Re-Accredited 'B++' 2.86 CGPA by NAAC
VEER NARMAD SOUTH GUJARAT UNIVERSITY
University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
Tel : +91 - 261 - 2227141 to 2227146, Toll Free : 1800 2333 011, Digital Helpline No.- 0261 2388888
E-mail : info@vnsgu.ac.in, Website : www.vnsgu.ac.in

ક્રમાંક :ઓથો./પરિપત્ર/૬૨૨/૨૦૨૫
તા.૧૭/૦૩/૨૦૨૫

પ્રતિ,
વડાશ્રી,
બાયોટેકનોલોજી ડિપાર્ટમેન્ટ,
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી,
સુરત.

વિષયઃ– NEP-2020 અંતર્ગત શૈક્ષણિક વર્ષ ૨૦૨૫–૨૬ થી અમલમાં આવનાર બાયોટેકનોલોજી પ્રોગ્રામનાં સેમેસ્ટર–૫ અને ૬ નો અભ્યાસક્રમ .

સુજ્ઞ શ્રી,

સવિનય જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૫–૨૬ થી અમલમાં આવનાર NEP-2020 અંતર્ગત નવા ક્રેડિટ સ્ટ્રક્ચર મુજબ બાયોટેકનોલોજી પ્રોગ્રામનાં સેમેસ્ટર–૫ અને ૬ અભ્યાસક્રમ બનાવવામાં આવેલા કોર્ષ અંગે ચર્ચા કરી બાયોટેકનોલોજી વિષયની અભ્યાસ સમિતિની તા.૧૮/૦૨/૨૦૨૫ની સભાનાં ઠરાવ ક્રમાંકઃ ૨ અન્વયે નીચે મુજબ કરેલ ભલામણ પર વિચારણા કરતા વિજ્ઞાન વિદ્યાશાખાની તા.૨૭/૦૨/૨૦૨૫ની સભાનાં ઠરાવ ક્રમાંકઃ૩૬ થી સ્વીકારી મંજૂર કરવા એકેડેમિક કાઉન્સિલને કરેલ ભલામણને એકેડેમિક કાઉન્સિલની તા.૦૪/૦૩/૨૦૨૫ની સભાનાં ઠરાવ ક્રમાંકઃ૨૫ થી સ્વીકારી મંજુર કરેલ છે, જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

<u>બાયોટેકનોલોજી વિષયની અભ્યાસ સમિતિની તા.૧૮/૦૨/૨૦૨૫ની સભાનાં ઠરાવ ક્રમાંકઃ ૨</u>

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૨૫–૨૬ થી અમલમાં આવનાર NEP-2020 અંતર્ગત નવા ક્રેડિટ સ્ટ્રક્ચર મુજબ બાયોટેકનોલોજી પ્રોગ્રામનાં સેમેસ્ટર–૫ અને ૬ નો અભ્યાસક્રમ સર્વાનુમતે મંજૂર કરી વિજ્ઞાન વિદ્યાશાખાને ભલામણ કરવામાં આવે છે.

<u>વિજ્ઞાન વિદ્યાશાખાની તા.૨૭/૦૨/૨૦૨૫ની સભાનાં ઠરાવ ક્રમાંકઃ૩</u>

:: આથી ઠરાવવામાં આવે છે કે, બાયોટેકનોલોજી વિષયની અભ્યાસ સમિતિની તા.૧૭/૦૨/૨૦૨૫ ની સભાનાં ઠરાવ ક્રમાંકઃ ૨ અન્વયે કરેલ ભલામણ સ્વીકારી શૈક્ષણિક વર્ષ ૨૦૨૫–૨૬ થી અમલમાં આવનાર NEP-2020 અંતર્ગત નવા ક્રેડિટ સ્ટ્રક્ચર મુજબ બાયોટેકનોલોજી પ્રોગ્રામનાં સેમેસ્ટર–૫ અને ૬ નો અભ્યાસક્રમ મંજૂર કરવા એકેડેમિક કાઉન્સિલને ભલામણ કરવામાં આવે છે.

એકેડેમિક કાઉન્સિલની તા.૦૪/૦૩/૨૦૨૫ની સભાનાં ઠરાવ ક્રમાંકઃ૨૫

:: આથી ઠરાવવામાં આવે છે કે, NEP-2020 અંતર્ગત નવા ક્રેડિટ સ્ટ્રક્ચર મુજબ બાયોટેકનોલોજી પ્રોગ્રામનાં સેમેસ્ટર–૫ અને ૬નો અભ્યાસક્રમ બાયોટેકનોલોજી વિષયની અભ્યાસ સમિતિની તા.૧૮/૦૨/૨૦૨૫ ની સભાનાં ઠરાવ ક્રમાંકઃ ૨ થી વિજ્ઞાન વિદ્યાશાખાને કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાની તા.૨૭/૦૨/૨૦૨૫ની સભાનાં ઠરાવ ક્રમાંકઃ૦૩ થી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ સ્વીકારી મંજૂર કરવામાં આવે છે.

(બિડાણઃ ઉપર મુજબ)

કુલસચિવ

પ્રતિ,
૧) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા,
૨) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત. .....જાણ સારૂ.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program

In

Biotechnology

[3 years (Degree) & 4 years (Honours/Honours with Research)]

Program Specific Outcomes (PSOs):

1. PSO-01: Strong foundation in biological sciences: Students will have a comprehensive understanding of fundamental concepts in biology, genetics, microbiology, biochemistry, and molecular biology. This knowledge will provide a solid base for further specialization in biotechnology.
2. PSO-02: Practical laboratory skills: Learners will gain hands-on experience in various laboratory techniques and instrumentation commonly used in biotechnology research and industry. This includes DNA/RNA isolation & purification, DNA sequencing, protein purification, cell culture, genetic engineering, and bioinformatics.
3. PSO-03: Critical thinking and problem-solving abilities: Through coursework, projects, and research opportunities, students will develop analytical skills to identify and address scientific problems in the field of biotechnology. This involves experimental design, data analysis, and interpretation.
4. PSO-04: Knowledge of biotechnological techniques and applications: Students will learn about the latest advancements in biotechnology, including genetic engineering, gene therapy, bio-molecular engineering, biostatistics and synthetic biology. Learners understand how these techniques can be applied in various sectors such as healthcare, agriculture, environmental science and pharmaceuticals.
5. PSO-05: Research experience: Many programs offer research opportunities, allowing students to work on cutting-edge projects alongside faculty members or industry professionals. This hands-on research experience will enhance their understanding of scientific methodologies and foster innovation in biotechnology.
6. PSO-06: Communication and teamwork skills: Collaboration is an essential aspect of biotechnology. Through group projects, presentations, and scientific writing assignments, students will develop effective communication skills and the ability to work collaboratively with peers, scientists, and industry professionals.
7. PSO-07: Ethical considerations: Biotechnology has ethical implications, and learners will gain an understanding of the ethical, legal, and societal aspects associated with the field. This knowledge will help them make informed decisions and contribute responsibly to the biotechnology industry.
8. PSO-08: Entrepreneur Skill: In addition to scientific knowledge, the program may foster entrepreneurial skills and an entrepreneurial mind-set. This includes teaching learners how to identify market opportunities, develop business plans, understand intellectual property rights, and navigate the commercialization process for biotechnological innovations. These skills can empower students to turn scientific discoveries into viable products or services, start their own biotechnology venture, or contribute to the growth of existing biotech companies.

Overall, a 4-year undergraduate program in Biotechnology with honours & honours with research will equip student with a strong theoretical foundation, practical skills, and the ability to contribute to the advancement of biotechnology through research and innovation. It can prepare them for further academic pursuits, such as to provide a solid foundation for various career paths in biotechnology research, industry, or related fields.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program in Biotechnology-Major

Teaching & Evaluation Scheme
Semester-V & VI

[Academic Year of Implementation 2025-2026]

Semester-V

Course Code	Course Title	Teaching Schedule Hours/Week	Exam Duration & Marks			Total Theory/Practical Marks	Credit
			Duration (Hours)	(CCE) Internal Marks	(SEE) External Marks		
BT-MJ-501	IKS in Biotechnology: Traditional and Modern Perspectives	2	1:00	25	25	50	2
BTP-MJ-501	IKS in Biotechnology: Traditional and Modern Perspectives: Practical	4	4:00 to 6:00	25	25	50	2
BT-MJ-502	Genetic Engineering	2	1:00	25	25	50	2
BTP-MJ-502	Genetic Engineering: Practical	4	4:00 to 6:00	25	25	50	2
BT-MJ-503	Molecular Genetics	2	1:00	25	25	50	2
BTP-MJ-503	Molecular Genetics: Practical	4	4:00 to 6:00	25	25	50	2
	Total	**18**	**21**	**150**	**150**	**300**	**12**

Semester-VI

Course Code	Course Title	Teaching Schedule Hours/Week	Exam Duration & Marks			Total Theory/Practical Marks	Credit
			Duration (Hours)	(CCE) Internal Marks	(SEE) External Marks		
BT-MJ-601	Microbial Biotechnology	2	1:00	25	25	50	2
BTP-MJ-601	Microbial Biotechnology: Practical	4	4:00 to 6:00	25	25	50	2
BT-MJ-602	Plant Tissue Culture Techniques	2	1:00	25	25	50	2
BTP-MJ-602	Plant Tissue Culture Techniques: Practical	4	4:00 to 6:00	25	25	50	2
BT-MJ-603	Animal Biotechnology	2	1:00	25	25	50	2
BTP-MJ-603	Animal Biotechnology: Practical	4	4:00 to 6:00	25	25	50	2
	Total	**18**	**21**	**150**	**150**	**300**	**12**

[Subject Code-2503001305011001]

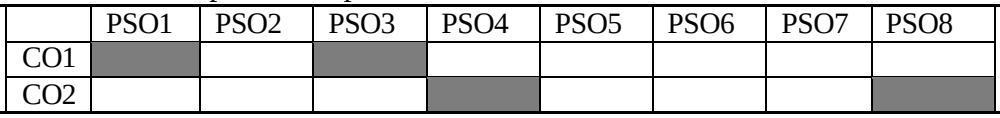
VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program in Biotechnology (B. Sc.)

