



પરિપત્ર:

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટીની લાઈફ સાયન્સીસ વિદ્યાશાખાનાં અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજોનાં આચાર્યશ્રીઓને સવિનય જણાવવાનું કે લાઈફ સાયન્સીસ વિદ્યાશાખા હેઠળનો NEP-૨૦૨૦ અંતર્ગત બાયોટેકનોલોજી વિષય સેમેસ્ટર-૬નો અભ્યાસક્રમ આ સાથે સામેલ છે.

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



ક્રમાંક/બીકેએનએમયુ/ એકેડેમિક/૬૬૯/૨૦૨૫

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી,

સરકારી પોલીટેકનિક કેમ્પસ,

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી રોડ,

ખડીયા, જૂનાગઢ-૩૬૨૨૬૩

તા.૦૮/૧૧/૨૦૨૫

પ્રતિ,

- ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી સંલગ્ન લાઈફ સાયન્સીસ 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 SCIENCES**
SYLLABUS FOR
BIOTECHNOLOGY (HONOURS) PROGRAMME
(SEMESTER- VI)
EFFECTIVE FROM JUNE, 2025

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

SUMMARY OF THE SYLLABUS

Sr. No.	Course Group	Course (Paper) Title	Paper No.	Credit	Teaching Hours	Internal Marks	External Marks	Practical Internal Marks	Practical External Marks	Total Marks
1	MAJOR-14	Genetic Engineering and Genomic Applications (Theory)	MAJBTT601	04	60	50	50	-	-	100
2	MAJOR-15	Advanced Biophysical and Analytical Techniques (Theory)	MAJBTT602	04	60	50	50	-	-	100
3	MAJOR-16	Combined Practical	MAJBTP603	04	60	-	-	50	50	100
4	MINOR-6	Environmental Biotechnology and Public Health (Theory)	MINBTT601	03	45	25	50	-	-	75
5	MINOR-6	Environmental Biotechnology and Public Health (Practical)	MINBTP601	01	35	-	-	25	-	25

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Course Level	5.5		Internal Marks	50
Programme	B.Sc Biotechnology		External Marks	50
Semester	VI		Practical Internal	-
Category of Course	MAJOR-14		Practical External	-
Course Credit	4		Prac. External Exam Duration	-
Teaching Hours	60		Total	100
Course Code	MAJBTT601		Exam Duration	2 hrs.
Course Title	MAJOR–14: Genetic Engineering and Genomic Applications			

Course Objectives:

- Understand the molecular basis and tools of genetic engineering.
- Explore genome editing technologies like CRISPR, TALEN, and ZFN.
- Study applications of genomics, transcriptomics, and proteomics in biotechnology.
- Learn about bioethics, biosafety, and regulatory guidelines.

Course Learning Outcomes: After completion of the course:

- Explain DNA cloning strategies and recombinant vector systems.
- Demonstrate understanding of genome editing and its applications.
- Evaluate ethical and biosafety considerations in genetic engineering.
- Apply molecular tools to solve biological and industrial problems.

Course Contents

Sem	Unit No.	Syllabus	Teaching Hours
6	1	Recombinant DNA Technology – Concepts and Tools • 1.1 Introduction and historical developments in genetic engineering. • 1.2 Restriction endonucleases – types, recognition sequences, and mode of action. • 1.3 DNA ligases, polymerases, and alkaline phosphatases – mechanisms and applications. • 1.4 Cloning vectors – plasmids, bacteriophage λ, cosmids, BAC, YAC, shuttle and expression vectors. • 1.5 Selection and screening of recombinant clones (blue-white selection, antibiotic markers, reporter genes).	15
	2	Gene Transfer and Transformation Methods • 2.1 Physical methods: microinjection, electroporation, gene gun, and liposome-mediated transfer. • 2.2 Biological methods: Agrobacterium-mediated transformation, viral vectors, and bacterial conjugation.	15

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		• 2.3 Transformation in prokaryotes and eukaryotes – principles and protocols. • 2.4 Expression of recombinant genes in bacterial, yeast, and plant systems. • 2.5 Detection and confirmation of transformants by hybridization and PCR.	
	3	Genome Editing and Gene Regulation • 3.1 Basics of genome editing and comparison of traditional vs. modern techniques. • 3.2 Site-directed mutagenesis – methods and applications. • 3.3 CRISPR-Cas9 system: components, mechanism, and case studies (agriculture and medicine). • 3.4 Other genome editing tools: TALENs, ZFNs, RNA interference (RNAi) and antisense RNA. • 3.5 Gene therapy approaches – ex vivo, in vivo, and ethical considerations.	15
	4	Applications, Bioethics, and Biosafety • 4.1 Production of recombinant proteins, enzymes, and vaccines (insulin, interferon, monoclonal antibodies). • 4.2 Transgenic plants and animals – examples and socio-economic benefits. • 4.3 Molecular diagnostics and gene therapy applications. • 4.4 Intellectual Property Rights (IPR), patenting of genes, and GMOs. • 4.5 Bioethics, biosafety levels, and regulatory frameworks (DBT, OECD, WHO guidelines).	15

