

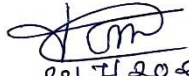


પરિપત્ર:

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટીની લાઈફ સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજોનાં આચાર્યશ્રીઓને સવિનય જણાવવાનું કે લાઈફ સાયન્સ વિદ્યાશાખા હેઠળનો NEP-૨૦૨૦ અંતર્ગત બાયોટેકનોલોજી વિષય સેમેસ્ટર-૫નો અભ્યાસક્રમ આ સાથે સામેલ છે.

માનનીય કુલપતિશ્રીની મંજૂરી અનુસાર સદર અભ્યાસક્રમ શૈક્ષણિક વર્ષ જુન, ૨૦૨૫ થી અમલવારી કરવાની રહે છે. લાઈફ સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજો ધ્વારા તેની અમલવારી કરવા જણાવવામાં આવે છે.




૨૨/૪/૨૦૨૫
ખાસ ફરજ પરના અધિકારી
(એકેડેમિક)

ક્રમાંક/બીકેએનએમયુ/ એકેડેમિક/૩૯૦/૨૦૨૫

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી,

સરકારી પોલીટેકનિક કેમ્પસ,

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી રોડ,

ખડીયા, જૂનાગઢ-૩૬૨૨૬૩

તા.૨૨/૦૭/૨૦૨૫

પ્રતિ,

- ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી સંલગ્ન લાઈફ સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમો ચલાવતી તમામ કોલેજોના આચાર્યશ્રીઓ તરફ....

નકલ સાદર રવાના:-

- માન.કુલપતિશ્રી/ કુલસચિવશ્રીનાં અંગત સચિવશ્રી.
- પરીક્ષા નિયામકશ્રી, ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી, જૂનાગઢ

નકલ રવાના જાણ તથા યોગ્ય કાર્યવાહી અર્થે:

- સીસ્ટમ મેનેજરશ્રી, આઈ.ટી.સેલ વિભાગ (વેબસાઇટ ઉપર પ્રસિદ્ધ થવા અર્થે.)



BHAKTA KAVI NARSINH MEHTA UNIVERSITY
JUNAGADH



BOARD OF STUDIES
FACULTY OF **LIFE SCIENCE**
SYLLABUS FOR
BIOTECHNOLOGY (HONOURS) PROGRAMME
(SEMESTER- V)
EFFECTIVE FROM JUNE, 2025

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Syllabus of B.Sc. (Honors) as per NEP-2020
Faculty of Life Science
Effective from June 2025
Subject: Biotechnology
SEMESTER-V

SUMMARY OF THE SYLLABUS

Sem No.	Sr. No.	Course Group	Course (Paper) Title	Paper No.	Credit	Teaching Hours	Internal Marks	External Marks	Practical Internal Marks	Practical External Marks	Total Marks	Total Marks	
5	1	MAJOR-11	Bioprocess and Biochemical Engineering	MAJBTT501	4	60	50	50	-	-	100	100	
	2	MAJOR-12	Genetics and Molecular Biology	MAJBTT502	4	60	50	50	-	-	100	100	
	3	MAJOR-13	Combine Practical	MAJBTP503	4	60	-	-	50	50	100	100	
	4	MINOR-4	Analytical methods and approaches	MINBTT501	3	45	25	50	-	-	75	100	
		MINOR-4	Analytical methods and approaches	MINBTP501	1	30	-	-	25	-	25		
	5	MINOR-5	Modern Molecular Techniques and Bioinformatic Tools	MINBTT502	3	45	25	50	-	-	75	100	
		MINOR-5	Modern Molecular Techniques and Bioinformatic Tools	MINBTP502	1	30	-	-	25	-	25		
	Total					20							

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Course Level	UG (5.0)	Internal Marks	50
Programme	B.Sc. Biotechnology	External Marks	50
Semester	V	Practical Internal	-
Category of Course	MAJOR-11	Practical External	-
Course Credit	4	Prac. External Exam Duration	-
Teaching Hours	60	Total	100
Course Code	MAJBTT501	Exam Duration	2 hrs.
Course Title	Bioprocess and Biochemical Engineering (Theory)		

