



પરિપત્ર:

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટીની સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજોનાં આચાર્યશ્રીઓને સવિનય જણાવવાનું કે સાયન્સ વિદ્યાશાખા હેઠળનો NEP-૨૦૨૦ અંતર્ગતનો લાઈફ સાયન્સ વિષયનો (બી.એસસી. બાયોટેકનોલોજી વિથ ઓનર્સ) નો સેમેસ્ટર-૪ નો અભ્યાસક્રમ આ સાથે સામેલ છે.

માનનીય કુલપતિશ્રીની મંજૂરી અનુસાર સદર અભ્યાસક્રમ શૈક્ષણિક વર્ષ જુન, ૨૦૨૪-૨૫ થી અમલવારી કરવાની રહે છે. સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજો ધ્વારા તેની અમલવારી કરવા જણાવવામાં આવે છે.



[Signature]
ખાસ ફરજ પરના અધિકારી
(એકેડેમિક)

ક્રમાંક/બીકેએનએમયુ/ એકેડેમિક/૧૭૬/૨૦૨૪

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી,

સરકારી પોલીટેકનિક કેમ્પસ,

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી રોડ,

ખડીયા, જૂનાગઢ-૩૬૨૨૬૩

તા.૧૫/૦૧/૨૦૨૫

પ્રતિ,

- ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી સંલગ્ન 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 LIFE SCIENCE STUDIES
FACULTY OF SCIENCE
SYLLABUS FOR
B.Sc. (BIOTECHNOLOGY) (HONOURS)
PROGRAMME
(SEMESTER- IV)
EFFECTIVE FROM JUNE, 2024-25**

BHAKTA KAVI NARSINH MEHTA UNIVERSITYSyllabus of **B.Sc. (Honors)** as per NEP-2020Faculty of **Science**

Effective from June 2024-25

Subject: Biotechnology**SEMESTER- IV****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
4	1	MAJOR-8	Enzymology	MAJBTT401	4	60	50	50	-	-	100
	2	MAJOR-9	Environmental Biotechnology	MAJBTT402	4	60	50	50	-	-	100
	3	MAJOR-10	Combine Practical	MAJBTP403	4	60	-	-	50	50	100
	4	MINOR-3	Immunology	MINBTP401	4	60	25	50	25	-	100
	Total				16						

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Course Level	UG (5.0)	Internal Marks	50
Programme	B.Sc. Biotechnology	External Marks	50
Semester	IV	Practical Internal	-
Category of Course	MAJOR-8	Practical External	-
Course Credit	4	Prac. External Exam Duration	-
Teaching Hours	60	Total	100
Course Code	MAJBTT401	Exam Duration	2 hrs.
Course Title	Enzymology		

Course Objectives:

- To introduce the fundamental concepts and historical background of enzymology.
- To develop an understanding of enzyme classification, properties, and mechanisms of action.
- To teach the kinetics of enzyme-catalyzed reactions and factors influencing enzyme activity.
- To provide insights into enzyme purification techniques and industrial applications.

Course Learning Outcomes: After completion of the course:

- Explain the basic principles, classification, and properties of enzymes.
- Demonstrate an understanding of enzyme catalysis, including the role of coenzymes and cofactors.
- Analyze enzyme kinetics using the Michaelis-Menten equation and determine K_m and V_{max} experimentally.
- Apply techniques for enzyme isolation, purification, and immobilization in laboratory and industrial settings.
- Evaluate the use of enzymes in biotechnological and industrial applications, including bioremediation.

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Sem	Unit No.	Syllabi	Teaching Hours
4	1	Introduction to Enzymes - Definition and Historical Background. - Classification of Enzymes: IUB Enzyme Nomenclature. - Properties of Enzymes: Specificity, Catalytic Efficiency, and Regulation. - Coenzymes, Cofactors, and Prosthetic Groups. - Isoenzymes and their Biological Significance.	15
	2	Mechanisms of Enzyme Action - Mechanisms of Catalysis: Acid-base Catalysis, Covalent Catalysis, and Metal Ion Catalysis. - Factors Affecting Enzyme Activity: pH, Temperature, Substrate Concentration, and Inhibitors. - Enzyme Regulation: Feedback Inhibition and Covalent Modifications. - Multi-enzyme Systems and Metabolic Pathways.	15
	3	Kinetics of Enzyme-Catalyzed Reactions: - Michaelis-Menten Equation: Derivation and Applications. - Determination of K_m and V_{max}. - Factors Influencing the Rate of Enzyme-Catalyzed Reactions: pH, Temperature, Substrate Concentration, and Inhibitors. Enzyme Inhibition: - Competitive, Non-competitive, and Uncompetitive Inhibitions.	15
	4	Enzyme Techniques and Applications Methods of Enzyme Isolation and Purification: - Extraction, Precipitation, Chromatography, and Electrophoresis Techniques. Introduction to Enzyme Immobilization: - Methods, Types, and Applications in Industry and Medicine.	15

