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.
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ક્રમાંકઃઓથો./પરિપત્ર/૧૩૬૪૦/૨૦૨૬
તા.૧૯/૦૬/૨૦૨૬

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

વિષયઃ– B.Sc. Biotechnology Sem.- 7 & 8 Honours (with OJT/without OJT) અને Honours with Research ના અભ્યાસક્રમ બાબત.

સુજ્ઞશ્રી,

સવિનય જણાવવાનું કે, NEP-2020 અંતર્ગત શૈક્ષણિક વર્ષ ૨૦૨૬–૨૭ થી અમલમાં આવનાર B.Sc. Biotechnology Sem.- 7 & 8 Honours (with OJT / without OJT) અને Honours with Research નો પેટાસમિતિ દ્વારા તૈયાર કરેલ અભ્યાસક્રમ બાયોટેકનોલોજી વિષયની અભ્યાસ સમિતિની તા.૦૨/૦૪/૨૦૨૬ ની સભાના ઠરાવ ક્રમાંકઃ૦૨ થી મંજૂર કરી વિજ્ઞાન વિદ્યાશાખાને કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાની તા.૦૪/૦૬/૨૦૨૬ની સભાના ઠરાવ ક્રમાંકઃ૧૪થી મંજૂર કરવા એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલની તા.૧૮/૦૬/૨૦૨૬ની સભાના ઠરાવ ક્રમાંકઃ૧૨ થી મંજૂર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

(બિડાણઃ ઉપર મુજબ)

કુલસચિવ વતી

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

.....જાણ સારૂ.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
Department of Biotechnology, VNSGU, Surat
TEACHING & EVALAUTION SCHEME (As per NEP 2020)
Programme Name: Undergraduate Program in Biotechnology (B. Sc. Biotechnology - Semester - VII) With Research/OJT

Structure																	
Course Category	**Course Code**	**Course Title**	**Mark Sheet Title in English**	**Level of Course**	**Teaching Hours/Week**		**Exam Duration (Hours)**		**Credit**		**Internal Marks**		**External Marks**		**Total**	
					TH	**PR**	**TH**	**PR**	**TH**	**PR**	**TH**	**PR**	**TH**	**PR**	**TH**	**PR**
Bachelor of Science	BT-MJ-701	Genomics and Proteomics	Genomics and Proteomics	400-499	2		1		2		25		25		50	
	BTP-MJ-701	Genomics and Proteomics: Practical	Genomics and Proteomics: Practical			4		6		2		25		25		50
	BT-MJ-702	Industrial Fermentation Technology	Industrial Fermentation Technology		2		1		2		25		25		50	
	BTP-MJ-702	Industrial Fermentation Technology: Practical	Industrial Fermentation Technology: Practical			4		6		2		25		25		50
	BT-MJ-703	GMP, Quality Control & Validation	GMP, Quality Control & Validation		2		1		2		25		25		50	
	BTP-MJ-703	GMP, Quality Control & Validation: Practical	GMP, Quality Control & Validation: Practical			4		6		2		25		25		50
	BT-ME-701	Sustainable Development Goals in Biotechnology	Sustainable Development Goals in Biotechnology		2		1		2		25		25		50	
	BTP-ME-701	Sustainable Development Goals in Biotechnology: Practical	Sustainable Development Goals in Biotechnology: Practical			4		6		2		25		25		50
	OR				OR											
	ME	Fundamentals of Cyber Security	Fundamentals of Cyber Security		4		2		4		50		50		100	
	BT-RP-01	Research Project / On-the-Job Training (OJT)	Research Project / On-the-Job Training (OJT)			12				6		75		75		150

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
Department of Biotechnology, VNSGU, Surat
TEACHING & EVALAUTION SCHEME (As per NEP 2020)
Programme Name: Undergraduate Program in Biotechnology (B. Sc. Biotechnology - Semester - VII) Without Research/OJT

Structure																	
Course Category	**Course Code**	**Course Title**	**Mark Sheet Title in English**	**Level of Course**	**Teaching Hours/Week**		**Exam Duration (Hours)**		**Credit**		**Internal Marks**		**External Marks**		**Total**	
					TH	**PR**	**TH**	**PR**	**TH**	**PR**	**TH**	**PR**	**TH**	**PR**	**TH**	**PR**
Bachelor of Science	BT-MJ-701	Genomics and Proteomics	Genomics and Proteomics	400-499	2		1		2		25		25		50	
	BTP-MJ-701	Genomics and Proteomics: Practical	Genomics and Proteomics: Practical			4		6		2		25		25		50
	BT-MJ-702	Industrial Fermentation Technology	Industrial Fermentation Technology		2		1		2		25		25		50	
	BTP-MJ-702	Industrial Fermentation Technology: Practical	Industrial Fermentation Technology: Practical			4		6		2		25		25		50
	BT-MJ-703	GMP, Quality Control & Validation	GMP, Quality Control & Validation		2		1		2		25		25		50	
	BTP-MJ-703	GMP, Quality Control & Validation: Practical	GMP, Quality Control & Validation: Practical			4		6		2		25		25		50
	BT-MJ-704	Entrepreneurship in Rural Economy	Entrepreneurship in Rural Economy		4		2		4		50		50		100	
	OR				OR											
	BT-MJ-705	IPR, Bioethics and Biosafety	IPR, Bioethics and Biosafety		4		2		4		50		50		100	
	BT-ME-701	Sustainable Development Goals in Biotechnology	Sustainable Development Goals in Biotechnology		2		1		2		25		25		50	
	BTP-ME-701	Sustainable Development Goals in Biotechnology: Practical	Sustainable Development Goals in Biotechnology: Practical			4		6		2		25		25		50
	OR				OR											
	ME	Fundamentals of Cyber Security	Fundamentals of Cyber Security		4		2		4		50		50		100	
	MJ-UGRM0107	Research Methodology-I	Research Methodology-I		2		1		2		25		25		50	

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
Department of Biotechnology, VNSGU, Surat
TEACHING & EVALAUTION SCHEME (As per NEP 2020)
Programme Name: Undergraduate Program in Biotechnology (B. Sc. Biotechnology - Semester - VIII) With Research/OJT

Structure																	
Course Category	**Course Code**	**Course Title**	**Mark Sheet Title in English**	**Level of Course**	**Teaching Hours/Week**		**Exam Duration (Hours)**		**Credit**		**Internal Marks**		**External Marks**		**Total**	
					TH	**PR**	**TH**	**PR**	**TH**	**PR**	**TH**	**PR**	**TH**	**PR**	**TH**	**PR**
Bachelor of Science	BT-MJ-801	Advanced Molecular Techniques	Advanced Molecular Techniques	400-499	2		1		2		25		25		50	
	BTP-MJ-801	Advanced Molecular Techniques: Practical	Advanced Molecular Techniques: Practical			4		6		2		25		25		50
	BT-MJ-802	Bioinformatics and Data Sciences	Bioinformatics and Data Sciences		2		1		2		25		25		50	
	BTP-MJ-802	Bioinformatics and Data Sciences: Practical	Bioinformatics and Data Sciences: Practical			4		6		2		25		25		50
	BT-MJ-803	Entrepreneurship in Life Science	Entrepreneurship in Life Science		2		1		2		25		25		50	
	BTP-MJ-803	Entrepreneurship in Life Science: Practical	Entrepreneurship in Life Science: Practical			4		6		2		25		25		50
	BT-ME-801	Nanotechnology	Nanotechnology		2		1		2		25		25		50	
	BTP-ME-801	Nanotechnology: Practical	Nanotechnology: Practical			4		6		2		25		25		50
	OR				OR											
	ME	Entrepreneurship	Entrepreneurship		4		2		4		50		50		100	
	BT-RP-02	Research Project / On-the-Job Training (OJT)	Research Project / On-the-Job Training (OJT)			12				6		75		75		150

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
Department of Biotechnology, VNSGU, Surat
TEACHING & EVALAUTION SCHEME (As per NEP 2020)
Programme Name: Undergraduate Program in Biotechnology (B. Sc. Biotechnology - Semester - VIII) Without Research/OJT

Structure																	
Course Category	**Course Code**	**Course Title**	**Mark Sheet Title in English**	**Level of Course**	**Teaching Hours/Week**		**Exam Duration (Hours)**		**Credit**		**Internal Marks**		**External Marks**		**Total**	
					TH	**PR**	**TH**	**PR**	**TH**	**PR**	**TH**	**PR**	**TH**	**PR**	**TH**	**PR**
Bachelor of Science	BT-MJ-801	Advanced Molecular Techniques	Advanced Molecular Techniques	400-499	2		1		2		25		25		50	
	BTP-MJ-801	Advanced Molecular Techniques: Practical	Advanced Molecular Techniques: Practical			4		6		2		25		25		50
	BT-MJ-802	Bioinformatics and Data Sciences	Bioinformatics and Data Sciences		2		1		2		25		25		50	
	BTP-MJ-802	Bioinformatics and Data Sciences: Practical	Bioinformatics and Data Sciences: Practical			4		6		2		25		25		50
	BT-MJ-803	Entrepreneurship in Life Science	Entrepreneurship in Life Science		2		1		2		25		25		50	
	BTP-MJ-803	Entrepreneurship in Life Science: Practical	Entrepreneurship in Life Science: Practical			4		6		2		25		25		50
	BT-MJ-804	Synthetic Biology	Synthetic Biology		4		2		4		50		50		100	
	BT-ME-801	Nanotechnology	Nanotechnology		2		1		2		25		25		50	
	BTP-ME-801	Nanotechnology: Practical	Nanotechnology: Practical			4		6		2		25		25		50
	OR				OR											
	ME	Entrepreneurship	Entrepreneurship		4		2		4		50		50		100	
	MJ-UGRM02028	Research Methodology - II	Research Methodology - II		2		1		2		25		25		50	

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program

In

Biotechnology

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

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program in Biotechnology

Major & Minor with Research/OJT

Teaching & Evaluation Scheme: Semester-VII

[Academic Year of Implementation 2026-2027]

Semester-VII

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-701	Genomics and Proteomics	2	1:00	25	25	50	2
BTP-MJ-701	Genomics and Proteomics: Practical	4	4:00 to 6:00	25	25	50	2
BT-MJ-702	Industrial Fermentation Technology	2	1:00	25	25	50	2
BTP-MJ-702	Industrial Fermentation Technology: Practical	4	4:00 to 6:00	25	25	50	2
BT-MJ-703	GMP, Quality Control & Validation	2	1:00	25	25	50	2
BTP-MJ-703	GMP, Quality Control & Validation: Practical	4	4:00 to 6:00	25	25	50	2
BT-ME-701	Sustainable Development Goals in Biotechnology	2	1:00	25	25	50	2
BTP-ME-701	Sustainable Development Goals in Biotechnology: Practical	4	4:00 to 6:00	25	25	50	2
OR							
ME	Fundamentals of Cyber Security	4	4:00	50	50	100	4
BT-RP-01	Research Project / On-the-Job Training (OJT)	12		75	75	150	6
Total		**36/34**	**--**	**275**	**275**	**550**	**22**

[Subject code-2603000507011111]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Employability and Skill Development
Subject Type	Discipline Specific Course
Course Code	BT-MJ-701
Course Level	400-499
Course Title	Genomics and Proteomics
Credit	2
Effective From	Academic Year: 2026-2027
Course Outcomes	**CO1:** Principle and scope of genomics, Genome sequencing strategies, functional genomics approaches, Gene silencing and evaluation of ethical, legal, and social implications of Human Genome Project. **CO2:** Techniques for protein identification and characterization, analyze omics data for biological problem-solving including structural analysis of proteins.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Course Content	**UNIT – 1: Mapping & Sequencing of Genomes** History & Scope of Genomics, Genetic and Physical Mapping, DNA sequencing (Sanger and Pyrosequencing), Analysis of DNA sequences, Assembling and Annotation of Genome sequences, Functional Genomics, Gene silencing, Human Genome Project, Ethical, Legal & Social Implications of Human Genome.	Teaching Hours: 15
	UNIT – 2: Expression Analysis & Characterization of Proteins Introduction, Protein Separation Techniques (2D Gel Electrophoresis, RPLC, HPLC), Protein Characterization (Mass Spectrometry, MALDI) Protein Microarrays, Structural Proteomics (X-ray Crystallography & NMR)	Teaching Hours: 15

Reference Books	• Peter J. Russell – iGenetics A Molecular Approach, 3rd Edition, Pearson Education, 2010 • S. B. Primrose and R.M. Twyman - Principles of Genome Analysis and Genomics, 7th Edition, Blackwell Publishing, 2006. • T. A. Brown – Genomes 4, Garland Science, Taylor & Francis Group