(3 Years Degree; 4 Years Honours/Honours with Research)

Semester-V

Course: BT-MJ-501: Indian Knowledge Systems in Biotechnology: Traditional and Modern Perspectives

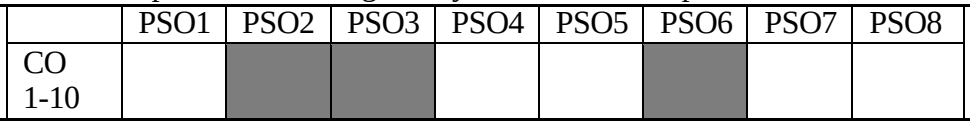
Course Code	BT-MJ-501
Course Title	**IKS in Biotechnology: Traditional and Modern Perspectives**
Credit	2
Course Level	300-399
Total engagement	2 Credits x 15 Hours = 30 Hours
Teaching per week	2 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2025-2026
Purpose of Course	To provide an integrated overview of biotechnology by blending traditional Vedic insights on microbiology with the ground breaking contributions of modern pioneers and influential leaders in Indian biotechnology.
Course Objectives	-Introduce students to key Vedic concepts in microbiology, including the origin and prevention of germs and traditional practices like Agnihotra. -Explore the significant contributions of modern pioneers. -Highlight the impact of influential women leaders in shaping Indian biotechnology. -Encourage a holistic understanding of how ancient knowledge and modern innovations can together address contemporary challenges in biotechnology.
Course Outcomes	CO-1: Students will develop the ability to critically analyze traditional Vedic concepts in microbiology, understanding how ancient texts explain the origin, prevalence and natural control of germs. They will learn to integrate these age-old practices with modern scientific principles, fostering innovative approaches to infection prevention and health. CO-2: Students will gain a comprehensive perspective on the evolution of modern biotechnology by examining transformative contributions from pioneering scientists and leaders. They will evaluate advancements in genetic engineering, sustainable agriculture, molecular biology and biotechnology policy as well as appreciate how these innovations have reshaped healthcare and social entrepreneurship.
Mapping between COs with PSOs	
Pre-requisite	Fundamentals of Science, Biology and Microbiology
Course Content	**UNIT-1:** Vedic Microbiology: Introduction to Vedic Knowledge and Microbiology, Origin and Prevalence of Germs — Teaching Hours: 10

	(Krmis), Prevention of Infection, Elimination of Pathogens by Sun Rays and Medicinal Plants, Science of Agnihotra	
	UNIT-2: Contributions of Modern Pioneers and Influential Leaders in Indian Biotechnology: Part A: Modern Pioneers: Venkatraman Ramakrishnan- Noble Laureate, MS Swaminathan – Architect of the Green Revolution, Dr. Anand Mohan Chakrabarty – Pioneer of Genetic Engineering, Dr. Har Gobind Khorana – Decoding the Genetic Code. Part B: Influential Women Leaders in Indian Biotechnology: Kiran Mazumdar-Shaw – Visionary Entrepreneur, Preethi Reddy – Integrating Healthcare with Biotechnology, Swati A. Piramal – Transforming Public Health and Policy, Vinita Gupta – Global Leadership in Pharmaceutical Biotechnology, Soumya Swaminathan – Global Health and Scientific Leadership, Renu Swarup – Shaping National Biotech Policy, Janaki Ammal- Plant Breeding, Cytogenetics and Phytogeography	Teaching Hours: 20
Reference Books	✓ Dubey, R. C. (2021) Vedic Microbiology-A Scientific Approach, 1st Edition, Motilal Banarsidass International, Delhi. (ISBN: 978-93-9069-625-3)	
e-learning resources	✓ https://doi.org/10.1002/anie.201001436 ✓ Swaminathan, M.S. Genesis and Growth of the Yield Revolution in Wheat in India: Lessons for Shaping our Agricultural Destiny. *Agric Res* 2, 183–188 (2013). https://doi.org/10.1007/s40003-013-0069-3 ✓ file:///C:/Users/abc/Downloads/dna2z,+JCB_COMM_626.pdf ✓ https://heinonline.org/HOL/LandingPage?handle=hein.journals/rvdpo59&div=6&id=&page ✓ file:///C:/Users/abc/Downloads/jcb.2010.20.pdf ✓ https://assets.cureus.com/uploads/review_article/pdf/254520/20240609-28399-d53hnk.pdf	
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment	
Evaluation Method	50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester end University examination.	

[Subject Code-2503001305011002]

BTP-MJ-501: Indian Knowledge Systems in Biotechnology: Traditional and Modern Perspectives Practical

Course Code	BTP-MJ-501
Course Title	**Indian Knowledge Systems in Biotechnology: Traditional and Modern Perspectives Practical**
Credit	2
Course Level	300-399
Total Engagement	2 Credit x 30 Hours = 60 Hours

Teaching per week	4 h X 1 day = 4 h
Minimum weeks per semester	15 weeks (Including Laboratory work, examination, preparation, holidays etc.)
Effective from	2025-2026
Purpose of Course	This course is designed to bridge ancient wisdom and modern innovation by exploring traditional Vedic concepts in microbiology alongside contemporary advancements in biotechnology. It integrates the study of Vedic texts and rituals with hands-on experiments, literature surveys, and comparative analyses to provide a holistic understanding of microbial processes and transformative biotech innovations.
Course Objectives	The course aims to develop the ability to interpret traditional methods of infection prevention and pathogen control by reviewing ancient texts, setting up microbial cultures, and simulating practices such as Agnihotra. It also seeks to cultivate analytical skills through experimental work, group data interpretation, and the compilation of research findings into coherent reports. Additionally, the curriculum emphasizes the evaluation of modern biotechnology advancements via comprehensive literature surveys and comparative analyses, culminating in multimedia presentations that synthesize insights from both traditional practices and modern scientific contributions.
Course Outcomes	1. Develop an understanding of traditional microbiological concepts by reviewing Vedic texts and scholarly articles. 2. Enhance literature synthesis skills through the preparation of a concise report on traditional infection prevention methods. 3. Acquire hands-on laboratory expertise by setting up microbial cultures to establish baseline growth patterns. 4. Learn experimental techniques by assessing the effects of sunlight on microbial cultures. 5. Evaluate the impact of natural remedies by applying medicinal plant extracts and recording their effects on microbial proliferation. 6. Gain practical insights into traditional fermentation by preparing Gundruk (pickle) and Chhurpi (cheese). 7. Build research competencies through a comprehensive literature survey on transformative modern biotechnological contributions. 8. Develop analytical skills by engaging in a comparative analysis of advancements in modern biotechnology across various fields. 9. Integrate and articulate research findings by compiling a detailed written report that bridges traditional Vedic concepts with modern biotechnology practices. 10. Broaden applied understanding of biotechnology through an Ayurveda Hospital visit, linking theory with real-world practice.
Mapping between COs with PSOs	
Pre-requisite	Fundamentals of Science, Biology and Microbiology

Course Content	1. Review Vedic texts and scholarly articles to explore traditional microbiological concepts, focusing on the origin and control of germs and the scientific background of Agnihotra. 2. Prepare a concise report summarizing their literature review, highlighting traditional methods of infection prevention and the rationale behind eliminating pathogens using natural elements. 3. Set up microbial cultures to establish baseline growth patterns, forming the foundation for subsequent experimental comparisons. 4. Conduct experiments by exposing microbial cultures to sunlight 5. Applying medicinal plant extracts, carefully recording the effects on microbial proliferation and pathogen elimination. 6. Preparation of Gundruk (Pickle) and Chhurpi (Cheese) a traditional fermented product of North-East India. 7. Perform a comprehensive literature survey on modern biotechnological contributions, gathering data from case studies, research articles, and reputable online resources to understand transformative innovations. 8. Engage in a comparative analysis of modern biotechnology advancements across fields such as agriculture, genetic engineering, molecular biology, healthcare, and policy-making, evaluating their overall impact. 9. Compile research findings into a detailed written report, integrating insights from both traditional Vedic concepts and modern biotechnology practices. 10. Ayurveda Hospital Visit
Reference Books	✓ Dubey, R. C. (2021) Vedic Microbiology-A Scientific Approach, 1st Edition, Motilal Banarsidass International, Delhi. (ISBN: 978-93-9069-625-3)
e-learning resources	• https://en.wikipedia.org/wiki/Chhurpi • https://en.wikipedia.org/wiki/Gundruk
Teaching Methodology	Laboratory work, Journal preparation
Evaluation Method	50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester end University examination

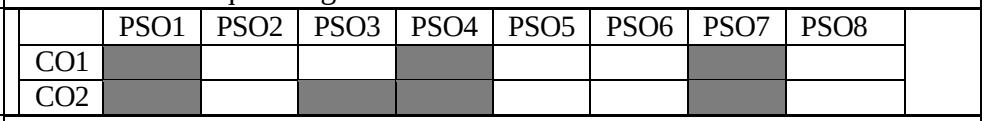
VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program in Biotechnology (B. Sc.)

(3 Years Degree; 4 Years Honours/Honours with Research)

Semester-V

Course: BT-MJ-502: Genetic Engineering

Course Code	BT-MJ-502
Course Title	**Genetic Engineering**
Credits	2
Course Level	300-399
Total engagement	2 Credits x 15 Hours = 30 Hours
Teaching per week	2 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2025-2026
Purpose of Course	This course will give students the introduction of gene modifications, DNA ends modifying enzymes, different types of vectors, PCR and genome sequencing methods.
Course Objectives	- To understand various types of enzymes and vectors - To teach the students basic principles of PCR, RT-PCR - learning of various gene sequencing methods
Course Outcomes	CO1: Students will gain knowledge about vectors and different enzymes CO2: Students will gain knowledge about various techniques like PCR, RT-PCR and sequencing methods.
Mapping between COs with PSOs	
Pre-requisite	Fundamentals of Biology and Biotechnology
Course Content	**UNIT-1:** Introduction to r-DNA technology, gene cloning and its importance, Restriction endo nucleases, DNA manipulative enzymes, adaptors, linkers, Vectors based on plasmid, M13, Phage lambda, yeast and other fungi, higher plants and animals, retroviral vector — Teaching Hours: 15 **UNIT-2:** Introduction of DNA to nonbacterial cells, Colony and plaque Hybridization, Practical use of Hybridization probes, PCR and its Variations, Isothermal Amplification, DNA sequencing method (Classical and NGS) — Teaching Hours: 15
Reference Books	Brown T. A. Gene Cloning and DNA analysis: An Introduction, John Wiley & Sons; 2016
e-learning resources	• https://sites.google.com/ignou.ac.in/bscbch-biochemistry/self-learning-material/bbccl-126-genetic-engineering-and-biotechnology • https://www.synthego.com/blog/genome-editing-techniques#7-gene-editing-techniques-tools-to-change-the-genome

	• https://www.cytosurge.com/applications/gene-editing-techniques
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment
Evaluation Method	50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester end University examination.

[Subject Code-2503001305022002]

BTP-MJ-502: Genetic Engineering Practical

Course Code	BTP-MJ-502
Course Title	**Genetic Engineering Practical**
Course Level	300-399
Credits	2
Total Engagement	2 Credits x 30 hours = 60 hours
Teaching per week	4 h x 1 day = 4 h
Minimum weeks Per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2025-2026
Purpose of Course	To provide undergraduate students with the opportunity to observe and understand the basic concepts of genetic engineering.
Course Objective	Course objectives for a Genetic engineering typically aim to provide students with a comprehensive understanding of the principles, processes, and mechanisms involved in the r-DNA technology. These objectives aim to provide students with a solid foundation in the principles of genetic engineering.
Course Outcomes	Upon completion genetic engineering Practical Course, students will: 1. Develop the skill of the plasmid isolation with alkaline lysis method. 2. Students will acquire the knowledge and skill of DNA isolation. 3. Students will acquire the practical knowledge of use of restriction endonucleases in Genetic engineering. 4. Students will develop the skill of technique gene transfer via transformation. 5. The students will be able to isolate coli phages from sewage sample 6. Students will be able to understand, differentiate, and demonstrate various PCR techniques and their applications in molecular biology, diagnostics, and research.