Suggested Reading:

1. Primrose & Twyman, *Principles of Gene Manipulation*
2. Glick & Pasternak, *Molecular Biotechnology*
3. Watson et al., *Molecular Biology of the Gene*
4. Griffiths, *An Introduction to Genetic Analysis*

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Course Level	5.5	Internal Marks	50
Programme	B.Sc. Biotechnology	External Marks	50
Semester	VI	Practical Internal	-
Category of Course	MAJOR-15	Practical External	-
Course Credit	4	Prac. External Exam Duration	-
Teaching Hours	60	Total	100
Course Code	MAJBTT602	Exam Duration	2 hrs.
Course Title	MAJOR-15: Advanced Biophysical and Analytical Techniques		

Course Objectives:

- Learn advanced instrumental methods for molecular characterization.
- Understand analytical principles behind spectroscopy, chromatography, and nanotech tools.
- Interpret data from advanced biophysical analyses.

Course Learning Outcomes: After completion of the course:

- Perform and interpret results from advanced spectroscopy and analytical tools.
- Understand structural biology tools like NMR and X-ray crystallography.
- Apply biosensor principles in modern biotechnology.

Course Contents

Sem	Unit No.	Syllabus	Teaching Hours
6	1	Spectroscopy Techniques – Principles and Biological Applications • 1.1 UV-Visible spectroscopy – basic principles, instrumentation, and biological applications. • 1.2 Infrared (IR) spectroscopy – functional group identification in biomolecules. • 1.3 Fluorescence spectroscopy – theory, fluorophores, and applications in biology. • 1.4 Mass spectrometry – ionization methods, mass analyzers, and applications in proteomics. • 1.5 Nuclear Magnetic Resonance (NMR) – principles, types of NMR, and biomolecular structure analysis.	15
	2	Advanced Structural Analysis Techniques • 2.1 Circular dichroism (CD) – principles and applications in secondary structure analysis. • 2.2 X-ray diffraction – fundamentals, crystallization, and	15

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		protein structure determination. • 2.3 Protein structure elucidation – primary, secondary, tertiary, and quaternary levels; structure-function relationships.	
	3	Nano-biotechnological Techniques and Interaction Studies • 3.1 Surface Plasmon Resonance (SPR) – working principle, instrumentation, and use in studying biomolecular interactions. • 3.2 Dynamic Light Scattering (DLS) – particle size analysis and stability of nanoparticles. • 3.3 Nanobiotechnology techniques – nanoparticle synthesis, characterization, and applications in biosensing and drug delivery.	15
	4	Biosensors, Biochips, and Data Analysis for Molecular Detection • 4.1 Biosensors – types (electrochemical, optical, piezoelectric), components, and real-time monitoring. • 4.2 Biochips and microarrays – fabrication, types (DNA, protein), and applications in diagnostics. • 4.3 Data analysis – normalization, quantification, and interpretation of high-throughput data. • 4.4 Integration of biosensing and informatics in systems biology and personalized medicine.	15

Suggested Reading:

1. *Wilson & Walker*, Principles and Techniques of Biochemistry and Molecular Biology
2. *Lakowicz*, Principles of Fluorescence Spectroscopy
3. *Alberts et al.*, Molecular Biology of the Cell

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Course Level	5.5		Internal Marks	-
Programme	B.Sc. Biotechnology		External Marks	-
Semester	VI		Practical Internal	50
Category of Course	MAJOR-16		Practical External	50
Course Credit	4		Prac. External Exam Duration	4 hrs.
Teaching Hours	60		Total	100
Course Code	MAJBTP603		Exam Duration	4 hrs.
Course Title	Combine Practical			

Course Objectives:

- To develop hands-on skills in fundamental molecular biology techniques including DNA isolation, PCR, and gel electrophoresis.
- To familiarize students with the principles and practice of genetic engineering, such as restriction digestion and bacterial transformation (simulation).
- To impart practical knowledge of spectrophotometric techniques for the quantification of biomolecules.
- To introduce techniques for protein analysis using SDS-PAGE.

