Centre for Biotechnology
Marwari College, Ranchi
M.Sc. Biotechnology Course Structure

Semester-I

T/P	Code	Subject	No. Of Lectures	Total Marks	Mid Sem Marks	End Sem Marks	Pass Marks	Exam. Hours
T	BT-101	Biochemistry	40	100	30	70	45	03
T	BT-102	Microbiology	40	100	30	70	45	03
T	BT-103	Cell Biology	40	100	30	70	45	03
T	BT-104	Molecular Biology	40	100	30	70	45	03
P	BT-105	Biochemistry Lab.	50	100		50 E+ 50 I	45	06
P	BT-106	Microbiology Lab.	50	100		50 E+ 50 I	45	06

Total- 600

Semester-II

T/P	Code	Subject	No. Of Lectures	Total Marks	Mid Sem Marks	End Sem Marks	Pass Marks	Exam. Hours
T	BT-201	Genetic Engineering	40	100	30	70	45	03
T	BT-202	Biostatistics	40	100	30	70	45	03
T	BT-203	Industrial Biotechnology	40	100	30	70	45	03
T	BT-204	Immunology	40	100	30	70	45	03
P	BT-205	Molecular Biology & R.D.T. Lab.	50	100		50E+ 50I	45	06
P	BT-206	Immunology Lab.	50	100		50E+ 50I	45	06

Total- 600

Semester-III

T/P	Code	Subject	No. of Lectures	Total Marks	Mid Sem Marks	End Sem Marks	Pass Marks	Exam. Hours
T	BT-301	Plant & Agricultural Biotechnology	40	100	30	70	45	03
T	BT-302	Biophysics & Nano-technology	40	100	30	70	45	03
T	BT-303	Ecology & Environment	40	100	30	70	45	03
T	BT-304	Animal Biotechnology	40	100	30	70	45	03
P	BT-305	Bio-analytical Lab.	50	100		50E+ 50I	45	06
P	BT-306	Plant Tissue Culture Lab.	50	100		50E+ 50I	45	06

Total- 600

Semester-IV

T/P	Code	Subject	No. of Lectures	Total Marks	Mid Sem Marks	End Sem Marks	Pass Marks	Exam. Hours
T	BT-401	Bio-informatics	40	100	30	70	45	03
T	BT-402	Legal & Social Aspects of Biotechnology	40	100	30	70	45	03
T	BT-403	Pharmaceutical Biotechnology	40	100	30	70	45	03
T	BT-404	Enzyme Engineering	40	100	30	70	45	03
P	BT-405	Bio-informatics Lab.	50	100		50E+ 50I	45	06
P	BT-406	Project Dissertation	50	100		50E+ 50I	45	06

Total- 600

GRAND TOTAL- 2400

M.Sc. Biotechnology

SEMESTER-I

BT 101-Biochemistry **(40 Hrs.)**

Instruction to question setter

1. The question paper shall be of 70 marks and divided into 4 groups.

Group 1 Multiple Choice question, fill in the blanks, match the column, true or false type
(15 x 1=15).
Group 2 Concept based questions (5 questions of 2 marks each)
5x2 = 10 with word limit 40.
Group 3 Short notes type (3 questions of 5 marks each)
3 x 5 = 15, with word limit 100.
Group 4 Brief answer type (3 questions of 10 marks each)
3 x 10 = 30, with word limit 250.

2. For group 2, 3 and 4, the paper setter may or may not give any choice.
3. The Questions must cover the entire syllabus with equal distribution of marks as far as practicable and all questions are compulsory.
4. Time of Examination: - Theory Papers – 03 Hours.
   Practical Papers- 06 Hours.

Unit I:- General Biochemistry

- Introduction.
- Structure of atoms, molecules and chemical bonds.
- Principles of biophysical chemistry (pH and buffers).
- Stabilizing interactions (Vander waals, electrostatic, hydrogen bonding, hydrophobic interaction).

Unit II:- Carbohydrates

- Classification (Monosaccharides, Oligosaccaharides and Polysaccharides).
- Structure and General Properties.
- Occurrence and Role in Biological System.
- Metabolism (Glycolysis, TCA Cycle, Pyruvate oxidation, Oxidative phosphorylation and ETC).

Unit III:- Proteins and Amino acids

- Amino-acids:- Classification, Structure & Properties.
- Protein Structure (Primary, Secondary, Tertiary & Quaternary),
- Protein folding, Stability of conformation.
- Protein classification.
- Metabolism (Transamination, Deamination, Urea cycle, Inborn errors of amino acid metabolism).
- Ramachandran plot.

Unit IV:- Lipids

- Classification.
- Structure and properties (Fats and Oils).
- Metabolism (alpha, B and W-oxidation, Biosynthesis of fatty acid).

Unit V:- Nucleic Acids, Vitamins and Hormones

- Nucleic acid:- Composition (DNA, RNA).
- Vitamins:- Classification, Characteristics, Requirements, Deficiency diseases.
- Hormones:- Classification, Some important hormones:- Role in living system (Plant and Animal).

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. Fundamental of Biochemistry- Dr. A.C. Deb.
   Biochemistry-Cantarow & Schepartr-Saundess.

M.Sc. Biotechnology

BT- 102 Microbiology (40 Hrs.)