Mapping between Cos with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO 8
	CO 1-6								
Pre-requisite	Fundamentals of Biology and Biotechnology								

Course content	1. Isolation of plasmid DNA from *E. coli.* 2. Extraction and purification of bacterial DNA using spin column. 3. Restriction digestion of vector. 4. Transformation of bacterial cells by $CaCl_2$. 5. Enrichment and isolation of coliphages from sewage. 6. Demonstration/Visit of all types of variations of PCR
Reference Books	• Patel, R., & Patel, K P. (2016) *Experimental Microbiology* (9 ed., Vol. II) Aditya Publication.
e-learning resources	• https://sites.google.com/ignou.ac.in/bscbch-biochemistry/self-learning-material/bbccl-126-genetic-engineering-and-biotechnology
Teaching Methodology	Laboratory work, Journal preparation
Evaluation Method	50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester end University examination.

[Subject Code- 2503001305033001]

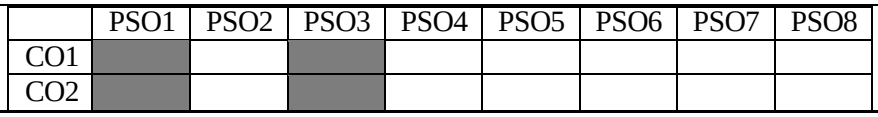
VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program in Biotechnology (B. Sc.)

(3 Years Degree; 4 Years Honours/Honours with Research)

Semester-V

Course: BT-MJ-503: Molecular Genetics

Course Code	BT-MJ-503	
Course Title	**Molecular Genetics**	
Credits	2	
Course Level	300-399	
Total engagement	2 Credits x 15 Hours = 30 Hours	
Teaching per week	2 h	
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)	
Effective from	2025-2026	
Purpose of Course	The purpose of the course is to give knowledge to the students regarding the fundamentals of genetic variations.	
Course Objectives	The objective is to explain students about how repairing and variations occur in the genome during evolution.	
Course Outcomes	CO1: Students would be able to get details of an important mechanism of Mutation and Repair of genome. CO2: Students would get insights about various Recombination mechanisms through which variations occur in the population .	
Mapping between COs with PSOs		
Pre-requisite	Genetics, Basics of Molecular biology	
Course Content	**UNIT-1: Mutability and Repair of DNA** Types of Mutations and mutagens, Proofreading errors, DNA Damage and its Repair: Photoreactivation, Base Excision Repair, Nucleotide Excision Repair, Recombination Repair, Translesion synthesis	Teaching Hours: 15
	UNIT-2: Homologous Recombination and Transposition -Models for Homologous Recombination, Site specific Recombination, RecBCD pathway, Classes of Transposable Elements, Transposons, Mechanism of Transposition	Teaching Hours: 15
Reference Books	• Watson J. *et al.* ((2014). Molecular Biology of genes, 7th Edition, Pearson Education Inc. • Willey, J. M., Sherwood, L. M. and Woolverton, C. J. (2008). Prescott, Harley and Klein's Microbiology, 7th Edition, MCGraw Hill International Edition. • Pal, J. K. and Ghaskadbi, S. S. (2009). Fundamentals of Molecular Biology, Oxford University Press.	

Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment
Evaluation Method	50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester end University examination

[Subject Code- 2503001305033002]

BTP-MJ-503: Molecular Genetics Practical

Course Code	BTP-MJ-503
Course Title	**Molecular Genetics Practical**
Credits	2
Course Level	300-399
Total engagement	2 Credits x 30 hours = 60 hours
Teaching per week	4 h X 1 day = 4 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2025-2026
Purpose of Course	The purpose of the course is to familiarize students with handling practical problems related to mutagenesis .
Course Objectives	The objective is to perform practical based on effect of mutagens on organisms which is responsible for genetic variations in the population.
Course Outcomes	CO1: Students will get insights how Ultraviolet radiations as mutagen affect the survival of bacteria. CO2: Several dyes also affect as mutagen and bring mutation in bacteria. Students will study the effect of these chemicals on survival rate of microorganisms. CO3: This practical reveal the method of isolation of recombinants in the culture. CO4: Isolation of yeast culture mutants would be practically performed by students. CO5: Students will gain insights about Ames test used to detect the chemical carcinogen. CO6: Students will learn how PCR technique is used for detecting mutation.
Mapping between COs with PSOs	
Pre-requisite	Genetics, Basics of Molecular biology
Course Content	1. To isolate pigment mutants of *Serretia marcescens* 2. To prepare a survival curve for the given bacterial culture using germicidal ultraviolet radiation as a mutagen. 3. To prepare a survival curve for the given bacterial using dye as a mutagen. 4. To prepare a master plate and carry out its replica plating. 5. To carry out Ames test for detection of a possible chemical carcinogen.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1 to 6								

Teaching Hours: 60

	6. PCR mediated site directed mutagenesis (Demonstration)	
Reference Books	• A. Nigam and A. Ayyagari (2009) Lab Manual in Biochemistry, Immunology and Biotechnology, Tata McGraw Hill Education Pvt. Ltd. • Patel R. J. & Patel K. R. (2016) Experimental microbiology Part MI, Aditya Publication, Ahmedabad	
Teaching Methodology	Laboratory work, Journal Preparation	
Evaluation Method	50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester end University examination.	

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program in Biotechnology (B. Sc.)

(3 Years Degree; 4 Years Honours/Honours with Research)

Semester-VI

Course: BT-MJ-601: Microbial Biotechnology

Course Code	BT-MJ-601
Course Title	**Microbial Biotechnology**
Credits	2
Course Level	300-399
Total engagement	2 Credits x 15 Hours = 30 Hours
Teaching per week	2 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2025-26
Purpose of Course	Microbial Biotechnology is intended to provide the student with a working knowledge of the Microorganisms and their role in biotechnological process such as Fermentation. The course involved discussion from designing of fermenter to strain improvement for fermentation industries.
Course Objectives	• To understand the commercial applications of microorganisms. • To learn concept of isolating enzyme and antibiotic producing microorganisms. • Acquire the ability and knowledge to isolate and screen the commercially important bacteria from different sources. • Understand how microbes are useful to human beings and how their products are commercialized. • The designing of fermenter and role of each component will be explored.
Course Outcomes	**CO1**: Apply knowledge of microbial biotechnology to design, optimize, and analyse fermentation processes for industrial applications. **CO2**: Demonstrate the ability to isolate, screen, and enhance microorganisms for the production of commercially important bio-products.
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	■			■	■			
CO2				■	■		■	■

Pre-requisite	Basic Microbiology and Biotechnology	
Course Content	**UNIT-1:** **INTRODUCTION TO MICROBIAL FERMENTATION** Concept of fermentation technology, Chronological development of industrial fermentation technology, Range of fermentation processes and products, Fermentation process outline, Fermentative production of Citric acid, Ethanol and Penicillin (Outline)	Teaching Hours: 15

	MICROBIAL SCREENING AND PRESERVATION Concept of microbial screening, Primary and Secondary screening, Isolation of industrially important microorganisms: Methods utilizing selection of desired characteristics, Methods not utilizing selection of desired characteristics, Future potential and needs of microbial screening, Maintenance and Preservation of Microbial cultures	
	UNIT-2: IMPROVEMENT OF MICROORGANISMS Types of Microbial mutants and their practical implications, Isolation of microbial mutants (Outline), Selection of mutants producing high yield of primary & secondary metabolites, Parasexual cycle, Protoplast fusion **FERMENTER DESIGN** Basic functions of fermenter, Aseptic operation and Containment, Factors involved in fermenter design, Typical batch fermenter, Air-lift bioreactor and CSTF	Teaching Hours: 15
Reference Books	• Stanbury PF, Whitaker A. Hall SJ. Principles of fermentation technology. Elsevier: 2013 Oct 22. • Crueger W, Crueger A. Biotechnology: A Textbook of Industrial Microbiology. Madison: Sinauer Tech.; 1989. • Patel AH. Industrial microbiology. Macmillan India; 1984. • Patel, R., & Patel, K. (2022). *Lecture notes on Introduction to Microbiology*. Aditya Publication.	
e-learning resources	• https://4lfonsina.wordpress.com/wp-content/uploads/2012/11/industrial-microbiology-an-introduction-0632053070-wiley.pdf • https://microbenotes.com/bioreactor/	
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment	
Evaluation Method	50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 50% SEE: External assessment based on semester end University examination	

[Subject Code-2603001306011002]

BTP-MJ-601: Microbial Biotechnology Practical

Course Code	BTP-MJ-601
Course Title	**Microbial Biotechnology Practical**
Credits	2
Course Level	300-399
Total engagement	2 Credit x 30 Hours = 60 Hours
Teaching per week	4 Hours
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2025-26

Purpose of Course	The course is designed to equip students with hands-on experience and technical skills in isolating, screening, and characterizing microorganisms for their ability to produce extracellular enzymes, antibiotics, and commercially valuable products. It also emphasizes understanding fermentation techniques and their applications in industrial microbiology.
Course Objectives	• To develop the ability to isolate and screen microorganisms for the production of enzymes and antibiotics. • To understand and apply techniques for studying antibiotic resistance in microorganisms. • To acquire practical knowledge of aerobic and anaerobic fermentation processes and their applications in the production of bio-products such as citric acid and ethanol. • To learn the methods for the estimation of bio-products and demonstrate the working principles of fermenters.
Course Outcomes	**CO1:** Students will gain knowledge on how to isolate and screen microorganisms for the production of industrially important enzymes like amylase and protease, and will understand their applications in various industries such as food, pharmaceuticals, and textiles. **CO2:** Students will acquire insights into the identification and evaluation of cellulase and lipase producers, and will understand their roles in biofuels, detergents, and waste management. **CO3:** Students will understand the application of the Gradient Plate Technique to study antibiotic resistance, and will gain knowledge of its significance in understanding microbial resistance mechanisms. **CO4:** Students will gain the ability to use the Replica Plate Technique to identify and analyse antibiotic-resistant mutants, and will understand its importance in microbial genetics and resistance studies. **CO5:** Students will acquire skills in screening microorganisms for antibiotic production using methods such as the Crowded Plate and Wilkin's techniques, and will understand their relevance in discovering new antibiotic sources. **CO6:** Students will gain the ability to prepare and interpret a standard curve for citric acid quantification, and will understand its importance in the assessment of fermentation processes in industrial applications. **CO7:** Students will understand the process of aerobic fermentation for citric acid production, and will gain knowledge of its applications in industrial bioprocess optimization. **CO8:** Students will learn to estimate alcohol concentration in fermentation samples using iodometric titration, and will gain an understanding of its role in ensuring fermentation quality and accuracy. **CO9:** Students will gain insights into performing anaerobic fermentation to produce ethanol, and will understand the significance of bioethanol production in sustainable energy solutions.