Course Learning Outcomes: After completion of the course:

- **Isolate and purify plasmid DNA** from bacterial cultures using standard protocols.
- **Perform restriction digestion and agarose gel electrophoresis** to analyze DNA fragments.
- **Conduct PCR amplification** and interpret results using gel documentation systems.
- **Quantify DNA and protein** using UV-Vis spectrophotometry and assess purity.
- **Demonstrate bacterial transformation procedures** using recombinant plasmid DNA in a simulated environment.
- **Analyze proteins using SDS-PAGE** and interpret banding patterns for molecular weight estimation.
- **Use or simulate biosensor-based techniques** for the detection of heavy metal contamination in water samples.

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Sr. No.	Practical Content	Teaching Hours
1	Isolation and Purification of Plasmid DNA	60 hrs
2	Restriction Digestion and Agarose Gel Electrophoresis	
3	PCR Amplification and Gel Documentation	
4	Quantification of DNA by UV Spectrophotometry	
5	Quantification of Protein by UV or Bradford Assay	
6	Transformation Using Recombinant Plasmid (Simulation)	
7	Analysis of Proteins by SDS-PAGE	
8	Preparation of Competent Cells (Demonstration)	
9	Agarose Gel Casting and Loading Practice	
10	Preparation of Buffers and Solutions (TE, TAE, Loading dye)	
11	Bacterial Culture and Growth Curve Analysis	
12	Antibiotic Sensitivity Test (Disc Diffusion Method)	
13	Plasmid Map Analysis and Restriction Site Prediction (Manual or Software-Aided)	
14	Detection of Heavy Metal Contamination Using Biosensors	
15	ELISA (Enzyme-Linked Immunosorbent Assay) – Demonstration or Simulation	

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	5.5		Internal Marks	25
Programme	B.Sc. Biotechnology		External Marks	50
Semester	VI		Practical Internal	-
Category of Course	MINOR-6		Practical External	-
Course Credit	3		Prac. External Exam Duration	-
Teaching Hours	50		Total	75
Course Code	MINBTT601		Exam Duration	2 hrs.
Course Title	Environmental Biotechnology and Public Health (Theory)			

Course Objectives:

- Understand interactions between biotechnology and public health.
- Learn modern approaches to bioremediation and disease prevention.
- Introduce the concept of One Health and sustainable biotechnology.

Course Learning Outcomes: After completion of the course:

- **Explain the interrelationship between biotechnology and public health**, including applications in disease diagnosis, vaccine development, and epidemiological surveillance.
- **Apply biotechnological techniques in environmental monitoring and bioremediation**, including detection and degradation of pollutants in air, water, and soil.
- **Describe the role of biofertilizers and biosensors** in promoting sustainable agriculture and environmental health.
- **Interpret the significance of modern public health tools**, such as molecular diagnostics, in controlling infectious diseases.
- **Discuss the One Health concept**, emphasizing the integration of human, animal, and environmental health for sustainable development.
- **Evaluate the impact of biotechnology in addressing challenges posed by climate change and ecological degradation.**

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Course Contents

Sem	Unit No.	Syllabus	Teaching Hours
6	1	Environmental Pollutants and Bioremediation • 1.1 Types and sources of environmental pollutants – air, water, and soil contaminants. • 1.2 Impact of pollutants on ecosystems and human health. • 1.3 Principles and types of bioremediation – in situ and ex situ approaches. • 1.4 Microbial degradation of pollutants – hydrocarbons, heavy metals, pesticides. • 1.5 Case studies on bioremediation of industrial and oil waste sites.	12
	2	Waste Management, Biofertilizers, and Biosensors • 2.1 Waste treatment methods – primary, secondary, and tertiary treatments for municipal and industrial waste. • 2.2 Role of microorganisms in solid and liquid waste treatment. • 2.3 Biofertilizers – types (nitrogen fixers, phosphate solubilizers), mode of action, and applications in agriculture. • 2.4 Biosensors for environmental monitoring – principles, components, and real-time analysis.	12
	3	Public Health Biotechnology • 3.1 Development of vaccines – traditional and recombinant vaccines, mRNA-based technologies. • 3.2 Diagnostic tools – molecular diagnostics (PCR, ELISA, rapid tests). • 3.3 Epidemiological surveillance – tools and technologies for tracking disease outbreaks. • 3.4 Role of biotechnology in controlling infectious diseases and improving healthcare access in developing nations.	11
	4	Sustainable Development, Climate Change, and One Health • 4.1 Principles of sustainable development and its integration with biotechnology. • 4.2 Climate change – causes, consequences, and mitigation strategies through biotechnology. • 4.3 Introduction to the One Health concept – integration of human, animal, and environmental health. • 4.4 Biotechnological interventions for ecosystem restoration and resilience.	10

