Syllabus and Course Scheme
Academic year 2024-25

B.Sc.- Biotechnology
Exam.2025

UNIVERSITY OF KOTA

MBS Marg, Swami Vivekanand Nagar, Kota - 324 005, Rajasthan, India

Website: uok.ac.in

B.Sc. Biotechnology Part-III Examination -2025

	Lec Hrs/week	**Exam** hrs	**Max** Marks
Core paper (Theory)			
BBT-19 Genetic Engineering and Recombinant DNA Technology	3	3	50
BBT-20 Applied Plant Biotechnology	3	3	50
BBT-21 Applied Animal Biotechnology	3	3	50
BBT-22 Industrial Biotechnology	3	3	50
BBT-23 Environmental Biotechnology	3	3	50
BBT-24 Computational Biology and IPR	3	3	50
Total of theory papers			**300**
Core paper (Practicals)			
BBT-25 Genetic Engineering and Recombinant DNA Technology+ Applied Plant Biotechnology		3	50
BBT-26 Applied Animal Biotechnology+ Industrial Biotechnology		3	50
BBT-27 Environmental Biotechnology + Computational Biology and IPR		3	50
Total of Practical papers			**150**
Grand Total (Theory+Practical)			**450**

The marks secured in the compulsory paper of Environmental studies shall not be counted in awarding the division to a candidate.

Maximum of three chances will be given to a candidate to pass compulsory paper.
Non appearance or absence in the examination of compulsory paper will be counted a chance. A candidate shall be eligible to appear in supplementary examination in maximum of two Core theory papers as per University Rules.
One percent of the maximum marks may be awarded as Grace marks to the candidate in accordance to the University Rules as applicable to all other Under Graduate examinations.
Minimum requirement of lectures completing each core theory and compulsory paper shall

be 78 hours, and for each practical 156 hours.

BIOTECH PRACTICALS – (I, II, III)

Distribution of Marks

Min. pass marks: 18		**Duration: 3 hours**	**Max. Marks: 50**
		REGULAR	**EX-STUDENT**
1. Major Exercise		12	12
2. Minor Exercise		10	10
3.Preparation		8	8
4. Spots (5)		10	10
5.Record		5	-
6.Viva-voce		5	10
TOTAL	**50**		**50**

B.Sc. Biotechnology Part-III Examination

	Lec Hrs/week	**Exam** hrs	**Max** Marks
Core paper (Theory)			
BBT-19 Genetic Engineering and Recombinant DNA Technology	3	3	50
BBT-20 Applied Plant Biotechnology	3	3	50
BBT-21 Applied Animal Biotechnology	3	3	50
BBT-22 Industrial Biotechnology	3	3	50
BBT-23 Environmental Biotechnology	3	3	50
BBT-24 Computational Biology and IPR	3	3	50
Total of theory papers			**300**
Core paper (Practicals)			
BBT-25 Genetic Engineering and Recombinant DNA Technology+ Applied Plant Biotechnology		3	50
BBT-26 Applied Animal Biotechnology+ Industrial Biotechnology		3	50
BBT-27 Environmental Biotechnology + Computational Biology and IPR		3	50
Total of Practical papers			**150**
Grand Total (Theory+Practical)			**450**

BBT-19 Genetic Engineering and Recombinant DNA Technology

Min. passmarks:18 **Duration: 3hours** **Max. Marks:50**

Note: Attempt any five questions, taking atleast one question from each unit. Each question carries equal marks.

UNIT-1

Introduction of genetic engineering. Isolation and purification of DNA from bacterial, plant and animal cells: agarose gel electrophoresis, Southern and Northern- blotting. SDS-PAGE and western blotting.Gene location: Hybridization techniques – Southern blotting; *In situ* hybridization.

Enzymes used in genetic engineering: restriction enzymes, DNA polymerases, kinases& phosphatases, DNA ligases and other enzymes.

UNIT-II

C-DNA synthesis and cloning: mRNA enrichment, reverse transcription, Linkers, adapters, blunt end ligation, homopolymer tailing. PCR.

Genomic and cDNA libraries: Preparation and uses.

DNA Sequencing: traditional (Sanger coulsion and Maxam gilbert method) and solid phase automated sequencing.

UNIT-III

Gene tagging and Application of transposons in gene tagging. Cloning Vectors: Plasmid vectors, Bacteriophage. Cloning and expression of foreign genes in prokaryotes (*E.coli*). Cloning and expression of foreign genes in eukaryotes(yeast). Brief idea about gene cloning in plant and mammalian cells.Application of molecular cloning.