Course Objectives:

- Understand the principles and methodologies involved in the isolation, screening, and improvement of microbial strains for industrial applications.
- Gain insight into the design, function, and operation of bioreactors, along with the factors influencing microbial growth kinetics.
- Learn the formulation of fermentation media, optimization techniques, and sterilization processes to ensure efficient microbial productivity.
- Explore the concepts, methods, and challenges involved in downstream processing for product recovery and purification.
- Understand the role of bioassays, quality control, and economic considerations in the industrial fermentation process.

Course Learning Outcomes: After completion of the course:

- Explain metabolic pathways and differentiate between primary and secondary metabolites in industrial microorganisms.
- Apply enrichment and screening techniques to isolate and evaluate industrially important microorganisms.
- Describe mutagenesis techniques and recombinant DNA technologies used in microbial strain improvement.
- Analyze the design, aeration, agitation, and heat control aspects of various fermenters and bioreactors.
- Conduct quality control tests and bioassays for assessing fermentation products.

Course Contents

Sem	Unit No.	Syllabus	Teaching Hours
5	1	FERMENTATION TECHNOLOGY & INDUSTRIALLY IMPORTANT MICROORGANISMS A. Historical perspective and concept - General Concept and historical development of industrial microbiology - Range of Fermentation Processes - Component parts fermentation process - Economic aspects of fermentation industry B. Isolation & improvement of industrially important microorganisms - Primary & Secondary Screening - Isolation methods using selection of desired characters - Improvement of industrially important microbes: Application of protoplast fusion and recombinant DNA technology.	15
	2	Fermenter Design, Sterilization & Aseptic Operations - Basic Fundamentals of Fermenter Systems. - Design Principles and Construction Parameters. - Classification of Bioreactors. - Aeration and Mixing Mechanisms. - Modes of Fermentation Operation: Batch and Continuous Fermentation - Sterilization in Industrial Fermentation: Introduction to Del Factor: kinetics of sterilization - Aseptic Handling and Containment Systems	15
	3	Formulation of Fermentation Media - Overview of Fermentation Media and Their Classifications. - Strategies for Media Design and Formulation. - Essential Media Components and Raw Materials: Carbon, Nitrogen, Minerals and Trace Elements, Precursors & Growth Enhancers, pH Buffers and Antifoam Agents Sources. - Media for Inoculum Development and Production Phases: Inoculum and Production medium - Media Optimization Approaches.	15
	4	Downstream Processing in Fermentation - Cell Separation Techniques: Precipitation, Sedimentation, Centrifugation, Filtration. - Cell Disruption Methods: Mechanical and Non mechanical methods. - Product Isolation and Purification: Liquid liquid extraction, Solvent recovery, Two Phase aqueous extraction, Super critical fluid extraction - Product Characterization and Assay: Physical, Chemical and Biological assay of fermentation products	15

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Suggested Reading:

1. Principles of Fermentation Technology by Stanbury & Whittaker: 2nd edition
2. Industrial Microbiology by Casida L.E.
3. A text book of Industrial Microbiology, 2nd edition by Wulf Crueger & Anneliese Crueger
4. Industrial Microbiology by A.H. Patel
5. Biotechnology: Food Fermentation Microbiology, Biochemistry & Technology vol. 1 & 2 by V.K. Joshi & Ashok Pandey

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Course Level	UG (5.0)	Internal Marks	50
Programme	B.Sc. Biotechnology	External Marks	50
Semester	V	Practical Internal	-
Category of Course	MAJOR-12	Practical External	-
Course Credit	4	Prac. External Exam Duration	-
Teaching Hours	60	Total	100
Course Code	MAJBTT502	Exam Duration	2 hrs.
Course Title	Genetics and Molecular Biology (Theory)		

Course Objectives:

- Understand the fundamental principles of microbial genetics and gene expression.
- Explore the mechanisms and applications of recombinant DNA technology in microbial systems.
- Examine the potential and applications of genetic and protein bioengineering in industrial and therapeutic contexts.