Instruction to question setter

1. The question paper shall be of 70 marks and divided into 4 groups.
Group 1 Multiple Choice question, fill in the blanks, match the column, true or false type
(15 x 1=15).
Group 2 Concept based questions (5 questions of 2 marks each)
5x2 = 10 with word limit 40.
Group 3 Short notes type (3 questions of 5 marks each)
3 x 5 = 15, with word limit 100.
Group 4 Brief answer type (3 questions of 10 marks each)
3 x 10 = 30, with word limit 250.
2. For group 2, 3 and 4, the paper setter may or may not give any choice.
3. The Questions must cover the entire syllabus with equal distribution of marks as far as practicable and all questions are compulsory.
4. Time of Examination: - Theory Papers – 03 Hours.
Practical Papers- 06 Hours.

UNIT-I: -History of microbiology and microbial taxonomy: -
discovery of micro-organism, spontaneous generation conflict, recognition of microbial role in disease, Discovery of microbial effects on organic and inorganic matter, microbiology in the twentieth century
microbial evolution and diversity, taxonomic rank, classification system, major characteristic used in taxonomy major division of life-domains/kingdom,Bergey's manual of systematic bacteriology
UNIT-II-Microscopic techniques and study of microbial structure : Visualization of cells and sub cellular components by light microscopy, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy , nature of bacterial cell surface –gram positive and gram negative cell wall, kinds of flagella, Ultra structure of flagella.

UNIT-III;Microbial nutrition, growth and its control:-
microbial nutrition ,nutritional types of microorganism
microbial growth and its mathematical expression
sterilization –control of microbial growth by physical and chemical methods
UNIT-IV-Microbial genetics-
Methods of genetic transfers – transformation, conjugation, transudation and sex-diction, mutation in microbes-types,mechanism,replica plating technique

UNIT V- Medical Microbiology:
Antimicrobial chemotherapy-development of chemotherapy, general characteristic of ant microbial drugs, mechanism of action of ant microbial agents, antibacterial drugs, drug resistance, antifungal drugs, antiviral drugs

REFERENCES:

1. Microbiology-Pelezar,Chan,Krieg Tata Mc Graw Hill Publications.
2. Microbiology-Concepts and application by Paul A. Ketchum, Wiley Publications.
3. Fundamentals of Microbiology-Frobisher, Sauders & toppan Publications.
4. Microbiology-Ronald M.Atlas.
5. Introductory Biotechnology-R.B.Singh C.B.D. India (1990).
6. Industrial Microbiology-Casidal,E.Wiley Eastern Ltd.
7. Fundamentaisl of Bacteriology-Salley.
8. Fontiers in Microbial technology-P.S.Bisen, CBS Publishers
9. Biotechnology:International Trends of perspectives A.T.Bull, G.Holl M.D. Lilly Oxford & TBH Publishers.
10. General Microbiology-C.B.Powar, H.F.Daginawala, Himalayan Publishing House.
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.

M.Sc. Biotechnology

BT –103 Cell Biology **(40 hrs)**

Instruction to question setter

1. The question paper shall be of 70 marks and divided into 4 groups.

Group 1 Multiple Choice question, fill in the blanks, match the column, true or false type (15 x 1=15).

Group 2 Concept based questions (5 questions of 2 marks each)
5x2 = 10 with word limit 40.

Group 3 Short notes type (3 questions of 5 marks each)
3 x 5 = 15, with word limit 100.

Group 4 Brief answer type (3 questions of 10 marks each)
3 x 10 = 30, with word limit 250.

2. For group 2, 3 and 4, the paper setter may or may not give any choice.
3. The Questions must cover the entire syllabus with equal distribution of marks as far as practicable and all questions are compulsory.
4. Time of Examination: - Theory Papers – 03 Hours.
   Practical Papers- 06 Hours.

Unit-I: - Membrane structure and function

- Structure of model membrane.
- Lipid bilayer and membrane protein.
- Diffusion.
- Osmosis
- Ion channels.
- Active transport.
- Ion pumps.
- Mechanism of sorting and regulation of intracellular transport.
- Electrical properties of membranes.

Unit-II: -Structural organization and function of intracellular organelles

- Cell wall/Cell membrane.
- Nucleus/Mitochondria.
- Golgi complex.
- Lysosomes.
- Endoplasmic reticulum.
- Peroxosomes.
- Plastids.
- Vacuoles.
- Choroplast.
- Structure & function of cytoskeleton & its role in motility.

Unit-III: - Cell division, Cancer and Programmed cell death

- Mitosis & Meiosis cell cycle control of cell division.
- Programmed cell death (apoptosis).
- Cancer Biology.

Unit-IV: - Cell signaling

- Hormones and their receptors.
- Cell surface receptors.
- Signaling through G protein coupled receptors.
- Signal transduction pathways.
- Regulation of signaling pathways.

Unit-V: -Cellular communication

- General principles of cell communication.
- Cell adhesion and roles of different adhesion.
- Gap junctions.
- Extra cellular matrix.
- Integrins.