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Suggested Reading:

1. **"Environmental Biotechnology: Principles and Applications"**
by Bruce E. Rittmann and Perry L. McCarty
— A comprehensive text covering microbial degradation, bioremediation, and environmental monitoring techniques.
2. **"Biotechnology for Environmental Management and Resource Recovery"**
by Samir Kumar Khanal
— Focuses on waste treatment, biofertilizers, biosensors, and sustainability aspects.
3. **"Principles of Environmental Biotechnology"**
by S. N. Jogdand
— Covers pollutants, bioremediation strategies, and microbial applications in environment.
4. **"Public Health Biotechnology"**
edited by J. Kumar
— Discusses molecular diagnostics, vaccines, epidemiological surveillance, and biotechnological tools for health improvement.
5. **"Climate Change and Biotechnology"**
edited by N. A. N. Mohamed
— Addresses climate change mitigation, biotechnology applications, and sustainable development principles.
6. **"One Health: People, Animals, and the Environment"**
by Ronald M. Atlas and Stanley Maloy
— Provides insight into the One Health concept integrating human, animal, and environmental health.
7. **"Environmental Microbiology"**
by Ian L. Pepper, Charles P. Gerba, and Terry J. Gentry
— Offers detailed coverage of microbial roles in pollutant degradation and environmental health.

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Course Level	5.5	Internal Marks	-
Programme	B.Sc. Biotechnology	External Marks	-
Semester	VI	Practical Internal	25
Category of Course	MINOR-6	Practical External	-
Course Credit	1	Prac. External Exam Duration	-
Teaching Hours	25	Total	25
Course Code	MINBTP601	Exam Duration	-
Course Title	Environmental Biotechnology and Public Health (PRACTICAL)		

Course Objectives:

- Understand interactions between biotechnology and public health.
- Learn modern approaches to bioremediation and disease prevention.
- Introduce the concept of One Health and sustainable biotechnology.

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

- Isolate and identify pollutant-degrading microbes and waterborne pathogens.
- Evaluate antioxidant and antimicrobial activities of natural extracts.
- Analyze public health data using basic computational tools.
- Conduct bioremediation experiments and use biosensors for contaminant detection.
- Prepare biofertilizers and understand their role in sustainable agriculture.

Sr. No.	Practical Content	Teaching Hours
1	Isolation of Pollutant-Degrading Microbes– Isolation and characterization of microbes degrading hydrocarbons or pesticides from contaminated soil/water samples.	35
2	Detection of Pathogens in Water Samples– Microbiological and molecular methods (e.g., coliform test, PCR) to detect bacterial contaminants in drinking water.	
3	Testing Antioxidant Activity of Plant Extracts– DPPH radical scavenging assay or similar techniques to evaluate antioxidant potential of natural extracts.	
4	Testing Antimicrobial Activity of Extracts– Agar well diffusion method to assess antimicrobial properties of plant or microbial extracts against pathogens.	
5	Analysis of Public Health Data (Simulation)– Interpretation and visualization of epidemiological data using statistical software or spreadsheet tools.	

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6	Bioremediation Experiment (Simulation or Setup)– Setup of small-scale bioremediation to study degradation of pollutants by microbial consortia.	
7	Demonstration of Biosensor for Water Quality Monitoring– Use or simulation of biosensors to detect contaminants (heavy metals, nitrates) in water samples.	
8	Preparation and Application of Biofertilizers– Culturing nitrogen-fixing or phosphate-solubilizing bacteria and testing effects on seed germination or growth.	

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.Jayaraman. Lab Manual in Biochemistry.
6. Biotechnology, U. Satyanarayan, Books and Allied
7. Practical manuals of Biotechnology, S. Chand

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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	5
	(2)		5
	OR		
	(1)		5
	(2)		5
Que. 2	(1)	Unit 2	5
	(2)		5
	OR		
	(1)		5
	(2)		5
Que. 3	(1)	Unit 3	5
	(2)		5
	OR		
	(1)		5
	(2)		5
Que. 4	(1)	Unit 4	5
	(2)		5
	OR		
	(1)		5
	(2)		5
Que. 5	(1)	Unit 1 & 2	5
	(2)		5
	OR		
	(1)	Unit 3 & 4	5
	(2)		5
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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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 practical from the given list of exercises as per the instruction of the examiner	50	40
2	Viva		10
Total			50