Course Learning Outcomes: After completion of the course:

- Gain a thorough understanding of the three primary mechanisms of horizontal gene transfer in microorganisms: transformation, transduction, and conjugation.
- Demonstrate foundational knowledge of genetic engineering and protein bioengineering techniques.
- Apply genetic manipulation strategies for the development of engineered strains and bio-products.

Course Contents

Sem	Unit No.	Syllabus	Teaching Hours
5	1	History and Concept of Genetics • History of genetics and molecular biology • Mendelian Laws of inheritance The Gene Concept • Units of genetic structure and genetic function • Gene Cistron relationship in Prokaryotes and Eukaryotes • Gene structure and architecture • DNA is the universal genetic material • DNA replication – mechanism and models	15
	2	Gene Expression and Regulation • Transcription and post transcriptional modifications • Genetic code and Ribosome • Translation and post translational modifications • Levels of gene expression and regulation	15

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	• Types and principles of gene regulation • Transcriptional regulation • The Operon Model: Regulation of lactose utilization – The lac operon • The Operon Model: Regulation of arabinose utilization – The ara operon • The Operon Model: Regulation of tryptophan biosynthesis – The trp operon • Post transcription control	
3	Gene Transfer and Recombination • Types of Recombination: Homologous recombination, Site specific recombination, Illegitimate recombination • Transformation: Natural transformation, competence, DNA uptake, role of natural transformation, Artificial induced competence, electroporation • Transduction: Generalized transduction, Specialized transduction and Abortive transduction • Conjugation: Mechanism of DNA transfer in Gram positive and Gram-negative bacteria • Transposable genetic elements	15
4	Genetic and Protein Engineering • Genetic engineering: aims and applications • Genetic manipulations of prokaryotes: • Isolation of DNA • Vectors of Recombinant-DNA Technology – pBR322, pUC, Bacteriophages, Cosmid, Phagmid, BACs, YACs • Insertion of DNA molecules into a vector • Transformation and Growth • Detection of Recombinant molecules – Colony Hybridization • Expression of foreign DNA • Genetic manipulations of eukaryotes: Genetic manipulation of plant cells, animal cells and yeasts • Site directed mutagenesis	15

Suggested Reading:

1. Advanced Molecular Biology, Twyman R. M.
2. Genes VII, Benjamin Lewin
3. Microbiology, Atlas R. M.
4. Essential of Molecular Biology – Malacinski G. M.
5. Molecular Genetics of Bacteria – Synder L. & Champness
6. Microbial Genetics – R. Maloy
7. Microbiology – Prescott L. M.
8. Microbial Genetics – Freifilder. D
9. Principles of Gene Manipulation – Old and Primrose
10. Biotechnology – Trevan M.D.

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Course Level	UG (5.0)	Internal Marks	-
Programme	B.Sc. Biotechnology	External Marks	-
Semester	V	Practical Internal	50
Category of Course	MAJOR-13	Practical External	50
Course Credit	4	Prac. External Exam Duration	4 hrs.
Teaching Hours	60	Total	100
Course Code	MAJBTP503	Exam Duration	4 hrs.
Course Title	Combine Practical		

Course Objectives:

- Understand the structure and manipulation of genetic materials such as DNA, plasmids, and proteins.
- Comprehend the mechanisms of gene expression and its regulation in microbial systems.
- Gain foundational knowledge in fermentation technology and microbial bioprocesses for industrial applications.

Course Learning Outcomes: After completion of the course:

- Demonstrate practical skills in the extraction and manipulation of genetic material under laboratory conditions.
- Analyse and explain the principles of gene expression and regulatory mechanisms in microorganisms.
- Apply techniques for strain improvement and identify industrially significant microbial strains.
- Design and formulate fermentation media to optimize microbial production in biotechnological processes.