<table>
<tr><td></td><td colspan="2">CO10: Students will acquire a comprehensive understanding of fermenter design and operation, and will learn how different components influence industrial bioprocesses and scalability.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td colspan="2"><table>
<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td><td>PSO7</td><td>PSO8</td></tr>
<tr><td>CO1 to 10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Pre-requisite</td><td colspan="2">Biology, Basic Chemistry</td></tr>
<tr><td>Course Content</td><td>1. Isolation and Screening of Extracellular enzyme producing Microorganisms: Amylase and Protease Producer
2. Isolation and Screening of Extracellular enzyme producing Microorganisms: Cellulase and Lipase Producer
3. Isolation of antibiotic-resistant mutant by Gradient Plate Technique (GPT).
4. Isolation of antibiotic-resistant mutant by Replica Plate Technique (RPT).
5. Isolation and screening of antibiotic producing microorganisms.
a. Crowded Plate Technique
b. Wilkin’s Technique
6. Preparation of standard curve for Citric acid.
7. Aerobic Fermentation of Citric acid by Eukaryotic Microorganisms.
8. Estimation of Alcohol by iodometric titration method.
9. Anaerobic Fermentation of Ethanol by Eukaryotic Microorganisms.
10. Demonstration of Fermenter.</td><td>Teaching Hours: 60 h</td></tr>
<tr><td>Reference Books</td><td colspan="2">• Aneja, K. (2014). Laboratory Manual of Microbiology and Biotechnology (1st ed.). MedTech.
• Patel, R., & Patel,K P. (2016) Experimental Microbiology (9 ed., Vol. I). Aditya Publication.</td></tr>
<tr><td>e-learning resources</td><td colspan="2">• https://www.youtube.com/watch?v=XApUZukvbmQ</td></tr>
<tr><td>Teaching Methodology</td><td colspan="2">Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment</td></tr>
<tr><td>Evaluation Method</td><td colspan="2">50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 50% SEE: External assessment based on semester end University examination.</td></tr>
</table>

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program in Biotechnology (B. Sc.)

(3 Years Degree; 4 Years Honours/Honours with Research)

Semester-VI

Course: BT-MJ-602 Plant Tissue Culture Techniques

Course Code	BT-MJ-602
Course Title	**Plant Tissue Culture Techniques**
Credits	2
Course Level	300-399
Total Engagement	2 Credits x 15 Hours = 30 Hours
Teaching per week	2 hours
Minimum weeks Per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2025-2026
Purpose of Course	The purpose of the "Plant Tissue Culture Techniques" course is to provide students with a foundational understanding of plant tissue culture techniques and their applications in plant biotechnology. This course aims to explore key concepts such as totipotency, micropropagation, and genetic regeneration, focusing on the practical use of these technologies in plant breeding, conservation, and crop improvement. The course also addresses the challenges and innovations in plant tissue culture, equipping students with the knowledge to apply these techniques in research and industry settings.
Course Objective	The objective of the " Plant Tissue Culture Techniques" course is to provide students with a comprehensive understanding of the fundamental principles and techniques used in plant tissue culture. The course aims to introduce key concepts such as totipotency and its applications in biotechnology, while covering essential techniques like micropropagation, somatic embryogenesis, and protoplast isolation. Students will explore advanced topics including synthetic seed technology, cryopreservation for genetic resource conservation, and the role of plant tissue culture in plant breeding and conservation.
Course Outcomes	Upon completion of the Plant Tissue Culture Techniques Course, students will: CO1: Students will have a solid understanding of the fundamental principles and techniques in plant tissue culture. They will be able to apply concepts of totipotency in plant biotechnology, utilize micropropagation methods for plant regeneration, and distinguish between direct and indirect organogenesis. CO2: Students will gain an in-depth understanding of advanced biotechnological techniques used in plant regeneration and genetic resource conservation. They will learn about the processes and applications of androgenesis and gynogenesis in plant breeding, as well as the role of embryo culture in enhancing crop varieties. The unit will also cover the isolation and culturing of protoplasts, synthetic seed technology for mass propagation, and

<table>
<tr><td></td><td colspan="10">the techniques of cryopreservation for long-term storage of plant genetic resources.</td></tr>
<tr><td rowspan="3">Mapping between Cos with PSOs</td><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td><td>PSO7</td><td>PSO8</td></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Pre-requisite</td><td colspan="10">Basic Biology</td></tr>
<tr><td rowspan="2"></td><td colspan="9">UNIT-1: Fundamentals of Plant Tissue Culture and Micropropagation: Introduction & General Techniques of Plant tissue culture, Totipotency in Plant Biotechnology: Techniques and Implications, Principles and Applications of Micropropagation, Micropropagation Methods: Direct and Indirect Organogenesis</td><td>Teaching Hours: 15</td></tr>
<tr><td colspan="9">UNIT-2: Applications of Biotechnology in Plant Regeneration and Preservation: Androgenesis and Gynogenesis: Applications and Key Factors, Embryo Culture in Plant Breeding and Biotechnology, Protoplast Isolation and Culturing Techniques, Synthetic Seed Technology & Cryopreservation: Methods, Challenges, and Applications</td><td>Teaching Hours: 15</td></tr>
<tr><td>Reference Books</td><td colspan="10">• Chawla, H. S. (2011). Introduction to plant biotechnology (3/e). CRC Press.
• Bhojwani, S. S., & Razdan, M. K. (1986). Plant tissue culture: theory and practice. Elsevier.
• Jha, T. B. (2005). Plant tissue culture: basic and applied. Universities press.
• Veeresham, C., & Kokate, C. K. (2006). Medicinal plant biotechnology. CBS Publishers and Distributers.
• Razdan, M. K. (2002). An introduction to plant tissue culture. Oxford and IBH publishing.</td></tr>
<tr><td>e-learning re-sources</td><td colspan="10">• Thorpe, T.A. (2007) ‘History of plant tissue culture’, Molecular Biotechnology, 37(2), pp. 169–180. Available at: https://doi.org/10.1007/s12033-007-0031-3.
• Dagla, H.R. (2012) ‘Plant tissue culture: Historical developments and applied aspects’, Resonance, 17(8), pp. 759–767. Available at: https://doi.org/10.1007/s12045-012-0086-8.
• Al-Khayri, J.M., Jain, S.M. and Johnson, D. V. (2016) Advances in plant breeding strategies: Breeding, biotechnology and molecular tools, Advances in Plant Breeding Strategies: Breeding, Biotechnology and Molecular Tools. Available at: https://doi.org/10.1007/978-3-319-22521-0.</td></tr>
<tr><td>Teaching Methodology</td><td colspan="10">Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment Laboratory work, Journal preparation</td></tr>
<tr><td>Evaluation Method</td><td colspan="10">50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 50% SEE: External assessment based on semester end University examination.</td></tr>
</table>

[Subject Code-2603001306022002]

BTP-MJ-602: Plant Tissue Culture Techniques Practical

Course Code	BTP-MJ-602
Course Title	**Plant Tissue Culture Techniques Practical**
Credits	2
Course Level	300-399
Total Engagement	2 Credits x 30 hours = 60 hours
Teaching per week	2 hours
Minimum weeks Per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2025-2026
Purpose of Course	The Purpose of Plant Tissue Culture Techniques practical is to provide undergraduate students with hands-on experience in various plant tissue culture techniques, enhancing their understanding of plant growth and development *in vitro*.
Course Objective	The Objective of these practical is to introduce undergraduate students to fundamental plant tissue culture techniques, including the preparation of growth media and the inoculation of various plant explants. These activities aim to enhance their skills in plant biotechnology, genetic manipulation, and tissue culture applications in plant breeding and conservation.
Course Outcomes	Upon completion of the Basics of Plant Tissue Culture Techniques Practical, students will: 1. Gain knowledge of essential equipment, tools, and techniques for setting up a tissue culture lab. 2. Gain the ability to prepare MS medium and understand its role in plant tissue culture for tissue regeneration. 3. Develop skills in inoculating various explants into MS medium and analyzing their growth and development. 4. Acquire the skills to prepare B5 medium and apply it for growing plant cells and tissues. 5. Inoculate explants into B5 medium and monitor their growth and differentiation. 6. Develop expertise in isolating protoplasts through Enzymatic methods for experimental applications. 7. Develop expertise in isolating protoplasts through mechanical methods for experimental applications. 8. Understand the process of anther isolation and culture for haploid induction in plant breeding. 9. Learn how to isolate and culture plant embryos for in vitro regeneration and propagation. 10. Acquire the ability to prepare synthetic seeds and recognize their role in plant propagation and conservation.

Mapping between Cos with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1-10								

Pre-requisite	Basic Biology

	1. To Study Key Components of a Plant Tissue Culture Lab. **2.** To prepare Murashige and Skoog (MS) Medium and learn its application in plant tissue culture. **3.** To inoculate different plant explants into MS medium and observe their growth. **4.** To prepare B5 medium and learn its application in plant tissue culture. **5.** To inoculate explants into B5 medium and observe their growth. **6.** To isolate protoplasts using Enzymatic Approach. **7.** To isolate protoplasts using Mechanical Approach. **8.** To isolate and culture anthers for haploid production in plant breeding. **9.** To isolate and culture plant embryos for regeneration. **10.** To prepare synthetic seeds for plant propagation and understand their applications.
Reference Books	• Bhojwani, S. S., & Razdan, M. K. (1986). *Plant tissue culture: theory and practice*. Elsevier. • Razdan, M. K. (2002). *An introduction to plant tissue culture*. Oxford and IBH publishing.
e-learning resources	• Kumar, R. (2016) 'Laboratory requirements in plant tissue culture', *Plant Biotechnology*, (January 2015), pp. 1–23. Available at: https://www.researchgate.net/publication/301564270_Laboratory_Requirements_in_Plant_Tissue_Culture. • Nongdam, P. (2016) 'Development of Synthetic Seed Technology in Plants and its Applications: A Review', *Int J Curr Sci*, 19(4), pp. 86–101.
Teaching Methodology	Laboratory work, Journal preparation
Evaluation Method	50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 50% SEE: External assessment based on semester end University examination

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program in Biotechnology (B. Sc.)