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Suggested Reading:

1. Nelson, D. L., & Cox, M. M. (2008). Lehninger Principles of Biochemistry. W. H. Freeman and Company, New York.
2. Palmer, T., & Bonner, P. (2007). Enzymes: Biochemistry, Biotechnology, Clinical Chemistry. Elsevier Science, Amsterdam.
3. Shanmugam, M. L. (2013). Enzyme Biochemistry. Springer, Berlin.
4. Joshi, V. K., Bansal, V. P. G., & Khare, S. G. (2011). Enzyme Technology. Springer, Berlin.
5. Crueger, W., & Crueger, A. (2013). Biotechnology: A Textbook of Industrial Microbiology. Panima Publishing Corporation, New Delhi.

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Course Level	UG (5.0)	Internal Marks	50
Programme	B.Sc. Biotechnology	External Marks	50
Semester	IV	Practical Internal	-
Category of Course	MAJOR-9	Practical External	-
Course Credit	4	Prac. External Exam Duration	-
Teaching Hours	60	Total	100
Course Code	MAJBTT402	Exam Duration	2 hrs.
Course Title	Environmental Biotechnology		

Course Objectives:

- To introduce the environmental impacts of conventional and modern fuels, and explore alternative energy sources like biogas and microbial hydrogen production.
- To study bioremediation processes for cleaning contaminated soil and water, focusing on oil spills, heavy metals, and other pollutants.
- To explore the role of microorganisms in degrading environmental pollutants such as pesticides, hydrocarbons, and petroleum products.
- To understand the applications of Phyto-remediation, bio-fertilizers, and nitrogen-fixing bacteria in environmental sustainability.
- To familiarize students with bioleaching processes and the role of microbes in enriching ores and extracting valuable metals.

Course Learning Outcomes: After completion of the course:

- Describe the environmental impact of conventional fuels (firewood, coal, gas) and modern fuels (biogas, microbial hydrogen, gasohol).
- Evaluate the role of methanogenic bacteria and other microorganisms in the production of biogas and microbial hydrogen.
- Understand and apply bioremediation techniques for oil spills, heavy metal contamination, and detergent degradation.
- Discuss the microbial degradation of lignin, cellulose, and the role of microorganisms in breaking down complex pollutants.
- Analyze the process of Phyto-remediation and its potential to clean contaminated environments.

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Course Contents

Sem	Unit No.	Syllabi	Teaching Hours
4	1	Conventional fuels and their environmental impact – Firewood, Plant, Animal, Water, Coal and Gas. Modern fuels and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol Gasohol	18
	2	Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes. Phyto-remediation. Degradation of pesticides and other toxic chemicals by micro-organisms- degradation aromatic and chlorinated hydrocarbons and petroleum products.	20
	3	Treatment of municipal waste and Industrial effluents. Bio-fertilizers Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM)	12
	4	• Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium). • Environmental significance of genetically modified microbes, plants and animals.	10

Suggested Reading:

1. Das, S. (2004). Environmental Biotechnology. Wiley Eastern Limited, New Delhi.
2. Bley, T., & Norsker, N. H. (2013). Environmental Biotechnology. Springer, Berlin.
3. Chawla, H. S. (2009). Introduction to Environmental Biotechnology. Addison-Wesley, New York.
4. Vance, J. M., & Gauthier, L. (2010). Environmental Microbiology and Biotechnology. Wiley-Blackwell, Oxford.
5. Kumar, H. D. (1999). Introduction to Environmental Biotechnology. Vikas Publishing House, New Delhi.