	• T. A. Brown – Gene Cloning and DNA Analysis - An Introduction, 7th edition, WILEY Blackwell • Snustad &Simmons- Principles of Genetics, 6th Edition, WILEY
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Employability and Skill Development
Subject Type	Discipline Specific Course
Course Code	BTP-MJ-701
Course Level	400-499
Course Title	Genomics and Proteomics: Practical
Credit	2
Effective From	Academic Year: 2026-2027
Course Outcomes	CO: To learn how Basic Mapping technique, DNA extraction from model organism, preparation of SDS Gel, isolation of proteins from plants, SDS-PAGE with isolated proteins, Different Staining Techniques (Coomassie brilliant blue & Silver Staining)
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO								

Course Content	1. To study Partial Restriction Digestion for Restriction Mapping. 2. To study the extraction of DNA from Yeast (*Saccharomyces cerevisiae*) 3. To study the isolation of total proteins from plants. 4. To study the gel preparation for SDS-PAGE. 5. To study the protein profiling by SDS-PAGE with different staining techniques (Coomassie brilliant blue & Silver Staining)	Teaching Hours: 60
Reference Books	• Sambrook & Russell (3rd ed.). (1989). Molecular Cloning: A Laboratory Manual (Vols. 1to3). Cold Spring Harbor Laboratory Press • T. Devasena, (2010); Enzymology; OXFORD University Press • Arti Nigam & Archana Ayyagari Lab Manual in Biochemistry, Immunology and Biotechnology Tata McGraw-Hill	
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments	
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

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Employability and Skill Development
Subject Type	Discipline Specific Course
Course Code	BT-MJ-702
Course Level	400-499
Course Title	Industrial and Fermentation Technology
Credit	2
Effective From	Academic Year: 2026-2027
Course Outcomes	**CO1:** Apply core principles of bioprocess engineering to analyse bioreactor systems, microbial growth kinetics, fluid rheology, oxygen transfer phenomena, and statistical methods for media optimization in batch and continuous fermentation processes. **CO2:** Students will learn, how metabolic pathways are discovered and manipulated, to produce desired metabolite, at industrial level.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Course Content

UNIT – 1: Bioprocess Engineering Bioreactors and types of bioreactors, Monod equation, Batch culture, and continuous culture. Fluid Rheology (Reynolds number, flow regimes, Power number (Np)), Oxygen transfer (OTR, OUR, kLa), Media optimization (Placket Burman, Response surface methodology).	Teaching Hours: 15
UNIT – 2: Metabolic Control and Strain Improvement Methods for decoding metabolic pathways, Feedback inhibition and its types, feedback repression, Mutants which do not produce feedback inhibitors or repressors, Mutants that do not recognize presence of inhibitors or repressors, use of auxotroph for production of primary metabolites.	Teaching Hours: 15

Reference Books	• Stanbury, P. F., Whitaker, A., & Hall, S. J. (2016). Principles of fermentation technology (3rd ed.). Elsevier. • Crueger, W., & Crueger, A. (1990). A textbook of industrial microbiology (2nd ed.). Sinauer Associates. • Doran, P. M. (2013). Bioprocess engineering principles (2nd ed.). Academic Press.

	• Nelson, D. L., & Cox, M. M. (2021). Lehninger Principles of Biochemistry (8^{th} ed.). • Montgomery, D. C. (2017). Design and analysis of experiments (9^{th} ed.). John Wiley & Sons
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Employability and Skill Development
Subject Type	Discipline Specific Course
Course Code	BTP-MJ-702
Course Level	400-499
Course Title	Industrial and Fermentation Technology: Practical
Credit	2
Effective From	Academic Year: 2026-2027
Course Outcomes	CO: Throughout the course, students will gain hands-on experience in bioprocess engineering by using statistical tools like Plackett–Burman and Response Surface Methodology to optimize yeast growth media. They will learn to measure and analyze Oxygen Transfer Rates (OTR) to ensure efficient aerobic fermentation and will study microbial kinetics by applying the Monod equation to growth curves. Additionally, students will design and operate both batch and continuous immobilized enzyme bioreactors, comparing their productivity and stability across different systems.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO									

Course Content	1. Screening of Variables for growth media of yeast using Placket Burman method. 2. Use of Response surface methodology for media optimization (for yeast) 3. Determination of Oxygen transfer rate (OTR) by sulphite oxidation method 4. Determination of factors affecting OTR 5. Construct Growth curve and Derive Monod equation (using Yeast) 6. Construction of Immobilized Invertase Enzyme bioreactor (Batch and continuous)	Teaching Hours: 60

Reference Books	• Stanbury, P. F., Whitaker, A., & Hall, S. J. (2016). Principles of fermentation technology (3rd ed.). Elsevier. • Crueger, W., & Crueger, A. (1990). A textbook of industrial microbiology (2nd ed.). Sinauer Associates. • Doran, P. M. (2013). Bioprocess engineering principles (2nd ed.). Academic Press.

	• Nelson, D. L., & Cox, M. M. (2021). Lehninger principles of biochemistry (8th ed.). W. H. Freeman. • Montgomery, D. C. (2017). Design and analysis of experiments (9th ed.). John Wiley & Sons • Suresh, S., Srivastava, V. C., & Mishra, I. M. (2009). Techniques for oxygen transfer measurement in bioreactors: A review. Chemical Engineering Journal, 152(2–3), 473–489. • Yang, Y., Deinstadt, M., & Eppendorf SE. (2018). Measuring the oxygen transfer rate (OTR) of fermentation bioreactors using the sulfite oxidation method. Eppendorf Bioprocess Center. • Monod, J. (1949). The growth of bacterial cultures. Annual Review of Microbiology, 3, 371–394. • Brena, B. M., & Batista-Viera, F. (2006). Immobilization of enzymes: A literature survey. Methods in Biotechnology, 22, 15–30. • Ross, D., Karimi, I. A., & Pandey, A. (2022). Bioprocess engineering principles (2nd ed.). Elsevier.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Employability
Subject Type	Discipline Specific Course
Course Code	BT-MJ-703
Course Level	400-499
Course Title	GMP, Quality Control & Validation
Credit	2
Effective From	Academic Year: 2026-2027
Course Outcomes	**CO1:** The student will learn the concept, evolution, objectives, and scope of Good Manufacturing Practices (GMP) and their importance in pharmaceutical, biotechnology, and food product industries. The student will understand the GMP regulatory frameworks of WHO, FDA, BIS, and ISO, and the role of organization, personnel, and training in maintaining quality systems. **CO2:** The student will understand the principles of validation and qualification, including types of validation, analytical method validation, and cleaning validation, in compliance with regulatory guidelines. The student will understand and demonstrate the process validation lifecycle, including documentation systems, deviation handling, complaints, recalls, and preparation of validation reports to support continuous quality improvement.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Course Content	**UNIT – 1: GMP Manufacturing Practices and Quality Control** Concept and Evolution of GMP, Objectives and Scope of GMP (Pharmaceutical, Biotechnology, Food Products), Importance of GMP and consequences of non-compliance, GMP Regulatory Frameworks (WHO, FDA 21 CFR 210 & 211, BIS, ISO 9001 & ISO 22000), Quality Management Systems and Quality Assurance overview, Organization & Personnel (roles, responsibilities, training and competency), Premises and Facility design, Layout and workflow, Environmental Controls (HVAC, cleanrooms and monitoring), Equipment Qualification concepts (DQ, IQ, OQ, PQ) and maintenance, Calibration and logbooks, Raw & Packaging Material Control (receipt, sampling, storage, release and traceability), Documentation Systems (SOPs, Batch Records, Change Control), Sanitation, Hygiene and Contamination Control, Deviations, CAPA, Complaints handling and Product Recalls.	Teaching Hours: 15

	UNIT – 2: Process Validation Quality Control Concepts & Objectives, Sampling Techniques, Specifications and basic statistical aspects, In-Process and Finished Product Quality Control, Analytical QC parameters (Accuracy, Precision, Specificity, Linearity, Range, Robustness, Solution Stability, LOD and LOQ), Handling of Out-of-Specification (OOS) results, Introduction to Validation and Qualification, Types of Validation (Process, Cleaning and Analytical Method Validation), Analytical Method Validation Parameters and Acceptance Criteria, Cleaning Validation Principles and Approaches, Process Validation Lifecycle (Process Design, Process Qualification, Continued Process Verification), Validation Master Plan (VMP), Documentation, Preparation of Validation Reports, Continuous Quality Improvement and Management Review.	Teaching Hours: 15
Reference Books	• WHO Good Manufacturing Practices – TRS 986 Annex 2: https://www.who.int/publications/m/item/trs986-annex2 • FDA Process Validation: General Principles and Practices: https://www.fda.gov/regulatory-information/search-fda-guidance-documents/process-validation-general-principles-and-practices • ICH Validation of Analytical Procedures (Q2(R1)): https://www.gmp-compliance.org/files/guidemgr/Q2(R1).pdf • WHO GMP Validation Guidelines – Annex 3 TRS 1019: https://www.who.int/docs/default-source/medicines/norms-and-standards/guidelines/production/trs1019-annex3-gmp-validation.pdf • FDA cGMP regulations (21 CFR Part 210/211) – https://www.ecfr.gov/current/title-21/chapter-I/subchapter-C/part-211	
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments	
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

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Skill Development
Subject Type	Discipline Specific Course
Course Code	BTP-MJ-703
Course Level	400-499
Course Title	GMP, Quality Control & Validation: Practical
Credit	2
Effective From	Academic Year: 2026-2027
Course Outcomes	CO: The student will learn and prepare GMP-compliant documentation such as Standard Operating Procedures (SOPs), demonstrate the principles of GMP facility layout, material and personnel flow, sanitation, hygiene, and contamination control through case studies and laboratory observations. The student will perform and document equipment calibration and qualification activities (IQ, OQ, PQ) for commonly used laboratory instruments to ensure reliability and accuracy. The student will learn and apply quality control techniques, The student will understand and prepare validation protocols and reports, including analytical method validation and cleaning validation, using experimental or model data.
Mapping between Cos and PSOs	

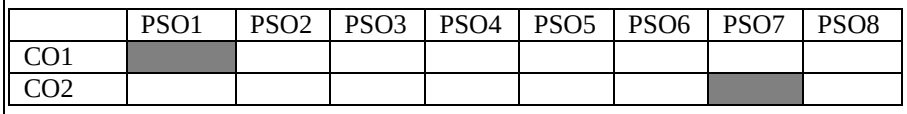
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO								

Course Content	1. Prepare a Report on Standard Operating Procedures (SOPs) for any Pharmaceutical/Biotechnology/Food product. 2. Case study of GMP outline of any reputed company. 3. Equipment Calibration and Report Documentation at your institute level 4. Labelling, Storage and Traceability according to QC Guidelines. 5. Prepare Report on: Validation Mock report.	Teaching Hours: 60
Reference Books	• World Health Organization (WHO). Good Manufacturing Practices for Pharmaceutical Products (TRS 986, Annex https://www.who.int/publications/m/item/trs986-annex2 • World Health Organization (WHO). Guidelines on Validation – GMP (TRS 1019, Annex 3). https://www.who.int/docs/default-source/medicines/norms-and-standards/guidelines/production/trs1019-annex3-gmp-validation.pdf	

	• U.S. Food and Drug Administration (FDA). Process Validation: General Principles and Practices. https://www.fda.gov/files/drugs/published/Process-Validation--General-Principles-and-Practices.pdf • U.S. Food and Drug Administration (FDA). Current Good Manufacturing Practice (cGMP) Regulations – 21 CFR Parts 210 & 211. https://www.ecfr.gov/current/title-21/chapter-I/subchapter-C • International Council for Harmonisation (ICH). Q2(R1): Validation of Analytical Procedures – Text and Methodology. https://www.fda.gov/media/152208/download • European Commission. EudraLex Volume 4 – EU Guidelines for Good Manufacturing Practice. https://health.ec.europa.eu/medicinal-products/eudralex/eudralex-volume-4_en
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VII
NCrF Credit Level	6
Course Type	Minor
Course Subtype	Employability
Subject Type	Intra-disciplinary
Course Code	BT-ME-701
Course Level	400-499
Course Title	Sustainable Development Goals in Biotechnology
Credit	2
Effective From	Academic Year: 2026-2027
Course Outcomes	**CO1:** Understand the Principles, Concept, Scope & Importance of sustainable and green biotechnology with Developmental Goals (SDGs). **CO2:** To get Knowledge regarding Bioremediation, Bio fertilizers, Biofuels , Bio-pesticides and Ethical, Regulatory, and Biosafety issues.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Course Content	**UNIT – 1: Foundations of Sustainable and Green Biotechnology** Concept, scope, and importance of sustainable and green biotechnology, United Nations Sustainable Development Goals (SDGs): overview and relevance to biotechnology and their role in achieving SDGs (2, 3, 6, 7, 12, 13, 15), Principles of green biotechnology and its applications.	Teaching Hours: 15
	UNIT – 2: Applications of Sustainable Biotechnology Concept and applications of: Bioremediation, Biofertilizers, Biofuels and Biopesticides, Biotechnology for clean water and sanitation, sustainable biomaterials and their applications, Ethical, Regulatory, and Biosafety issues.	Teaching Hours: 15