(3 Years Degree; 4 Years Honours/Honours with Research)

Semester-VI

Course: BT-MJ-603: Animal Biotechnology

Course Code	BT-MJ-603
Course Title	**Animal Biotechnology**
Credits	2
Course Level	300-399
Total engagement	2 Credits x 15 Hours = 30 Hours
Teaching per week	2h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation &holidays)
Effective from	2025-2026
Purpose of Course	The purpose of the course is to give knowledge to the students regarding the fundamentals of animal biotechnology.
Course Objectives	The objective is to explain students about aseptic techniques, basics of cultured cells and animal reproductive biology.
Course Outcomes	CO1: Students would be able to get details of equipments for cell culture, sterile handling and types of tissue culture. CO2: Students would get insights about biology of cultured cells, cell culture media and animal reproductive biology.
Mapping between Cos with PSOs	See table below
Pre-requisite	Biology, Cell biology
Course Content	See table below

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

UNIT-1: Introduction to Animal Biotechnology and Aseptic Techniques Introduction, Applications of animal biotechnology, Advantages and limitations of animal tissue culture, Equipment for cell culture, Types of tissue culture, Aseptic environment and sterile handling.	Teaching Hours:15
UNIT-2: Biology of Cultured Cells and Animal Reproductive Biology Cell adhesion, Cell proliferation, Cell differentiation, Physical properties of media, Complete media and Sterilization of media, *In vitro* fertilization, Artificial insemination, Embryo transfer technology	Teaching Hours:15

Reference Books	• Freshney, I. (2016). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications (8th ed.). Wiley-Blackwell • Gordon I, editor (2017). Reproductive technologies in farm animals 2nd ed. CABI • B. K. Sinha and Rinesh Kumar (2008). Principles of Animal Cell Culture, IBD Co., Lucknow • M. M. Ranga (2019). Animal Biotechnology (3rd Edition), Agrobios, India.
e-learning resources	SWAYAM (https://swayam. gov. in/)
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment
Evaluation Method	50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 50% SEE: External assessment based on semester end University examination.

[Subject Code-2603001306033002]

BTP-MJ-603: Animal Biotechnology Practical

Course Code	BTP-MJ-603
Course Title	**Animal Biotechnology Practical**
Credits	2
Course Level	300-399
Total engagement	4 h x 15 weeks = 60 Hours
Teaching per week	4h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2025-2026
Purpose of Course	The purpose of the course is to familiarize students with handling practical problems related to animal biotechnology.
Course Objectives	The objective is to perform practical based on animal cell culture.
Course Outcomes	CO1: To provide basic knowledge of buffers and its preparation. CO2: Preparation of cell culture media and to explain its importance in culture. CO3: Practical skills of students will be enhanced as they learn the sterilization of media for culturing animal cells CO4: Students will learn the isolation of cells from tissue. CO5: Students will gain insights about cell viability assay. CO6: To learn antioxidation activity by DPPH assay. CO7: Students will learn how to extract DNA from animal tissue.
Mapping between Cos with PSOs	
Pre-requisite	Basic Biology

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1 to 7								

Course Content	1. Preparation of buffers: PBS/HBSS 2. Preparation of media for animal cell culture: RPMI 1640/DMEM. 3. Sterilization of buffers and animal cell culture media. 4. Isolation of cells from spleen/Chick fibroblast. 5. Cell viability assay (Trypan blue). 6. DPPH radical scavenging assay. 7. DNA extraction from animal tissue.	Teaching Hours:60
Reference Books	• Freshney, I. (2016). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications (8th ed.). Wiley-Blackwell • Sudha Gangal (2007). Principles and Practice of Animal Tissue Culture, Universities Press, Hyderabad.	
e-learning resources	• https://videos.thermofisher.com/detail/video/5765965627001/cell-culture:-cell-culture-basics	
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment	
Evaluation Method	50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 50% SEE: External assessment based on semester end University examination	

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty): Minor Elective

Teaching & Evaluation Scheme

Semester-V & VI

[Academic Year of Implementation 2025-2026]

Semester-V

Course Code	Course Title	Teaching Schedule Hours/Week	Exam Duration & Marks			Total Theory/Practical Marks	Credit
			Duration (Hours: Minutes)	(CCE) Internal Marks	(SEE) External Marks		
BT-ME-501	Immunotechnology	2	1:00	25	25	50	2
BTP-ME-501	Immunotechnology: Practical	4	4:00 to 6:00	25	25	50	2
	Total	**6**	**7:00**	**50**	**50**	**100**	**4**
BT-ME-502	Advances in Bioinformatics	2	1:00	25	25	50	2
BTP-ME-502	Advances in Bioinformatics: Practical	4	4:00 to 6:00	25	25	50	2
	Total	**6**	**7:00**	**50**	**50**	**100**	**4**
BT-ME-503	Enzymology	2	1:00	25	25	50	2
BTP-ME-503	Enzymology: Practical	4	4:00 to 6:00	25	25	50	2
	Total	**6**	**7:00**	**50**	**50**	**100**	**4**
BT-ME-504	Introduction to Nanobiotechnology	2	1:00	25	25	50	2
BTp-ME-504	Introduction to Nanobiotechnology: Practical	4	4:00 to 6:00	25	25	50	2
	Total	**6**	**7:00**	**50**	**50**	**100**	**4**

Semester-VI

Course Code	Course Title	Teaching Schedule Hours/Week	Exam Duration & Marks			Total Theory/Practical Marks	Credit
			Duration (Hours: Minutes)	(CCE) Internal Marks	(SEE) External Marks		
BT-ME-601	Pharmaceutical Biotechnology	2	1:00	25	25	50	2
BTP-ME-601	Pharmaceutical Biotechnology: Practical	4	4:00 to 6:00	25	25	50	2
	Total	**6**	**7:00**	**50**	**50**	**100**	**4**
BT-ME-602	Environmental Biotechnology	2	1:00	25	25	50	2
BTP-ME-602	Environmental Biotechnology: Practical	4	4:00 to 6:00	25	25	50	2
	Total	**6**	**7:00**	**50**	**50**	**100**	**4**

[Subject Code-25030013050410001]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty)

(3 Years Degree; 4 Years Honours/Honours with Research)

Semester-V

Course: BT-ME-501: Immunotechnology

Course Code	BT-ME-501
CourseTitle	**Immunotechnology**
Credits	2
Course Level	300-399
Total Engagement	2 Credits x 15Hours = 30 Hours
Teaching per week	2 hours
Minimum weeks Per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2025-2026
Purpose of Course	The course of Immunotechnology aims at the application of basic aspects of the Immune system for diagnostics and therapeutics.
Course Objective	To learn about various diagnostic tools, and learn about various types of autoimmune disorders and a variety of vaccines.
Course Outcomes	CO1: Gain a comprehensive understanding of monoclonal antibody production, hybridoma technology, and key diagnostic techniques such as ELISA, radioimmunoassay, and immunofluorescence, which are essential for disease detection and therapeutic applications. CO2: To develop knowledge of immune disorders, including hypersensitivity, autoimmune diseases, and immunodeficiency, while also understanding the principles of vaccine development and their role in disease prevention.

Mapping between Cos with PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Pre-requisite	Fundamentals of Immunology	
	UNIT-1: Monoclonal Antibodies & Diagnostic Techniques Precipitation, Agglutination, Flocculation, ELISA, CLIA, Immunochromatography and Immunofluorescence, Types of monoclonal antibodies, Hybridoma technology	Teaching Hours :15
	UNIT-2: Immune Disorders & Vaccines Hypersensitivity Type I, II, III & IV, Autoimmune Diseases, Immunodeficiency, Vaccines and their types.	Teaching Hours :15
Reference Books	• Willey, J.M., Sherwood, L. M., & Woolverton, C. J. (2008). Prescott Harley & Klein's Microbiology, 7th Edition, The MCGraw-Hil Companies, Inc. • Kuby Janis, (2007). *Immunology*, 6th Edition, Freeman and Company. • Ashim K. Chakravarty (2012). Immunology and Immunotechnology Oxford University Press, ISBN-13: 978-0-19-567688-4	
e-learning resources	• SWAYAM(https://swayam.gov.in/)	

Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment Laboratory work, Journal preparation
Evaluation Method	50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 50% SEE: External assessment based on semester end University examination.

[Subject Code-2503001305041002]

BTP-ME-501: Immunotechnology Practical

CourseCode	BTP-ME-501
CourseTitle	**Immunotechnology Practical**
Credits	2
Course Level	300-399
Total Engagement	2 Credits x 30 hours= 60 hours
Teachingperweek	2 hours
Minimum weeks Per semester	15 weeks
Effectivefrom	2025-2026
Purposeof Course	The purpose of the Immunotechnology Practical Course is to provide students with hands-on experience in key immunological techniques used for diagnostic, therapeutic, and research applications.
Course Objective	The course aims to equip students with practical skills in immunology. It focuses on preparing students for research and diagnostic applications in biotechnology and clinical settings.
Course Outcomes	CO1: Teach students to quantify antigen concentrations using advanced techniques like rocket Immunoelectrophoresis. CO2: Students will gain the ability to perform the radial precipitation test. CO3: Develop students' proficiency in applying immunological techniques for diagnostics and research purposes. CO4: Students will develop the skill of technique, Dot ELISA. CO5: To learn the diagnostic method of typhoid. CO6: Students will gain insights about Southern blotting.
Mapping between Cos with PSOs	
Pre-requisite	Basics of Immunology
Course Content	1. Immunochromatography Assay. 2. Radial precipitation test. 3. Antigen Capture ELISA. 4. Dot ELISA. 5. Dreyer's tube test for diagnosis of typhoid. 6. Demonstration of Southern blotting.
Reference Books	• Textbook of Medical Laboratory Technology clinical Laboratory Science and Molecular Diagnosis 2 Vol Set 3rd Ed. (2018) by Praful Godkar and Darshan P. Godkar.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO 1 to 6								

Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminar sand/or Assignment.
e-learning resources	• https://www.bio-rad-antibodies.com/elisa-types-direct-indirect-sandwich-competition-elisa-formats.html • https://www.nature.com/articles/nprot.2006.73
Evaluation Method	50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 50% SEE: External assessment based on semester end University examination.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty)

(3 Years Degree; 4 Years Honours/Honours with Research)

Semester-V

Course: BT-ME-502: Advances in Bioinformatics

Course Code	BT-ME-502	
Course Title	**Advances in Bioinformatics**	
Credit	2	
Course Level	300-399	
Total Engagement	2 Credits x 15 Hours = 30 Hours	
Teaching per Week	2 h	
Minimum weeks per Semester	15 weeks (Including Classwork, examination, preparation, holidays etc.)	
Effective From	2025-2026	
Purpose of Course	This course will give students an advance information to the various techniques of Bioinformatics. The students will become familiar with the use of a wide variety of internet applications using various tools used for phylogenetic analysis and protein prediction.	
Course Objective	The objective of this course is to provide students with theory that how to use of common computational tools and databases which are used to investigate molecular and evolution concepts	
Course Outcomes	CO1: Students will learn about construction of various phylogenetic trees by distance and cladistic methods and also learn how to perform cladogram/dendogram from various computational tools. CO2: Students will learn about various tools and techniques for prediction of protein structures and also learn about different online tools for protein structure modelling.	

Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								

Pre-requisite	Basic of Biology, Biotechnology, Biochemistry, Microbiology	
Course Content	**UNIT-1: MOLECULAR PHYLOGENY:** Phenotypic & Molecular Phylogeny, Mechanism of Molecular Phylogeny, Representation of Phylogeny, Molecular Clocks; Methods of Phylogeny (Cladistic methods – Maximum parsimony, Maximum Likelihood; Distance Method – UPGMA & NJ method; Tools for Phylogenetic analysis.	Teaching Hours :15
	UNIT-2: PROTEIN STRUCTURE PREDICTION & MODELLING: Methods for Secondary structure prediction: Chou Fasman and GOR; Protein structures evaluation (Procheck); Software for Secondary structure prediction.; Protein Modelling: Methods of Protein Modelling, Homology Modelling, Threading or fold recognition and Ab-initio structure prediction methods.; Tools for Protein structure prediction (Predict Protein); Tools for protein	Teaching Hours :15

	structure modelling – Swiss Model.	
Reference Books	• S. C. Rastogi, N. Mendiratta and P. Rastogi, 2nd Edition "Bioinformatics: Concepts, Skill & Applications", CBS publisher & Distributor, 2009. • Mount, D.W., "Bioinformatics: Sequence and Genome analysis", Cold Spring Harbour Laboratory Press, 2001. • Zhumur Gosh and Bibekanand Mallick "Bioinformatics: Principle and Application", Oxford University Press, 2008. • Simminder Kaur Thukral and Orpita Bosu, Pap/Cdr edition, "Bioinformatics: Database, Tools and Algorithms", Oxford University Press, USA, 2007. • N. J. Chikhale and V.S. Gomase, 1st Edition, "Bioinformatics: Theory & Practices", Himalaya Publishing House Limited, 2007. • Lesk, A. K., "Introduction to Bioinformatics" 4th Edition, Oxford University Press, 2013.	
e-learning resources	https://en.wikipedia.org/wiki/List_of_protein_structure_prediction_software https://predictprotein.org/ https://en.wikipedia.org/wiki/List_of_phylogenetics_software	
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment	
Evaluation Method	50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 50% SEE: External assessment based on semester end University examination.	

[Subject Code-2503001305041004]

BTP-ME-502: Advances in Bioinformatics Practical

Course Code	BTP-ME-502
Course Title	**Advances in Bioinformatics Practical**
Credit	2
Course Level	300-399
Total Engagement	2 Credits x 30 Hours = 60 Hours
Teaching per Week	4 h
Minimum weeks per Semester	15 weeks (Including Classwork, examination, preparation, holidays etc.)
Effective From	2025-2026
Purpose of Course	The students will become familiar with the use of a wide variety of internet applications using various tools used for phylogenetic analysis and protein prediction.
Course Objective	The objective of this course is to provide students with practical experience of use of common computational tools and databases which are used to investigate molecular and evolution concepts
Course Outcomes	CO1: Students will learn about how to retrieve sequence and structure from different biological databases. CO2: Students will learn about how to download .pdb file protein data Bank. CO3: Students will learn about how to get various information from different metabolic pathway. CO4: Students will learn about how to display .pdf file and analysis it. CO5: Students will learn about how to perform similarity

<table>
<tr><td></td><td colspan="9">& homology Search. CO6: Students will learn about how to perform multiple sequence analysis by Clustal family. CO7: Students will learn about how to perform cladogram/dendogram from various computational tools. CO8: Students will learn about how to build protein model by using swiss model. CO9: Students will learn about how to find out active site of protein.CO10: Students will learn about various tools and techniques for evaluation of protein structures.</td></tr>
<tr><td rowspan="2">Mapping between COs with PSOs</td><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td><td>PSO7</td><td>PSO8</td><td></td></tr>
<tr><td>CO1 to 10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Pre-requisite</td><td colspan="9">Basic of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
<tr><td>Course Content</td><td colspan="8">1. Nucleotide and protein Sequence retrieval from NCBI/EMBL
2. Protein Structure retrieval from Protein Data Bank (PDB)
3. Exploring information from metabolic pathway database
4. Protein structure visualization by RasMol
5. Pairwise sequence alignment using BLAST/FASTA
6. Multiple sequence alignment using Clustal Omega/Clustal X
7. Creation of Cladogram / Phylogram using NJ and UPGMA method
8. Perform homology modelling using Swiss model
9. Analysis of Binding Site of Protein
10. Evaluation of predicted structure by Procheck and Ramachandran Plot</td><td>Teaching Hours :60</td></tr>
<tr><td>Reference Books</td><td colspan="9">• S. C. Rastogi, N. Mendiratta and P. Rastogi, 2nd Edition “Bioinformatics: Concepts, Skill & Applications”, CBS publisher & Distributor, 2009.
• Zhumur Gosh and Bibekanand Mallick “Bioinformatics: Principle and Application”, Oxford University Press, 2008.
• Simminder Kaur Thukral and Orpita Bosu, Pap/Cdr edition, “Bioinformatics: Database, Tools and Algorithms”, Oxford University Press, USA, 2007.</td></tr>
<tr><td>e-learning resources</td><td colspan="9">• https://www.ncbi.nlm.nih.gov/
• https://www.rcsb.org/
• https://www.genome.jp/kegg/
• https://blast.ncbi.nlm.nih.gov/Blast.cgi
• https://www.ebi.ac.uk/thornton-srv/software/PROCHECK/
• https://swissmodel.expasy.org/</td></tr>
<tr><td>Teaching Methodology</td><td colspan="9">Classwork, Discussion, Self-Study, Seminars and/or Assignment</td></tr>
<tr><td>Evaluation Method</td><td colspan="9">50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 50% SEE: External assessment based on semester end University examination.</td></tr>
</table>

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty)

(3 Years Degree; 4 Years Honours/Honours with Research)

Semester-V

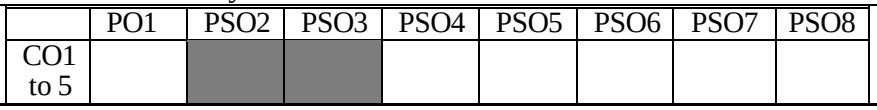
Course: BT-ME-503: Enzymology

Course Code	BT-ME-503
Course Title	**Enzymology**
Credits	2
Course Level	300-399
Total engagement	2 Credits x 15 Hours = 30 Hours
Teaching per week	2h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2025-2026
Purpose of Course	The purpose of the course is to give knowledge to the students regarding the fundamentals of Enzymology.
Course Objectives	The objective is to explain students about what are enzymes, how they function and their industrial applications.
Course Outcomes	CO1: Students would be able to get details about what are enzymes and how they function. CO2: Students would get insights about enzyme kinetics and their applications.
Mapping between COs with PSOs	<table><tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th><th>PSO7</th><th>PSO8</th></tr><tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>
Pre-requisite	Biology, Biotechnology, Biochemistry, Microbiology
Course Content	**UNIT-1: Basics of Enzymology.** Introduction and Historical background, nomenclature and classification, coenzyme, cofactor, apoenzyme, holoenzyme Physical and chemical properties of enzyme, Factors affecting enzyme activity, Active site, Mechanism of enzyme action, Lock and key model, Induced fit model. — Teaching Hours: 15
	UNIT-2: Enzyme Kinetics. Order of reaction, Michaelis Menten equation, significance of Km and Vmax, LB plot, Hans plot, Eadie hofstee plo Enzyme inhibitors (competitive, uncompetitive, non competitive), Enzyme units, Industrial application of enzymes. — Teaching Hours: 15
Reference Books	• Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2005). Lehninger principles of biochemistry. Macmillan. • T. Devasena (2015) Enzymology, Oxford university Press. • T. Palmer (2007), Enzyme Biochemistry, Biotechnology and Clinical Enzymology, Woodhead Publishing Limited.
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment

Evaluation Method	50% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 50% External based on semester end University examination.

[Subject Code-2503001305041006]

Course: BTP-ME-503: Enzymology Practical

Course Code	BTP-ME-503
Course Title	**Enzymology Practical**
Credits	2
Course Level	300-399
Total engagement	4 h x 15 weeks = 60 Hours
Teaching per week	4 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2025-2026
Purpose of Course	The purpose of the course is to familiarize students to work with enzymes.
Course Objectives	To familiarize students about how enzyme function, enzyme units and enzyme kinetics. .
Course Outcomes	CO1: Students will learn about importance of standard curve, for estimating enzyme activity. CO2: Students will get insights about estimation of enzyme units. CO3: Students will gain insights about how incubation temperature affects enzyme activity. CO4: Students will gain insights about how pH affects enzyme acticity. CO5: Students will learn to calculate important kinetic parameters like Km and Vmax of enzyme.
Mapping between COs with PSOs	
Pre-requisite	Biology, Biotechnology, Biochemistry, Microbiology.
Course Content	1. Estimation of reducing sugar by DNSA method (standard graph of invert sugar) 2. Determination of units of Enzyme (Invertase) 3. Determination of optimum temperature on enzyme activity. 4. Determination of optimum pH on enzyme activity. 5. Determination of Km and Vmax using substrate vs velocity plot. Teaching Hours: 60
Reference Books	• Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2005). Lehninger principles of biochemistry. Macmillan. • T. Devasena (2015) Enzymology, Oxford university Press. • T. Palmer (2007), Enzyme Biochemistry, Biotechnology and Clinical Enzymology, Woodhead Publishing Limited.
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment
Evaluation Method	50% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 50% External based on semester end University examination.

[Subject Code-2503001305041007]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program in Biotechnology (B. Sc.)

(3 Years Degree; 4 Years Honours/Honours with Research)

Semester V

Course: BT-ME-504: Introduction to Nanobiotechnology

Course Code	BT-ME-504	
Course Title	**Introduction to Nanobiotechnology**	
Course Level	300-399	
Credit	02	
Total engagement	02 Credits x 15 Hours = 30 Hours	
Teaching per week	02 Hours	
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)	
Effective from	2025-2026	
Purpose of Course	The course is designed to provide knowledge regarding different aspects of Nanobiotechology. It is an emerging field with applications in diverse filed related to biotechnology. This course will familiarise learner with different synthesis methods, molecular nanobiotechnology and application of nanomaterials.	
Course Objective	• To make students aware about different the field of nanobiotechnology along with different synthesis methods. • To discuss the application of nanomaterials like DNA, proteins and CNT in the field of biotechnology.	
Course Outcomes	• The students will gain knowledge about the field of nanobiotechnology and different methods applicable for synthesis of nanoparticles. • The students will get information about nanobiotechnological application of biomolecules (DNA and Proteins) and Carbon Nano tubes (CNT).	
Mapping between COs with PSOs		
Pre-requisite	Basic Knowledge of Biology and Biochemistry	
Course Content	**UNIT 1: Introduction and Synthesis of Nonmaterial:** Introduction to Nanobiotechnology, Types and Properties of Nanomaterials, Approaches (Top-down and Bottom-up) and Techniques (Physical: Ball milling, Thermal or flame synthesis, Spray pyrolysis, Laser Ablation and Arc discharge; Chemical: Sol-gel, Sonochemistry, Photochemical, Nanoprecipitation, Chemical Vapour Deposition; Biological or Biosynthesis) synthesis of Nanoparticles, Stability of Nanoparticle, Introduction to Nanolithography (Soft lithography, Photolithography, Magnetolithography, Nanoimprint, Dip Pen, Enzymatic nanolithography) for Self-assembly of nanomaterials.	Teaching Hours: 15