REFERENCES:

1. Glick, B.T and Pastermak J.J.(1998) Molecular biotechnology, Principles and application of recombinant DNA, Washington D.C. ASM Press.
2. Howe.C. (1995) Gene Cloning and manipulation, Cambridge University Press USA.
3. Lewin, B., Gene VIII New York, Oxford University Press.
4. Rigby, P.W.J. (1987) Genetic Engineering Academic Press Inc. Florida, USA.
5. Sambrook et al (2000) Molecular cloning Volumes I,II & III Cold spring Harbor Laboratory Press, New York, USA.
6. Walker J.M. and Gingold, E.B. (1983) Molecular Biology & Biotechnology (Indian Edition) Royal Society of Chemistry U.K.
7. Karp. G (2002) Cell & Molecular Biology, 3rd Edition, John Wiley & Sons; INC .
8. Molecular Biology of Gene-Watson et al –PEARSON Education.
9. Genetics-Strickberger.
10. Molecular Biology of cell-Bruce Alberts et.at, Garland

11. AnimalCytology & Evolution-MJD, White Cambridge University Publications.
12. Molecular Cell Biology-Daniel, Scientific American Books.
13. Cell Biology-Jack D.Bruke, The William Twilkins Company.
14. Principles of Gene Manipulations-Old & Primrose, Black Well Scientific Publications.
15. Cell Biology-Ambrose & Dorouthy M Easty, ELBS Publications.
16. Fundamentals of Cytology-Sharp, Mc Graw Hill Company.
17. Cytology-Wilson & Marrision, Reinform Publications.

M.Sc. Biotechnology

BT104 Molecular Biology (40 Hrs.)

Instruction to question setter

1. The question paper shall be of 70 marks and divided into 4 groups.

Group 1 Multiple Choice question, fill in the blanks, match the column, true or false type
(15 x 1=15).

Group 2 Concept based questions (5 questions of 2 marks each)
5x2 = 10 with word limit 40.

Group 3 Short notes type (3 questions of 5 marks each)
3 x 5 = 15, with word limit 100.

Group 4 Brief answer type (3 questions of 10 marks each)
3 x 10 = 30, with word limit 250.

2. For group 2, 3 and 4, the paper setter may or may not give any choice.
3. The Questions must cover the entire syllabus with equal distribution of marks as far as practicable and all questions are compulsory.
4. Time of Examination: - Theory Papers – 03 Hours.
   Practical Papers- 06 Hours.

Unit-I: -Organization of gene and chromosomes

- Operon, interrupted genes, gene families.
- Structure of chromatin and chromosomes.
- Unique and repetitive DNA, heterocheomatin, euchromatin.
- Transpasons & Insection sequences.

Unit-II: - DNA replication, repair and recombination

- Unit of replication, enzymes involved replication origin and replication fade fidelity of replication, extra chromosomal (replication).
- DNA damage and repair mechanisms.

Unit-III: - RNA Synthesis and processing

- Transcription factors and machinery formation of initiation comples, transcription activators and repressors, RNA polymerizes.
- Copping elongation and termination, RNA-processing, DNA editing, Splicing polydenylation.
- Structure and function of different types of RNA, RNA transport.

Unit-IV: - Protein synthesis and processing

- Ribosome, formation of initiation comples initiation factor and their regulation elongation & elongation factors, termination.
- Genetic code, aminoacylation of tRNA, aminoacyl tRNA synthetate, translational-proof reading, translation inhibitors.
- Post translational modification of proteins.

Unit-V: - Control of gene expression of transcription and translation level

- The operon concept, positive and negative regulation.
- Regulation through catabolite-expression, CAP protein as a positive control factor.

REFERENCES:

1. Glick, B.T and Pastermak J.J.(1998) Molecular biotechnology, Principles and application of recombinant DNA, Washington D.C. ASM Press.
2. Howe.C. (1995) Gene Cloning and manipulation, Cambridge University Press USA.
3. Lewin, B., Gene VIII New York, Oxford University Press.
4. Rigby, P.W.J. (1987) Genetic Engineering Academic Press Inc. Florida, USA.
5. Sambrook et al (2000) Molecular cloning Volumes I,II & III Cold spring Harbor Laboratory Press, New York, USA.
6. Walker J.M. and Gingold, E.B. (1983) Molecular Biology & Biotechnology (Indian Edition) Royal Society of Chemistry U.K.
7. Karp. G (2002) Cell & Molecular Biology, 3rd Edition, John Wiley & Sons; INC .
8. Molecular Biology of Gene-Watson et al –PEARSON Education.
9. Glick, B.R & Padternak J.J. (1994) Molecular Biotechnology, Principles and Applications of Recombinant DNA, American Society for Microbiology, Washington D.C.
10. Christopler H. (1995) Gene cloning and Manipulating, Cambridge University Press.
11. Nicholl, D.S.T. (1994) An Introduction of Genetic Engineering, Cambridge University Press.
12. Old R.W. and Primrose, S.B. (1986) Principles of Gene manipulation, An introduction to genetic engineering (3rd Edition) Black well Scientific Publications.
13. Watson J.D. Hopins, N.H. Roberts, J.W. Steetz J.A. and Weiner A.M. (1988). Molecular Biology of Society for Microbiology.
14. Lewin B. (1994) Genes VI, New York, Oxford University Press.

15. Recombinant DNA – Watson et al.

LAB WORK

BT 105 Biochemistry Lab. (50 hrs.)

1. To understand principles of colorimetery/spectrophotometry. (Lambert Beer's Law).
2. Preparation of Buffers (Acetate, Citrate, etc.).
3. Preparation of standard graph.
4. Quantitative estimation of sugar in given solution.
5. Quantitative estimation of protein in given solution.
6. Quantitative estimation of DNA in given solution.
7. Quantitative estimation of RNA in given solution.
8. Quantitative estimation of Lipid in given solution.
9. Isolation and extraction of protein from biological sources.
10. Separation of macromolecules by paper chromatography.
11. Separation of macromolecules by thin layer chromatography.
12. Assay of enzyme activity.