Reference Books	• Abha Kumari (2025), Sustainable Technologies for Value Addition to Biomass Waste. Elsevier, ISNB: 978-0-443-36318-4 • R. K. Salar (2013), Biotechnology: Prospects & Applications, Springer, eISBN: 978-81-322-1683-4 • Alan H. Scragg (2005), Environmental Biotechnology, Oxford University Press, ISBN-13: 9780199268672 • OECD, Biotechnology for Sustainable Development • Christoph Wittmann & James C. Liao (2017), Industrial Biotechnology, Wiley, ISBN-978-3-527-34179-5
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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
SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VII
NCrF Credit Level	6
Course Type	Minor
Course Subtype	Employability
Subject Type	Intra-disciplinary
Course Code	BTP-ME-701
Course Level	400-499
Course Title	Sustainable Development Goals in Biotechnology: Practical
Credit	2
Effective From	Academic Year: 2026-2027
Course Outcomes	CO: To characterize microbial biofertilizers, analyze vermicompost & energy consumption and evaluate the effectiveness of biofertilizers.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO								

Course Content	1. Production and characterization of microbial bio-fertilizers (Azotobacter/Rhizobium) 2. Preparation and analysis of compost. 3. Seed germination and growth promotion assay using biofertilizers. 4. To Analyze Energy consumption of the given Area. 5. Case study-based practical on sustainability.	Teaching Hours: 60
Reference Books	• Abhakumari (2025), Sustainable Technologies for Value Addition to Biomass Waste. Elsevier, ISNB: 978-0-443-36318-4 • R. K. Salar (2013), Biotechnology: Prospects & Applications, Springer, eISBN: 978-81-322-1683-4 • Alan H. Scragg (2005), Environmental Biotechnology, Oxford University Press, ISBN-13: 9780199268672 • OECD, Biotechnology for Sustainable Development • Christoph Wittmann & James C. Liao (2017), Industrial Biotechnology, Wiley, ISBN-978-3-527-34179-5	
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments	
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

Major & Minor with Research/OJT

Teaching & Evaluation Scheme: Semester-VIII

[Academic Year of Implementation 2026-2027]

Semester-VIII

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-801	Advanced Molecular Techniques	2	1:00	25	25	50	2
BTP-MJ-801	Advanced Molecular Techniques: Practical	4	4:00 to 6:00	25	25	50	2
BT-MJ-802	Bioinformatics and Data Sciences	2	1:00	25	25	50	2
BTP-MJ-802	Bioinformatics and Data Sciences: Practical	4	4:00 to 6:00	25	25	50	2
BT-MJ-803	Entrepreneurship in Life Science	2	1:00	25	25	50	2
BTP-MJ-803	Entrepreneurship in Life Science: Practical	4	4:00 to 6:00	25	25	50	2
BT-ME-801	Nanotechnology	2	1:00	25	25	50	2
BTP-ME-801	Nanotechnology: Practical	4	4:00 to 6:00	25	25	50	2
OR							
ME	Entrepreneurship	4	4:00	50	50	100	4
BT-RP-02	Research Project / On-the-Job Training (OJT)	12		75	75	150	6
Total		**36/34**	**--**	**275**	**275**	**550**	**22**

[Subject code-2703000508011111**]**

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VIII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Employability and Skill Development
Subject Type	Discipline Specific
Course Code	BT-MJ-801
Course Level	400-499
Course Title	Advanced Molecular Techniques
Credit	2
Effective From	Academic Year: 2026-27
Course Outcomes	**CO1:** Explain and apply the principles of advanced protein and nucleic acid techniques, including Western blotting, affinity purification, flow cytometry, hybridization, and isothermal amplification, in biotechnology applications. **CO2:** Explain and apply the principles of advanced protein and nucleic acid techniques, including Western blotting, affinity purification, flow cytometry, hybridization, and isothermal amplification, in biotechnology applications.

Mapping between Cos and PSOs

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

Course Content

UNIT – 1: Advanced Techniques for Protein Analysis

Advanced Western blotting: quantitative Western, normalization, common pitfalls. Tag-based and affinity purification: basic idea of fusion/epitope tags (His, GST, FLAG) and Ni-NTA/antibody-based affinity chromatography. Flow cytometry: principle of fluorescence-based single-cell analysis, basic plots/gating idea, and key applications (immunophenotyping of immune cells, apoptosis, cell cycle – at concept level). Protein–protein interaction methods: Basic concept of co-immunoprecipitation (Co-IP). Immunofluorescence techniques: Basic principle of fluorescence-based protein localization (concept level).

Teaching Hours: 15

	UNIT – 2: Advanced Techniques in Nucleic Acid & PCR Isothermal amplification: basic concepts and application of LAMP. Nucleic acid hybridization: principles and uses of Southern and Northern blotting. Primer design: Basic principles of primer design for nucleic acid amplification. DNA–protein interaction analysis: Basic concept of Electrophoretic Mobility Shift Assay (EMSA). Comparative analysis of molecular techniques: Selection of amplification and hybridization methods for research and diagnostic applications. Applications in molecular diagnostics: Role of molecular techniques in pathogen detection and disease diagnosis.	Teaching Hours: 15
Reference Books	• Green, M.R., & Sambrook, J. (2012). Molecular Cloning: A Laboratory Manual (4th ed.). New York: Cold Spring Harbor Laboratory Press. • Brown, T.A. (2020). Gene Cloning and DNA Analysis: An Introduction (7th ed.). Oxford: Wiley-Blackwell. • Primrose, S.B., & Twyman, R.M. (2013). Principles of Gene Manipulation and Genomics (8th ed.). Oxford: Wiley-Blackwell. • Simpson, R.J. (2003). Proteins and Proteomics: A Laboratory Manual. New York: Cold Spring Harbor Laboratory Press. • Lesk, A.M. (2016). Introduction to Protein Science: Architecture, Function and Genomics (3rd ed.). Oxford: Oxford University Press. • Buckingham, L., & Flaws, M. (2019). Molecular Diagnostics: Fundamentals, Methods and Clinical Applications (3rd ed.). Philadelphia: F.A. Davis Company. • Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., & Losick, R. (2014). Molecular Biology of the Gene (7th ed.). Boston: Pearson Education. • Simpson, R.J. (2003). *Proteins and Proteomics: A Laboratory Manual*. New York: Cold Spring Harbor Laboratory Press. • Doudna, J.A., & Sternberg, S.H. (2017). *A Crack in Creation: Gene Editing and the Unthinkable Power to Control Evolution*. Boston: Houghton Mifflin Harcourt. • Buckingham, L., & Flaws, M.L. (2019). *Molecular Diagnostics: Fundamentals, Methods and Clinical Applications* (3rd ed.). Philadelphia: F.A. Davis Company. **E-Resources** • Genome Editing and Engineering (https://onlinecourses.nptel.ac.in/noc24_bt71/preview) • Computational Genomics (https://onlinecourses.nptel.ac.in/noc26_bt39/preview) Research/Review papers • https://pubmed.ncbi.nlm.nih.gov/12634793/ • https://pubmed.ncbi.nlm.nih.gov/10871386/ • https://pubmed.ncbi.nlm.nih.gov/20685252/ • https://pubmed.ncbi.nlm.nih.gov/15900442/ • https://pubmed.ncbi.nlm.nih.gov/24738055/ • https://pubmed.ncbi.nlm.nih.gov/19400705/ • https://pubmed.ncbi.nlm.nih.gov/18474036/ • https://pubmed.ncbi.nlm.nih.gov/26551336/ • https://pubmed.ncbi.nlm.nih.gov/28667615/ • https://pmc.ncbi.nlm.nih.gov/articles/PMC6918834/	

Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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-2703000508011112]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VIII
NCrF Credit Level	6.0
Course Type	Major
Course Subtype	Employability and Skill Development
Subject Type	Discipline Specific
Course Code	BTP-MJ-801
Course Level	400-499
Course Title	Advanced Molecular Techniques: Practical
Credit	2
Effective From	Academic Year: 2026-2027
Course Outcomes	Integrate and apply immunological, molecular biology, and bioinformatics approaches to design, perform, and analyze experimental and in silico workflows, including PCR optimization, protein analysis, antigen design, and recombinant DNA techniques, for accurate data interpretation in research and diagnostic application
Mapping between COs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO								

Course Content	1. Immunological Assays and Flow Cytometry Data Analysis (ELISA – indirect/sandwich and virtual flow cytometry interpretation) 2. Primer Design, *In Silico* PCR Validation, and Advanced Design Strategies 3. PCR Optimization and Gradient PCR Analysis 4. Bioinformatics Analysis of Protein Structure, Localization, and Function	Teaching Hours: 60

	5. Rational Antigen Design and Epitope Prediction 6. Recombinant DNA Analysis and Quantitative Data Interpretation (Restriction mapping, plasmid construction, gel densitometry using ImageJ, and EMSA concept)	
Reference Books	• Green, M.R., & Sambrook, J. (2012). Molecular Cloning: A Laboratory Manual (4th ed.). New York: Cold Spring Harbor Laboratory Press. • Brown, T.A. (2020). Gene Cloning and DNA Analysis: An Introduction (7th ed.). Oxford: Wiley-Blackwell. • Primrose, S.B., & Twyman, R.M. (2013). Principles of Gene Manipulation and Genomics (8th ed.). Oxford: Wiley-Blackwell. • Simpson, R.J. (2003). Proteins and Proteomics: A Laboratory Manual. New York: Cold Spring Harbor Laboratory Press. • Lesk, A.M. (2016). Introduction to Protein Science: Architecture, Function and Genomics (3rd ed.). Oxford: Oxford University Press. • Buckingham, L., & Flaws, M. (2019). Molecular Diagnostics: Fundamentals, Methods and Clinical Applications (3rd ed.). Philadelphia: F.A. Davis Company. • Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., & Losick, R. (2014). Molecular Biology of the Gene (7th ed.). Boston: Pearson Education. • Simpson, R.J. (2003). *Proteins and Proteomics: A Laboratory Manual*. New York: Cold Spring Harbor Laboratory Press. • Doudna, J.A., & Sternberg, S.H. (2017). *A Crack in Creation: Gene Editing and the Unthinkable Power to Control Evolution*. Boston: Houghton Mifflin Harcourt. • Buckingham, L., & Flaws, M.L. (2019). *Molecular Diagnostics: Fundamentals, Methods and Clinical Applications* (3rd ed.). Philadelphia: F.A. Davis Company.	
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments	
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

SYLLABUS

[Subject code-2703000508021111]

Program Name	B. Sc. Biotechnology Honors
Semester	VIII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Employability and Skill Development
Subject Type	Discipline Specific Course
Course Code	BT-MJ-802
Course Level	400-499
Course Title	Bioinformatics and Data Science
Credit	2
Effective From	Academic Year: 2026-27
Course Outcomes	**CO1:** To introduce fundamental concepts of bioinformatics and data science relevant to biological research. **CO2:** To develop basic skills in biological data analysis, visualization, and interpretation.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Course Content	**UNIT – 1: Introduction to Bioinformatics** Definition, scope, and applications of bioinformatics, biological data types: sequence, structure, expression, variation, Overview of omics technologies: genomics, transcriptomics, proteomics, metabolomics, biological databases: primary, secondary, and composite databases, Introduction to data standards and data formats (FASTA, GenBank, PDB)	Teaching Hours: 15
	UNIT – 2: Sequence Analysis and Data Science Basics Pairwise sequence alignment: global and local alignment, Database similarity search tools: BLAST, FASTA, Multiple sequence alignment: Clustal Omega, MUSCLE (concepts), Introduction to data science: data types, data preprocessing, cleaning, Introduction to Next-Generation Sequencing (NGS) data analysis, including quality control (FastQC), sequence alignment (e.g., BWA/Bowtie), variant calling (GATK), and basic downstream analysis and interpretation.	Teaching Hours: 15
Reference Books	• Baxevanis, A. D. & Ouellette, B. F. F. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins • Mount, D. W. Bioinformatics: Sequence and Genome Analysis	