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

	UNIT 2: Molecular Nanotechnology and Application of Nanomaterials: DNA as nanostructure (structural forms of DNA), DNA tweezers and FRET technology, Self-assembly Proteins (Protein cages: Dps, Ferritin, Virus capsid and Protein rings: Phage recombinase, TRAP), Application of protein nanostructure, Introduction and properties of Carbon nanotubes (CNT), Application of CNT in diagnostic equipment, Gene delivery (liposomes), Cancer treatment, Photocatalysis of pollutants using nanomaterial, Application of Nanomaterials in food and agriculture.	Teaching Hours: 15
Reference Books	• Goodshell, David S. Biotechnology: Lessons from Nature. John Wiley & sons, 2004 • Sharon Madhuri et al Bio-nanotechnology, Ane Books Pvt. Ltd., 2014 • Kulkarni, Sulabha K. Nanobiotechnology: Principles and Practices. Springer, 2014	
e-learning resources	• Bochman, M., Paeschke, K. & Zakian, V. DNA secondary structures: stability and function of G-quadruplex structures. Nat Rev Genet 13, 770–780 (2012). https://doi.org/10.1038/nrg3296 • Lapenta, F., Aupič, J., Vezzoli, M. et al. Self-assembly and regulation of protein cages from pre-organised coiled-coil modules. Nat Commun 12, 939 (2021). https://doi.org/10.1038/s41467-021-21184-6	
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment	
Evaluation Method	50% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 50% External based on semester end University examination	

[Subject Code-2503001305041008]

BTP-ME-504: Introduction to Nanobiotechnology Practical

Course Code	BTP-ME-504
Course Title	**Introduction to Nanobiotechnology Practical**
Course Level	300-399
Credit	02
Total engagement	02 Credits x 30 Hours = 60 Hours
Teaching per week	04 Hours
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2025-2026
Purpose of Course	To provide practical understanding regarding synthesis and characterisation of nanoparticles.
Course Objective	To educate and give practical exposure about laboratory scale production of nanoparticles and its characterisation.
Course Outcomes	CO1-3: Student will be able to synthesis nanoparticles using different methods. CO4: This practical will allow students to analysis nanoparticles on the basis of its optical property.

<table>
<tr><td></td><td colspan="2">CO5: One of the possible application of nanoparticles is to use it as antimicrobial agent. This practical will give student hands on experience to test antimicrobial activity of prepared nanoparticles.
CO6: Student will learn to study nanoparticles using various tools.
CO7: This Practical will create awareness regarding different techniques that can be used for the characterisation of nanoparticles.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td colspan="2"><table><tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td><td>PSO7</td><td>PSO8</td></tr><tr><td>CO1 to 07</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table></td></tr>
<tr><td>Pre-requisite</td><td colspan="2">Basic Knowledge of Biology and Biochemistry</td></tr>
<tr><td>Course Content</td><td>1. Synthesis of metal nanoparticles using sodium citrate (Chemical method).
2. Synthesis of nanoparticles using fungal/bacterial cell (biological method).
3. Synthesis of nanoparticles using plant extract (biological method).
4. Analyse nanoparticles using UV-Vis spectrophotometer.
5. In vitro study to confirm antimicrobial activity of nanoparticles against bacteria.
6. Study of nanoparticles by using Image J Analysis Tool.
7. Awareness (Visit/Demonstration) about different methods (FTIR, Microscopy and Particle size analysis) for characterisation of nanoparticles.</td><td>Teaching Hours: 60</td></tr>
<tr><td>Reference Books</td><td colspan="2">• Gérrard Eddy Jai Poinern, A Laboratory Course in Nanoscience and Nanotechnology, CRC Press Taylor & Francis Group, LLC, 2015.</td></tr>
<tr><td>e-learning resources</td><td colspan="2">• https://doi.org/10.1039/D0MA00807A
• https://doi.org/10.1186/s12951-022-01477-8
• https://doi.org/10.1039/C8NR02278J</td></tr>
<tr><td>Teaching Methodology</td><td colspan="2">Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment</td></tr>
<tr><td>Evaluation Method</td><td colspan="2">50% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 50% External based on semester end University examination.</td></tr>
</table>

[Subject Code-2603001306044001]

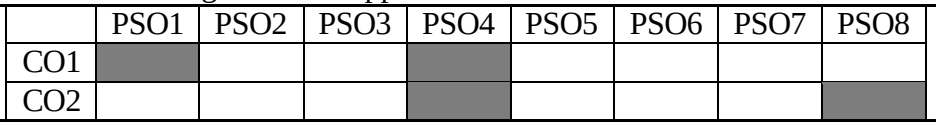
VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program in Biotechnology (B. Sc.)

(3 Years Degree; 4 Years Honours/Honours with Research)

Semester-VI

Course: BT-ME-601: Pharmaceutical Biotechnology

Course Code	BT-ME-601
Course Title	**Pharmaceutical Biotechnology**
Course Level	200-399
Credit	02
Total engagement	02 Credits x 15 Hours = 30 Hours
Teaching per week	02
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2025-2026
Purpose of Course	The course is designed to provide knowledge regarding different drug delivery systems and therapeutic usage of RNA, Enzyme and Hormones (with specific example). The course will give ideation about the phases in drug discovery and development along with the regulatory authorities involved.
Course Objective	• To make students aware about different Drug Delivery systems and approaches for better delivery of biotechnology derived drugs. To get acquitted about different regulatory agencies involved in the process of drug approval and marketing • The discussion of drug designing and development will create awareness about preclinical and clinical procedures along with different pharmaceutical parameters like pharmacodynamics and pharmacokinetics that should be taken into consideration during the process.
Course Outcomes	CO1: The students will gain knowledge about contribution of biotechnological techniques in pharmaceutical product development and therapeutics. The students will have knowledge of different drug delivery systems. CO2: The students will get information regarding drug discovery and development process. The students will be aware of regulatory authorities involved in drug molecule approval.
Mapping between COs with PSOs	
Pre-requisite	Basic Knowledge of Biology And Biochemistry
Course Content	**UNIT 1: Biopharmaceuticals, Drug Delivery and Therapeutics:** Biopharmaceuticals: Current Status and future prospects, Drug delivery systems (Liposomes, Nasal spray, biodegradable polymer), Therapeutic — Teaching Hours: 10

	technology (RNAi and Antisense), Enzyme and Hormones in Therapy (Superoxide dismutase, DNAse and Insulin)	
	UNIT 2: Drug Discovery, Development and Regulatory Affairs: Phases of drug creation (Drug discovery process and Drug development, pre-clinical and clinical pharmacology), Pharmacodynamics, Pharmacokinetics, Investigational New Drug Application (IND), Regulatory agency: Food and Drug Administration (FDA), International Council for Harmonisation (ICH), Central Drugs Standard Control Organisation (CDSCO), Indian Pharmacopoeia Commission (IPC).	Teaching Hours: 20
Reference Books	• Walsh G. Pharmaceutical biotechnology: Concepts and applications. John Wiley and Sons; 2013 • Rang H P. Drug Discovery and Development. Technology in Transition. 2012 • Ho RJ, Gibaldi M. Biotechnology and Biopharmaceuticals. Transforming Proteins and Genes into Drugs.2003 • Jogdand SN. Medical Biotechnology. Himalaya Publishing House, 2008	
e-learning resources	• Novel Drug Delivery Systems: An Important Direction for Drug Innovation Research and Development - PMC https://pmc.ncbi.nlm.nih.gov/articles/PMC11124876/ • https://doi.org/10.1021/acs.chemmater.2c03003 • Pharmaceutical Biotechnology: Fundamentals and Applications | SpringerLink https://link.springer.com/book/10.1007/978-3-031-30023-3#toc	
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment	
Evaluation Method	50% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 50% External based on semester end University examination.	

[Subject Code-2603001306044002]

BTP-ME-601: Pharmaceutical Biotechnology Practical

Course Code	BTP-ME-601
Course Title	**Pharmaceutical Biotechnology Practical**
Course Level	200-399
Credit	02
Total engagement	02 Credits x 30 Hours = 60 Hours
Teaching per week	04
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2025-2026

<table>
<tr><td>Purpose of Course</td><td>The create practical understanding regarding pharmaceutical products, their testing and production.</td></tr>
<tr><td>Course Objective</td><td>To extent the understanding about primary test, practical parameters, regulatory compliance test, laboratory scale production applicable in the field of Pharmaceutical Biotechnology.</td></tr>
<tr><td>Course Outcomes</td><td>• Student will be able to understand the parameters like the concept of sterility of the given pharmaceutical product which is prerequisite for safety of any marketed product.
• Plant extract can be a possible therapeutic molecule. Minimum inhibitory concentration (MIC) of plant extract against microbial growth will be studied. This estimated MIC can be used for further research on the crude plant extract.
• Create understanding for preparation of simple synthetic drug
• Assay for estimating purity of synthetic drug will help student to understand the testing of synthetic drug.
• This experiment that will create general awareness regarding components of daily hygiene products and nutraceuticals.
• Practical 6 to 8: The drug discovery and development process demands various tests to be fulfilled by the new drug molecule. The tests are in compliance to the various regulatory authorities. These experiments will develop ideation regarding test that are applicable on the drug molecule under regulatory authorities.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td><table><tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td><td>PSO7</td><td>PSO8</td></tr><tr><td>CO1 to 8</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table></td></tr>
<tr><td>Pre-requisite</td><td>Basic Knowledge of Biology and Biochemistry</td></tr>
<tr><td>Course Content</td><td>1. Sterility testing of pharmaceutical products
2. Determine Minimum Inhibitory Concentration (MIC) of plant extract (leaf/flower/root/fruit) (Disc diffusion method)
3. To prepare simple synthetic drug molecule (Antiseptic- Iodine solution/ Laxative- Magnesium Hydroxide mixture/ Castor oil emulsion/ Astringent- Calamine lotion)
4. Assay of purity of synthetic drug (Chlorpheniramine Maleate/ Isoniazid/Chloroquine Phosphate/Dapsone)
5. Design and conduct a simple experiment for laboratory level production of daily hygiene products (toothpaste/ shampoo/ soap/detergent/ antiseptic lotion/ energy drink/immunity booster)
6. Demonstration regarding Dissolution test for pharmaceutical products (IPC standard)
7. Demonstration regarding Disintegration test for pharmaceutical products (IPC standard)
8. Demonstration regarding Preservative Efficacy test (PET) for cosmetics products (EU standard: ISO 11930:2019 and ISO 29621:2017)</td></tr>
<tr><td>Reference Books</td><td>• The Indian Pharmacopoeia Commission, Ministry of Health & Family Welfare Government of India, Indian Pharmacopoela 2010, Vol.1 Sixth Edition;
• Gupta A.K., Jain V.K., Pharmaceutics-I Practical Note Book, CBS Publishers & Distributors Pvt.Ltd.2020; 15
• Mehta R.M., Dispensing Pharmacy, Vallabh Prakashan, New Delhi, 2017; 150-151.
• Subrahmanyam C.V.S., Thimmasetty J.J, Prabhushankar G.L., Laboratory manual of Pharmaceutics. Vallabh Publication, Delhi, 2019; 47-48.
• R. J. Patel and K. R. Patel, Experimental Microbiology Volume-2, Aditya, Ahmedabad, Gujarat, India</td></tr>
</table>

e-learning resources	• chlorphenamine-hydrogen-maleate.pdf https://cdn.who.int/media/docs/defaultsource/medicines/pharmacopoeia/omitted-monographs/chlorphenamine-hydrogen-maleate.pdf?sfvrsn=5c45cbd2_5 • https://doi.org/10.1016/j.jpha.2011.09.002
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment
Evaluation Method	50% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 50% External based on semester end University examination.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program in Biotechnology (B. Sc.)