BT 106

Microbiology Lab. (50 Hrs.)

1. *Aseptic techniques:*
2. *Preparation of media and sterilization*

BT 201: Genetic Engineering (40 hrs)

3. Is olation of microorganisms from air, water and soil samples
4. *Dilution and pour and spread plating colony purification.*
5. *Enumeration of microorganisms. Total vs viable counts.*
6. *Identification of isolated bacteria gram staining, other staining methods metabolic characterization (e.g. IMVIC test)*
7. *Test of antibodies against given bacteria*
8. *One step growth of bacterial phage*

SEMESTER- II

BT 201: Genetic Engineering (40 hrs)

Instruction to question setter

1. The question paper shall be of 70 marks and divided into 4 groups.

Group 1 Multiple Choice question, fill in the blanks, match the column, true or false type
(15 x 1=15).
Group 2 Concept based questions (5 questions of 2 marks each)
5x2 = 10 with word limit 40.
Group 3 Short notes type (3 questions of 5 marks each)
3 x 5 = 15, with word limit 100.
Group 4 Brief answer type (3 questions of 10 marks each)
3 x 10 = 30, with word limit 250.

2. For group 2, 3 and 4, the paper setter may or may not give any choice.
3. The Questions must cover the entire syllabus with equal distribution of marks as far as practicable and all questions are compulsory.
4. Time of Examination: - Theory Papers – 03 Hours.
Practical Papers- 06 Hours.

Unit I: - Gene Cloning
- Basics:- Recombinant DNA Techniques.
- Construction of genomic & cDNA libraries.

Unit II: - Tools
- Enzymes: - The molecular scissors, (Restriction Endonucleases, exonucleases).
- Vectors: - Vehicles. (Qualities of an ideal vector, Types:- Vectors for bacteria plant and animal cells).

Unit III:- Techniques
- Electrophoresis, Blotting PCR, gel retardation techniques-DNA foot printing, RAPD, RFLP and AFLP.
- DNA fingerprinting.
- DNA sequencing.
- Site directed mutagenesis.

Unit IV:- DNA, Purification and Manipulations.
- Genomic and plasmid DNA isolation from living cells.
- Phage DNA isolation
- **Manipulation of DNA**

Unit V:-Applications:-
- Artificial Insulin genes
- Pharmaceutical compounds.
- Recombinant Vaccines.
- Diagnostic Reagent.
- Gene therapy-Prospect & problem.

REFERENCES:

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

8. Gene cloning: An introduction- T.A. Brown

M.SC. (BIOTECHNOLOGY)

BT 202 Biostatistics (40 Hrs.)

Instruction to question setter

1. The question paper shall be of 70 marks and divided into 4 groups.

Group 1 Multiple Choice question, fill in the blanks, match the column, true or false type
(15 x 1=15).
Group 2 Concept based questions (5 questions of 2 marks each)
5x2 = 10 with word limit 40.
Group 3 Short notes type (3 questions of 5 marks each)
3 x 5 = 15, with word limit 100.
Group 4 Brief answer type (3 questions of 10 marks each)
3 x 10 = 30, with word limit 250.

2. For group 2, 3 and 4, the paper setter may or may not give any choice.
3. The Questions must cover the entire syllabus with equal distribution of marks as far as practicable and all questions are compulsory.
4. Time of Examination: - Theory Papers – 03 Hours.
   Practical Papers- 06 Hours.
5. The question paper shall be of 70 marks of which 40% must be numerical.

UNIT-I-Measures of central tendency and dispersion; Correlation and Regression.

UNIT-II- Probability distribution; Bionomial Distribution, Poission Distribution and Normal Distribution.
Unit-III- Sampling Distribution; Difference between parametric and non-parametric statistics; confidence interval.
Unit-IV- Errors; level of significance, t-test, chi-square test.
Unit-V- Analysis of variance; Basic introduction to Multivariate statistics, etc.

Reference:

1. Bliss,C.J.K. Statistics in biology, Vol.1 Mc Graw Hill, Nerw York.
2. Compbelt R.C. Statistics for Biologists, Cambridge Univ. Press, Cambridge.
3. Daniel Biostatistics Panima Publications Corporation.
4. Swardlaw, A.C. Practical statistics for Experimental Biologists, John Wiley and sons, Ine, NY.
5. Khan -Fundamentals of biostatistics Publishing Corporation.
6. Biostatistics-Zar.
7. Biostatistics-Mahajan.
8. Biostatistics-Veer Bala Rastogi.
9. Biostatistics-Khan and Khanum.
10. Biostatistics-Jasra and Raj. Biostatistics-Mishra and Mishra

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BT 203 Industrial Biotechnology (40 Hrs.)

Instruction to question setter

1. The question paper shall be of 70 marks and divided into 4 groups.

Group 1 Multiple Choice question, fill in the blanks, match the column, true or false type
(15 x 1=15).

Group 2 Concept based questions (5 questions of 2 marks each)
5x2 = 10 with word limit 40.

Group 3 Short notes type (3 questions of 5 marks each)
3 x 5 = 15, with word limit 100.

Group 4 Brief answer type (3 questions of 10 marks each)
3 x 10 = 30, with word limit 250.

2. For group 2, 3 and 4, the paper setter may or may not give any choice.
3. The Questions must cover the entire syllabus with equal distribution of marks as far as practicable and all questions are compulsory.
4. Time of Examination: - Theory Papers – 03 Hours.
   Practical Papers- 06 Hours.