	• Pevsner, J. Bioinformatics and Functional Genomics • Lesk, A. M. Introduction to Bioinformatics • Higdon et al. Biological Data Analysis • Bioinformatics Data Skills – Vince Buffalo, O'Reilly Media • Next-Generation DNA Sequencing Informatics – Cold Spring Harbor Laboratory Press • FastQC – Babraham Bioinformatics • Genome Analysis Toolkit (GATK) – Broad Institute • Burrows-Wheeler Aligner (BWA) – Li & Durbin
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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

SYLLABUS **[Subject code-2703000508021112]**

Program Name	B. Sc. Biotechnology Honors
Semester	VIII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Employability and Skill Development
Subject Type	Discipline Specific Course
Course Code	BTP-MJ-802
Course Level	400-499
Course Title	Bioinformatics and Data Science: Practical
Credit	2
Effective From	Academic Year: 2026-27
Course Outcomes	Demonstrate proficiency in the use of bioinformatics tools and databases to retrieve, analyze, and interpret nucleotide and protein sequences, perform sequence alignment (pairwise and multiple), conduct similarity searches using BLAST, and visualize three-dimensional protein structures for comprehensive biological analysis.
Mapping between Cos and PSOs	<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>CO</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>
Course Content	1. Introduction to bioinformatics tools and databases & retrieval of nucleotide and protein sequences from NCBI 2. Use of UniProt for protein information analysis 3. Pairwise sequence alignment using online tools 4. BLAST analysis for sequence similarity search 5. Multiple sequence alignment using Clustal Omega 6. Retrieval and visualization of protein structures from PDB Teaching Hours: 60
Reference Books	• *Bioinformatics: Methods and Applications* (co-authored with N. Mendiratta and P. Rastogi) • Baxevanis, A. D. & Ouellette, B. F. F. *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins* • Mount, D. W. *Bioinformatics: Sequence and Genome Analysis* • Pevsner, J. *Bioinformatics and Functional Genomics* • Lesk, A. M. *Introduction to Bioinformatics* • Higdon et al. *Biological Data Analysis*
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments

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-2703000508031111]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VIII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Entrepreneurship
Subject Type	Discipline Specific / Intra-disciplinary
Course Code	BT-MJ-803
Course Level	400-499
Course Title	Entrepreneurship in Life Sciences
Credit	2
Effective From	Academic Year: 2026-27
Course Outcomes	**CO1:** Students will be able to explain concepts of innovation, biotechnology entrepreneurship and start-up ecosystem including TRL and bio economy. **CO2:** Students will be able to apply basic business models, intellectual property concepts, regulatory frameworks and financial principles in biotechnology ventures.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Course Content

UNIT – 1: Innovation & Biotechnology Entrepreneurship Ecosystem Concept of Innovation & Design Thinking, Types of Innovation in Life Sciences, Overview of Biotechnology Entrepreneurship, Start-up Ecosystem in India & Gujarat (BIRAC, GSBTM, Start-up India), Introduction to Bioeconomy & Sustainable Entrepreneurship, Technology Readiness Levels (TRL) – Basic Concept	Teaching Hours: 15
UNIT – 2: Fundamentals of Business & Commercialization Basics of Business Models (Business Model Canvas), Introduction to Intellectual Property Rights (Patents – Overview), Introduction to Regulatory Bodies (CDSCO, FSSAI – Overview), Basic Financial Literacy: Costing, Break-even Concept, Marketing Basics for Biotech Products, Ethical & Societal Considerations in Biotech Ventures	Teaching Hours: 15

Reference Books

- Shimasaki, C. (2014) Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Academic Press, USA.
- Drucker, P. F. (2014) Innovation and Entrepreneurship. Harper Business.
- Osterwalder, A., & Pigneur, Y. (2010) Business Model Generation. Wiley, USA.

	• Desai, V. Dynamics of Entrepreneurial Development and Management. Himalaya Publishing House, India. • Gopalakrishnan, N. S., & Agitha, T. G. (2017) Principles of Intellectual Property. Eastern Book Company, India.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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-2703000508031112]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VIII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Entrepreneurship
Subject Type	Discipline Specific / Intra-disciplinary
Course Code	BTP-MJ-803
Course Level	400-499
Course Title	Entrepreneurship in Life Sciences: Practical
Credit	2
Effective From	Academic Year: 2026-27
Course Outcomes	Students will be able to develop, analyze and present a feasible biotechnology startup idea by applying business model tools, conducting market feasibility assessment, performing basic financial evaluation and preparing a structured startup concept report.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO								

Course Content	1. Business Model Canvas Preparation 2. Market Survey & Feasibility Study 3. Entrepreneur Interview & Report Writing 4. Cost Estimation & Break-even Calculation Exercise 5. TRL Identification Exercise 6. Preparation of Mini Start-up Concept Note 7. Pitch Presentation 8. Submission of Start-up Concept Report (5–8 Pages)	Teaching Hours: 60
Reference Books	• Shimasaki, C. (2014) Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Academic Press, USA. • Drucker, P. F. (2014) Innovation and Entrepreneurship. Harper Business. • Osterwalder, A., & Pigneur, Y. (2010) Business Model Generation. Wiley, USA. • Desai, V. Dynamics of Entrepreneurial Development and Management. Himalaya Publishing House, India. • Gopalakrishnan, N. S., & Agitha, T. G. (2017) Principles of Intellectual Property. Eastern Book Company, India.	
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments	
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

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VIII
NCrF Credit Level	6
Course Type	Minor
Course Subtype	Employability and Skill Development
Subject Type	Discipline Specific
Course Code	BT-ME-801
Course Level	400-499
Course Title	Nanotechnology
Credit	2
Effective From	Academic Year: 2026-27
Course Outcomes	**CO1:** Students will learn about the nanostructure that are actively take part in the bodily functions. The property of self-assembly and hierarchical arrangement will be discussed. This will help them to understand the concept behind the structural and functional requirement of nano-assembly for efficient working. **CO2:** The application of nanomaterial as drug delivery and biosensors will be discussed. The students will be introduced to the recent filed of protein nanotechnology. The unit will cover the aspect related to the possible toxicological effect of nanomaterials.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Course Content

UNIT – 1: Introduction to Nanobiotechnology Biotechnology and Nanotechnology: Introduction and Notable Prospects; Introduction to cellular Nanostructures: Nanopores and Biomolocular motors; Structural aspects of biomolecules as bio-nanomachinery (DNA and Protein assembly); Forces responsible for structural stability of biomoleclues (covalent, hydrogen bonds, electrostatic, hydrophobic); Hierarchical self-assembled nano-structures, self-organisation (Lipid bilayer membrane); Enzyme flexibility as challenge in structural design of nanoparticles.	Teaching Hours: 15
UNIT – 2: Applications of Nanotechnology and Assessment of Toxicity of Nanomaterials Nanomaterials for drug delivery system; Importance of protein nanotechnology; Construction of ordered protein array; Nanosystems for biosensing, Nano-Biosensors; Optical nanosensors, Impact of nanomaterials on Microbial system	Teaching Hours: 15

	Nanotoxicity testing, factors affecting nanotoxicity (chemical and physical). Introduction to Safety of nanomaterials, Basics of nanotoxicity, Models and assays for Nanotoxicity assessment; Mechanism of Nanosize particle toxicity-Passage through biological membranes-toxicokinetics Fate of nanomaterials in different stratas of environment that affect the human population; Regulations and permissible limits.	
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 • Tuan Vo-Dinh. Protein Nanotechnology: Protocols, Instrumentations and Applications. Humana press.2005. • Huang X., Yufang Zhu Y., Kianfar E. (2021), Nano Biosensors: Properties, applications and electrochemical techniques, Journal of Materials Research and Technology, 2, pp 1649-1672. (https://doi.org/10.1016/j.jmrt.2021.03.048)	
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments	
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

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VIII
NCrF Credit Level	6
Course Type	Minor
Course Subtype	Employability and Skill Development
Subject Type	Discipline Specific
Course Code	BTP-ME-801
Course Level	400-499
Course Title	Nanotechnology: Practical
Credit	2
Effective From	Academic Year: 2026-27
Course Outcomes	Student will understand the concept of DLS scanning and zetapotential which is closely related to particle size analysis of nanomaterial. Student will be able to synthesis nanoparticles using different methods. One of the possible application of nanoparticles is to use it as antimicrobial agent. This practical course will give student hands on experience to test antimicrobial activity of prepared nanoparticles and will create awareness regarding computer-aided tools that can be used for designing the nanoparticles.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO								

Course Content	1. Demonstration of measurement of nanoparticles using dynamic light scattering (DLS). 2. Demonstration of Zeta potential and its effect on nanoparticle size. 3. Preparation of nanoparticles using plant extract 4. Sol-gel synthesis of nanoparticles 5. Antimicrobial activity of nanoparticles (Disc diffusion method) 6. Demonstration of Computer-aided Design tools for Nanoparticles.	Teaching Hours: 60
Reference Books	• McNeil, S.E., (2011) Characterization of Nanoparticles Intended for Drug Delivery", Humana press • Gérrard Eddy Jai Poinern, A Laboratory Course in Nanoscience and Nanotechnology, CRC Press Taylor & Francis Group, LLC, 2015. • R. J. Patel and K. R. Patel, Experimental Microbiology Volume-2, Aditya, Ahmedabad, Gujarat, India • Khac, K.T., Phu, H.H., Thi, H.T., Thuy, V.D., Thi, H.D. (2023) Biosynthesis of silver nanoparticles using tea leaf extract (*Camellia sinensis*) for photocatalyst and antibacterial effect, Heliyon 9 e20707 (https://doi.org/10.1016/j.heliyon.2023.e20707).	

	• Sathiyabama, M., Boomija, R. V., Muthukumar, S., Gandhi, M., Salma, S., Kokila Prinsha, T., Rengasamy B. (2024) Green synthesis of chitosan nanoparticles using tea extract and its antimicrobial activity against economically important phytopathogens of rice, Scientific Reports 14 pp 7381 (https://doi.org/10.1038/s41598-024-58066-y) • Raja, K., Mary Jaculine, M., Jose, M., Sunil Verma, Prince, A.A.M., Ilangovan, K., Sethusankar, K., Jerome Das S. (2015) Sol–gel synthesis and characterization of α-Fe2O3 nanoparticles. Superlattices and Microstructures 86 pp 306-312 (http://dx.doi.org/10.1016/j.spmi.2015.07.044) • NanoMaterials CAD software (https://nanocad.com/products/nanocad-free/)
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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

Major & Minor without Research/OJT

Teaching & Evaluation Scheme Semester-VII

[Academic Year of Implementation 2026-2027]

Semester-VII

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-701	Genomics and Proteomics	2	1:00	25	25	50	2
BTP-MJ-701	Genomics and Proteomics: Practical	4	4:00 to 6:00	25	25	50	2
BT-MJ-702	Industrial Fermentation Technology	2	1:00	25	25	50	2
BTP-MJ-702	Industrial Fermentation Technology: Practical	4	4:00 to 6:00	25	25	50	2
BT-MJ-703	GMP, Quality Control & Validation	2	1:00	25	25	50	2
BTP-MJ-703	GMP, Quality Control & Validation: Practical	4	4:00 to 6:00	25	25	50	2
BT-MJ-704	Entrepreneurship in Rural Economy	4	2	50	50	100	4
			OR				
BT-MJ-705	IPR, Bioethics and Biosafety	4	2	50	50	100	4
BT-ME-701	Sustainable Development Goals in Biotechnology	2	1:00	25	25	50	2
BTP-ME-701	Sustainable Development Goals in Biotechnology: Practical	4	4:00 to 6:00	25	25	50	2
			OR				
ME	Fundamentals of Cyber Security	4	4:00	50	50	100	4
MJ-UGRM0107	Research Methodology-I	2	1:00	25	25	50	2
Total		**28**	**---**	**275**	**275**	**550**	**22**