Sr. No.	Practical Content	Teaching Hours
1	Isolation of DNA (<i>Demonstration only</i>)	60 hrs
2	Estimation of DNA	
3	Conjugation in <i>E. coli</i> by plate method	
4	Isolation of plasmid (<i>Demonstration only</i>)	
5	Transformation of plasmid	
6	Isolation and extraction of protein	
7	Estimation of protein	
8	Primary screening of industrially important microorganisms producing: antibiotics, organic acids, amylases	
9	Bioassay of penicillin using <i>Bacillus</i> spp.	

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10	Laboratory fermentation & estimation of ethyl alcohol by <i>Saccharomyces</i>	
11	Laboratory fermentation & estimation of amylase by <i>Bacillus</i> spp.	
12	Sterility testing of fermentation products	
13	Immobilization of yeast cells using calcium alginate entrapment method	
14	Methylene Blue Reduction Time test for milk	
15	Fermentation production & estimation of citric acid	

Suggested Reading:

1. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.
2. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India.
3. Dubey. R.C., Maheshwari. D.K., Practical Microbiology, S. Chand & Company Ltd., New Delhi
4. Konika Sharma., manual of Microbiology – Tools & Techniques, Ane Books, Delhi.
5. International student edition: Microbiology- A laboratory Manual 4th edition. by James G. Chappuccino & Natalie Sherman.
6. Bacteriological Techniques by F.J. Baker.
7. Introduction to Microbial Techniques by Gunasekaran.

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Course Level	UG (5.0)	Internal Marks	25
Programme	B.Sc. Biotechnology	External Marks	50
Semester	V	Practical Internal	-
Category of Course	MINOR-4	Practical External	-
Course Credit	3	Prac. External Exam Duration	-
Teaching Hours	45	Total	75
Course Code	MINBTT501	Exam Duration	2 hrs.
Course Title	Analytical methods and approaches (Theory)		

Course Objectives:

- Grasp the foundational concepts and practical uses of various microscopy methods.
- To Explain and apply the core principles of absorption fluorimetry, colorimetry, and spectrophotometry across multiple spectral regions, including visible, ultraviolet, and infrared.
- Conduct microscopic analyses and quantitative assays to evaluate microbial metabolites and products.
- To Understand the theory and practical applications of different electrophoretic techniques commonly used in molecular biology.
- Acquire practical proficiency in techniques such as starch-gel electrophoresis, native and SDS polyacrylamide gel electrophoresis, agarose gel electrophoresis, pulse-field gel electrophoresis, immunoelectrophoresis, isoelectric focusing, and Western blotting.

Course Learning Outcomes: After completion of the course:

- Apply proper laboratory practices for the safe and effective manipulation of microorganisms.
- Examine and interpret the microscopic morphology of microorganisms to better understand their structure and function.
- Execute a range of electrophoresis-based techniques, including starch-gel, native and SDS-PAGE, agarose-gel, pulse-field gel electrophoresis, immunoelectrophoresis, isoelectric focusing, and Western blotting.
- Explain the fundamental concepts of chromatography and its role in the separation and analysis of biological molecules.

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Course Contents

Sem	Unit No.	Syllabus	Teaching Hours
5	1	Microscopy 1.1 Simple microscopy, 1.2 phase contrast microscopy, 1.3 florescence microscopy 1.4 Electron microscopy (TEM and SEM) 1.4 dark field microscopy 1.5 confocal microscopy	12
	2	Spectroscopy 2.1 Absorption fluorimetry, 2.2 colorimetry, 2.3 spectrophotometry (visible, UV, infrared), 2.4 centrifugation, 2.5 cell fractionation techniques, 2.6 isolation of sub-cellular organelles and particles.	12
	3	Chromatography 3.1 Introduction to the principle of chromatography. 3.2 Paper chromatography and thin layer chromatography, 3.3 column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC.	11
	4	Electrophoresis 4.1 introduction to Starch-gel, polyacrylamide gel (native and SDS-PAGE), 4.2 agarose-gel electrophoresis, 4.3 pulse field gel electrophoresis, 4.4 immuno- electrophoresis, 4.5 isoelectric focusing, 4.6 Western blotting.	10