UNIT-IV

Methods of Gene transfer -microinjection, electroporation, microprojectile, shot gun method ultra -sonication, Liposome fusion, microlasers. Use of *Agrobacterium tumefaciens* and *A.rhizogenes*, Ti plasmids.

Application of bio informatics in search for DNA homology.

UNIT-V

Therapeutic use of r-DNA technology: Products of human therapeutic interest(insulin, hGH), antisense molecules, recombinant vaccines. Gene therapy.

Transgenic plants: Bt transgenic (cotton, brinjal), flavr savr tomato, golden rice.

Protein engineering. Transgenic animals.

Reference Books:

1. Sambrose and Russell. (2001), Molecular Cloning. 3 volumes. CSH Lab Pres. Hellen, K., Adrian, M. and John W. (2000). Recombinant DNA and Biotechnology.
2. Old and Primrose. (1994). Principles of Gene Manipulation, Blackwell Scientific Publications.
3. Glick B.R and Pasternak J.J. (2010), Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press.
4. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford,
5. Primrose, S. B. Twyman, P.M. and Old, R. W. (2001) Principles of gene manipulation(6th Ed.). Black well publishers.
6. Old and Primrose. (1994). Principles of Gene Manipulation, Blackwell Scientific Publications.

BBT – 20 Applied Plant Biotechnology

Min. passmarks:18 **Duration: 3hours** **Max. Marks:50**

Note: Attempt any five questions, taking at least one question from each unit. Each question carries equal marks.

UNIT-I

Introduction of plant tissue culture. Tissue culture laboratory organization. Concept of totipotency, Cyto-differentiation and its importance. Aseptic techniques.
Culture medium: Nutritional requirements of explants, PGR's and their *in vitro* roles, media preparation. Explants: Characteristics sterilization and Selection.

UNIT-II

Principle, protocol and importance of antherculture, pollen culture, organ culture, callus culture, cell suspension culture.Clonal propagation. Somatic embryogenesis and synthetic seed production. Bioreactors – their types, construction and use in secondary metabolite production.

UNIT-III

Protoplast Culture: Principle, Methods of fusion. Somatic hybridization.
Screening and identification of hybrid and cybrid.
Basic Techniques in r-DNA Technology for Plant transformation: Ti and Ri plasmids.

UNIT-IV

Genetic markers: Marker gene and reporter genes with examples.
Vectors and their applications in plant biotechnology : pBR322, phage , cosmids, phagmids.
Direct DNA transfer (particle bombardment, electroporation, microinjection).

UNIT-V

Plant secondary metabolites and their production. Hairy root culture for production of useful metabolites Applications of plants biotechnology in breeding and crop improvement. Therapeutic proteins and edible vaccines.

Reference Books:

1. Introduction to Plant Tissue Culture: M.K. Razdan
2. Plant Tissue Culture Theory & Practical: S.S. Bhojwani & M.R. Razdan
3. Slan A.C. (1996), Plant Tissue Culture- Oxford &(BH Publishing co. pvt.ltd.)
4. Lydiane kyle John Kleyin plant test tubes: An Introduction to micro propagation.
5. Introduction to plant biotechnology by H.S. Chawla
6. Plant Tissue Culture: Application and Limitations. Bhowjwani, S.S. 1990.
7. Plant Cell Culture, Advances in Biochemical Engineering and Biotechnology. Anderson, L.A.,Recombinant DNA. Watson, 1992.
8. Gene transfer to Plants. Portykns, 1995.
9. Plant Biotechnology, Ashwani Kumar, Shikha Rohy, I.K. International Pvt. Ltd, 2006.
10. Biotechnology by B.D.Singh (Kalyani Publishers)

BBT – 21 Applied Animal Biotechnology

Min. passmarks:18 **Duration: 3hours** **Max. Marks:50**

Note: Attempt any five questions, taking at least one question from each unit. Each question carries equal marks.

UNIT-I

Introduction and scope of animal tissue culture. Natural media and artificially defined media. Primary cell culture: Disaggregation of tissues, enzymatic disaggregation and mechanical disaggregation.
Cell lines: Cloning, selection and maintenance of cell lines.

UNIT-II

Growth kinetics of animal cells in cultures. Primary culture, Secondary culture (Transformed cell and continuous cell lines). Bioreactors for animal cell culture.
In Vitro Fertilization: Need and general Methodology.

UNIT-III

Transfection of animal cell lines. Large scale culture of cells.Growth factors promoting proliferation of animal cells: EGF, FGF, PDGF, IL-1. IL-2, NGF and Erythropoietin. Cryopreservation of cell line, ovum, sperm and embryo. *In vitro* fertilization and embryo transfer

UNIT-IV

Expression of cloned proteins in animal cells: Expression vector, over.production and down stream processing of the expressed proteins. Production and application of monoclonal antibodies.