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Employability and Skill Development
Subject Type	Discipline Specific Course
Course Code	BT-MJ-701
Course Level	400-499
Course Title	Genomics and Proteomics
Credit	2
Effective From	Academic Year: 2026-2027
Course Outcomes	**CO1:** Principle and scope of genomics, Genome sequencing strategies, functional genomics approaches, Gene silencing and evaluation of ethical, legal, and social implications of Human Genome Project. **CO2:** Techniques for protein identification and characterization, analyze omics data for biological problem-solving including structural analysis of proteins.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Course Content	**UNIT – 1: Mapping & Sequencing of Genomes** History & Scope of Genomics, Genetic and Physical Mapping, DNA sequencing (Sanger and Pyrosequencing), Analysis of DNA sequences, Assembling and Annotation of Genome sequences, Functional Genomics, Gene silencing, Human Genome Project, Ethical, Legal & Social Implications of Human Genome.	Teaching Hours: 15
	UNIT – 2: Expression Analysis & Characterization of Proteins Introduction, Protein Separation Techniques (2D Gel Electrophoresis, RPLC, HPLC), Protein Characterization (Mass Spectrometry, MALDI) Protein Microarrays, Structural Proteomics (X-ray Crystallography & NMR)	Teaching Hours: 15

Reference Books	• Peter J. Russell – iGenetics A Molecular Approach, 3rd Edition, Pearson Education, 2010 • S. B. Primrose and R.M. Twyman - Principles of Genome Analysis and Genomics, 7th Edition, Blackwell Publishing, 2006. • T. A. Brown – Genomes 4, Garland Science, Taylor & Francis Group

	• T. A. Brown – Gene Cloning and DNA Analysis - An Introduction, 7th edition, WILEY Blackwell • Snustad &Simmons- Principles of Genetics, 6th Edition, WILEY
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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-2603000507011112]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT **SYLLABUS**	
Program Name	B. Sc. Biotechnology Honors
Semester	VII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Employability and Skill Development
Subject Type	Discipline Specific Course
Course Code	BTP-MJ-701
Course Level	400-499
Course Title	Genomics and Proteomics: Practical
Credit	2
Effective From	Academic Year: 2026-2027
Course Outcomes	CO: To learn how Basic Mapping technique, DNA extraction from model organism, preparation of SDS Gel, isolation of proteins from plants, SDS-PAGE with isolated proteins, Different Staining Techniques (Coomassie brilliant blue & Silver Staining)
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO								

Course Content	6. To study Partial Restriction Digestion for Restriction Mapping. 7. To study the extraction of DNA from Yeast (*Saccharomyces cerevisiae*) 8. To study the isolation of total proteins from plants. 9. To study the gel preparation for SDS-PAGE. 10. To study the protein profiling by SDS-PAGE with different staining techniques (Coomassie brilliant blue & Silver Staining)	Teaching Hours: 60
Reference Books	• Sambrook & Russell (3rd ed.). (1989). Molecular Cloning: A Laboratory Manual (Vols. 1to3). Cold Spring Harbor Laboratory Press • T. Devasena, (2010); Enzymology; OXFORD University Press • Arti Nigam & Archana Ayyagari Lab Manual in Biochemistry, Immunology and Biotechnology Tata McGraw-Hill	
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments	
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

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Employability and Skill Development
Subject Type	Discipline Specific Course
Course Code	BT-MJ-702
Course Level	400-499
Course Title	Industrial and Fermentation Technology
Credit	2
Effective From	Academic Year: 2026-2027
Course Outcomes	**CO1:** Apply core principles of bioprocess engineering to analyse bioreactor systems, microbial growth kinetics, fluid rheology, oxygen transfer phenomena, and statistical methods for media optimization in batch and continuous fermentation processes. **CO2:** Students will learn, how metabolic pathways are discovered and manipulated, to produce desired metabolite, at industrial level.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Course Content

UNIT – 1: Bioprocess Engineering Bioreactors and types of bioreactors, Monod equation, Batch culture, and continuous culture. Fluid Rheology (Reynolds number, flow regimes, Power number (Np)), Oxygen transfer (OTR, OUR, kLa), Media optimization (Placket Burman, Response surface methodology).	Teaching Hours: 15
UNIT – 2: Metabolic Control and Strain Improvement Methods for decoding metabolic pathways, Feedback inhibition and its types, feedback repression, Mutants which do not produce feedback inhibitors or repressors, Mutants that do not recognize presence of inhibitors or repressors, use of auxotroph for production of primary metabolites.	Teaching Hours: 15

Reference Books	• Stanbury, P. F., Whitaker, A., & Hall, S. J. (2016). Principles of fermentation technology (3rd ed.). Elsevier. • Crueger, W., & Crueger, A. (1990). A textbook of industrial microbiology (2nd ed.). Sinauer Associates. • Doran, P. M. (2013). Bioprocess engineering principles (2nd ed.). Academic Press.

	• Nelson, D. L., & Cox, M. M. (2021). Lehninger Principles of Biochemistry (8^{th} ed.). • Montgomery, D. C. (2017). Design and analysis of experiments (9^{th} ed.). John Wiley & Sons
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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-2603000507021112]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT **SYLLABUS**	
Program Name	B. Sc. Biotechnology Honors
Semester	VII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Employability and Skill Development
Subject Type	Discipline Specific Course
Course Code	BTP-MJ-702
Course Level	400-499
Course Title	Industrial and Fermentation Technology: Practical
Credit	2
Effective From	Academic Year: 2026-2027
Course Outcomes	CO: Throughout the course, students will gain hands-on experience in bioprocess engineering by using statistical tools like Plackett–Burman and Response Surface Methodology to optimize yeast growth media. They will learn to measure and analyze Oxygen Transfer Rates (OTR) to ensure efficient aerobic fermentation and will study microbial kinetics by applying the Monod equation to growth curves. Additionally, students will design and operate both batch and continuous immobilized enzyme bioreactors, comparing their productivity and stability across different systems.

Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
	CO									
Course Content	1. Screening of Variables for growth media of yeast using Placket Burman method. 2. Use of Response surface methodology for media optimization (for yeast) 3. Determination of Oxygen transfer rate (OTR) by sulphite oxidation method 4. Determination of factors affecting OTR 5. Construct Growth curve and Derive Monod equation (using Yeast) 6. Construction of Immobilized Invertase Enzyme bioreactor (Batch and continuous)									Teaching Hours: 60
Reference Books	• Stanbury, P. F., Whitaker, A., & Hall, S. J. (2016). Principles of fermentation technology (3rd ed.). Elsevier. • Crueger, W., & Crueger, A. (1990). A textbook of industrial microbiology (2nd ed.). Sinauer Associates. • Doran, P. M. (2013). Bioprocess engineering principles (2nd ed.). Academic Press.									

	• Nelson, D. L., & Cox, M. M. (2021). Lehninger principles of biochemistry (8th ed.). W. H. Freeman. • Montgomery, D. C. (2017). Design and analysis of experiments (9th ed.). John Wiley & Sons • Suresh, S., Srivastava, V. C., & Mishra, I. M. (2009). Techniques for oxygen transfer measurement in bioreactors: A review. Chemical Engineering Journal, 152(2–3), 473–489. • Yang, Y., Deinstadt, M., & Eppendorf SE. (2018). Measuring the oxygen transfer rate (OTR) of fermentation bioreactors using the sulfite oxidation method. Eppendorf Bioprocess Center. • Monod, J. (1949). The growth of bacterial cultures. Annual Review of Microbiology, 3, 371–394. • Brena, B. M., & Batista-Viera, F. (2006). Immobilization of enzymes: A literature survey. Methods in Biotechnology, 22, 15–30. • Ross, D., Karimi, I. A., & Pandey, A. (2022). Bioprocess engineering principles (2nd ed.). Elsevier.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Employability
Subject Type	Discipline Specific Course
Course Code	BT-MJ-703
Course Level	400-499
Course Title	GMP, Quality Control & Validation
Credit	2
Effective From	Academic Year: 2026-2027
Course Outcomes	**CO1:** The student will learn the concept, evolution, objectives, and scope of Good Manufacturing Practices (GMP) and their importance in pharmaceutical, biotechnology, and food product industries. The student will understand the GMP regulatory frameworks of WHO, FDA, BIS, and ISO, and the role of organization, personnel, and training in maintaining quality systems. **CO2:** The student will understand the principles of validation and qualification, including types of validation, analytical method validation, and cleaning validation, in compliance with regulatory guidelines. The student will understand and demonstrate the process validation lifecycle, including documentation systems, deviation handling, complaints, recalls, and preparation of validation reports to support continuous quality improvement.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Course Content	**UNIT – 1: GMP Manufacturing Practices and Quality Control** Concept and Evolution of GMP, Objectives and Scope of GMP (Pharmaceutical, Biotechnology, Food Products), Importance of GMP and consequences of non-compliance, GMP Regulatory Frameworks (WHO, FDA 21 CFR 210 & 211, BIS, ISO 9001 & ISO 22000), Quality Management Systems and Quality Assurance overview, Organization & Personnel (roles, responsibilities, training and competency), Premises and Facility design, Layout and workflow, Environmental Controls (HVAC, cleanrooms and monitoring), Equipment Qualification concepts (DQ, IQ, OQ, PQ) and maintenance, Calibration and logbooks, Raw & Packaging Material Control (receipt, sampling, storage, release and traceability), Documentation Systems (SOPs, Batch Records, Change Control), Sanitation, Hygiene and Contamination Control, Deviations, CAPA, Complaints handling and Product Recalls.	Teaching Hours: 15

	UNIT – 2: Process Validation Quality Control Concepts & Objectives, Sampling Techniques, Specifications and basic statistical aspects, In-Process and Finished Product Quality Control, Analytical QC parameters (Accuracy, Precision, Specificity, Linearity, Range, Robustness, Solution Stability, LOD and LOQ), Handling of Out-of-Specification (OOS) results, Introduction to Validation and Qualification, Types of Validation (Process, Cleaning and Analytical Method Validation), Analytical Method Validation Parameters and Acceptance Criteria, Cleaning Validation Principles and Approaches, Process Validation Lifecycle (Process Design, Process Qualification, Continued Process Verification), Validation Master Plan (VMP), Documentation, Preparation of Validation Reports, Continuous Quality Improvement and Management Review.	Teaching Hours: 15
Reference Books	• WHO Good Manufacturing Practices – TRS 986 Annex 2: https://www.who.int/publications/m/item/trs986-annex2 • FDA Process Validation: General Principles and Practices: https://www.fda.gov/regulatory-information/search-fda-guidance-documents/process-validation-general-principles-and-practices • ICH Validation of Analytical Procedures (Q2(R1)): https://www.gmp-compliance.org/files/guidemgr/Q2(R1).pdf • WHO GMP Validation Guidelines – Annex 3 TRS 1019: https://www.who.int/docs/default-source/medicines/norms-and-standards/guidelines/production/trs1019-annex3-gmp-validation.pdf • FDA cGMP regulations (21 CFR Part 210/211) – https://www.ecfr.gov/current/title-21/chapter-I/subchapter-C/part-211	
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments	
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-2603000507031112]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Skill Development
Subject Type	Discipline Specific Course
Course Code	BTP-MJ-703
Course Level	400-499
Course Title	GMP, Quality Control & Validation: Practical
Credit	2
Effective From	Academic Year: 2026-2027
Course Outcomes	CO: The student will learn and prepare GMP-compliant documentation such as Standard Operating Procedures (SOPs), demonstrate the principles of GMP facility layout, material and personnel flow, sanitation, hygiene, and contamination control through case studies and laboratory observations. The student will perform and document equipment calibration and qualification activities (IQ, OQ, PQ) for commonly used laboratory instruments to ensure reliability and accuracy. The student will learn and apply quality control techniques, The student will understand and prepare validation protocols and reports, including analytical method validation and cleaning validation, using experimental or model data.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO								

Course Content	6. Prepare a Report on Standard Operating Procedures (SOPs) for any Pharmaceutical/Biotechnology/Food product. 7. Case study of GMP outline of any reputed company. 8. Equipment Calibration and Report Documentation at your institute level 9. Labelling, Storage and Traceability according to QC Guidelines. 10. Prepare Report on: Validation Mock report.	Teaching Hours: 60