Suggested Reading:

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley& Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia. 3.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA. 4.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell.7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

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Course Level	UG (5.0)	Internal Marks	-
Programme	B.Sc. Biotechnology	External Marks	-
Semester	V	Practical Internal	25
Category of Course	MINOR-4	Practical External	-
Course Credit	1	Prac. External Exam Duration	-
Teaching Hours	30	Total	25
Course Code	MINBTP501	Exam Duration	-
Course Title	Analytical methods and approaches (PRACTICAL)		

Course Objectives:

- Understand the fundamental principles and applications of various microscopy techniques.
- Comprehend the theoretical basis and practical uses of absorption fluorimetry, colorimetry, and spectrophotometry across visible, ultraviolet, and infrared spectra.
- Perform microscopic examinations and conduct quantitative analyses to investigate microbial products.
- Understand the concepts and practical applications of electrophoretic techniques commonly used in molecular biology.
- Gain hands-on experience with electrophoresis methods, including starch-gel, native and SDS-PAGE, agarose-gel, pulse field gel electrophoresis, immunoelectrophoresis, isoelectric focusing, and Western blotting.

Course Learning Outcomes: Upon completion of this course, students will be able to:

- Apply safe and effective laboratory practices for the handling and manipulation of microorganisms.
- Analyze microbial structures using microscopy to gain deeper insights into their morphology and characteristics.
- Conduct a variety of electrophoretic techniques, including starch-gel, native and SDS-PAGE, agarose-gel, pulse field gel electrophoresis, immunoelectrophoresis, isoelectric focusing, and Western blotting.
- Explain the principles of chromatography and evaluate its role in the separation and analysis of biomolecules.

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Sr. No	Practical Content	Teaching Hours
1	Native gel electrophoresis of proteins	30
2	SDS-polyacrylamide slab gel electrophoresis of proteins under reducing conditions	
3	Separation of subcellular organelles	
4	Preparation of protoplasts from leaves	
5	Separation of amino acids by paper chromatography	
6	Identification of lipids in a given sample using thin-layer chromatography (TLC)	
7	Verification of Beer's Law and determination of the molar extinction coefficient of NADH	
8	Demonstration of ultracentrifugation technique	

Suggested reading:

1. S.R. Thimmaiah, Standard methods in Biochemical Analysis, Kalayani Pub.
2. Sawhney and Randhir Singh, Introductory Practical Biochemistry, Narosa Pub.
3. BeeduSashidar Rao & Vijay Deshpande, Experimental Biochemistry, I K Int. Pvt. Ltd.
4. Plummer. An introduction to practical Biochemistry, 3rd Edition
5. J.Jayraman. Lab Manual in Biochemistry.
6. Biotechnology, U. Satyanarayan, Books and Allied
7. Practical manuals of Biotechnology, S. Chand

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Course Level	UG (5.0)	Internal Marks	25
Programme	B.Sc. Biotechnology	External Marks	50
Semester	V	Practical Internal	-
Category of Course	MINOR-5	Practical External	-
Course Credit	3	Prac. External Exam Duration	-
Teaching Hours	45	Total	75
Course Code	MINBTT502	Exam Duration	2 hrs.
Course Title	Modern Molecular Techniques and Bioinformatic Tools (Theory)		

Course Objectives:

- Understand the principles and applications of key molecular biology techniques, including DNA amplification, sequencing, and hybridization methods.
- Gain knowledge of advanced tools such as gene synthesizers and methods for gene mapping and gene therapy.
- Explore the fundamentals and applications of molecular markers in genetic analysis.
- Acquire a foundational understanding of bioinformatics, including its scope, branches, and relevance to genome analysis.
- Familiarize themselves with major bioinformatics databases and tools for retrieving and analyzing biological information.