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Course Level	UG (5.0)		Internal Marks	-
Programme	B.Sc. Biotechnology		External Marks	-
Semester	IV		Practical Internal	50
Category of Course	MAJOR-10		Practical External	50
Course Credit	4		Prac. External Exam Duration	4 hrs.
Teaching Hours	60		Total	100
Course Code	MAJBTP403		Exam Duration	4 hrs.
Course Title	Combine Practical			

Course Objectives:

- To familiarize students with the techniques for enzyme assay, purification, and immobilization.
- To study the effects of environmental factors such as pH, temperature, and inhibitors on enzyme activity.
- To introduce the principles of enzyme kinetics and the determination of key parameters like K_m and V_{max} .
- To explore bioremediation strategies and the role of microorganisms in the degradation of environmental pollutants.
- To provide practical knowledge of the treatment of municipal and industrial waste using microorganisms.

Course Learning Outcomes: After completion of the course:

- Perform enzyme assays for salivary amylase, measure enzyme activity, and interpret data using a calorimeter.
- Analyze the effects of environmental factors like pH and temperature on enzyme activity using catalase or urease.
- Determine enzyme kinetics parameters (K_m and V_{max}) for amylase using starch as a substrate and interpret the results.
- Investigate the potential of microorganisms in bioremediation, including the degradation of oil spills, heavy metals, and toxic chemicals.
- Apply practical techniques for the isolation and identification of microorganisms capable of degrading lignin, cellulose, and pollutants from industrial effluents.

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Sr. No.	Syllabi	Teaching Hours
1	Enzyme assay of salivary amylase using calorimeter	60
2	Study the effect of pH on the activity of catalase or amylase.	
3	Analyze the effect of temperature on enzyme activity using catalase or urease.	
4	Determination of Km and Vmax for amylase using starch as a substrate.	
5	Study competitive and non-competitive inhibition of enzyme alkaline phosphatase	
6	Extraction of enzymes from natural sources	
7	Partial purification of enzymes using ammonium sulfate precipitation.	
8	Analysis of purified enzymes using SDS-PAGE to determine molecular weight.	
9	Immobilization of amylase using sodium alginate and calcium chloride.	
10	Examine the environmental impact of modern fuels such as methanogenic bacteria, biogas.	
11	Investigate bioremediation of soil and water contaminated with oil spills.	
12	Investigate bioremediation of soil and water contaminated with heavy metals.	
13	Isolation of lignin and cellulose degrading microorganisms	
14	Examine the treatment of municipal waste and industrial effluents.	
15	Study algal and fungal biofertilizers, including VAM (vesicular-arbuscular mycorrhizae).	

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Suggested Reading:

1. Janeway, C. A., Travers, P., Walport, M., & Shlomchik, M. J. (2001). Immunobiology. Garland Science, New York.
2. Kuby, J. (2007). Immunology. W. H. Freeman and Company, New York.
3. Murphy, K., Travers, P., & Walport, M. (2012). Janeway's Immunobiology. Garland Science, New York.
4. Abbas, A. K., Lichtman, A. H., & Pillai, S. (2014). Cellular and Molecular Immunology. Elsevier, Amsterdam.
5. Rosenberg, S. A., & Herberman, R. B. (2000). Cancer Immunotherapy: Immune Suppression and Immunotherapy. Springer Science & Business Media, New York.
6. Parker, C. W. (2009). Introduction to Immunology. Elsevier, Amsterdam.
7. Boyle, J. (2003). Immunology: A Short Course. Wiley-Liss, New York.
8. Celli, J. A., & Endres, M. J. (2009). Immunology for Pharmacy Practice. McGraw-Hill, New York.

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Course Level	UG (5.0)	Internal Marks	25
Programme	B.Sc. Biotechnology	External Marks	50
Semester	IV	Practical Internal	-
Category of Course	MINOR-3	Practical External	-
Course Credit	3	Prac. External Exam Duration	-
Teaching Hours	45	Total	75
Course Code	MINBTT401	Exam Duration	2 hrs.
Course Title	Immunology (Theory)		

Course Objectives:

- To provide foundational knowledge of the immune system and its components.
- To explore the molecular structure and functions of immunoglobulins and T-cell receptors.
- To understand the mechanisms of immune responses, including humoral and cellular immunity.
- To introduce advanced topics such as antibody diversity, MHC, and immune regulation.