(3 Years Degree; 4 Years Honours/Honours with Research)

Semester-VI

Course: BT-ME-602: Environmental Biotechnology

Course Code	BT-ME-602
Course Title	**Environmental Biotechnology**
Course Level	200-399
Credit	02
Total engagement	02 Credits x 15 Hours = 30 Hours
Teaching per week	02
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2025-2026
Purpose of Course	The course "Environmental Biotechnology" aims to provide students with a comprehensive understanding of bioenergy, bioremediation, and waste management technologies. It focuses on sustainable energy production, environmental remediation techniques, and effective waste treatment processes to promote a cleaner and more sustainable environment.
Course Objective	The objective of "Environmental Biotechnology" course is to provide students with an understanding of bioenergy, bioremediation, and waste management technologies, focusing on sustainable solutions for energy production and environmental cleanup. It aims to equip students with the knowledge and skills to apply these technologies in addressing real-world environmental challenges.
Course Outcomes	CO1: Students will gain a comprehensive understanding of bioenergy sources and bioremediation technologies. They will be equipped to evaluate the potential of renewable bioenergy sources and apply bioremediation techniques for environmental clean-up. CO2: students will understand wastewater treatment methods and municipal waste management systems. Students will also gain insights into bioleaching, biopolymer production, and their real-world applications in sustainable environmental management.
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Pre-requisite	Basic Knowledge of Biology And Biochemistry	
Course Content	**UNIT-I: BIOENERGY & BIOREMEDIATION** Biogas Technology, Bioethanol Production from Cellulosic Waste, Microbial Hydrogen Production, Biotransformation of Xenobiotics, Environmental Carcinogenicity Testing, Principles and Types of Bioremediations and Phytoremediation	Teaching Hours: 15

	UNIT-II: WASTE MANAGEMENT & SPECIAL PROCESSES Characteristics of Wastewater, Aerobic Biological Wastewater Treatment: Activated Sludge and Oxidation Ponds, Anaerobic Biological Wastewater Treatment: UASB and Anaerobic Baffled Reactor, Municipal Waste Management Rules, Bioleaching: Types and Methods, Biopolymers: Types, Preparation, Properties and Practical Applications	Teaching Hours: 15
Reference Books	• Fulekar MH, Environmental Biotechnology, CRC Press; 2010 Jul 19. • Thakur IS. Environmental Biotechnology. IK International, New Delhi. 2006. • Pepper IL, Gerba CP, Gentry TJ, Maier RM, editors. Environmental microbiology. Academic press; 2011 Oct 13.	
e-learning resources	• https://www.researchgate.net/publication/343967531_Bioremediation	
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment	
Evaluation Method	50% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 50% External based on semester end University examination.	

[Subject Code-2603001306044004]

BTP-ME-602: Environmental Biotechnology Practical

Course Code	BTP-ME-602
Course Title	**Environmental Biotechnology Practical**
Credits	2
Course Level	300-399
Total Engagement	2 Credits x 30 Hours = 60 Hour
Teaching per week	4 hours
Minimum weeks Per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2025-2026
Purpose of Course	The purpose of this course is to introduce students to the key concepts and methodologies used in environmental monitoring and pollution assessment. It aims to enhance their understanding of the impact of pollution on natural resources and provides practical experience in analyzing water and soil quality, as well as exploring real-world case studies of environmental disasters.
Course Objective	The objective of this course is to provide students with practical skills in environmental monitoring and analysis, focusing on water and soil quality assessment, as well as microbial isolation techniques. Students will gain hands-on experience in evaluating pollution levels and understanding the impact of industrial and environmental contamination through case studies and field visits.

<table>
<tr><td>Course Outcomes</td><td colspan="9">Upon completion of the Environmental Biotechnology Practical Course, students will:
Students will learn to measure the Biological Oxygen Demand (BOD) to assess the organic pollution in water.
Students will develop skills to determine the Chemical Oxygen Demand (COD) for evaluating the level of chemical pollutants in water.
Students will learn to measure the concentration of dissolved solids in wastewater, indicating water quality.
Students will gain experience in isolating microorganisms from contaminated soil for environmental analysis.
Students will learn techniques for isolating microorganisms from industrial wastewater to understand microbial contamination.
Students will perform coliform testing to assess the microbial quality of water.
Students will isolate bacteria from petroleum-contaminated soil.
Students will use pH strips/pH meter to evaluate the acidity or alkalinity of water and soil samples.
Students will analyze the environmental and human impact of the Bhopal Gas Tragedy through case study analysis.
Students will gain practical insights into wastewater treatment processes by visiting a treatment plant.</td></tr>
<tr><td rowspan="2">Mapping between COs with PSOs</td><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td><td>PSO7</td><td>PSO8</td></tr>
<tr><td>CO1 to 10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Pre-requisite</td><td colspan="9">Basic Science</td></tr>
<tr><td></td><td colspan="9">1. Estimation of BOD in polluted water samples.
2. Estimation of COD in polluted water samples.
3. Estimation of Total Dissolved Solids (TDS) in waste water samples.
4. Isolation of microorganisms from Polluted soil.
5. Isolation of microorganisms from Industrial effluents.
6. Determination of quality of water sample (Coliform test).
7. Isolation of Bacteria from Crude Petroleum Oil Contaminated Soil.
8. Measurement of Water & Soil Quality Using pH Strips/pH Meter.
9. Case Study: Bhopal Gas Tragedy.
10. Visit to a Wastewater Treatment Plant.</td></tr>
<tr><td>Reference Books</td><td colspan="9">Fulekar MH, Environmental biotechnology, CRC Press; 2010 Jul 19.
Thakur IS. Environmental Biotechnology. IK International, New Delhi. 2006.</td></tr>
</table>

e-learning resources	• https://www.sciencedirect.com/topics/engineering/total-dissolvedsolid#:~:text=Water%20and%20effluents&text=TDS%20is%20usually%20given%20as,%CE%BCho'%20or%20'%CE%BCS'. • https://www.researchgate.net/publication/343601060_Case_study_for_Bhopal_Gas_Tragedy
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment Laboratory work, Journal preparation
Evaluation Method	50% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 50% External based on semester end University examination.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty):
Skill Enhancement Course

Teaching & Evaluation Scheme
Semester-V & VI
[Academic Year of Implementation 2025-2026]

Semester-V

Course Code	Course Title	Teaching Schedule Hours/Week	Exam Duration & Marks			Total Theory/Practical Marks	Credit
			Duration (Hours: Minutes)	(CCE) Internal Marks	(SEE) External Marks		
BT-SEC-501	Separation Techniques in Molecular Biology	1	00:30	13	12	25	1
BTP-SEC-501	Separation Techniques in Molecular Biology: Practical	2	03:00	12	13	25	1
	Total	**3**	**03:30**	**25**	**25**	**50**	**2**

Semester-VI

Course Code	Course Title	Teaching Schedule Hours/Week	Exam Duration & Marks			Total Theory/Practical Marks	Credit
			Duration (Hours: Minutes)	(CCE) Internal Marks	(SEE) External Marks		
---	---	---	---	---	---	---	---
---	---	---	---	---	---	---	---

[Subject Code for Theory -2503001305066001]
[Subject Code for Practical-2503001305066002]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty)

(3 Years B. Sc. Degree; 4 Years B. Sc. with Honours/Honours with Research)

Semester-V

Skill Enhancement Course: BT-SEC-501: Separation Techniques in Molecular Biology

Course Code	BT-SEC-501/ BTP-SEC-501	
Course Title	**Separation Techniques in Molecular Biology**	
Credits	2	
Course Level	300-399	
Total engagement	1 Credits x 15 Hours + 1 Credit x 30 Hours = 45 Hours	
Teaching per week	3 h	
Minimum weeks per semester	15 weeks (Including class work, examination, preparation & holidays)	
Effective from	2025-26	
Purpose of Course	This course is to provide students with a comprehensive understanding of electrophoretic techniques and their applications in molecular biology and biochemistry.	
Course Objectives	- To introduce students to the fundamental principles of electrophoresis - To explore various types of electrophoresis, such as agarose gel electrophoresis, polyacrylamide gel electrophoresis (PAGE) - To provide hands-on experience with electrophoretic techniques, including sample preparation, gel casting, running electrophoresis, and staining/destaining procedures.	
Course Outcomes	CO1: Students will demonstrate a thorough understanding of the principles and mechanisms underlying electrophoretic techniques for DNA, RNA and Protein separation. CO2: Students will gain hands-on experience and technical proficiency in preparing and running various gel electrophoresis for separation and analysis of Nucleic acid and Protein.	
Mapping between COs with PSOs		
Pre-requisite	Biology; Chemistry, Physics	
Course Content	**UNIT-1: Electrophoretic Techniques** General Principles, Support media and Buffers, Electrophoresis of Protein (SDS-PAGE, Native gels, Gradient gels, Detection, Estimation and Recovery of Proteins in Gels), Electrophoresis of Nucleic acids (Agarose Gel Electrophoresis of DNA, DNA Sequencing Gels, Electrophoresis of RNA).	Teaching Hours: 15
	UNIT-2: Practical 1. Preparation of Agarose gel. 2. Separation of DNA using Agarose Electrophoresis. 3. Elution of DNA fragment from Agarose gel. 4. Quantitative determination of DNA and RNA by Spectroscopic method.	Teaching Hours: 30

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	■			■			■	
CO2	■	■		■				

	5. Separation of protein using SDS-PAGE (Demonstration).	
Reference Books	• Aneja, K. (2014). Laboratory Manual of Microbiology and Biotechnology (1st ed.). MedTech. • Michov, B. (2022). Electrophoresis Fundamentals: Essential Theory and Practice. De Gruyter. • Sengar, G. S. (2011). Laboratory Manual on Biotechnology. Studium Press Pvt. Ltd. • Wilson, W. (2018). Principles and Techniques of Biochemistry and Molecular Biology (8th ed.). Cambridge University Press.	
e-learning resources	• https://www.youtube.com/dbtvnsgu • https://www.bio-rad.com	
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment	
Evaluation Method	50% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 50% External based on semester end University examination.	