Reference Books	• World Health Organization (WHO). Good Manufacturing Practices for Pharmaceutical Products (TRS 986, Annex https://www.who.int/publications/m/item/trs986-annex2 • World Health Organization (WHO). Guidelines on Validation – GMP (TRS 1019, Annex 3). https://www.who.int/docs/default-source/medicines/norms-and-standards/guidelines/production/trs1019-annex3-gmp-validation.pdf
	• U.S. Food and Drug Administration (FDA). Process Validation: General Principles and Practices. https://www.fda.gov/files/drugs/published/Process-Validation--General-Principles-and-Practices.pdf • U.S. Food and Drug Administration (FDA). Current Good Manufacturing Practice (cGMP) Regulations – 21 CFR Parts 210 & 211. https://www.ecfr.gov/current/title-21/chapter-I/subchapter-C • International Council for Harmonisation (ICH). Q2(R1): Validation of Analytical Procedures – Text and Methodology. https://www.fda.gov/media/152208/download • European Commission. EudraLex Volume 4 – EU Guidelines for Good Manufacturing Practice. https://health.ec.europa.eu/medicinal-products/eudralex/eudralex-volume-4_en
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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

SYLLABUS

Program Name	B.Sc. Biotechnology Honors
Semester	VII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Entrepreneurship
Subject Type	Intra-disciplinary
Course Code	BT-MJ-704
Course Level	400-499
Course Title	Entrepreneurship in Rural Economy
Credit	4
Effective From	Academic Year: 2026-2027
Course Outcomes	**CO1:** Explain and evaluate rural entrepreneurship concepts, cow-based enterprise models, and relevant government support schemes for sustainable rural development. **CO2:** Apply biotechnology techniques to develop value-added products (Jeevamrut, Panchgavya, vermicompost, biogas) and design a basic sustainable rural enterprise plan with financial and scheme linkage components. **CO3:** Describe the scientific basis and applications of bio-based rural technologies such as Jeevamrut, Panchgavya, vermicomposting, and biogas in sustainable agriculture. **CO4:** Develop and evaluate basic rural enterprise strategies involving value addition, market linkage, and financial feasibility for bio-based and dairy-related enterprises.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								

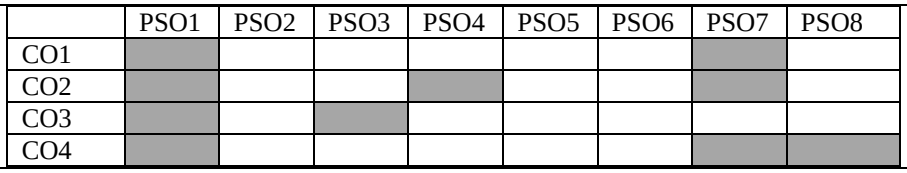
Course Content	**UNIT – 1: Rural Entrepreneurship Fundamentals** Types of rural enterprises (agriculture, processing, services). Role of cow-based economy including A2 vs A1 milk and utilization of dung and urine. Opportunities and challenges in rural enterprises with reference to Gujarat. Socio-economic importance and contribution to SDGs.	Teaching Hours: 15

	UNIT – 2: Rural Entrepreneurship Ecosystem Institutional support: NABARD, KVIC, MUDRA, SVEP, and related schemes. Role of SHGs and women entrepreneurship. Support systems including finance, training, and capacity building. Case studies of successful rural enterprises such as dairy cooperatives.	Teaching Hours: 15
	UNIT – 3: Bio-based Rural Technologies Concepts of Jeevamrut and Panchgavya in agriculture. Principles of vermicomposting and biogas production. Waste-to-resource conversion and role of bio-inputs in sustainable rural development	Teaching Hours: 15
	UNIT – 4: Rural Enterprise Development and Value Addition Value addition of cow-based products and rural resources. Basics of enterprise development including idea generation, cost considerations, and market linkage. Marketing strategies such as branding and packaging. Analysis of rural enterprises from economic and sustainability perspectives.	Teaching Hours: 15
Reference Books	• Khanka, S.S. (2014). Entrepreneurship Development. New Delhi: S. Chand Publishing. • Desai, V. (2011). Dynamics of Entrepreneurial Development and Management. Mumbai: Himalaya Publishing House. • Charantimath, P.M. (2018). Entrepreneurship Development and Small Business Enterprises. New Delhi: Pearson Education. • De, S. (2005). Outlines of Dairy Technology. New Delhi: Oxford University Press. • Prasad, R. (2012). Principles of Dairy Farming. New Delhi: Kalyani Publishers. • Purohit, S.S. (2016). Organic Farming: Principles and Practices. Jodhpur: Agrobios (India). • Pathak, R.K. (2017). Handbook of Organic Farming. New Delhi: ICAR Publications. • Subba Rao, N.S. (2017). *Biofertilizers in Agriculture and Forestry*. New Delhi: Oxford & IBH Publishing. **Government Reports & Manuals** • National Bank for Agriculture and Rural Development (NABARD). Annual Reports and Rural Entrepreneurship Scheme Guidelines. • Khadi and Village Industries Commission (KVIC). Village Industries Development Manuals. • Ministry of Micro Small and Medium Enterprises (MSME). Government of India Scheme Documents. • National Centre of Organic Farming. Biofertilizer and Organic Input Preparation Manuals. • Ministry of Rural Development, Government of India. *Start-Up Village Entrepreneurship Programme (SVEP) Guidelines*. **E-Resources** • https://onlinecourses.swayam2.ac.in/e-learning/preview/ini24_hs07 (SWAYAM Course-Tribal Entrepreneurship & Economy) • https://www.intechopen.com/chapters/79567 **Research/Review papers** • https://pmc.ncbi.nlm.nih.gov/articles/PMC8814384/ • https://pubmed.ncbi.nlm.nih.gov/34998645/	

	• https://pubmed.ncbi.nlm.nih.gov/28413254/ • https://pubmed.ncbi.nlm.nih.gov/34026314/ • https://pubmed.ncbi.nlm.nih.gov/39524546/ • https://pubmed.ncbi.nlm.nih.gov/40609196/ • https://www.mdpi.com/2079-9276/14/7/102
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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

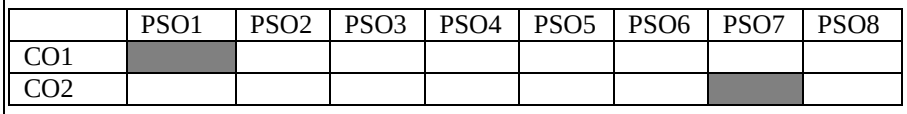
SYLLABUS

Program Name	B.Sc. Biotechnology Honors
Semester	VII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Employability
Subject Type	NIL
Course Code	BT-MJ-705
Course Level	400-499
Course Title	IPR, Bioethics and Biosafety
Credit	4
Effective From	Academic Year: 2026-2027
Course Outcomes	**CO1:** The learner will be able to apply bioethical principles and frameworks to evaluate ethical issues in biotechnology, including regulatory roles of national and international bioethics bodies and ethical implications of biological weapons. **CO2:** To apply biosafety regulations and risk assessment principles to select appropriate containment levels (BL-1 to BL-4) and ensure safe handling, spill management, and biological waste disposal. **CO3:** To understand IPR and patent law frameworks, including patenting of living organisms, the Indian Patent Act and its amendments, USA and European patent systems, and WIPO/TRIPS provisions with post-TRIPS changes in India. **CO4:** To apply patenting procedures to biological products, manage IPR commercialization (licenses, royalties), understand plant variety protection under UPOV and Indian law, and analyze landmark IPR cases.
Mapping between Cos and PSOs	
Course Content	**UNIT – 1: Fundamentals of Bioethics** Bioethics & its Origin; Principles; Different approaches to Ethics; Past, Present & Future Bioethical conflicts in Biotechnology; Bioethics Advisory Committee-IBC of UNESCO, ICMR Ethics guidelines-General principles, General Ethical issues, Informed consent process; Biological weapons & their implications.
	Teaching Hours: 15

	UNIT – 2: Biosafety & Biosecurity Overview of Biosafety; Cartagena Protocol on Biosafety; Indian Biosafety Framework; Risk Assessment-Risk group & Biosafety levels, Process of Risk assessment; Containment & its methods; Different containment levels- BL-1, BL-2, BL-3, BL-4; Biological spillage, Precautions, Managing Biological waste & Treatment.	Teaching Hours: 15
	UNIT – 3: Fundamentals of IPR Introduction & types of IPR; Patenting of living organism-Brief history; Indian Patent Act 1970 & its Amendment; Patent law in other countries- USA & Europe; International Conventions & Treaties- WIPO, TRIPS Agreement-features, principles, major changes in Indian Patent system post-TRIPS.	Teaching Hours: 15
	UNIT – 4: Patenting in Biotechnology Basic requirement of Patent; Patent Application; Patenting Biological products; Selling an invention, licenses & royalties; UPOV Convention 1961 & Functions; Plant variety Protection & Farmer's Right Act-plant variety, need & objective for protection, registration, Farmer's Rights; Case studies in IPR- Diamond vs Chakraborty case (1980), Neem Patent Case.	Teaching Hours: 15
Reference Books	• Brauer, D. (1995). Biotechnology: Legal, economic and ethical dimensions (Vol. 12). Weinheim, Germany: VCH Publishers • Goel, D., & Parashar, S. (2013). IPR, biosafety and bioethics. New Delhi, India: Pearson Education India. • Gupta, P. K. (2010). Elements of biotechnology (2nd ed.). Meerut, India: Rastogi Publications. • ICMR. (2018). Handbook on national ethical guidelines for biomedical and health research involving human participants. New Delhi, India	
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments	
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

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VII
NCrF Credit Level	6
Course Type	Minor
Course Subtype	Employability
Subject Type	Intra-disciplinary
Course Code	BT-ME-701
Course Level	400-499
Course Title	Sustainable Development Goals in Biotechnology
Credit	2
Effective From	Academic Year: 2026-2027
Course Outcomes	**CO1:** Understand the Principles, Concept, Scope & Importance of sustainable and green biotechnology with Developmental Goals (SDGs). **CO2:** To get Knowledge regarding Bioremediation, Bio fertilizers, Biofuels , Bio-pesticides and Ethical, Regulatory, and Biosafety issues.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Course Content	**UNIT – 1: Foundations of Sustainable and Green Biotechnology** Concept, scope, and importance of sustainable and green biotechnology, United Nations Sustainable Development Goals (SDGs): overview and relevance to biotechnology and their role in achieving SDGs (2, 3, 6, 7, 12, 13, 15), Principles of green biotechnology and its applications.	Teaching Hours: 15
	UNIT – 2: Applications of Sustainable Biotechnology Concept and applications of: Bioremediation, Biofertilizers, Biofuels and Biopesticides, Biotechnology for clean water and sanitation, sustainable biomaterials and their applications, Ethical, Regulatory, and Biosafety issues.	Teaching Hours: 15

Reference Books	• Abha Kumari (2025), Sustainable Technologies for Value Addition to Biomass Waste. Elsevier, ISNB: 978-0-443-36318-4 • R. K. Salar (2013), Biotechnology: Prospects & Applications, Springer, eISBN: 978-81-322-1683-4 • Alan H. Scragg (2005), Environmental Biotechnology, Oxford University Press, ISBN-13: 9780199268672 • OECD, Biotechnology for Sustainable Development

	• Christoph Wittmann & James C. Liao (2017), Industrial Biotechnology, Wiley, ISBN-978-3-527-34179-5
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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 SYLLABUS	
Program Name	B. Sc. Biotechnology Honors
Semester	VII
NCrF Credit Level	6
Course Type	Minor
Course Subtype	Employability
Subject Type	Intra-disciplinary
Course Code	BTP-ME-701
Course Level	400-499
Course Title	Sustainable Development Goals in Biotechnology: Practical
Credit	2
Effective From	Academic Year: 2026-2027
Course Outcomes	CO: To characterize microbial biofertilizers, analyze vermicompost & energy consumption and evaluate the effectiveness of biofertilizers.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO								

Course Content	6. Production and characterization of microbial bio-fertilizers (Azotobacter/Rhizobium) 7. Preparation and analysis of compost. 8. Seed germination and growth promotion assay using biofertilizers. 9. To Analyze Energy consumption of the given Area. 10. Case study-based practical on sustainability.	Teaching Hours: 60
Reference Books	• Abhakumari (2025), Sustainable Technologies for Value Addition to Biomass Waste. Elsevier, ISNB: 978-0-443-36318-4 • R. K. Salar (2013), Biotechnology: Prospects & Applications, Springer, eISBN: 978-81-322-1683-4 • Alan H. Scragg (2005), Environmental Biotechnology, Oxford University Press, ISBN-13: 9780199268672 • OECD, Biotechnology for Sustainable Development • Christoph Wittmann & James C. Liao (2017), Industrial Biotechnology, Wiley, ISBN-978-3-527-34179-5	
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments	
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