Course Learning Outcomes: After completion of the course:

- Apply molecular biology techniques such as PCR, blotting methods, and DNA sequencing in experimental and research contexts.
- Interpret and utilize genetic tools like AFLP, RFLP, RAPD, SNPs, and other molecular markers for DNA analysis.
- Demonstrate understanding of gene therapy methods, restriction mapping, and chromosomal analysis techniques like walking and jumping.
- Describe the structure, function, and importance of biological databases and effectively navigate resources such as NCBI, EBI, and KEGG.
- Differentiate between primary and secondary biological databases and retrieve relevant data from nucleic acid, protein, and literature repositories.
- Evaluate protein structures using classification systems like SCOP and CATH and understand their applications in structural biology.

Course Contents

Sem	Unit No.	Syllabus	Teaching Hours
5	1	Molecular Biology-1 1.1 DNA Amplification: PCR -Types and Applications 1.2 DNA Sequencing: Pyrosequencing 1.3 Next Generation Sequencing 1.4 Artificial synthesis of DNA (Gene Machine/ DNA Synthesizer) 1.5 Hybridization Techniques: Southern, Northern & Western Blotting	12
	2	Molecular Biology-2 2.1 Molecular Markers: AFLP, RFLP, RAPD, SSR, SNP, Micro satellite & Mini satellite 2.2 Gene Therapy 2.3 Restriction Mapping 2.4 DNA Foot Printing 2.5 Chromosome Walking & Chromosome Jumping	12
	3	Introduction to Bioinformatics 3.1 Overview of Human Genome Project 3.2 Overview of Bioinformatics, Branches & Applications 3.3 Major Bioinformatics Resources: NCBI, EBI, SIB, ExPASy, KEGG, NIH, NIG 3.4 Biological Databases: Nature of Biological data, Importance of Biological Databases in Biological Discovery 3.5 Brief classification of Biological Databases (Based on Nucleic Acids Research (NAR) Journal)	11
	4	Biological Databases 4.1 Differences and sources of primary and secondary databases with a few examples 4.2 Nucleic acid sequence databases: GenBank, ENA, DDBJ 4.3 Protein databases: UniProt, InterPro, RCSB-PDB & MMDB 4.4 Introduction to literature databases: PubMed, PMC, OMIM & NCBI Bookshelf 4.5 Structural Classification of Proteins: SCOP & CATH	10

Suggested Reading:

1. Introduction to Bioinformatics by T. Attwood and D. Parry-Smith, Prentice Hall
2. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by A.D. Baxevanis and B.F.F Ouellette, Wiley Interscience.
3. Essentials of Genomics and Bioinformatics by C.W. Sensen, John Wiley and Sons
4. Bioinformatics: Sequence and Genome Analysis by D.W. Mount, Cold Spring Harbor Laboratory Press.
5. Lesk, A.M. 2002, Introduction to Bioinformatics. Oxford University Press

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6. Rastogi, S.C., Mendiratta, N. and Rastogi, P. 2004 Bioinformatics: Concepts, Skills & Applications. CBS Publishers & Distributors
7. Andreas D. Baxevanis, Current Protocols in Bioinformatics, John Wiley & Son
8. Old & primrose, Principle of Gene Manipulation, Blackwell Pub.
9. T. A. Brown, Gene Cloning DNA analysis-Blackwell Pub.
10. Karp, Cell & Molecular Biology: concepts & Experiments. 4th Edition.
11. Lodish, Cell & Molecular Biology, W.H. Freeman. 5th Edn.
12. Watson, Molecular Biology of the Genes. Pearson Publication.
13. Glick, Molecular Biotechnology, ASM Publication.

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Course Level	UG (5.0)	Internal Marks	-
Programme	B.Sc. Biotechnology	External Marks	-
Semester	V	Practical Internal	25
Category of Course	MINOR-5	Practical External	-
Course Credit	1	Prac. External Exam Duration	-
Teaching Hours	25	Total	25
Course Code	MINBTP502	Exam Duration	-
Course Title	Modern Molecular Techniques and Bioinformatic Tools (PRACTICAL)		

Course Objectives:

- Understand and apply fundamental bioinformatics concepts and terminologies.
- Navigate and utilize key biological databases for gene, protein, and structural information.
- Perform sequence alignments and analyze sequence similarity using bioinformatics tools.
- Visualize and interpret three-dimensional protein structures using molecular visualization software.
- Develop essential skills in using online and offline tools for genomic and proteomic analysis.