Unit-I Cell growth and bio-product formation kinetics: Quantification of cell growth, growth patterns and kinetics in batch culture, fed-bach and continuous bioreactors environmental factors affecting growth kinetics, heat, generation by microbial growth, unstructured non segregated model, models for transient behaviour, kinetics of product formation.

Unit-II Media and air sterilization: introduction and the kinetics of death, batch and continuous
Sterilization of media, air sterilization, various type of sterilization equipments, sterilization of media by membrane filters.

Unit-III Agitation and aeration: types of impellors and sparger, oxygen transfer rate, oxygen
Uptake rate, volumetric oxygen transfer rate (kLa), measurement of kLa, power requirement for agitation in gaseous and non gaseous systems.

Unit-IV Scale up, operation and control of bioreactors: Concepts of various bioreactor
Configurations, scale-up, various criteria for scale-up scale-down, bioreactor instrumentation and control.

Unit-V Whole Cell immobilization and their industrial Applications.

Reference:

1. Microbial Biotechnology- Glaser A.N. & Nilaido H.,W.H. Freeman & Co.
2. Industrial Microbiology, Agrobios –Prerscott & Dunn - (India) Publishers.
3. A Text of Industrial Micribiology 2nd Edition-Crueger & Crueger A, Panima Publishing Corporation.
4. Principles of Fermentation Technology-Stanbury P.F., Ehitakes H., Hall S.J. - Aditya Books (1) Ltd.

5. BT 204 Immunology (40 Hrs.)

Instruction to question setter

1. The question paper shall be of 70 marks and divided into 4 groups.

Group 1 Multiple Choice question, fill in the blanks, match the column, true or false type
(15 x 1=15).

Group 2 Concept based questions (5 questions of 2 marks each)
5x2 = 10 with word limit 40.

Group 3 Short notes type (3 questions of 5 marks each)
3 x 5 = 15, with word limit 100.

Group 4 Brief answer type (3 questions of 10 marks each)
3 x 10 = 30, with word limit 250.

2. For group 2, 3 and 4, the paper setter may or may not give any choice.
3. The Questions must cover the entire syllabus with equal distribution of marks as far as practicable and all questions are compulsory.
4. Time of Examination: - Theory Papers – 03 Hours.
   Practical Papers- 06 Hours.

Unit-I: -

- Immune response and immunity.
- Anatomical organization of immune system.
- Cells of the immune system.
- Antigens; Hap tens: Structure and properties.
- Activation of T & B cells: Antigen processing, Presentation and cell cooperation.

Unit-II: -

- Immunoglobolines: Molecular structure types & functions.
- Molecular mechanisms of antibody diversity.
- Antigen-Antibody interaction, avidity and affinity measurements.
- Complement system: Components, activation pathways and role in inflammation.

Unit-III: -

- Cytolines, Structural & functional aspects clinical significance.
- Major histocompatability system : structure polymorphism, distribution, variation and function.
- Immunoregulation.
- Hypersensitivity: Different types, mechanisms and clinical features.

Unit-IV: -

- Immunodeficiency syndromes.
- Autoimmunity.
- Vaccine: Types and mode of action.
- Monoclonal antibodies: Production and applications.

Unit-V: -

- **Effector's mechanism**
- Cell mediated cytetoxicity : Mechanism of cytotoxic T cells and NK cells-mediated target cell lysis, Antibody dependent cell mediated aytotoxicity: macrophage mediated cytotoxicity.
-

REFERENCES:

1. William, E. Paul (1989) fundamental immunology, 2nd Edition Raven Press, New York.
2. William, R. Clark (1991) the Experimental Foundations of Modern Immunology (4th Edition) John Wiley and Sons, New York.
3. Ivan, M. roitt (1994) Clack well Scientific Publications, London.
4. Immunology-Kubey.
5. Immunology-Abbas.
6. Immunology-Tizzard.
7. Practical Immunology-Talwar.
8. Immunology-Roit.

LAB WORK

BT 205 Molecular Biology and RDT Lab (50 Hrs.)

1. Calibration of ocular and stage micrometer using light microscope.
2. Measurement of average cell size.
3. Preparatio of agarose gel for AGE and gel casting.
4. Loading of sample for AGE and running of sample.
5. Staining and Vis nalisation of DNA Bands en gel.
6. Preparation of polyacrylamide gel for PAGE & gel casting.
7. Loading of sample for PAGE and running of sample.
8. Isolation of genomic DNA from plant cell.
9. Isolation of genomic DNA from bacterial cell.
10. Isolation of plasmid DNA from bacterial cell. (8-10 behind).
11. Staining and visualization of protein bands on gel.
12. Restriction digestion of DNA by different Restriction Enzymes.
13. Making competent cells.
14. Demonstration of PCR.

LAB WORK

BT 206: Immunology Lab (50 Hrs.)

1. Cell counting method.
2. Blood group test.
3. Double diffusion.
4. Agar gel emmunodiffusion.
5. IgG purification.
6. Single immuno radial diffusion.
7. Immunoelectrophoresis.
8. ELISA.
9. WIDAL test.

M.Sc. Biotechnology

SEMESTER-III

BT 301 Plant & Agricultural Biotechnology (40 Hrs.)

Instruction to question setter

1. The question paper shall be of 70 marks and divided into 4 groups.

Group 1 Multiple Choice question, fill in the blanks, match the column, true or false type
(15 x 1=15).