Major & Minor without Research/OJT

Teaching & Evaluation Scheme Semester-VIII

[Academic Year of Implementation 2026-2027]

Semester-VIII

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-801	Advanced Molecular Techniques	2	1:00	25	25	50	2
BTP-MJ-801	Advanced Molecular Techniques: Practical	4	4:00 to 6:00	25	25	50	2
BT-MJ-802	Bioinformatics and Data Science	2	1:00	25	25	50	2
BTP-MJ-802	Bioinformatics and Data Science: Practical	4	4:00 to 6:00	25	25	50	2
BT-MJ-803	Entrepreneurship in Life Science	2	1:00	25	25	50	2
BTP-MJ-803	Entrepreneurship in Life Science: Practical	4	4:00 to 6:00	25	25	50	2
BT-MJ-804	Synthetic Biology	4	2:00	50	50	100	4
BT-ME-801	Nanotechnology	2	1:00	25	25	50	2
BTP-ME-801	Nanotechnology: Practical	4	4:00 to 6:00	25	25	50	2
			OR				
ME	Entrepreneurship	4	4:00	50	50	100	4
MJ-UGRM02028	Research Methodology-II	2	1:00	25	25	50	2
Total		**28**	**---**	**275**	**275**	**550**	**22**

[Subject code-2703000508011111]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS

Program Name	B. Sc. Biotechnology Honours
Semester	VIII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Employability and Skill Development
Subject Type	Discipline Specific
Course Code	BT-MJ-801
Course Level	400-499
Course Title	Advanced Molecular Techniques
Credit	2
Effective From	Academic Year: 2026-27
Course Outcomes	**CO1:** Explain and apply the principles of advanced protein and nucleic acid techniques, including Western blotting, affinity purification, flow cytometry, hybridization, and isothermal amplification, in biotechnology applications. **CO2:** Explain and apply the principles of advanced protein and nucleic acid techniques, including Western blotting, affinity purification, flow cytometry, hybridization, and isothermal amplification, in biotechnology applications.

Mapping between Cos and PSOs

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

Course Content

UNIT – 1: Advanced Techniques for Protein Analysis

Advanced Western blotting: quantitative Western, normalization, common pitfalls. Tag-based and affinity purification: basic idea of fusion/epitope tags (His, GST, FLAG) and Ni-NTA/antibody-based affinity chromatography. Flow cytometry: principle of fluorescence-based single-cell analysis, basic plots/gating idea, and key applications (immunophenotyping of immune cells, apoptosis, cell cycle – at concept level). Protein–protein interaction methods: Basic concept of co-immunoprecipitation (Co-IP). Immunofluorescence techniques: Basic principle of fluorescence-based protein localization (concept level).

Teaching Hours: 15

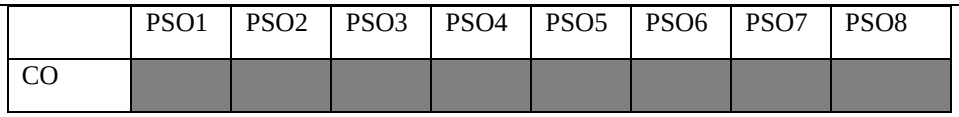
	UNIT – 2: Advanced Techniques in Nucleic Acid & PCR Isothermal amplification: basic concepts and application of LAMP. Nucleic acid hybridization: principles and uses of Southern and Northern blotting. Primer design: Basic principles of primer design for nucleic acid amplification. DNA–protein interaction analysis: Basic concept of Electrophoretic Mobility Shift Assay (EMSA). Comparative analysis of molecular techniques: Selection of amplification and hybridization methods for research and diagnostic applications. Applications in molecular diagnostics: Role of molecular techniques in pathogen detection and disease diagnosis.	Teaching Hours: 15
Reference Books	• Green, M.R., & Sambrook, J. (2012). Molecular Cloning: A Laboratory Manual (4th ed.). New York: Cold Spring Harbor Laboratory Press. • Brown, T.A. (2020). Gene Cloning and DNA Analysis: An Introduction (7th ed.). Oxford: Wiley-Blackwell. • Primrose, S.B., & Twyman, R.M. (2013). Principles of Gene Manipulation and Genomics (8th ed.). Oxford: Wiley-Blackwell. • Simpson, R.J. (2003). Proteins and Proteomics: A Laboratory Manual. New York: Cold Spring Harbor Laboratory Press. • Lesk, A.M. (2016). Introduction to Protein Science: Architecture, Function and Genomics (3rd ed.). Oxford: Oxford University Press. • Buckingham, L., & Flaws, M. (2019). Molecular Diagnostics: Fundamentals, Methods and Clinical Applications (3rd ed.). Philadelphia: F.A. Davis Company. • Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., & Losick, R. (2014). Molecular Biology of the Gene (7th ed.). Boston: Pearson Education. • Simpson, R.J. (2003). *Proteins and Proteomics: A Laboratory Manual*. New York: Cold Spring Harbor Laboratory Press. • Doudna, J.A., & Sternberg, S.H. (2017). *A Crack in Creation: Gene Editing and the Unthinkable Power to Control Evolution*. Boston: Houghton Mifflin Harcourt. • Buckingham, L., & Flaws, M.L. (2019). *Molecular Diagnostics: Fundamentals, Methods and Clinical Applications* (3rd ed.). Philadelphia: F.A. Davis Company. **E-Resources** • Genome Editing and Engineering (https://onlinecourses.nptel.ac.in/noc24_bt71/preview) • Computational Genomics (https://onlinecourses.nptel.ac.in/noc26_bt39/preview) Research/Review papers • https://pubmed.ncbi.nlm.nih.gov/12634793/ • https://pubmed.ncbi.nlm.nih.gov/10871386/ • https://pubmed.ncbi.nlm.nih.gov/20685252/ • https://pubmed.ncbi.nlm.nih.gov/15900442/ • https://pubmed.ncbi.nlm.nih.gov/24738055/ • https://pubmed.ncbi.nlm.nih.gov/19400705/ • https://pubmed.ncbi.nlm.nih.gov/18474036/	

	• https://pubmed.ncbi.nlm.nih.gov/26551336/ • https://pubmed.ncbi.nlm.nih.gov/28667615/ • https://pmc.ncbi.nlm.nih.gov/articles/PMC6918834/
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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-2703000508011112]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS

Program Name	B. Sc. Biotechnology Honours
Semester	VIII
NCrF Credit Level	6.0
Course Type	Major
Course Subtype	Employability and Skill Development
Subject Type	Discipline Specific
Course Code	BTP-MJ-801
Course Level	400-499
Course Title	Advanced Molecular Techniques: Practical
Credit	2
Effective From	Academic Year: 2026-2027
Course Outcomes	Integrate and apply immunological, molecular biology, and bioinformatics approaches to design, perform, and analyze experimental and in silico workflows, including PCR optimization, protein analysis, antigen design, and recombinant DNA techniques, for accurate data interpretation in research and diagnostic application
Mapping between COs and PSOs	
Course Content	7. Immunological Assays and Flow Cytometry Data Analysis (ELISA – indirect/sandwich and virtual flow cytometry interpretation) 8. Primer Design, *In Silico* PCR Validation, and Advanced Design Strategies 9. PCR Optimization and Gradient PCR Analysis 10. Bioinformatics Analysis of Protein Structure, Localization, and Function 11. Rational Antigen Design and Epitope Prediction 12. Recombinant DNA Analysis and Quantitative Data Interpretation (Restriction mapping, plasmid construction, gel densitometry using ImageJ, and EMSA concept) Teaching Hours: 60
Reference Books	• Green, M.R., & Sambrook, J. (2012). Molecular Cloning: A Laboratory Manual (4th ed.). New York: Cold Spring Harbor Laboratory Press.

	• Brown, T.A. (2020). Gene Cloning and DNA Analysis: An Introduction (7th ed.). Oxford: Wiley-Blackwell. • Primrose, S.B., & Twyman, R.M. (2013). Principles of Gene Manipulation and Genomics (8th ed.). Oxford: Wiley-Blackwell. • Simpson, R.J. (2003). Proteins and Proteomics: A Laboratory Manual. New York: Cold Spring Harbor Laboratory Press. • Lesk, A.M. (2016). Introduction to Protein Science: Architecture, Function and Genomics (3rd ed.). Oxford: Oxford University Press. • Buckingham, L., & Flaws, M. (2019). Molecular Diagnostics: Fundamentals, Methods and Clinical Applications (3rd ed.). Philadelphia: F.A. Davis Company. • Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., & Losick, R. (2014). Molecular Biology of the Gene (7th ed.). Boston: Pearson Education. • Simpson, R.J. (2003). *Proteins and Proteomics: A Laboratory Manual*. New York: Cold Spring Harbor Laboratory Press. • Doudna, J.A., & Sternberg, S.H. (2017). *A Crack in Creation: Gene Editing and the Unthinkable Power to Control Evolution*. Boston: Houghton Mifflin Harcourt. • Buckingham, L., & Flaws, M.L. (2019). *Molecular Diagnostics: Fundamentals, Methods and Clinical Applications* (3rd ed.). Philadelphia: F.A. Davis Company.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VIII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Employability and Skill Development
Subject Type	Discipline Specific Course
Course Code	BT-MJ-802
Course Level	400-499
Course Title	Bioinformatics and Data Science
Credit	2
Effective From	Academic Year: 2026-27
Course Outcomes	**CO1:** To introduce fundamental concepts of bioinformatics and data science relevant to biological research. **CO2:** To develop basic skills in biological data analysis, visualization, and interpretation.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Course Content	**UNIT – 1: Introduction to Bioinformatics** Definition, scope, and applications of bioinformatics, biological data types: sequence, structure, expression, variation, Overview of omics technologies: genomics, transcriptomics, proteomics, metabolomics, biological databases: primary, secondary, and composite databases, Introduction to data standards and data formats (FASTA, GenBank, PDB)	Teaching Hours: 15
	UNIT – 2: Sequence Analysis and Data Science Basics Pairwise sequence alignment: global and local alignment, Database similarity search tools: BLAST, FASTA, Multiple sequence alignment: Clustal Omega, MUSCLE (concepts), Introduction to data science: data types, data preprocessing, cleaning, Introduction to Next-Generation Sequencing (NGS) data analysis, including quality control (FastQC), sequence alignment (e.g., BWA/Bowtie), variant calling (GATK), and basic downstream analysis and interpretation.	Teaching Hours: 15

Reference Books	• Baxevanis, A. D. & Ouellette, B. F. F. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins • Mount, D. W. Bioinformatics: Sequence and Genome Analysis • Pevsner, J. Bioinformatics and Functional Genomics • Lesk, A. M. Introduction to Bioinformatics • Higdon et al. Biological Data Analysis • Bioinformatics Data Skills – Vince Buffalo, O'Reilly Media • Next-Generation DNA Sequencing Informatics – Cold Spring Harbor Laboratory Press • FastQC – Babraham Bioinformatics • Genome Analysis Toolkit (GATK) – Broad Institute • Burrows-Wheeler Aligner (BWA) – Li & Durbin
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VIII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Employability and Skill Development
Subject Type	Discipline Specific Course
Course Code	BTP-MJ-802
Course Level	400-499
Course Title	Bioinformatics and Data Science: Practical
Credit	2
Effective From	Academic Year: 2026-27
Course Outcomes	Demonstrate proficiency in the use of bioinformatics tools and databases to retrieve, analyze, and interpret nucleotide and protein sequences, perform sequence alignment (pairwise and multiple), conduct similarity searches using BLAST, and visualize three-dimensional protein structures for comprehensive biological analysis.
Mapping between Cos and PSOs	<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>CO</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>
Course Content	7. Introduction to bioinformatics tools and databases & retrieval of nucleotide and protein sequences from NCBI 8. Use of UniProt for protein information analysis 9. Pairwise sequence alignment using online tools 10. BLAST analysis for sequence similarity search 11. Multiple sequence alignment using Clustal Omega 12. Retrieval and visualization of protein structures from PDB Teaching Hours: 60
Reference Books	• *Bioinformatics: Methods and Applications* (co-authored with N. Mendiratta and P. Rastogi) • Baxevanis, A. D. & Ouellette, B. F. F. *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins* • Mount, D. W. *Bioinformatics: Sequence and Genome Analysis* • Pevsner, J. *Bioinformatics and Functional Genomics* • Lesk, A. M. *Introduction to Bioinformatics* • Higdon et al. *Biological Data Analysis*

Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VIII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Entrepreneurship
Subject Type	Discipline Specific / Intra-disciplinary
Course Code	BT-MJ-803
Course Level	400-499
Course Title	Entrepreneurship in Life Sciences
Credit	2
Effective From	Academic Year: 2026-27
Course Outcomes	**CO1:** Students will be able to explain concepts of innovation, biotechnology entrepreneurship and start-up ecosystem including TRL and bio economy. **CO2:** Students will be able to apply basic business models, intellectual property concepts, regulatory frameworks and financial principles in biotechnology ventures.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Course Content

UNIT – 1: Innovation & Biotechnology Entrepreneurship Ecosystem Concept of Innovation & Design Thinking, Types of Innovation in Life Sciences, Overview of Biotechnology Entrepreneurship, Start-up Ecosystem in India & Gujarat (BIRAC, GSBTM, Start-up India), Introduction to Bioeconomy & Sustainable Entrepreneurship, Technology Readiness Levels (TRL) – Basic Concept	Teaching Hours: 15
UNIT – 2: Fundamentals of Business & Commercialization Basics of Business Models (Business Model Canvas), Introduction to Intellectual Property Rights (Patents – Overview), Introduction to Regulatory Bodies (CDSCO, FSSAI – Overview), Basic Financial Literacy: Costing, Break-even Concept, Marketing Basics for Biotech Products, Ethical & Societal Considerations in Biotech Ventures	Teaching Hours: 15

Reference Books

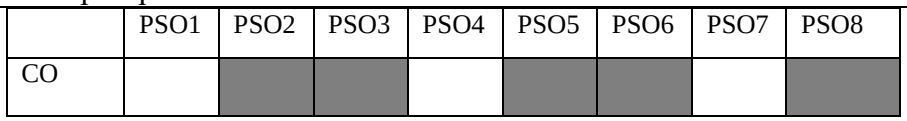
- Shimasaki, C. (2014) Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Academic Press, USA.
- Drucker, P. F. (2014) Innovation and Entrepreneurship. Harper Business.

	• Osterwalder, A., & Pigneur, Y. (2010) Business Model Generation. Wiley, USA. • Desai, V. Dynamics of Entrepreneurial Development and Management. Himalaya Publishing House, India. • Gopalakrishnan, N. S., & Agitha, T. G. (2017) Principles of Intellectual Property. Eastern Book Company, India.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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-2703000508031112]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VIII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Entrepreneurship
Subject Type	Discipline Specific / Intra-disciplinary
Course Code	BTP-MJ-803
Course Level	400-499
Course Title	Entrepreneurship in Life Sciences: Practical
Credit	2
Effective From	Academic Year: 2026-27
Course Outcomes	Students will be able to develop, analyze and present a feasible biotechnology startup idea by applying business model tools, conducting market feasibility assessment, performing basic financial evaluation and preparing a structured startup concept report.
Mapping between Cos and PSOs	
Course Content	9. Business Model Canvas Preparation 10. Market Survey & Feasibility Study 11. Entrepreneur Interview & Report Writing 12. Cost Estimation & Break-even Calculation Exercise 13. TRL Identification Exercise 14. Preparation of Mini Start-up Concept Note 15. Pitch Presentation 16. Submission of Start-up Concept Report (5–8 Pages) Teaching Hours: 60
Reference Books	• Shimasaki, C. (2014) Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Academic Press, USA. • Drucker, P. F. (2014) Innovation and Entrepreneurship. Harper Business. • Osterwalder, A., & Pigneur, Y. (2010) Business Model Generation. Wiley, USA. • Desai, V. Dynamics of Entrepreneurial Development and Management. Himalaya Publishing House, India. • Gopalakrishnan, N. S., & Agitha, T. G. (2017) Principles of Intellectual Property. Eastern Book Company, India.

Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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-2703000508051111]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS

Program Name	B.Sc. Biotechnology Honors
Semester	Sem.-VIII
NCrF Credit Level	6
Course Type	Major
Course Subtype	Nil
Subject Type	Discipline Specific
Course Code	BT-MJ-804
Course Level	400-499
Course Title	Synthetic Biology
Credit	4
Effective From	Academic Year: 2026-2027
Course Outcomes	**CO1:** Explain the fundamental concepts, historical development, and interdisciplinary foundations of synthetic biology, and differentiate it from systems biology. **CO2:** Apply molecular, genome editing, and computational tools of synthetic biology to design, model, and construct genetic circuits, metabolic pathways, and synthetic systems. **CO3:** Analyse diverse applications of synthetic biology in healthcare, bio-manufacturing, metabolic engineering, bio-sensing, and microbiome engineering. **CO4:** Evaluate current research areas, emerging technologies, and future challenges in synthetic biology, including genome-level engineering, xenobiology, and industrial translation
Mapping between Cos and PSOs	See table below
Course Content	**UNIT – 1: Fundamental Concepts in Synthetic Biology** Definition and historical development of synthetic biology, Synthetic Biology versus Systems Biology, Synthesis and Engineering Tools: DNA Synthesis, Protein Engineering, Pathway Engineering, Genome Engineering, Computational and Theoretical Tools: Genomics, Proteomics and Metabolomics Tools, Challenges and Future Perspectives.
	Teaching Hours: 15

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								

	UNIT – 2: Tools used in Synthetic Biology DNA manipulation techniques: PCR, cloning, and gene synthesis, Introduction to genome editing techniques: CRISPR-Cas9, Standard biological parts and devices, Modularity and abstraction in genetic engineering, and Computational, tools for designing genetic circuits, Cell signaling and communication, Metabolic engineering and pathway design, Synthetic microbial communities	Teaching Hours: 15
	UNIT – 3: Applications of Synthetic Biology Gene therapies, Metabolic engineering – products, Bio-production of chemicals, fuels, and pharmaceuticals; Biosensors and bio-actuators Microbiome engineering: Therapeutic strains & Probiotics, Leveraging intracellular architecture. Scaling-up and bio-manufacturing.	Teaching Hours: 15
	UNIT – 4: Areas of Research and Current Scenario of Synthetic Biology DNA-based circuits, Synthetic metabolic pathway engineering and Genome-level engineering, Protocell construction, Xenobiology, Products for synthetic biology, along with their Products.	Teaching Hours: 15
Reference Books	• Secretariat of the Convention on Biological Diversity (2015). Synthetic biology, Montreal, Technical Series No. 82, 118 pages. • Huimin Zhao (Ed.), Synthetic Biology: Tools and Applications, Academic Press, Elsevier, 2013. • Jing Liang, Yunzi Luo, and Huimin Zhao, Synthetic biology: putting synthesis into biology, Wiley Interdiscip Rev Syst Biol Med, 3,7-20,2011. • Biotechnology Industry Organization (BIO). 2013. Current Uses of Synthetic Biology for Renewable Chemicals, Pharmaceuticals, and Biofuels. Available at: http://www.bio.org/sites/default/files/SyntheticBiology-and-Everyday-Products-2012.pdf, accessed on 7 March 2013.	
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments	
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

SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VIII
NCrF Credit Level	6
Course Type	Minor
Course Subtype	Employability and Skill Development
Subject Type	Discipline Specific
Course Code	BT-ME-801
Course Level	400-499
Course Title	Nanotechnology
Credit	2
Effective From	Academic Year: 2026-27
Course Outcomes	**CO1:** Students will learn about the nanostructure that are actively take part in the bodily functions. The property of self-assembly and hierarchical arrangement will be discussed. This will help them to understand the concept behind the structural and functional requirement of nano-assembly for efficient working. **CO2:** The application of nanomaterial as drug delivery and biosensors will be discussed. The students will be introduced to the recent filed of protein nanotechnology. The unit will cover the aspect related to the possible toxicological effect of nanomaterials.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Course Content	**UNIT – 1: Introduction to Nanobiotechnology** Biotechnology and Nanotechnology: Introduction and Notable Prospects; Introduction to cellular Nanostructures: Nanopores and Biomolocular motors; Structural aspects of biomolecules as bio-nanomachinery (DNA and Protein assembly); Forces responsible for structural stability of biomoleclues (covalent, hydrogen bonds, electrostatic, hydrophobic); Hierarchical self-assembled nano-structures, self-organisation (Lipid bilayer membrane); Enzyme flexibility as challenge in structural design of nanoparticles.	Teaching Hours: 15

	UNIT – 2: Applications of Nanotechnology and Assessment of Toxicity of Nanomaterials Nanomaterials for drug delivery system; Importance of protein nanotechnology; Construction of ordered protein array; Nanosystems for biosensing, Nano-Biosensors; Optical nanosensors, Impact of nanomaterials on Microbial system Nanotoxicity testing, factors affecting nanotoxicity (chemical and physical). Introduction to Safety of nanomaterials, Basics of nanotoxicity, Models and assays for Nanotoxicity assessment; Mechanism of Nanosize particle toxicity-Passage through biological membranes-toxicokinetics Fate of nanomaterials in different stratas of environment that affect the human population; Regulations and permissible limits.	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 • Tuan Vo-Dinh. Protein Nanotechnology: Protocols, Instrumentations and Applications. Humana press.2005. • Huang X., Yufang Zhu Y., Kianfar E. (2021), Nano Biosensors: Properties, applications and electrochemical techniques, Journal of Materials Research and Technology, 2, pp 1649-1672. (https://doi.org/10.1016/j.jmrt.2021.03.048)	
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments	
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.	

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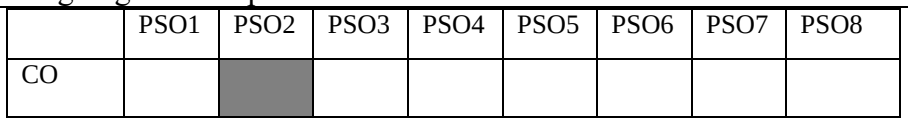
SYLLABUS

Program Name	B. Sc. Biotechnology Honors
Semester	VIII
NCrF Credit Level	6
Course Type	Minor
Course Subtype	Employability and Skill Development
Subject Type	Discipline Specific
Course Code	BTP-ME-801
Course Level	400-499
Course Title	Nanotechnology: Practical
Credit	2
Effective From	Academic Year: 2026-27
Course Outcomes	Student will understand the concept of DLS scanning and zetapotential which is closely related to particle size analysis of nanomaterial. Student will be able to synthesis nanoparticles using different methods. One of the possible application of nanoparticles is to use it as antimicrobial agent. This practical course will give student hands on experience to test antimicrobial activity of prepared nanoparticles and will create awareness regarding computer-aided tools that can be used for designing the nanoparticles.
Mapping between Cos and PSOs	
Course Content	7. Demonstration of measurement of nanoparticles using dynamic light scattering (DLS). 8. Demonstration of Zeta potential and its effect on nanoparticle size. 9. Preparation of nanoparticles using plant extract 10. Sol-gel synthesis of nanoparticles 11. Antimicrobial activity of nanoparticles (Disc diffusion method) 12. Demonstration of Computer-aided Design tools for Nanoparticles. Teaching Hours: 60
Reference Books	• McNeil, S.E., (2011) Characterization of Nanoparticles Intended for Drug Delivery", Humana press • Gérrard Eddy Jai Poinern, A Laboratory Course in Nanoscience and Nanotechnology, CRC Press Taylor & Francis Group, LLC, 2015. • R. J. Patel and K. R. Patel, Experimental Microbiology Volume-2, Aditya, Ahmedabad, Gujarat, India

	• Khac, K.T., Phu, H.H., Thi, H.T., Thuy, V.D., Thi, H.D. (2023) Biosynthesis of silver nanoparticles using tea leaf extract (*Camellia sinensis*) for photocatalyst and antibacterial effect, Heliyon 9 e20707 (https://doi.org/10.1016/j.heliyon.2023.e20707). • Sathiyabama, M., Boomija, R. V., Muthukumar, S., Gandhi, M., Salma, S., Kokila Prinsha, T., Rengasamy B. (2024) Green synthesis of chitosan nanoparticles using tea extract and its antimicrobial activity against economically important phytopathogens of rice, Scientific Reports 14 pp 7381 (https://doi.org/10.1038/s41598-024-58066-y) • Raja, K., Mary Jaculine, M., Jose, M., Sunil Verma, Prince, A.A.M., Ilangovan, K., Sethusankar, K., Jerome Das S. (2015) Sol–gel synthesis and characterization of α-Fe2O3 nanoparticles. Superlattices and Microstructures 86 pp 306-312 (http://dx.doi.org/10.1016/j.spmi.2015.07.044) • NanoMaterials CAD software (https://nanocad.com/products/nanocad-free/)
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignments
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.