UNIT-V

Application of animal cells cultures for studies of gene expression.. Production and application of monoclonal antibodies.
Transgenic animals: Technique and application, Sheep and Mice.

Reference Books:

1. Animal Tissue Culture- Mathur
2. Animal Tissue Culture - R. IanFreshney
3. Animal biotechnology- M.M.Ranga
4. Cell & Tissue Culture in animals- Masters
5. Biotechnology-expanding horizons B.D. Singh

BBT - 22 Industrial Biotechnology

Min. passmarks:18 **Duration: 3hours** **Max. Marks:50**

Note: Attempt any five questions, taking at least one question from each section. Each question carries equal marks.

UNIT- I

Fermentation- Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology- A brief survey of organisms, processes, products. Bioreactor / Fermenter –Types and operation of Bioreactors, Media design for fermentation processes, Solid substrate & liquid fermentations.

UNIT- II

Basic concepts of Upstream and Downstream processing in Bioprocess.
Primary Metabolites- Production of commercially important primary metabolites like organic acids, amino acids and alcohols.

UNIT- III

Secondary Metabolites- Production processes for various classes of secondary metabolites: Antibiotics, Vitamins and Steroids.

UNIT- IV

Production of Industrial Enzymes. Cheese, Beer, SCP & Mushroom culture, Production of recombinant proteins having therapeutic and diagnostic applications, vaccines.

UNIT - V

Production of Biopesticides, Biofertilizers, Biopolymers, Biodiesel

Reference Books:

1. Casida, L.E. “Industrial Microbiology”, New Age International (P) Ltd, 1968.
2. Presscott, S.C. and Cecil G. Dunn, “Industrial Microbiology”, Agrobios (India), 2005.
3. Cruger,Wulf and Anneliese Crueger, “Biotechnology: A Textbook of Industrial Microbiology”, 2nd Edition, Panima Publishing, 2000.
4. Stanbury, P.F., A. Whitaker and S.J. Hall “Principles of Fermentation Technology”, 2 nd Edition, Butterworth – Heinemann (an imprint of Elsevier), 1995.
5. C.F.A Bryce and EL.Mansi, Fermentation microbiology & Biotechnology, 1999.
6. K.G.Ramawat & Shaily Goyal, Comprehensive Biotechnology, 2009, S.Chand.

BBT - 23 Environmental Biotechnology

Min. passmarks:18 **Duration: 3hours** **Max. Marks: 50**

Note: Attempt any five questions, taking at least one question from each unit. Each questioncarries equalmarks.

UNIT-I

Pollution of air, water and land with reference to their causes, nature of pollutions, impact and control strategies environmental damage by agriculture, perspectives of pollution in urban, industrial and rural areas. Habitat Pollution by Chlorinated Hydrocarbons (DDT, PCBs, Dioxin etc), Organophosphates, Heavy Metals, Die-offs, Endocrine disrupting chemicals.The scope of environmental biotechnology.

UNIT-II

Liquid waste treatment; Biofilters, activated sludgesystems; membrane bioreactors.
Biotechnological approaches for solid waste management.
Phytotechnology-terrestrial phytosystems, metal phytoremediation,
Phytotechnology-aquatic phytosystems, nutrient film techniques, algal treatment systems.

UNIT-III

Biodegradation of macromolecules; Biodegradation of xenobiotics; Vermicomposting.
Heavy metal pollution; Bioremediationof metal contaminated soils, spilled oil and grease deposits and synthetic pesticides.Microorganisms and organic pollutants;Extremophiles

UNIT-IV

Biosensors to detect environmental pollutants.Natural pesticides – Neem and *Thuringiensis*.
Biotechnology strategies in forestry and wasteland management.
Biotechnology in biodiversity conservation: gene banks, germplasm conservation andDNA Banks.

UNIT-V

Biological control of other insects swarming the agriculture fields. Enrichment of ores by microorganisms (biomining). Biofertilizers, nitrogen-fixing microorganisms enriching the soil with assimilable nitrogen compounds.
Genetically modified organisms and Biosafety- a general account.

Reference Books:

1. Environmental Biotechnology: Concepts and Applications Hans-Joachim Jördening, Josef Winter John Wiley & Sons,
2. Advanced Environmental Biotechnology By S.K.Agarwal APH Publishing,
3. Environmental Biotechnology By S.N Jogdand Himalaya Publishing
4. Textbook of Environmental Biotechnology By Mohapatra I. K. International Pvt Ltd
5. Environmental Biotechnology: Basic Concepts and Applications By Indu Shekhar Thakur
6. Environmental Biotechnology: Theory and Application By Gareth G. Evans , Judy Furlong.
7. Manahan, S.E. 1997. Environmental Science and Technology. Lewis, New York.
8. Evans, G.M. and Furlong J.C. 2003. Environmental Biotechnology: Theory and Application. John Wiley and Sons.
9. Thomas, J.A. and Fuchs, R. 2002. Biotechnology and Safety Assessment. Academic Press.