Course Learning Outcomes: Upon completion of this course, students will be able to:

- Define and explain basic terminologies and principles in bioinformatics.
- Access and retrieve data from biological databases such as NCBI, UniProt, and RCSB PDB.
- Perform gene and protein sequence searches and understand database outputs.
- Carry out pairwise sequence alignments using tools like NCBI BLAST and interpret alignment results.
- Visualize and analyze 3D protein structures using tools such as RasMol.
- Integrate data from multiple sources to support bioinformatics-driven biological analysis.

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Sr. No	Practical Content	Teaching Hours
1	Introduction to Basic Terminologies in Bioinformatics	25
2	Exploring Biological Databases	
3	NCBI: Searching for Gene Sequences	
4	UniProt Knowledgebase (UniProtKB): Searching for Protein Sequences	
5	RCSB PDB: Searching for 3D Structures of Proteins	
6	Pairwise Sequence Alignment using NCBI BLAST	
7	Analysis of 3D Protein Structures using RasMol	

Suggested reading:

1. Introduction to Bioinformatics by T. Attwood and D. Parry-Smith, Prentice Hall
2. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by A.D. Baxevanis and B.F.F Ouellette, Wiley Interscience.
3. Essentials of Genomics and Bioinformatics by C.W. Sensen, John Wiley and Sons
4. Bioinformatics: Sequence and Genome Analysis by D.W. Mount, Cold Spring Harbor Laboratory Press.

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Paper Style:

Time: 2 Hours

Total Marks: 50

Instructions:

1. Illustrate your answer with neat and labelled diagrams.
2. Figure to the right side indicates full marks of questions.

EXTERNAL ASSESSMENT BY UNIVERSITY			
Que. No.	Particulars	Unit	Marks
Que. 1	(1)	Unit 1	05
	(2)		05
	OR		
	(1)		05
	(2)		05
Que. 2	(1)	Unit 2	05
	(2)		05
	OR		
	(1)		05
	(2)		05
Que. 3	(1)	Unit 3	05
	(2)		05
	OR		
	(1)		05
	(2)		05
Que. 4	(1)	Unit 4	05
	(2)		05
	OR		
	(1)		05
	(2)		05
Que. 5	(1)	Unit 1 & 2	05
	(2)		05
	OR		
	(1)	Unit 3 & 4	05
	(2)		05
		Total	50

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INTERNAL EVALUATION SCHEME (MAJOR)			
INTERNAL ASSESSMENT			
No.	Particulars	Marks	Weightage
1	Internal Test	50	25
2	Assignment		10
3	Field Visit Report/Class Presentation		10
4	Attendance		5
Total			50

INTERNAL EVALUATION SCHEME (MDC)			
INTERNAL ASSESSMENT			
No.	Particulars	Marks	Weightage
1	Internal Test	50	25
2	Assignment		10
3	Field Visit Report/Class Presentation		10
4	Attendance		5
Total			50

INTERNAL EVALUATION SCHEME			
INTERNAL ASSESSMENT			
No.	Particulars	Marks	Weightage
1	Practical Performance	50	40
2	Viva		10
Total			50

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SEMESTER-V

Paper Style:

INTERNAL EVALUATION SCHEME			
INTERNAL ASSESSMENT PRACTICAL			
No.	Particulars	Marks	Weightage
1	Perform any Four practical from the given list of exercises as per the instruction of the examiner.	50	40
2	Viva		10
Total			50
ASSESSMENT BY UNIVERSITY			
EXTERNAL EXAMINER ASSESSMENT PRACTICAL			
No.	Particulars	Marks	Weightage
1	Perform any three or four practicals from the given list of exercises as per the instructions of the examiner	50	40
2	Viva		10
Total			50