Group 2 Concept based questions (5 questions of 2 marks each)
5x2 = 10 with word limit 40.

Group 3 Short notes type (3 questions of 5 marks each)
3 x 5 = 15, with word limit 100.

Group 4 Brief answer type (3 questions of 10 marks each)
3 x 10 = 30, with word limit 250.

2. For group 2, 3 and 4, the paper setter may or may not give any choice.
3. The Questions must cover the entire syllabus with equal distribution of marks as far as practicable and all questions are compulsory.
4. Time of Examination: - Theory Papers – 03 Hours.
   Practical Papers- 06 Hours.

Unit I: - Introduction of Tissue Culture

- Tissue Culture Media, Initiation and maintenance of callus and suspension culture, single cell clones.
- Use of growth regulators.

Unit-II: - Organogenesis and In vitro pollination

- Organogenesis, somatic embryo genesis rapid clonal propagation and production of virus-free plants. Haploid plant production.
- Embryo culture and Embryo rescue.

Unit-III: - Protoplast fusion and Gene Transfer

- Protoplast culture, Protoplast fusion selection of hybrid-cells, Cybrids, Cryoprescevation, Methods of gene transfer, Gene transfer in Nuclear genome, Chloroplast transformation.
- Molecular Markers-Comparison of different types of markers: RFLP, RAPD, AFLP, Ad-PCR.
- Construction of Molecular maps.

Unit-IV: - Transgenic Plants: Molecular farming

- Genetic improvement of plants using different in-vitro culture Techniques.
- Development of crops adaptable to environmental stress, diseases and Pcsts.

Unit-V:-

- Biopesticides.
- Bioinsactisides.
- Soil reclamation.
- Plytoremedation.
-

Reference:

1. Plant Biotechnology- H.S. Chawla
2. Plant Tissue Culture- M.K. Razdan
3. Biotechnology- B.D. Singh
4. Plant Tissue Culture- Y.P.S. Bajaj
5. Biotechnology in Agriculture- A. Mizrahi

Biotechnology in Agriculture- S. Natesh

BT 302 Biophysics & Nano technology (40 Hrs.)

6.

Instruction to question setter

1. The question paper shall be of 70 marks and divided into 4 groups.

Group 1 Multiple Choice question, fill in the blanks, match the column, true or false type
(15 x 1=15).

Group 2 Concept based questions (5 questions of 2 marks each)
5x2 = 10 with word limit 40.

Group 3 Short notes type (3 questions of 5 marks each)
3 x 5 = 15, with word limit 100.

Group 4 Brief answer type (3 questions of 10 marks each)
3 x 10 = 30, with word limit 250.

2. For group 2, 3 and 4, the paper setter may or may not give any choice.
3. The Questions must cover the entire syllabus with equal distribution of marks as far as practicable and all questions are compulsory.
4. Time of Examination: - Theory Papers – 03 Hours.
   Practical Papers- 06 Hours.

Unit I:-Bio-energetics : Laws of thermodynamics (1st and 2nd laws), electrical properties of biological compartments, electrochemical gradients, membrane potential, chemiosmotic hypothesis.
Energetics of a living body : Sources of heat limits to temperature, heat dissipation and conservation, Lambert-Beer law. Spectrophotometry and colorimetry Primary events in photosynthesis, Correction of vision faults, Generation and reception of sonic vibrations. Hearing aids.
Unit II:-Intra and intermolecular interactions in biological system : Spatial and charge compatibility as determinant of such interactions.
Unit III:-Physical methods applied to find out molecular structure : X-rays crystallography and NMR.
General spectroscopy : UV, Visible and infra red fluorescence, atomic absorption, IR, Raman spectra.
Unit IV:-Centrifugation : Principles, instrumentation and applications.
Electrophoresis : Principles, instrumentation and applications (PAGE and Agarose).
Chromatography : Paper, TLC, Gel filtration and Affinity, Ion exchange, GLC and HPLC.
Unit V:-Introduction to Nanobiotechnology, biological problems; Nanocrystals in Biological Detection; Microfluidic Meets Nano: Potential for Nanobiotechnology; Protein based nanocyrstals; Microbial nanoparticle production; DNA based nanostructures and Gold nanoparticle conjugates; Luminescent quantum dots for biological imaging; Emerging Nanotechnologies: nano labels, biosensors, medicine

Reference:

1. Narayanan, P- Essentials of Biophysics, New Age Int. Pub. New Delhi.
2. Roy R.N.- A Text Book of Biophysics 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. Princi8ples of instrumental analysis-Skoog and West.,
6. Analytical Biochemistry-Holme and Peek.
7. Organic Spectroscopy-Kemp.
8. Biological Spectroscopy-Campbell and Dwek.
9. Niemeyer and Mirkin ed. Nanobiotechnology: concepts, applications & perspectives,
10. Jain, KK. Nanobiotechnology in molecular diagnostics: current techniques and Applications

BT 303: Ecology and Environment (40 Hrs.)

Instruction to question setter

1. The question paper shall be of 70 marks and divided into 4 groups.

Group 1 Multiple Choice question, fill in the blanks, match the column, true or false type
(15 x 1=15).

Group 2 Concept based questions (5 questions of 2 marks each)
5x2 = 10 with word limit 40.

Group 3 Short notes type (3 questions of 5 marks each)
3 x 5 = 15, with word limit 100.

Group 4 Brief answer type (3 questions of 10 marks each)
3 x 10 = 30, with word limit 250.

