabus with equal distribution of marks as far as practicable.

Unit-1. BIOSAFETY REGULATIONS (10 hrs.)

1. National and international level Biosafety regulation
2. Trials on fields
3. Risk verses benefits
4. Hazardous materials used in biotechnology-handling and disposal

Unit-2. INTELLECTUAL PROPERTY RIGHT (10 hrs.)

1. Implications of IPRs and agricultural technology
2. WTO and WTO agreements
3. Developing countries: development and trade
4. Patenting

Unit-3. BIOETHICS (5 hrs.)

1. What is bioethics?
2. Bioethics of resource management

Unit-4. ENTERPRENEURSHIP (Introduction) (10 hrs.)

1. Introduction to entrepreneurship
2. Identification of business opportunities
3. Project formulation and project report
4. Market survey and research
5. Financial institutions in the development of industrial units

Unit-5. BASICS OF ENTERPRENEURSHIP IN DETAIL (5 hrs.)

1. Costing and pricing
2. Human resource management
3. Risk and uncertainties in the investment decision

REFERENCES:

1. Bioethics and Biosafety – V. Sree Krishna
2. Biotechnology – B.D. Singh
3. Biotechnology – P.K. Gupta
4. Ecology – P.D. Singh

B. Sc. Honours in Biotechnology Part – III

Semester – VI

Paper – 20, Immunology Lab. and Project (50 periods)

Full Marks: 50 (Lab.) (25E + 25I) + 50 (Project) = 100 Time: 4 Hrs. Pass Marks:
45

1. Agar gel immunodiffusion.
2. Single radial immunodiffusion.
3. Radial immunodiffusion.
4. Ouchterlony double diffusion.
5. IgG purification.
6. WIDAL test.
7. Blood grouping.
8. Blood cell counting (WBC, RBC)