BBT -24 Computational Biology and IPR

Min. passmarks:18 **Duration: 3hours** **Max. Marks:50**

Note: Attempt any five questions, taking atleast one question from each unit. Each question carries equal marks.

UNIT- I

Introduction to Bioinformatics and Biological Databases.: Principles of DNA and Protein sequencing, File Formats for storage of Sequence and Structural Data, Primary Sequence Databases of Nucleic Acids and Proteins, Organism Specific Genome Databases, Structural Databases.

UNIT- II

Specialized Sequence Databases of Expressed Sequence Tags, Gene Expression, Single Nucleotide Polymorphism, OMIM, Unigene etc., Data Retrival with ENTERZ, SRS and DBGET, Secondary Databases (Pfam, PROSITE,PRINT, Block, etc.)

UNIT- III

Algorithms and Tools: Sequence Alignment (Pair wise and Multiple). Alignment Algorithms, Database, Similarity Searches (BLAST, FASTA AND psi-BLAST). Amino Acid Substitution
Matrices (PAM, BLOSUM), Profiles and Motifs.

UNIT- IV

Introduction to Intellectual Property: Patents, Types, Trademarks, Copyright & Related Rights,
Industrial Design and Rights, Traditional Knowledge, Geographical Indications- importance of IPR –patentable and non patentables – patenting life – legal protection of biotechnological inventions –World Intellectual Property Rights Organization (WIPO).

UNIT- V

Grant of Patent and Patenting Authorities: Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; An introduction to Patent Filing. Procedures; Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patent owner.

Reference Books:

1. Bioinformatics: Concepts, Skills and Application by Rastogi, S.C
2. B N Mishra, Bioinformatics: Concept and application, Pearson Education (in Press)
3. Anthony JF Griffths: An intro to Genetic analysis. 1st Ed.
4. Michael Starkey and Ramnath Elaswarapu; Genomics Protocols, Humana Pres
5. Stephen Misner & Stephen Krawetz Bioinformatics Methods and Protocol
6. Lawrence Hunter – Artificial Intelligence & Mol. Biology.
7. Westhead P: Instant notes on Bioinformatics; Viva Publication
8. Hooman H Rasidi Bioinformatics Basic Application in Biological Science and medicine; CRC Press.
9. Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.
10. Singh K K (2015). Biotechnology and Intellectual Property Rights: Legal and Social Implications.

PRACTICAL

BT-25 Genetic Engineering and Recombinant DNA Technology+ Applied Plant Biotechnology

1. Isolation of plasmid DNA.
2. Isolation of phage DNA.
3. Restriction mapping of Plasmid DNA.
4. Cloning in Vectors.
5. PCR.
6. To study the production of transgenic.
7. Isolation & identification of secondary metabolites from plant cell
8. Preparation of synthetic seeds: Encapsulation Techniques.
9. Demonstration of protoplast fusion employing PEG.

BBT-26 Applied Animal Biotechnology+ Industrial Biotechnology.

1. To study of transplantations -tumors, organs, cells.
2. Western- blotting.
3. Batch fermentation in conical flask.
4. Solid state fermentation.
5. Screening of microbes for production of industrially important enzymes.
6. Optimization of conditions for optimal production of enzyme: - Media composition, Incubation temperature, Aeration, Incubation time.
7. Instrumentation of fermentor.Design of various types of fementers & bioreactors.
10. Study different parts of fermenter.
11. A visit to any educational institute/industry to see an industrial fermenter, and downstream processing operations.

BBT-27 Environmental Biotechnology + Computational Biology and IPR

1. To estimate total hardness of water
2. To estimate Calcium hardness of water
3. To estimate the total solids (TS), total dissolved solids (TDS) and suspended solids (SS) in the given water sample
4. To estimate dissolved oxygen content of wastewater.
5. To estimate chemical oxygen demand of the given sample.
6. To estimate Biological Oxygen Demand (BOD)
7. To measure the concentration of chloride in it the given sample
8. Working on Biological databases, NCBI, DDBJ, EMBL.
9. Visualizing and Retrieving protein and nucleic acid sequences, structures, EST sequences, SNP data using database browsers and genome browsers.
10. Converting sequences between different formats. Nucleic acid sequence analysis by using
11. Phylogeny approaches. BLAST and FASTA.
12. Protein Sequence analysis and structure predication working on docking and visualizing