2. For group 2, 3 and 4, the paper setter may or may not give any choice.
3. The Questions must cover the entire syllabus with equal distribution of marks as far as practicable and all questions are compulsory.
4. Time of Examination: - Theory Papers – 03 Hours.
   Practical Papers- 06 Hours.

Unit I:- Ecosystem and Environment

- Physical and biotic environment (Biotic and abiotic interactions).
- Habitat and Niche (concepts).
- Ecosystem:- Structure and Function (Energy Flow and Mineral Cycling).
- Some Indian ecosystems (Terested & Aquatic).

Unit II:- Sopecies Interactions

- Types of interactions (Interspecific competition, Herbivry, Carnivory).
- Community Ecology (Nature, Structure and attributes).
- Ecological succession (Types, concept of climax).
-

Unit III:- Waste Management

- Solid waste management (Composting, Vern composting, Biogas production).
- Lique waste management (Sewage and Industrial effluents).
- Air & Water Pollution (Source & Control).

Unit IV:- Global Environmental Issues

- Genetically Modified Food (SCPs).
- Ozone depletion (UV-rays and its effects).
- Global warning (Greenhouse gases).

Unit V:- Applications

- Biofertilizers.
- Biofuel.

Reference:

1. Microbial Biotechnology (1995) 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. (1994).
3. Fungal Ecology and Biotechnology (1993) Rastogi Publications, Meerut.
4. Environmental Science: Physical principles and applications – Egbert Bocker et al.
5. Hzardous waste management-Charles A. Wentz.
6. Waste water engineering: treatment, disposal and reuse-Metcalf and Eddy, Inc., Tata Mc. Graw Hill, New Delhi.
7. Environmental Chemistry- A.K. Dey, Wiley Eastern Ltd. New Delhi.
8 Introduction to Biodeteroration- D. Allsop and Seal, ELBS/Forward Arnold.

BT-304 Animal Biotechnology (40 Hrs.)

Instruction to question setter

1. The question paper shall be of 70 marks and divided into 4 groups.

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3 x 10 = 30, with word limit 250.

2. For group 2, 3 and 4, the paper setter may or may not give any choice.
3. The Questions must cover the entire syllabus with equal distribution of marks as far as practicable and all questions are compulsory.
4. Time of Examination: - Theory Papers – 03 Hours.
   Practical Papers- 06 Hours.

Unit I: - **Culture Media and In vitro Culture Techniques**

- Structure and organization of animal cells.
- Introduction to cell lines-Primary & established cell lines and their culture.
- Media maintenance.
- Types of media.
- Role of serum and its disadvantages.
- Serum-free media.
- Advantages of serum-free media.

Unit-II: - Basic techniques in cell & tissue culture

- Sources of cells-techniques of cell culture: Slide and cover slip cultures.
- Flask cultures.
- Test tube culture technique.
- Cell synchronization.
- Scaling-up of animal cell culture.
- Cell line & cloning-somatic cell fusion.

Unit-III: - Transformation

- Immortalization.
- Aberrant growth control.
- Tumorigenicity-organ and histotypic cultures.
- Measurement of cell death:Apoptosis.

Unit-IV: - Transgenic Animals

- Methodology-embryonic stem cell method-Microinjection method.
- Retroviral vector method-applications of transgenic animals.
- Gene therapy.

Unit-V: - Application of animal cell culture

- Stem cell culture.
- Embryonic stem cell culture and their applications.
- In vitro fertilization.
- Vaccines.
- Hybridoma technology and Monoclonal antibodies production.

Reference:

1. Animal Biotechnology-K.Ranga
2. Ravishankar G.A. and Venkatraman L-Biotechnology Applications of Plant Tissue & Cell Culture (Oxford & IBH Publication Co. Pvt. Ltd.)
3. Bhan-Tissue Culture, Mittal Publications, New Delhi
4. Islan A.C.-Tissue Culture Technology
5. Animal Biotechnology –N. Buttler

Lab Work

BT 305 Bio-analytical Lab. (50 Hrs.)

1. **Centrifugation Techniques:** Introduction
2. Basic principle of sedimentation, basic idea of types of centrifuges, density gradient centrifugation, preparative centrifugation, analysis of sub cellular fractions, & applications of analytical centrifugation.
3. **Separation of insoluble products:** sedimentation, filtration, centrifugation, coagulation and flocculation..
6. Phyto chemical analysis.
7. **Chromatography: Chromatographic techniques.**

Lab Work

BT 306: Plant Tissue Culture Lab. (45 Hrs.)

1. To set up plant tissue culture lab.
2. General methodology of sterilization.
3. Preparation of stoch solution of Tissue Culture Medium.
4. Surface sterilization of explants.
5. Production of callus from leaf explant.
6. Growth of plant cells into undifferentiated mass.
7. Large scale cultivation of plant cells in suspension.
8. Induction of differentiation by modulating the hormonal balance.
9. Growth of callus from. Daucus Carota explants.
10. Plant protoplast isolation.

SEMESTER-IV

BT 401 Bio-informatics (40 Hrs.)

Instruction to question setter

1. The question paper shall be of 70 marks and divided into 4 groups.

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5x2 = 10 with word limit 40.

Group 3 Short notes type (3 questions of 5 marks each)
3 x 5 = 15, with word limit 100.

Group 4 Brief answer type (3 questions of 10 marks each)
3 x 10 = 30, with word limit 250.