Course Learning Outcomes: After completion of the course:

- Describe the components and functions of the mammalian immune system, including the roles of B and T lymphocytes.
- Explain the molecular structure of antibodies and the genetic basis of antibody diversity.
- Analyze humoral and cellular immune responses and their regulation mechanisms.
- Illustrate the processes of antigen presentation, including the role of MHC molecules in immunity.

Course Contents

Sem	Unit No.	Syllabi	Teaching Hours
4	1	Immune Response - An overview, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses,	12

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		Tlymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells)	
	2	Regulation of immunoglobulin gene expression – clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), antibody diversity.	12
	3	Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing. Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of recognition. Autoimmune diseases, Immunodeficiency-AIDS.	12
	4	Vaccines & Vaccination – adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, passive & active immunization. Introduction to immunodiagnostics – RIA, ELISA.	12

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Course Level	UG (5.0)	Internal Marks	-
Programme	B.Sc. Biotechnology	External Marks	-
Semester	IV	Practical Internal	25
Category of Course	MINOR-3	Practical External	-
Course Credit	1	Prac. External Exam Duration	-
Teaching Hours	25	Total	25
Course Code	MINBTP401	Exam Duration	-
Course Title	Immunology (PRACTICAL)		

Course Objectives:

- To familiarize students with practical techniques in immunology, including blood grouping and antigen-antibody interactions.
- To develop an understanding of immunological diagnostic tools like ELISA, RIA, and precipitation tests.
- To provide hands-on experience in lymphocyte isolation and the study of immune cell functions.
- To demonstrate protein-antibody interactions and their applications in immunoblotting.

Course Learning Outcomes:

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

- Perform ABO and Rh blood grouping and explain the principles behind antigen-antibody reactions.
- Conduct and interpret results from ELISA to detect the presence of antigens or antibodies.
- Understand and apply the principles of Radioimmunoassay (RIA) using simulated setups.
- Perform and analyze precipitation tests like Ouchterlony diffusion to study antigen-antibody interactions.
- Demonstrate antigen-antibody agglutination using advanced techniques such as latex bead assays.
- Isolate lymphocytes using Ficoll density gradient centrifugation and identify T-cell and B-cell populations.

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- Investigate protein-antibody interactions through immunoblotting techniques.
- Observe and interpret the process of phagocytosis in macrophages or neutrophils using appropriate models.

Sr. No	Syllabi	Teaching Hours
1	Perform ABO and Rh blood grouping to understand antigen-antibody reactions.	25
2	Conduct a basic ELISA to detect antigens or antibodies in a sample.	
3	Use a simulated setup to understand the principles and applications of RIA.	
4	Perform precipitation tests such as Ouchterlony double diffusion or radial immunodiffusion.	
5	Study antigen-antibody agglutination using latex beads or blood typing reagents.	
6	Isolate lymphocytes using Ficoll density gradient centrifugation to study T-cell and B-cell populations.	
7	Demonstrate protein-antibody interactions using immunoblotting techniques.	
8	Perform a microscopic observation of phagocytosis in macrophages or neutrophils using a suitable model (e.g., yeast cells).	

Suggested reading:

1. "Manual of Clinical Laboratory Immunology" by Noel R. Rose, et al.
2. "Methods in Immunology and Immunochemistry" by Curtis A. Williams and Merle K. Chase
3. "Laboratory Immunology and Serology" by Mary Louise Turgeon
4. "Immunology: A Laboratory Manual" by Judy Owen and Jenni Punt

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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			
INTERNAL ASSESSMENT			
No.	Particulars	Marks	Weightage
1	Internal Test	50	25
2	Assignment		10
3	Field visit report/ class presentation		10
4	Attendance		05
	Total		50

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

INTERNAL EVALUATION SCHEME		
INTERNAL ASSESSMENT PRACTICAL		
No.	Particulars	Weightage
1	Perform any Four practical from the given list of exercises as per the instruction of the examiner.	40
2	Viva	10
	Total	50

ASSESSMENT BY UNIVERSITY		
Que. No.	Particulars	Marks
EXTERNAL EXAMINER		
1	Perform any Three or Four practical from the given list of exercises as per the instruction of the examiner	40
2	Viva-voce	10
	Total	50

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