2. For group 2, 3 and 4, the paper setter may or may not give any choice.
3. The Questions must cover the entire syllabus with equal distribution of marks as far as practicable and all questions are compulsory.
4. Time of Examination: - Theory Papers – 03 Hours.
   Practical Papers- 06 Hours.

UNIT I

Introduction, Scope, Application.
Major Resources and databases.

UNIT II

- **Sequence** formats-FASTA, genebank.
  Sequence similarity, Basic scoring matrices (PAM, BLOSUM).

UNIT III

Pairwise alignment global & LOCAL.
Distance similarity search. BLAST (Types) and FASTA.

UNIT IV

Basics of some Bio-informatics softwares EMBOSS,
RAJMOL, DEEP VIEW.

UNIT V

Introduction to VB.
NET.Introduction to DBMS (SQL).

Reference:

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. Microarry Bioinformatics-Stekel Cambridge.
7. Bioinformatics-Mehrotra Vikas.
8. Bioinformatics-Lacroix Elsevier.

BT 402 Legal & Social Aspects of Biotechnology (40 Hrs.)

Instruction to question setter

1. The question paper shall be of 70 marks and divided into 4 groups.

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2. For group 2, 3 and 4, the paper setter may or may not give any choice.
3. The Questions must cover the entire syllabus with equal distribution of marks as far as practicable and all questions are compulsory.
4. Time of Examination: - Theory Papers – 03 Hours.
   Practical Papers- 06 Hours.

Unit-I:- Biosafety Regulations

- National and Internation level of Biosafety regulation.
- Trials on fields.
- Up scaling of field trials.
- Screen-newsletter on Biosafety.
- Risk versus benefits.

Unit-II:- Bio-hazard

- Hazardous materials used in Biotechnology-handling & disposal.
- Characterization and quality control of biotechnology derived products.

Unit-III:- Bioethics

- Ethical issues using stem cell culture.
- Ethical issues using Human cloning.
- Restriction and regulation of genetically modified organisms.
- Social ethical issues in Biotechnology.

Unit-IV:- Intellectual Property Right (IPR)

- Implications of IPR & agricultural technology.
- WTO & WTO agreement developing and trade.
- Technical assistance and training GATT.

Unit-V:- Patenting

- Patent cooperation treaty (PCT).
- Patenting & procedure for granting of patent.
- Steps to a patent.
- Compulsory licence**.**

Reference:

V.Sree Krishna-bioethics and biosafety.

BT 403 Pharmaceutical Biotechnology (40 Hrs.)

1.

Instruction to question setter

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4. Time of Examination: - Theory Papers – 03 Hours.
   Practical Papers- 06 Hours.

Unit-I: -Immunotechnology

- Approches to correct immune dysfunction; Cytolines and their functions.
- Invitro production of cytolines.
- Hybridoma Technology: Application of Mabs in diagnosis and Therapy.
- Anti-idiotypic & catalytic antibodies.
- Synthesis of blood proteins.

Unit-II: - Biopharmaceuticals

- Basic concept of Bioavailability; Factors influencing bioavailability.
- Pharmacokinetics (Drug administration Absorption, Distribution, Absorption distribution, Biotransformation, Excretion).

Unit-III: - Biomedical Engineering I

- Enzyme therapy and its application gene therapy.
- Recombinant Vaccine: Synthetic vaccine: DNA vaccines.
- Pharmaceutical compounds.

Unit-IV: - Biomedical Engineering II

- Recombinant DNA Technology- As tool foe genetic diseases, diagnosis and to control infections diseases: diagnostic reagents.
- Artificial insulin gene.

Unit-V: - Drug Designing :

- Cancer diagnosis and therapy.
- Drug design, moral drug delivery system, improved formulation.
- Pharmacogenomics

Reference:

1. Maulik and Patel, Molecular Biotechnology – Therapeutic applications and strategies.
2. Zito, Pharmaceutical Biotechnology.

BT –404Enzyme Engineering (40 Hrs.)

Instruction to question setter

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2. For group 2, 3 and 4, the paper setter may or may not give any choice.
3. The Questions must cover the entire syllabus with equal distribution of marks as far as practicable and all questions are compulsory.
4. Time of Examination: - Theory Papers – 03 Hours.
   Practical Papers- 06 Hours.

Unit-I: - **Introduction, Classification**
- Historical perspectives, Nomenclature, Characteristics.

Unit-II: -
- Commercial sources of enzymes:- Extraction and purification of enzymes.
- Enzymes immobilization.

Unit-III:-
- Principles of catalysis.
- Enzymes Inhibition and Regulation.
- Mechanism of action.

Unit-IV:-
- Michalis-Menten's equation.
- Relationship between km and (s).
- Significance of um and um values.

Unit-V:-
- Enzymes modification: (Site specific and Non-specific mutagenesis).
- In-vitro-Applications (Industries, Medicines, Diagnosis).

Reference:

1. Principles of Biochemistry-Smith et al., Mc Graw-Hill International book Company 8th edition 2002.
2. Principles of Biochemistry-Leninger, Nelson, Cox, CBS publishers, 2002,3rd Ed.
3. Fundamentals of Biochemistry-Voet et al., John Wile and Sons, Inc, 1995, 2nd Ed.
4. Harper's Biochemistry-R.K.Murray, D.K. Granner, P.A. Mayes and V.W.Rodwell, Prentice-Hall International 2001.

Lab. Work

BT 405 Bio-informatics Lab. (50 Hrs.)

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.

BT 406: Project Dissertation (03 Months) (100 Marks)